

ELECTRONIC FUEL INJECTION

SERVICE TOOLS

| Description | Part Number | Page |
|---------------------------------|-------------------|----------------------------------|
| ECM ADAPTER TOOL..... | 529 036 166 | 6-7, 27, 32, 34-35 |
| FLUKE 115 MULTIMETER | 529 035 868 | 6-7, 16-17, 27, 29, 32-33, 35 |
| FUEL HOSE DISCONNECT TOOL | 529 036 037 | 18 |
| POWER INTERFACE | 515 177 223 | 14 |
| SMALL HOSE PINCHER | 295 000 076 | 24 |

SERVICE TOOLS – OTHER SUPPLIER

| Description | Part Number | Page |
|--|-------------|------|
| FLUKE AUTOMOTIVE BACK PROBE PIN..... | TP40 | 30 |
| FLUKE SUREGRIP INSULATED TEST LEADS..... | TL224 | 30 |

SERVICE PRODUCTS

| Description | Part Number | Page |
|-------------------------|-------------------|------|
| DIELECTRIC GREASE | 293 550 004 | 31 |

GENERAL

WARNING

When electrically disconnecting or removing the throttle body from the intake manifold, always remove the tether cord from the engine cut-off switch and disconnect the battery.

WARNING

Always disconnect battery prior to working on the fuel system. Always disconnect battery exactly in the specified order, BLACK (-) cable first. Electrical connections should be disconnected prior to disconnecting fuel lines.

WARNING

Fuel is flammable and explosive under certain conditions. Wear safety glasses and work in a well ventilated area. Do not smoke or allow open flames or sparks in the vicinity.

WARNING

Proceed with care and use appropriate safety equipment when working on the fuel system. Wipe off any fuel spillage in the engine compartment. Do not allow fuel to spill on hot engine parts and/or on electrical connectors.

Cover the fuel line connection with an absorbent shop rag before disconnecting them. Slowly disconnect the fuel hose to minimize spilling.

WARNING

Replace any damaged, leaking or deteriorated fuel lines or connections. After working on the fuel system, always pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

SYSTEM DESCRIPTION

The electronic fuel injection system (EFI) is comprised of various sensors used for detecting ongoing operating conditions of the engine and vehicle, and includes all the components that perform the required adjustments to the engine.

Electrical System

ECM (Electronic Control Module)

The ECM controls the engine operation and the vehicle power management. To control the engine, the ECM reads the inputs from the sensors which it compares to predetermined parameters stored in the ECM (fuel and ignition maps), makes computations, and activates the outputs accordingly (injectors, ignition coils etc.).

Subsection 03 (ELECTRONIC FUEL INJECTION)

EFI Sensors

To control the injection system, the engine management uses input signals from the following sensors:

- Camshaft position sensor (CAPS)
- Crankshaft position sensor (CPS)
- Manifold absolute pressure and temperature sensor (MAPTS)
- Throttle position sensor (TPS) which is integrated to the throttle body (Electronic Throttle Control (ETC))
- Throttle accelerator sensor (TAS).
- Coolant Temperature Sensor (CTS)

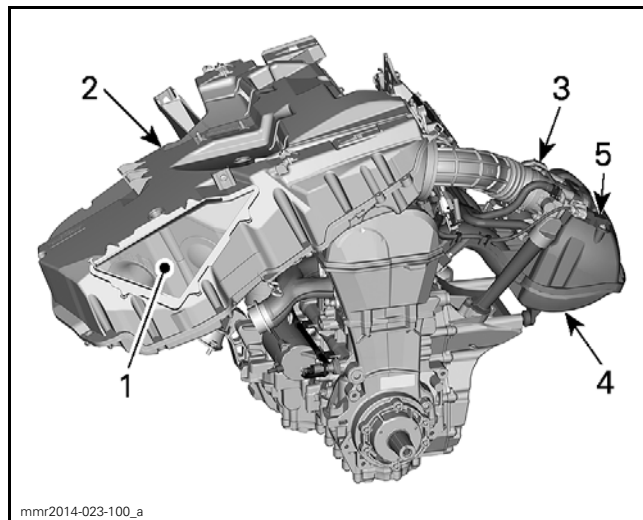
Air Intake System

Air Filter

Air flows through a mesh screen filter in the air intake silencer mounted over the engine. The mesh filter prevents snow from being drawn into the engine.

Air is then drawn in through the throttle body, the air intake manifold and into the engine.

Manifold absolute pressure and temperature are measured in the intake manifold.



1. Mesh screen filter
2. Air intake system
3. Throttle body (Electronic Throttle Control (ETC))
4. Intake manifold
5. Manifold absolute pressure and temperature sensor (MAPTS)

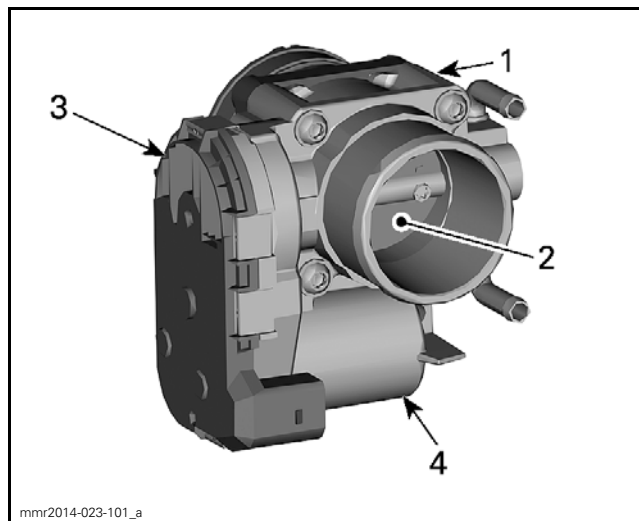
Throttle Body ((ETC) Electronic Throttle Control)

Air for combustion is drawn in by the engine. The air flows through the throttle body (ETC) and is controlled by a throttle plate.

The Electronic Throttle Control (ETC) is a heated single 46 mm throttle body with integrated dual throttle position sensors (TPS) and electric throttle actuator (ETA) and is mounted on the intake manifold.

The ETA allows the ECM to electronically control the throttle plate opening which regulates the amount of air that enters the engine, and therefore engine speed.

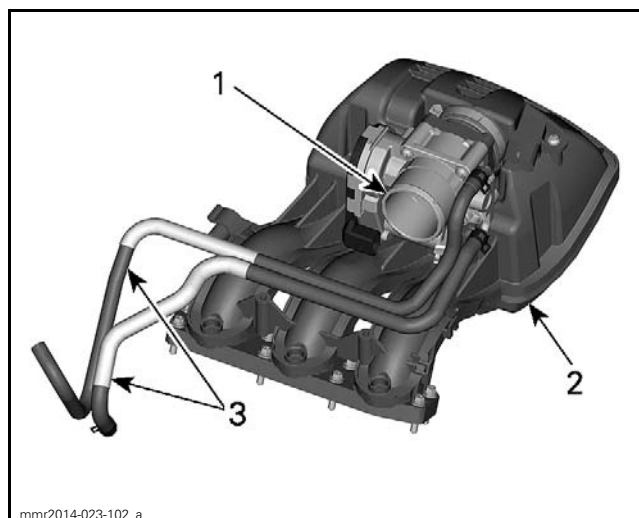
There is no idle air control valve (IACV).



ELECTRONIC THROTTLE CONTROL (ETC)

1. Throttle body
2. Throttle plate
3. Dual Throttle Position Sensor (TPS)
4. Electric throttle actuator (ETA) (electric motor)

Engine coolant flows through the throttle body (ETC) to prevent potential freezing of the throttle plate.



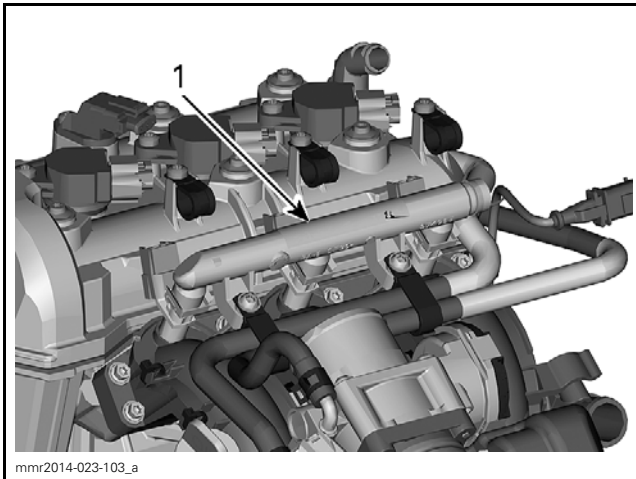
1. Throttle body (ETC)
2. Intake manifold
3. Coolant-heated lines

Fuel System

Fuel Rail

A fuel rail is mounted on the intake manifold. The fuel rail, which is used to secure the injectors to the manifold, also provides to the injectors the fuel pressure that it receives from the fuel pump.

The fuel pressure applied to the fuel rail is regulated by the fuel pressure regulator located in the fuel pump module.

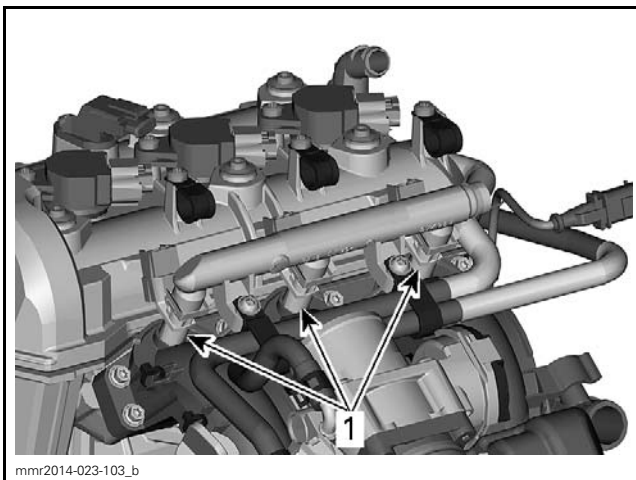


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1. Fuel rail

Fuel Injectors

Three fuel injectors are used to inject fuel into the intake ports of the cylinder head. One injector is used per cylinder.



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1. Fuel injectors

Fuel is injected in accordance with injection signals received from the ECM.

Fuel Pump

An electric fuel pump with an integrated pressure regulator and fuel system filters is used. For more details on the fuel pump unit, refer to *FUEL TANK AND FUEL PUMP* subsection.

ADJUSTMENT

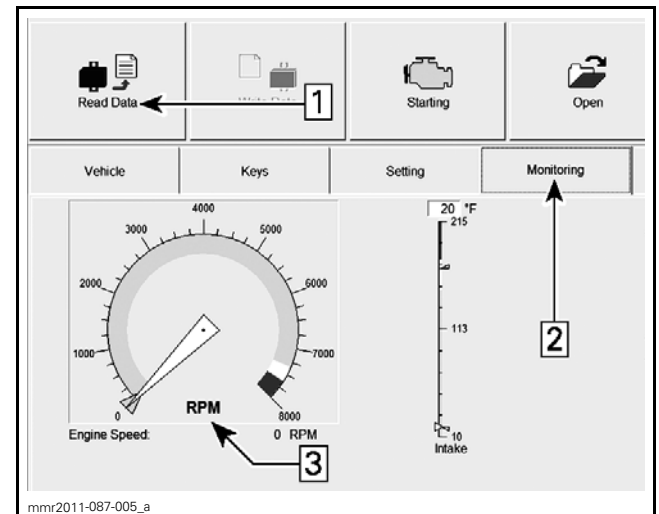
IDLE SPEED

Idle speed is not adjustable. The EMS (Engine Management System) controls the idle speed of the engine through the iTC system by controlling throttle plate opening using the ETA (electric throttle actuator).

The vehicle multifunction gauge can provide a readout of the engine's idle RPM.

Indicated engine RPM may be verified using the applicable B.U.D.S. software version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

In B.U.D.S., select the following:



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VERIFYING ENGINE RPM USING B.U.D.S.

- Step 1: Click on the Read Data button
- Step 2: Select the Monitoring page tab
- Step 3: Read the engine RPM indication

NOTE: The gauge and B.U.D.S. use the same signal to provide the engine RPM indication.

TROUBLESHOOTING

DIAGNOSTIC TIPS

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

It is important to ensure that the engine and propulsion system, fuel delivery and electrical systems are functioning normally.

Subsection 03 (ELECTRONIC FUEL INJECTION)

For diagnostics purposes, use B.U.D.S. software. See *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

After a problem has been solved, be sure to clear the fault(s) recorded in the ECM using the B.U.D.S. software.

WARNING

Electrical actuators and electronic modules may be powered up as soon as the START/REAR button is depressed. Always disconnect the battery prior to disconnecting any electrical or electronic parts.

Never use a battery charger to temporarily substitute the battery as it may cause the ECM to function erratically, or not at all.

Check related-circuit fuse solidity and condition with an ohmmeter. A visual inspection could lead to a false diagnosis.

Poor Idling

If poor idling is experienced, check the following:

- Poor quality fuel or water in the fuel
- Fault codes using B.U.D.S.
- Throttle body cleanliness
- Engine leaks or other mechanical problem.

Electrical Related Problems

It is important to check the following in the electrical system:

- Battery voltage
- Fuses
- Ground connections
- Wiring and connectors.

Ensure that all electronic components are original BRP recommended components. Any modification to the wiring harness may lead to poor system operation or generate fault codes.

Electrical Connections

Pay particular attention to ensure that terminals and pins are not out of their connectors, corroded, or out of shape.

When probing terminals, pay attention not to deform the terminals as this could cause a loose or intermittent connection that would be difficult to troubleshoot.

NOTE: Do not apply dielectric grease or other lubricants on the ECM connectors.

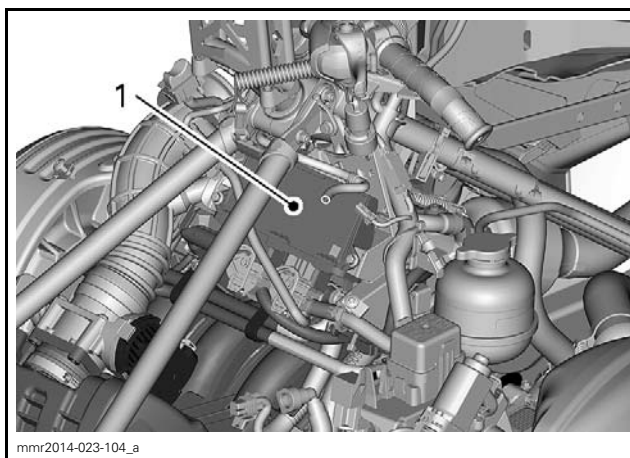
PROCEDURES

ENGINE CONTROL MODULE (ECM)

NOTE: As a first troubleshooting step, always check for applicable fault codes using B.U.D.S. software.

ECM Location

The ECM is located above the air intake manifold.

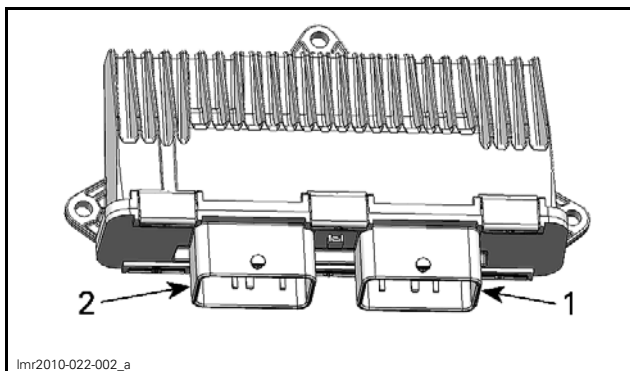


ECM LOCATION, FUEL TANK REMOVED FOR CLARITY
1. ECM

ECM Connector Identification

There are 2 connectors connected to the ECM:

- Engine harness connected to ECM-A
- Vehicle system control harness connected to ECM-B.



ECM CONNECTOR IDENTIFICATION - COOLING FINS FACING OUT

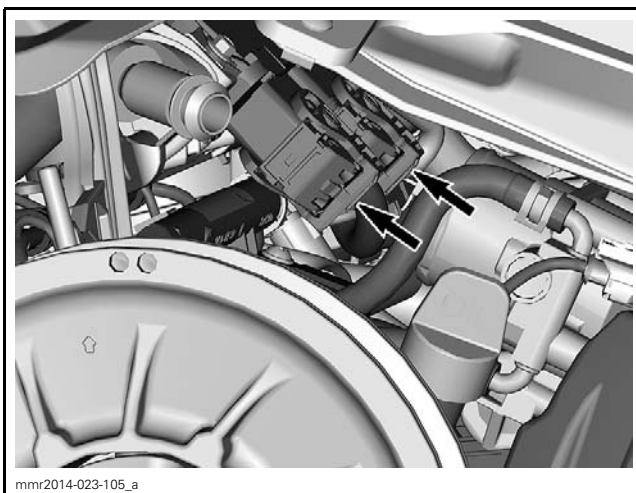
1. Connector A
2. Connector B

The ECM connectors have 48 pins.

NOTE: For connector information, cleaning and probing, refer to *CONNECTOR INFORMATION* subsection.

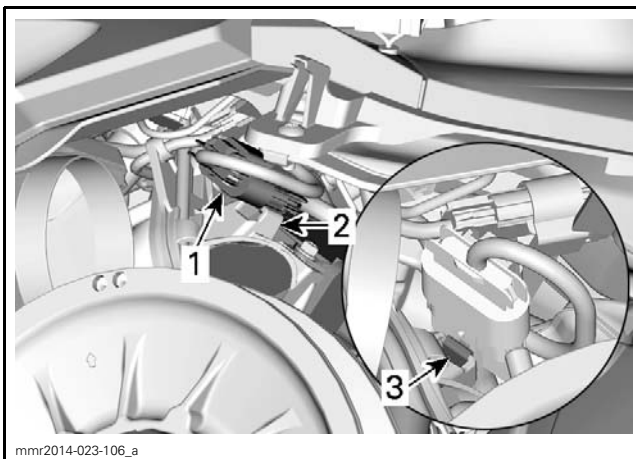
ECM Connector Access

1. Refer to appropriate subsection to remove;
 - Side panels
 - Upper body module (REV-XS)
 - Air intake silencer and gauge support assembly (REV-XR)
 - Air intake and vent hoses.
2. Reach in above the driven pulley, between the fuel tank and ECM support.



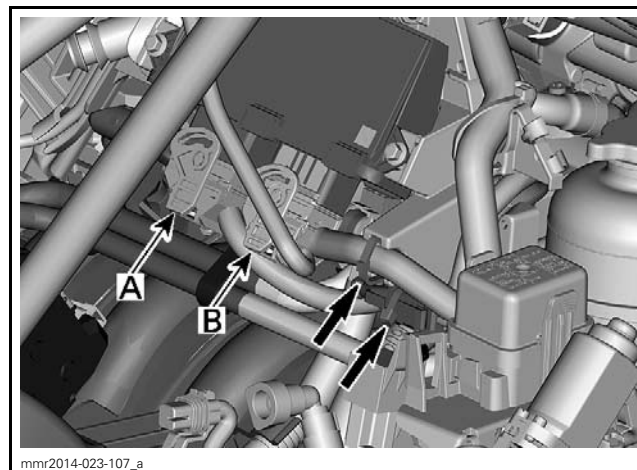
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3. Remove throttle accelerator sensor (TAS) connector from ECM support and disconnect it.



1. TAS connector
2. ECM support
3. TAS clip

4. Cut the locking tie(s) that secure the ECM connector harnesses to the ECM support.



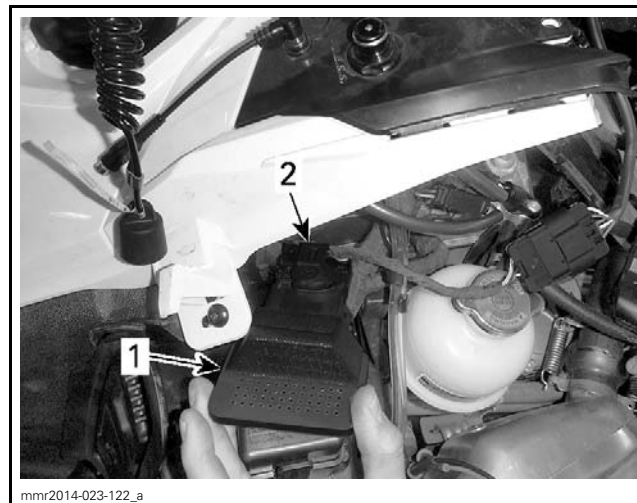
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FUEL TANK REMOVED FOR CLARITY

- A. ECM-A connector
- B. ECM-B connector

NOTE: The ECM is mounted with the cooling fins facing forward. Therefore, ECM A connector is on the LH side of the vehicle, and ECM B connector is on the RH side.

5. Disconnect the ECM connector(s) from the LH side of the vehicle and pull them outwards from the RH side for installation on the ECM adapter tool.



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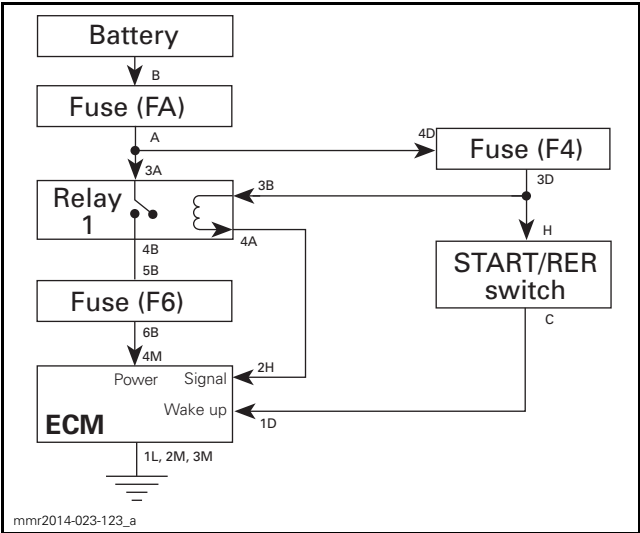
1. ECM adapter tool
2. ECM connector

6. Reconnect TAS connector on the RH side of vehicle for testing.

Subsection 03 (ELECTRONIC FUEL INJECTION)



ECM Power Circuit Diagram



ECM Power Circuit Validation

Briefly press START/RER button.

This should wake up the ECM . The ECM will then activate relay 1 for approximately 12 seconds after which it will turn off all power. If the tether cord is installed when the START/RER button is pressed, the power will stay on for approximately 40 seconds.

| |
|---|
| QUICK INDICATION THAT ECM IS POWERED (ASSUMING THE OBSERVED COMPONENT IS WORKING) |
| Multifunction gauge comes ON. |
| Fuel pump turns on for approx. 2 seconds (if tether cord installed). |

If ECM does not turn on, check the following:

- Fuse FA, F4 and F6.

- Battery voltage. Refer to *CHARGING SYSTEM* subsection.
- Relay R1.
- START/RER switch. Refer to *STARTING SYSTEM* subsection.
- ECM power circuit wires and ground wires.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

NOTE: When relay 1 is not working, the ECM and the complete vehicle electrical system will not be powered.

ECM Wake Up Circuit Test

1. Disconnect ECM-B connector, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Install ECM-B connector on the ECM adapter tool.

| REQUIRED TOOL | |
|---------------------------------------|--|
| ECM ADAPTER TOOL (P/N 529 036 166) | |

3. Use a multimeter and select Vdc.

| REQUIRED TOOL | |
|---|--|
| FLUKE 115 MULTIMETER (P/N 529 035 868) | |

4. While pressing START/RER button, read voltage as follows.

| ECM ADAPTER | BATTERY | READING |
|----------------|----------------------|-----------------|
| PIN | TERMINAL | VOLTAGE |
| 1D | Negative (Ground) | Battery Voltage |


If voltage is as per specification, refer to *ECM POWER CIRCUIT TEST*.

If voltage is out of specification:

- Test the START/RER switch, refer to *STARTING SYSTEM* subsection.
- If START/RER switch tests good, test wiring and connectors from battery to ECM. Refer to *WIRING DIAGRAM*.

ECM Power Circuit Test

1. Connect ECM-B connector on the ECM adapter tool.

| REQUIRED TOOL | |
|---------------------------------------|---|
| ECM ADAPTER TOOL (P/N 529 036 166) |  |

2. Install an appropriate fused jumper wire between the following terminals on the ECM adapter tool.

| JUMPER WIRE COORDINATES ON ECM ADAPTER | |
|--|--------------|
| 2H | 2M, 3M or 1L |

NOTE: When the jumper is installed, the multi-function gauge should come on.


If the multifunction gauge did not come on, check the following:

- Fuses FA, F4 and F6
- Relay 1
- Wiring between ECM-B contact 2H and fuse FA, refer to the *WIRING DIAGRAM* subsection
- ECM ground circuit, refer to *CONTINUITY TEST OF ECM GROUND CIRCUITS* in this subsection.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

If gauge came on, carry on with the following step.

3. Set multimeter to Vdc.

| REQUIRED TOOL | |
|---|---|
| FLUKE 115 MULTIMETER (P/N 529 035 868) |  |

4. Check for voltage as follows.


| ECM ADAPTER | BATTERY | READING |
|-------------|-------------------|---------------------|
| PIN | TERMINAL | Ω |
| 4M | Negative (Ground) | Close to 0 Ω |

If voltage is not measured, check the wiring and connections between ECM and fuse F6, refer to the *WIRING DIAGRAM* subsection.


If all items mentioned in this test and in *ECM WAKE UP CIRCUIT TEST* tested good, try a new ECM.

Continuity Test of ECM Ground Circuits

1. Connect ECM-B connector on the ECM adapter tool.

| REQUIRED TOOL | |
|---------------------------------------|---|
| ECM ADAPTER TOOL (P/N 529 036 166) |  |

2. Set multimeter to Ω and probe adapter terminals as per following table.

| REQUIRED TOOL | | |
|---|-------------------|---|
| FLUKE 115 MULTIMETER (P/N 529 035 868) | |  |
| ECM ADAPTER | BATTERY | READING |
| PIN | TERMINAL | Ω |
| 1L | Negative (Ground) | Close to 0 Ω |
| 2M | | |
| 3M | | |



If any measurement is out of specification refer to *POWER DISTRIBUTION* subsection and check the following:

- Wiring and connections
- Engine ground
- Battery ground
- Frame ground.

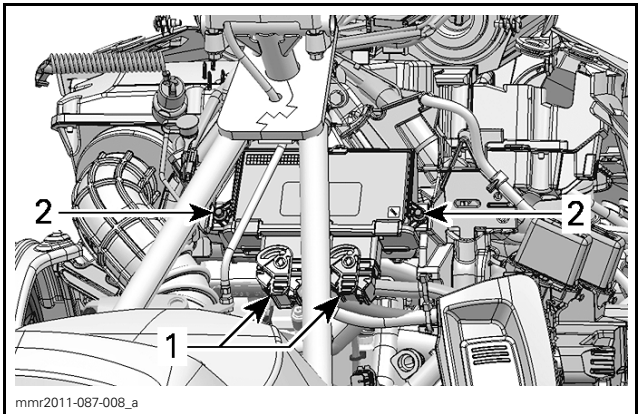
ECM Removal

NOTE: If a new ECM is to be installed, first read the procedures in *ECM REPLACEMENT* in this subsection.

1. Disconnect battery cables.

NOTICE Always disconnect the BLACK (–) battery cable first, then disconnect RED (+) cable.

- 2. Refer to appropriate subsection and remove:
 - Side panels
 - Upper body module (REV-XS)
 - Air intake silencer and gauge support assembly (REV-XR)
 - Console.
- 3. Move fuel tank backward without disconnecting it, refer to *FUEL TANK AND FUEL PUMP* subsection.
- 4. Disconnect both ECM connectors from ECM.
- 5. Remove ECM retaining screws and remove the ECM from its support.



ECM REMOVAL
1. ECM connectors
2. ECM retaining screws

ECM Installation

- 1. Reverse removal procedure however, pay attention to the following.

| ECM SCREW TIGHTENING TORQUE |
|-----------------------------|
| 2.5 N•m (22 lbf•in) |

- 2. Reconnect ECM connectors.
- 3. Reconnect battery cables.

WARNING
Always reconnect the RED (+) battery cable first, then reconnect BLACK (–) cable.

- 4. If a new ECM is installed, refer to *ECM REPLACEMENT* in this subsection.

NOTICE Always replace ECM by the same part number or by a BRP approved equivalent.

ECM Replacement

NOTE: Prior to replacing an ECM, ensure that all the recommendations in the general introduction of this subsection have been followed and all applicable testing procedures have been carried out.

When the ECM is replaced, data must be entered into the new ECM. Refer to *ECM MANUAL DATA ENTRY FOR ECM REPLACEMENT* further in this subsection.

ECM Manual Data Entry for ECM Replacement

Use one of the following 2 methods to collect the required information. The 1st being the easiest:

- 1. Use B.U.D.S. to obtain the data from a saved .mpem file on your PC computer.
- 2. Collect the information from the vehicle and BOSSWeb.

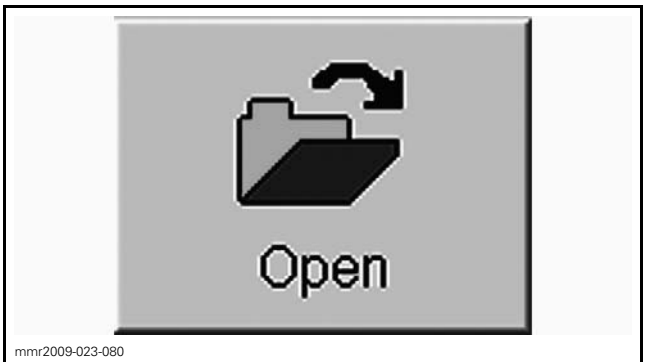
Once the required information has been collected, refer to *ENTERING THE COLLECTED INFORMATION INTO THE ECM*.

1st Collecting Method: Obtaining the Data from a Saved .mpem File

- 1. Start B.U.D.S.

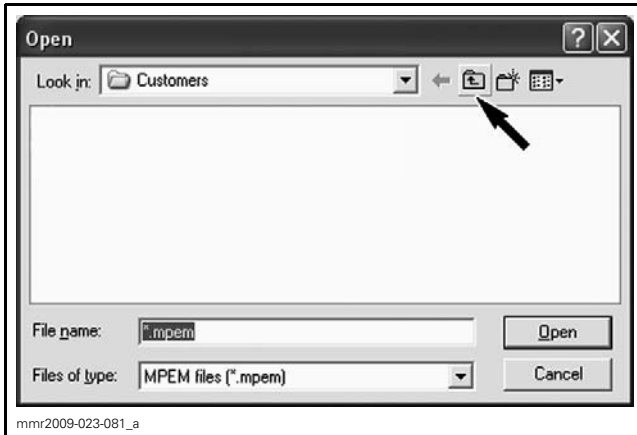
NOTE: It is not necessary to perform any connection. The PC computer can be used alone.

- 2. In B.U.D.S., click on the **Open** button.



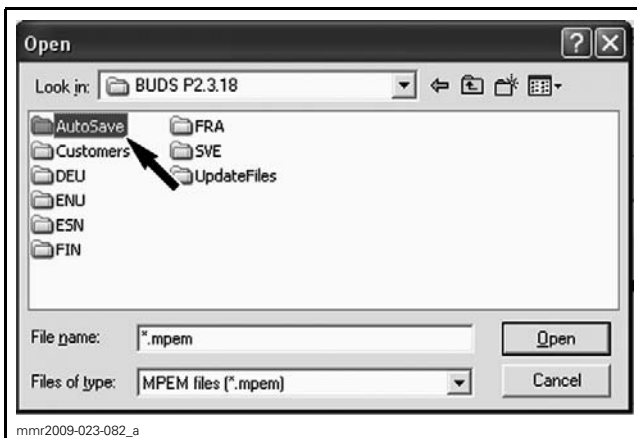
OPEN

- 3. Click once on the **Folder Up** button in the Open box.



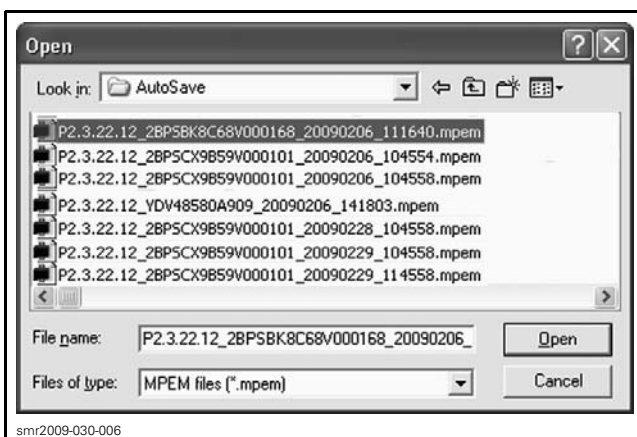
OPEN

Double click on the **AutoSave** folder.



NOTE: You may have to go to another **AutoSave** folder from a previous version of B.U.D.S.

4. Choose the latest file saved for this specific vehicle.



IMPORTANT: Be sure to use the file that specifically matches the vehicle you are servicing.

NOTE: The file name structure is as follows:

B.U.D.S. version_VIN_date read (yyyymmdd)_hour read (hhmmss).mpem

Example:

P2.3.22.12_2BPSBK8C68V000168_20090206_111640.mpem

Therefore:

B.U.D.S. version: P2.3.22.12

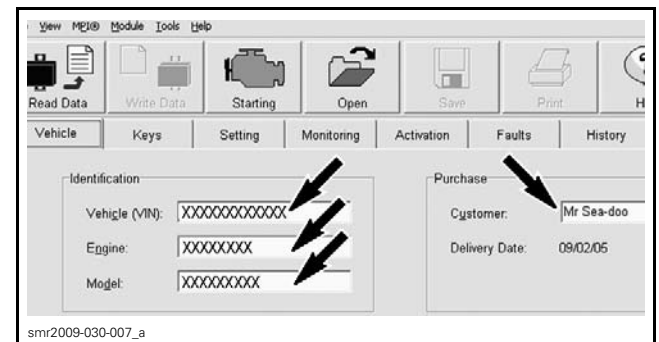
VIN: 2BPSBK8C68V000168

Date: 2009 02 06

Hour: 11h 16m 40s

5. Select the **Vehicle** page tab and record (write down) the following information.

1. Vehicle serial number
2. Engine serial number (without the leading "M")
3. Vehicle model number
4. Customer name.



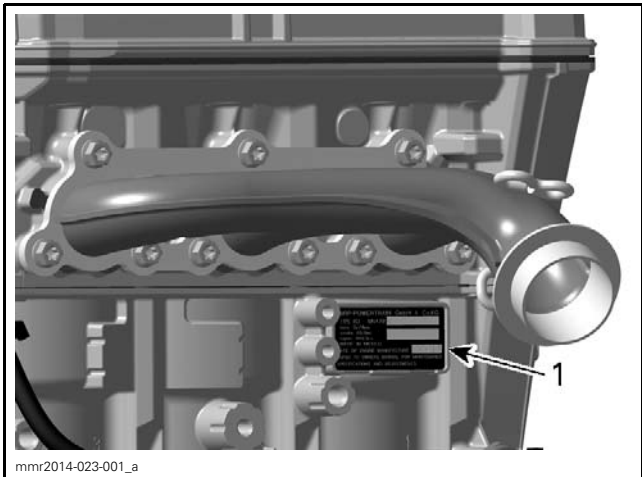
VEHICLE TAB

6. Enter recorded data in ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM.*

2nd Collecting Method: Collect the Information from the Vehicle and BOSSWeb

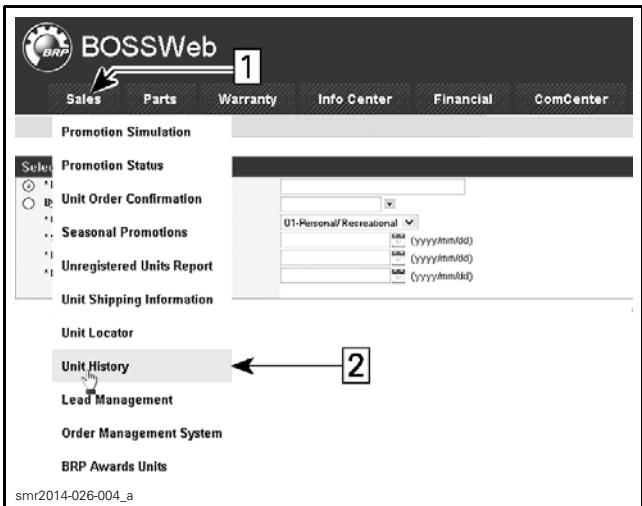
1. Record engine serial number.

Subsection 03 (ELECTRONIC FUEL INJECTION)

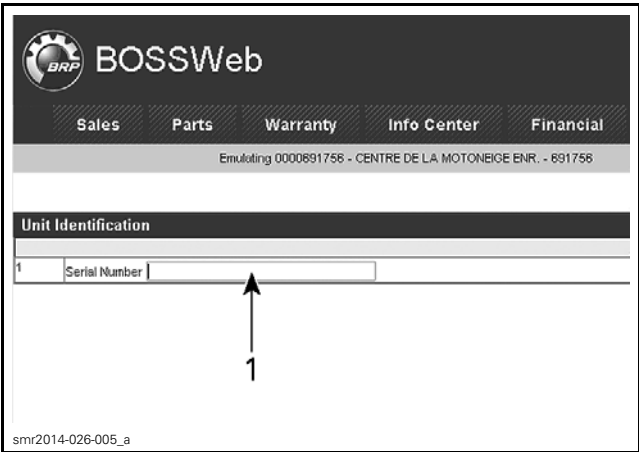


FRONT SIDE OF ENGINE
1. Engine serial number

2. Record the following numbers using BOSSWeb. Look in **Sales** menu and choose **Unit history**.
- 1. Vehicle serial number
 - 2. Vehicle model number
 - 3. Customer name.



SERVICE, UNIT HISTORY
1. Click on SALES menu
2. Select Unit History

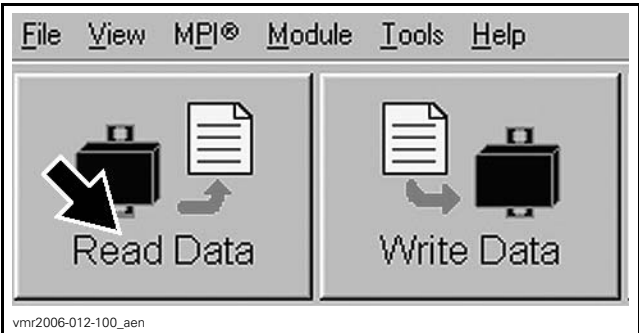


1. Vehicle Serial Number here

3. Enter the recorded data in the new ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM*.

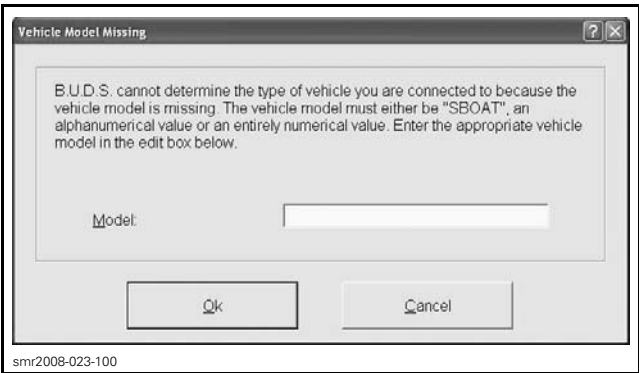
Entering the Collected Information Into the ECM

- 1. Connect the vehicle to B.U.D.S.. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* sub-section.
- 2. In B.U.D.S., click the **Read Data** button to read the new ECM.



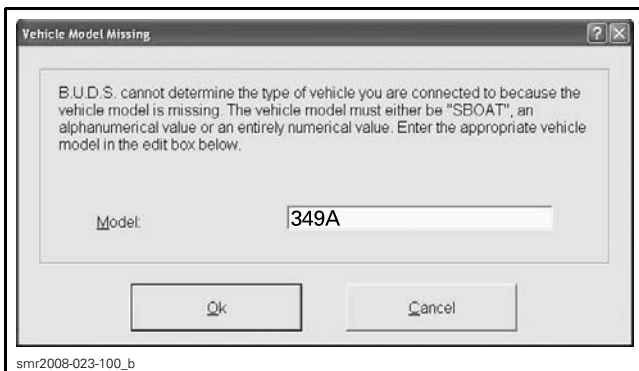
NOTE: A BEEP will sound repeatedly until the tether cord cap (D.E.S.S. key) is programmed into the new ECM.

The following screen window will pop up.



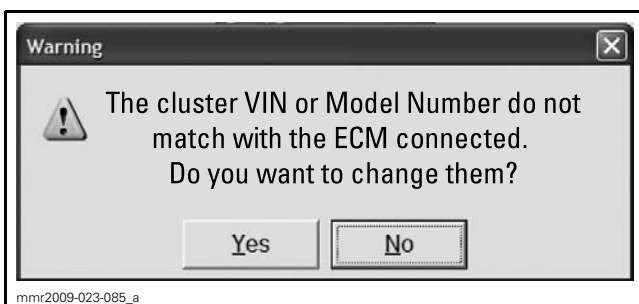
3. Enter the vehicle model number.

NOTICE Enter only the appropriate product model number as obtained when gathering the information.



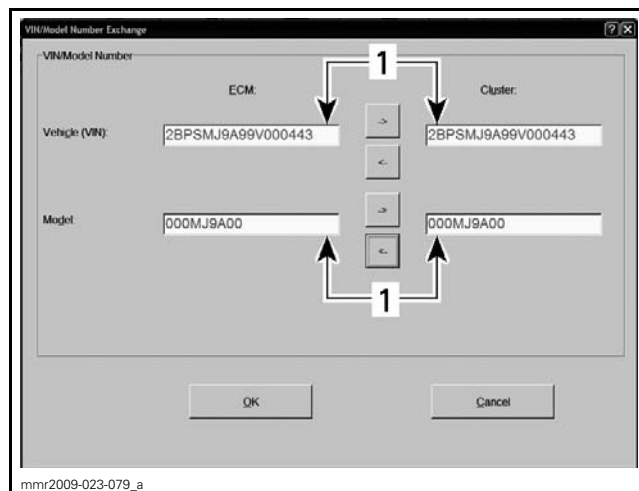
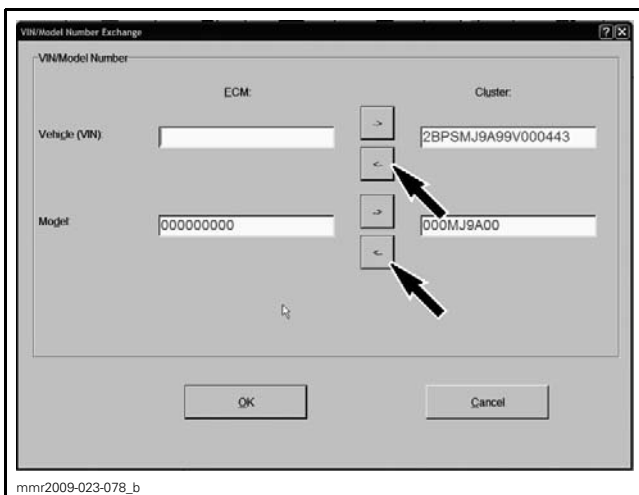
4. Click **Ok** once the required data has been entered.

5. The following message will appear on B.U.D.S. screen.



6. Click **Yes** to match ECM and gauge.

7. The serial numbers are purposely missing as seen in B.U.D.S. Click the arrows indicated in the following illustration to transfer the gauge numbers into the ECM.

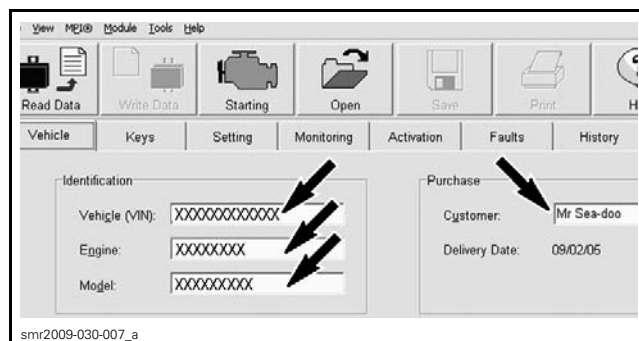


1. Matching numbers

8. Click the **OK** button to complete the procedure.

9. Select the **Vehicle** page tab and ensure all of the following information you recorded previously is precisely entered in the new ECM.

1. Vehicle serial number (VIN)
2. Engine serial number (do not enter the "M" at the beginning of the engine number)
3. Vehicle model number
4. Customer name.



VEHICLE TAB

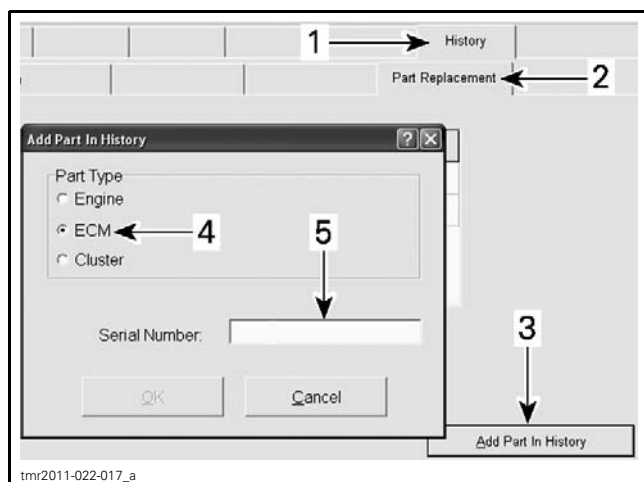
10. Enter all missing information.

NOTICE Pay particular attention when typing the V.I.N. and model numbers. Once **Write Data** button is pressed, the data cannot be modified.

11. Click on the following tabs:

- History
- Part Replacement
- Add Part in History.

12. Enter the old ECM serial number in the **Add Part In History** window.



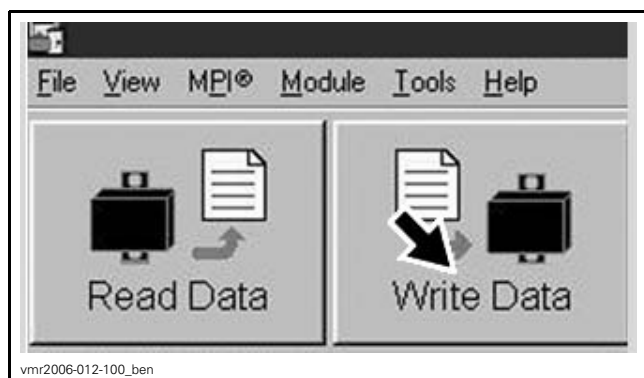
TYPICAL - ADDING PART IN HISTORY

1. History page tab
2. Part Replacement tab
3. Add part in history button
4. ECM selection
5. Add ECM serial number here

NOTE: The ECM serial number can be found on the ECM sticker that also identifies the part number.

13. Click on the **OK** button.

14. Click on the **Write Data** button.



15. Perform the *THROTTLE POSITION SENSOR INITIALIZATION* procedure, refer to *THROTTLE POSITION SENSOR (TPS)* further in this subsection.

16. Program the tether cord cap (D.E.S.S. key) into the new ECM, refer to *DIGITAL ENCODED SECURITY SYSTEM (D.E.S.S.)* subsection.

17. Set the gauge units of display. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

18. Start the engine and ensure proper operation.

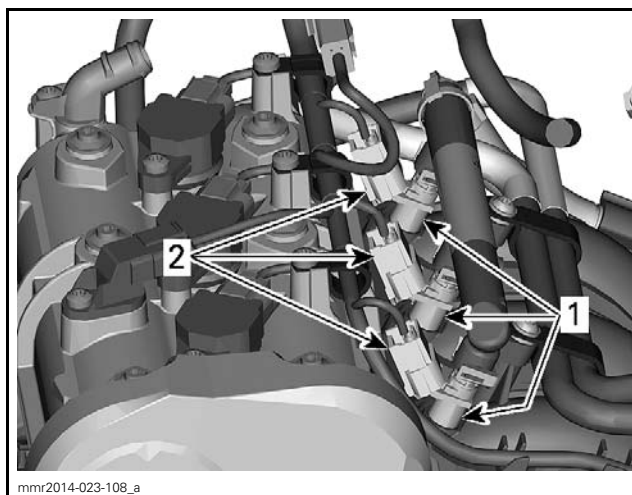
19. Reinstall any remaining removed parts.

FUEL INJECTOR

Fuel Injector Connector Access

1. Refer to appropriate subsection to remove:

- Side panels
- Upper body module (REV-XS)
- Air intake silencer and gauge support assembly (REV-XR)
- Console
- Air intake hose.



1. Fuel Injectors
2. Fuel Injector connectors

Fuel Injector Operation Test with B.U.D.S. (Dynamic)

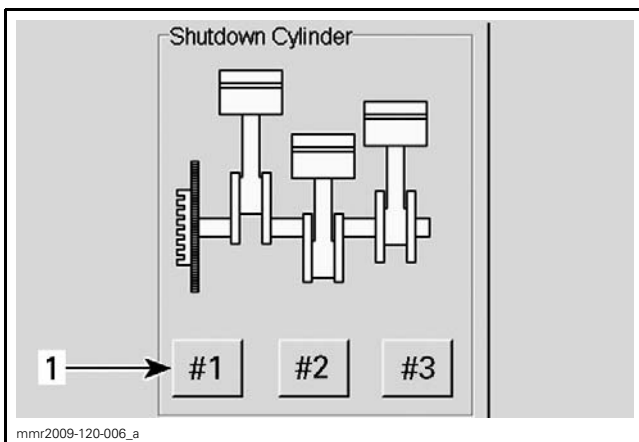
1. Connect vehicle to B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.*

2. Start engine.

3. In B.U.D.S., click the following:

- **Read Data** button
- **Monitoring** tab.

4. Using the B.U.D.S. software, shut down each engine cylinder one at a time by clicking on the button under the applicable cylinder.



MONITORING AND ECM TABS

1. Click on cylinder number to be tested

If the engine RPM drops when clicking on a cylinder, the injector and the ignition of this cylinder are functioning normally.

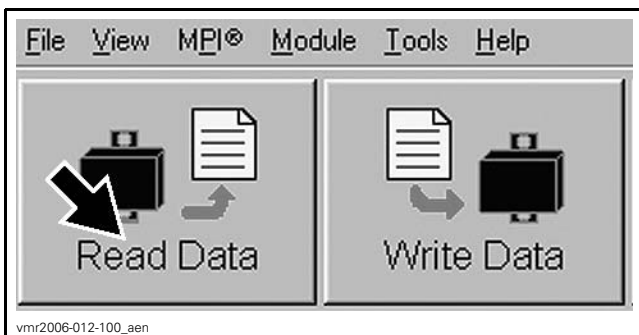
If the engine RPM does not drop when clicking on a cylinder, this cylinder is not functioning properly. Check the following:

- Fuel injector operation. Refer to *FUEL INJECTOR OPERATION TEST WITH B.U.D.S. (STATIC)*.
- Spark plug and ignition coil. Refer to *IGNITION SYSTEM*.
- Engine condition.

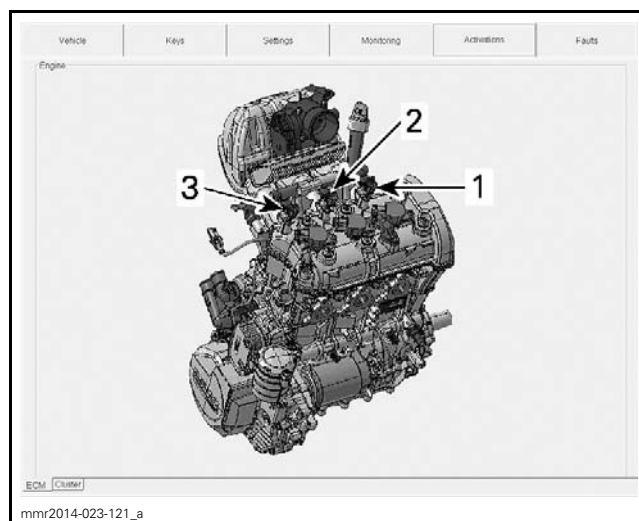
Fuel Injector Operation Test with B.U.D.S. (Static)

NOTICE After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate engine and prevent a potential backfire due to fuel accumulation in the engine.

1. Connect vehicle to B.U.D.S.. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., click the **Read Data** button to read the new ECM.



3. On the **Activation** page of B.U.D.S. software, energize the fuel injector to be tested.



INJECTOR ACTIVATION IN B.U.D.S.

1. Click on injector 1 to activate
2. Click on injector 2 to activate
3. Click on injector 3 to activate

You should hear the injector functioning.

This will validate the injector mechanical and electrical operation.

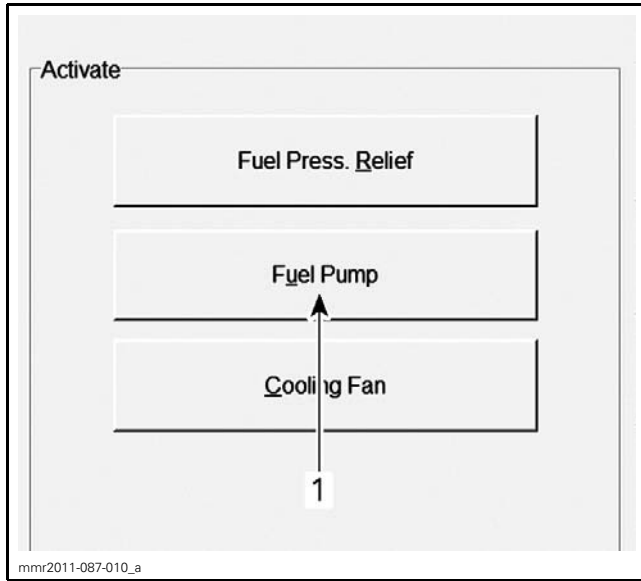
If the injector does not function, carry out the *FUEL INJECTOR RESISTANCE TEST*.

Fuel Injector Balance Test

NOTICE After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate the engine of fuel.

1. Install a fuel pressure gauge as described in *FUEL PUMP PRESSURE TEST* of *FUEL TANK AND FUEL PUMP* subsection.
2. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. In B.U.D.S., select the following:
 - **Read Data** button
 - **Activation** page tab.
4. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.

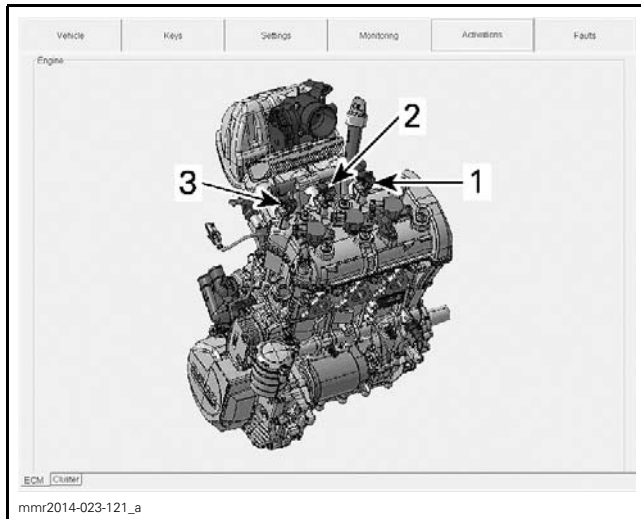
Subsection 03 (ELECTRONIC FUEL INJECTION)



1. Fuel Pump activation button

5. Fuel pressure must be within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection. Re-activate fuel pump as necessary.

6. In B.U.D.S., energize fuel injector no. 1.



INJECTOR ACTIVATION IN B.U.D.S.

1. Click on injector 1 to activate
2. Click on injector 2 to activate
3. Click on injector 3 to activate

7. Record the fuel pressure drop for injector no. 1.

8. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.

9. Repeat the procedure for fuel injector no. 2 and no. 3 and record the pressure drop for each injector.

10. The maximum fuel pressure drop between injectors should not exceed the following specification:

MAXIMUM FUEL PRESSURE DROP ALLOWED BETWEEN FUEL INJECTORS

10 kPa (1.5 PSI)

If the pressure drop between fuel injectors is greater than the specification, replace the injector with the least pressure drop, then repeat the test.

11. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
12. Remove fuel pressure gauge and reinstall removed parts.
13. Set engine emergency shut off switch to OFF.
14. Crank engine in drowned mode (accelerator held all the way in) to ventilate the engine of the fuel that was injected during the test.

⚠ WARNING

Always crank engine in drowned mode to ventilate all fuel that was injected during the test. Failure to do so may result in severe engine damage and injury.

Fuel Injector Leakage Test

Test Setup

1. Ensure there is enough fuel in fuel tank.
2. Ensure fuel pressure from fuel pump is within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection.

NOTE: Keep the pressure gauge installed for the leakage test.

3. Remove tether cord from engine cut-off switch.
4. Set engine emergency stop switch to STOP.

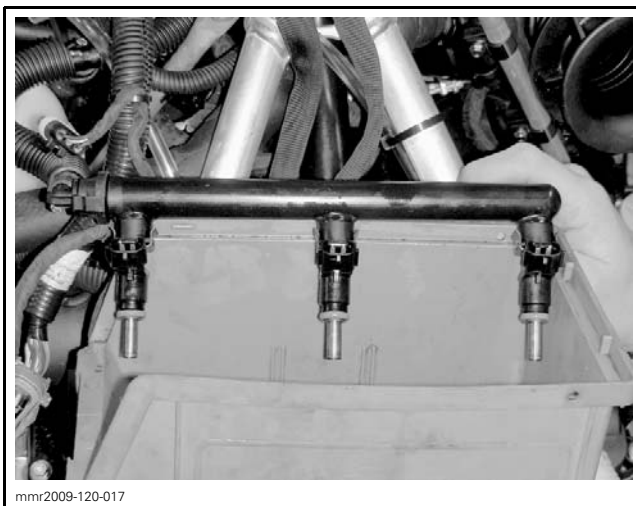
⚠ WARNING

The engine emergency stop switch is set to STOP to prevent any spark in the engine compartment should the engine be cranked. Fuel vapors may ignite in presence of a spark creating a fire hazard.

5. Disconnect the vehicle from B.U.D.S. by disconnecting the POWER INTERFACE (P/N 515 177 223) from the vehicle diagnostic connector.



6. Wait for vehicle electrical power to shut off; the multifunction gauge will turn off.
7. Remove fuel rail with injectors from engine however, **do not** disconnect fuel pump pressure hose from fuel rail. Refer to *FUEL INJECTORS* in this subsection.
8. Position fuel rail so that an appropriate container may be placed under the injectors to collect any fuel leakage.

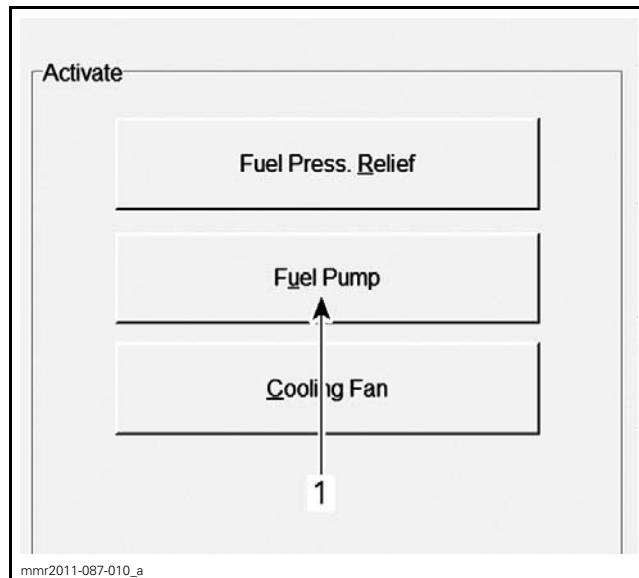


INJECTOR LEAKAGE TEST SETUP

9. Install tether cord on engine cut-off switch.
10. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection

Leakage Test

1. In B.U.D.S., select the following:
 - **Activation** page tab
 - **ECM** page.
2. Click on the **Fuel Pump** button to activate fuel pump for a few seconds.



ACTIVATION AND ECM TABS

1. [Click here](#)

3. Check for fuel leakage from the injector nozzles.
4. Monitor fuel pressure at fuel pressure gauge. If pressure drops below 372 kPa (54 PSI) during the test, re-activate fuel pump as necessary.

Subsection 03 (ELECTRONIC FUEL INJECTION)

| FUEL INJECTOR LEAKAGE | |
|-----------------------|---------------------------|
| TEST DURATION | SPECIFICATION |
| 2 minutes | 1 drop per minute maximum |

If test is not within specification, replace the faulty fuel injector.

- 5. Properly reinstall fuel rail. Refer to *FUEL RAIL* in this subsection.
- 6. Reinstall remaining removed components.




WARNING

Wipe up any spilled fuel.

Fuel Injector Resistance Test

- 1. Ensure vehicle electrical power is off.
- 2. Disconnect connector “A” from the ECM, refer to *ECM CONNECTOR ACCESS* in this subsection.
- 3. Remove cover from the front fuse box and locate fuse F1 (ignition/injector fuse).
- 4. Check resistance value between fuse box and ECM connector terminals as follows.

| REQUIRED TOOL | |
|---|---|
| FLUKE 115 MULTIMETER (P/N 529 035 868) |  |

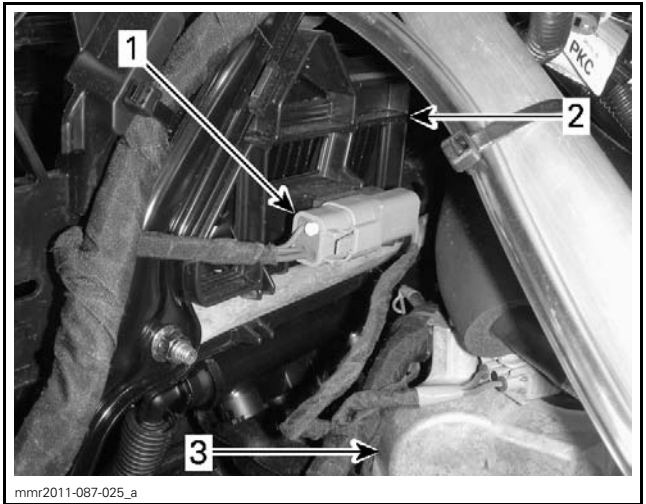
NOTE: It is not necessary to remove the fuse. Refer to *POWER DISTRIBUTION* subsection for fuse box information.

| INJECTOR | ECM | FUSE BOX | READING |
|----------|-----|----------|------------------------|
| CYLINDER | PIN | TERMINAL | Ω @ 20°C (68°F) |
| 1 | 3B | 2A | 12 ± 0.6 Ω |
| 2 | 1K | | |
| 3 | 1J | | |

If resistance value obtained is correct, carry out a *FUEL INJECTOR INPUT VOLTAGE TEST*.

If resistance value obtained is incorrect, repeat test at 3-HIC connector located on front side of ECM support.

| INJECTOR | ECM | HIC | READING |
|----------|-----|-----|------------------------|
| CYLINDER | PIN | | Ω @ 20°C (68°F) |
| 1 | 3B | 1 | 12 ± 0.6 Ω |
| 2 | 1K | | |
| 3 | 1J | | |



HIC CONNECTOR LOCATION
1. HIC connector
2. ECM support
3. Engine valve cover

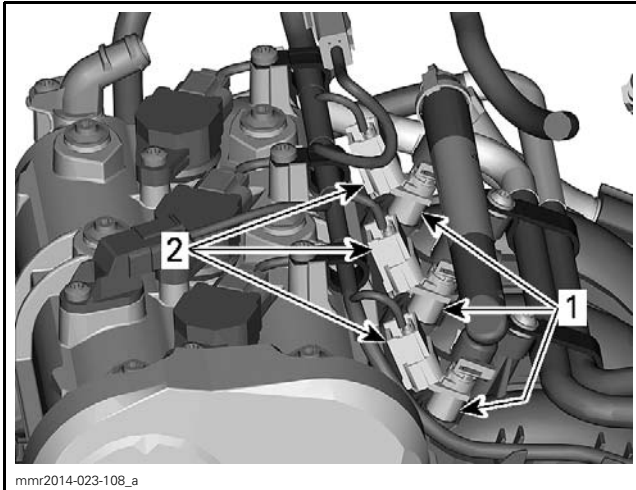
If resistance value obtained is incorrect, remove injector connector and check resistance value between injector pins as follows. Refer to *FUEL INJECTOR ACCESS* in this subsection.

| INJECTOR | | READING |
|----------|---|------------------------|
| PIN | | Ω @ 20°C (68°F) |
| 1 | 2 | 12 ± 0.6 Ω |

If readings are out of specifications, replace injector.

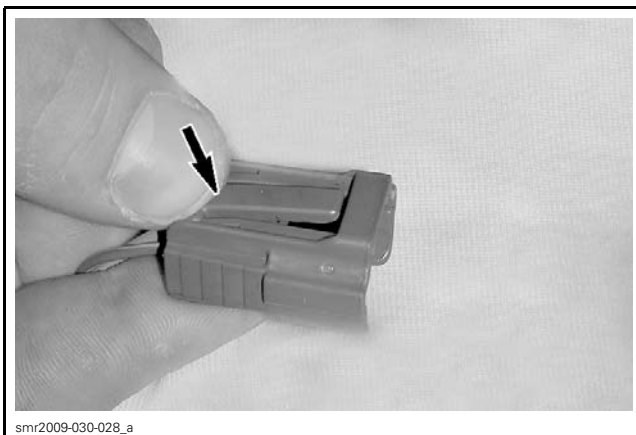
Fuel Injector Input Voltage Test

- 1. Ensure both ECM connectors are properly connected.
- 2. Ensure the HIC connector is properly connected.
- 3. Disconnect the fuel injector connector. Refer to *FUEL INJECTOR CONNECTOR ACCESS* in this subsection.



1. Fuel Injectors
2. Fuel Injector connectors

NOTE: Press against tab underneath connector as illustrated to unlock it.



PRESS HERE TO UNLOCK

4. Ensure fuse F1 (Ignition/Injector fuse) is properly installed.
5. Set engine emergency stop switch to STOP to prevent engine starting.
6. Install tether cord on engine cut-off switch.

NOTE: With tether cord installed on engine cut-off switch, vehicle electrical power will stay on for approximately 20 seconds.

7. Momentarily press the START/REAR button to wake up the ECM.

NOTE: It is not necessary to activate the injector since it is continuously powered when the ECM is awake.

8. Use a multimeter and set it to Vdc. Read voltage.

| INJECTOR | INJECTOR | BATTERY | READING |
|----------|-----------------|-------------------|---------|
| CYLINDER | WIRE | TERMINAL | VOLTAGE |
| 1 | VIOLET/ BLUE | Battery Ground | Vdc |
| 2 | | | |
| 3 | | | |

If injector input voltage is good, carry out the following:


- Circuit continuity test between injector and ECM, refer to *WIRING DIAGRAM* subsection.
- *FUEL INJECTOR SIGNAL TEST* further in this subsection.

If injector input voltage is not good, check the following:

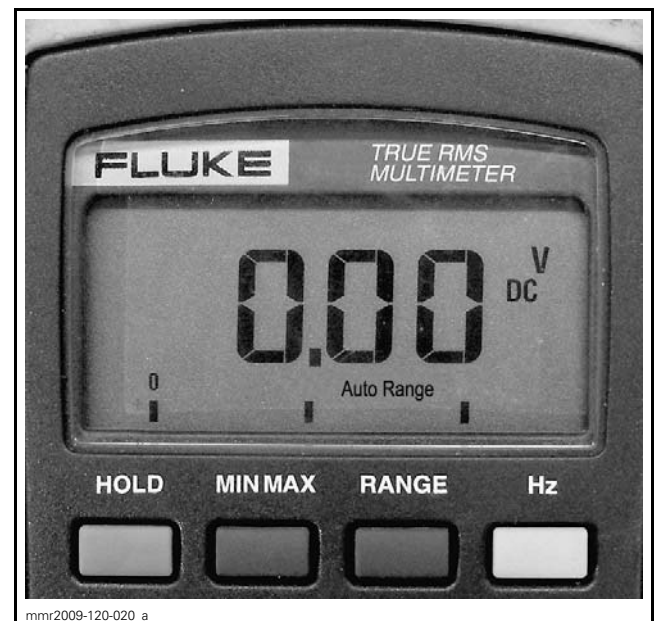
- Fuse F1
- Circuit continuity between fuse F1 and injector. Refer to *POWER DISTRIBUTION* and *WIRING DIAGRAM* subsections.

Fuel Injector Signal Test

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the **Activation** page tab.
3. Set multimeter to Vdc.

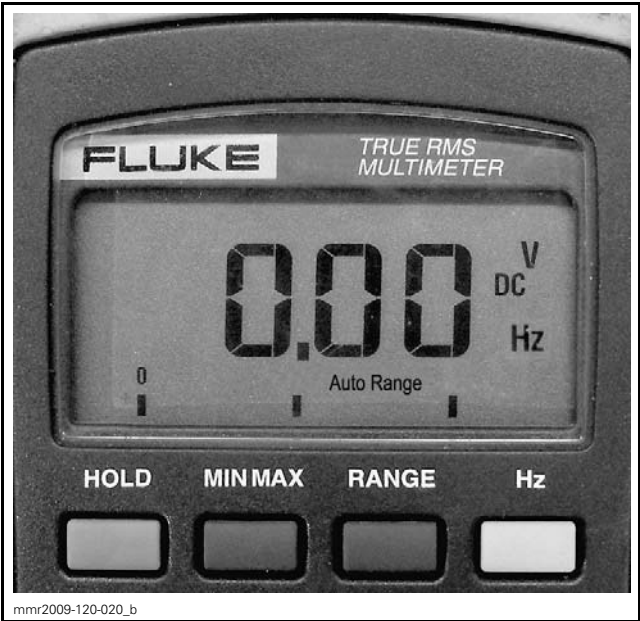
| REQUIRED TOOL | |
|---|---|
| FLUKE 115 MULTIMETER (P/N 529 035 868) |  |

NOTE: Make sure multimeter is in the **Auto** Range mode.

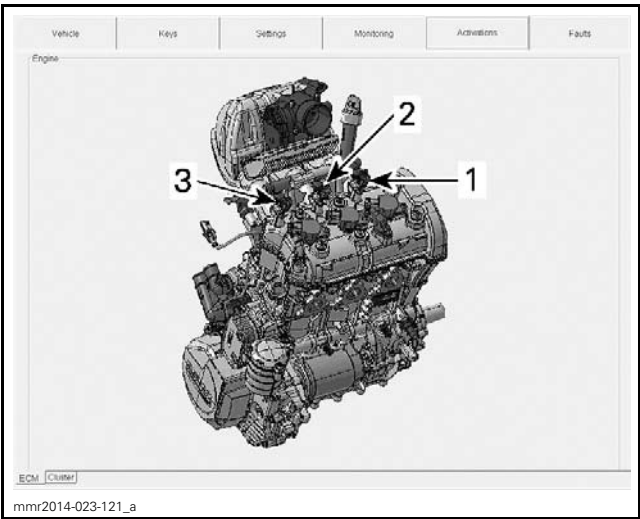


Subsection 03 (ELECTRONIC FUEL INJECTION)

4. Press the Hz button so that the display shows Hz.



5. Connect the multimeter probes as indicated in the following table and using the B.U.D.S. software, activate each injector and read the frequency on the multimeter.



INJECTOR ACTIVATION IN B.U.D.S.
1. Click on injector 1 to activate
2. Click on injector 2 to activate
3. Click on injector 3 to activate

NOTE: The multimeter counts the pulses per seconds (Hertz) of current the ECM sends to the injector.

| INJECTOR | INJECTOR | BATTERY | READING |
|----------|----------------|-------------------|---------|
| CYLINDER | WIRE | TERMINAL | FREQ. |
| 1 | BROWN/ RED | Battery Ground | 9 Hz |
| 2 | BROWN/ BLUE | | |
| 3 | BROWN/ GREY | | |

If reading is good, the control circuit is functional. If there is no reading, check continuity of control circuit (ECM to injectors). Refer to *WIRING DIAGRAM* for circuit details.

Fuel Injector Access

1. Refer to appropriate subsection to remove:
 - Side panels
 - Upper body module (REV-XS)
 - Air intake silencer and gauge support assembly (REV-XR)
 - Console.
2. Move fuel tank backward without disconnecting it, refer to *FUEL TANK AND FUEL PUMP* subsection.
3. Disconnect both ECM connectors.

Fuel Injector Removal

1. Disconnect fuel pump electrical connector, refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Start engine and let run until it runs out of fuel.
3. Disconnect the battery, refer to *CHARGING SYSTEM* subsection.

⚠ WARNING

When removing or disconnecting the fuel injectors, always remove the tether cord from the engine cut-off switch and disconnect the battery.

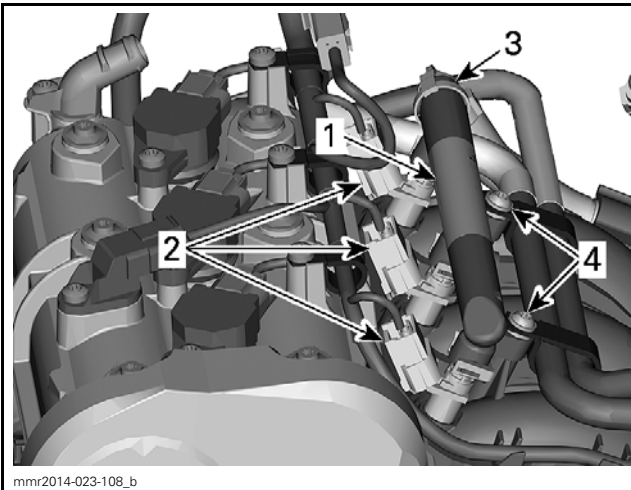
4. Remove parts required for access to the fuel rail and fuel injectors, refer to *FUEL INJECTOR ACCESS*.
5. Disconnect the fuel injector electrical connectors.
6. Disconnect the fuel pressure hose from the fuel rail.

| REQUIRED TOOL | |
|---|--|
| FUEL HOSE DISCONNECT TOOL (P/N 529 036 037) | |



NOTE: Wrap a rag around the hose end to catch any fuel leakage.

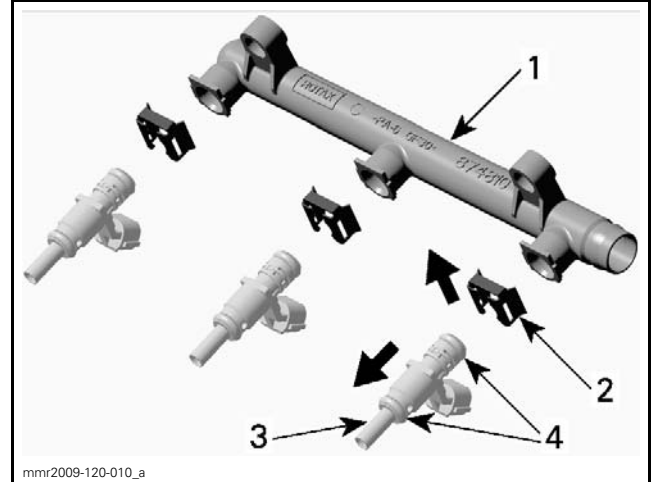
7. Remove the fuel rail mounting screws (2).



1. Fuel rail
2. Injector connectors
3. Fuel pressure hose disconnect
4. Fuel rail mounting screws

8. Pull on fuel rail to remove the fuel rail and injectors from the engine.

9. Remove the fuel injector retaining clips (2) from the fuel rail.



TYPICAL - FUEL RAIL ASSEMBLY

1. Fuel rail
2. Fuel injector retaining clip
3. Injector
4. Injector O-rings

10. Pull the fuel injector(s) out of the fuel rail.

Fuel Injector Installation

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

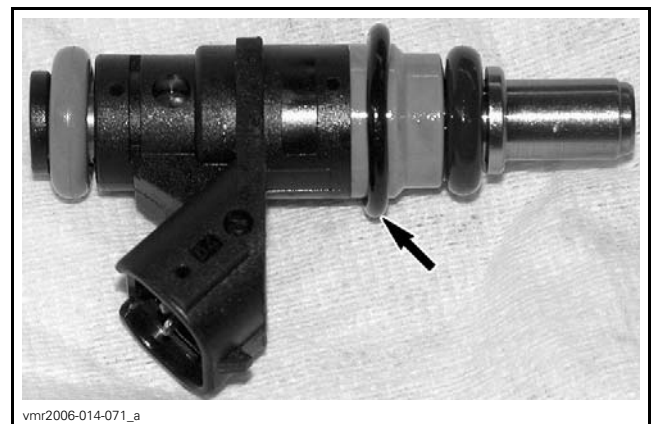
NOTICE If installing the removed injector(s), ensure injector O-rings are in good condition. Replace O-rings as required.

1. Apply a thin film of engine oil to O-rings to ease insertion in rail.
2. Install fuel injector with your hand. Do not use any tool.

FUEL INJECTOR INSTALLATION

| O-RINGS | New | Lubricate with engine oil |
|---------|-----|---------------------------|
|---------|-----|---------------------------|

3. Ensure proper positioning of the intake manifold O-ring on injector as in following illustration.

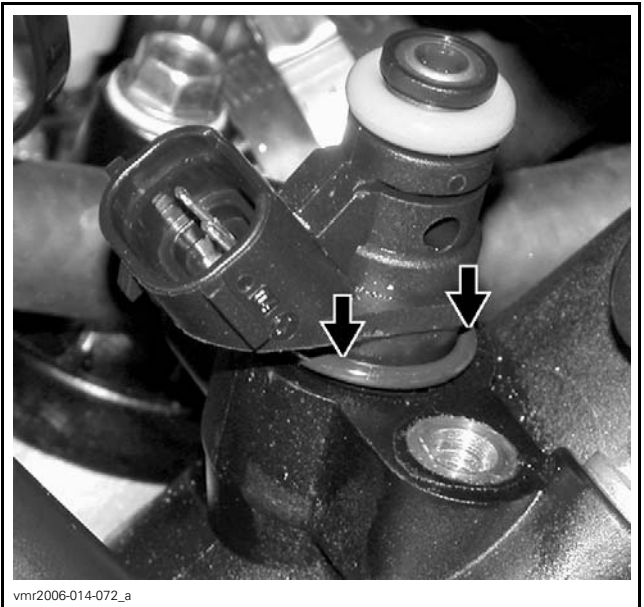


TYPICAL - INTAKE MANIFOLD O-RING POSITION

Subsection 03 (ELECTRONIC FUEL INJECTION)

4. Carefully insert injector in air intake manifold paying attention to the manifold O-ring.

NOTICE Gently push O-ring in evenly all around while inserting injector. O-ring must be completely inserted and not visible, before completing the insertion of the injector.

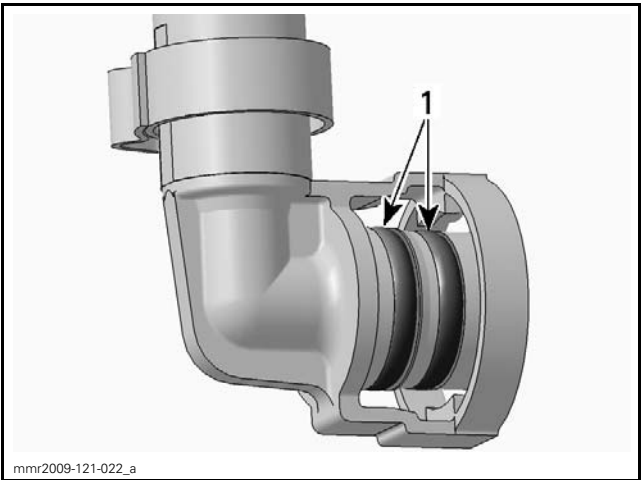


TYPICAL

5. Firmly push injector until it bottoms out.
6. Install fuel rail.

| FUEL RAIL RETAINING SCREW | |
|---------------------------|---|
| Tightening torque | 9 N•m ± 1 N•m (80 lbf•in ± 9 lbf•in) |

7. Apply engine oil on O-rings of fuel pressure hose fitting.



FUEL PRESSURE HOSE FITTING

1. Apply oil on O-rings

8. Connect fuel pressure hose to fuel rail.

IMPORTANT: Push fuel hose fitting on fuel rail until you hear a "click". Try pulling on fuel hose fitting to ensure it is properly locked.

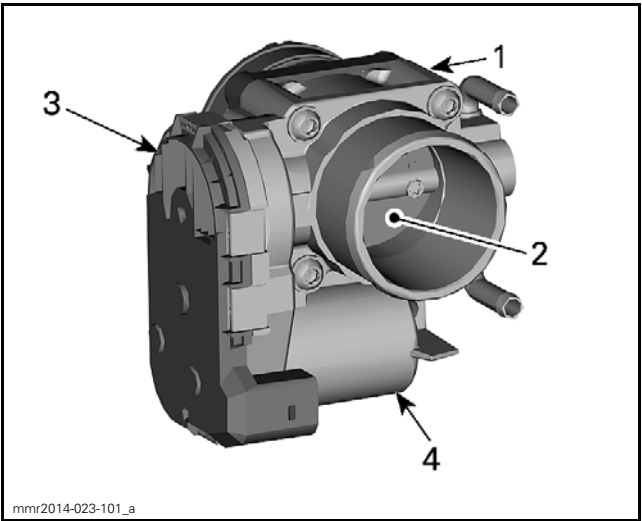
Pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

WARNING
Failure to pressurize the fuel system and checking for fuel leaks may result in severe injury or a life threatening situation should a leak occur.

9. Reinstall all remaining removed parts.

THROTTLE BODY (ETC (ELECTRONIC THROTTLE CONTROL))

Throttle Body (ETC) Description



1. Throttle body
2. Throttle plate
3. TPS (Throttle Position Sensor) (inside)
4. ETA (Electric Throttle Actuator) (electric motor inside)

Electric Throttle Actuator (ETA)

The electric throttle actuator (ETA) is a DC motor on the throttle body that regulates the throttle plate via a drive gear. It receives its control signal from the ECM. Pulse width modulation (PWM) is used to control the motor.

Throttle Plate Operating Positions

Two torsional springs are connected to the throttle plate. A main spring and another one in a plunger mechanism.

When there is no power to the throttle actuator (ETA), the plunger mechanism maintains the throttle plate at a rest position. This also serves as the limp home position.

When the throttle plate is opened by the ETA as commanded by the ECM, it acts against the main spring. If the ETA failed, the return spring would bring the throttle plate back to the limp home position.

| ECM | ENGINE | THROTTLE BODY |
|---|---|---|
| OFF | Stopped | Throttle actuator: Off. Throttle plate: Rest position, maintained opened at approximately 8° (1). This is also the limp home position. |
| ON | Not started | Throttle actuator: On. Throttle plate: Moves from the rest position to approximately 15°. It then moves back to the rest position. This is the diagnostic mode where the rest position, actuator opening force to overcome the return springs and the motor return rate are monitored. If any of these parameters are out of range, a fault code is initiated. |
| ON | Not started. Very cold environment | Throttle actuator: On. Throttle plate: Execute check for ice on throttle plate. If throttle plate does not reach the fully closed position, throttle plate is moving until closed position can be reached. |
| ON | Started. Normal operation at idle | Throttle actuator: On. Throttle plate: Moves from the rest position to idle position (approximately 1-3°) according to ECM injection and ignition maps. Throttle plate is opened and closed as necessary to control the idle speed. |
| ON | Started. Normal operation at various RPM | Throttle actuator: On. Throttle plate: Opens and closes according to ECM torque management priorities. |
| (1) Degree values are given from the fully closed position. | | |

Throttle Body (ETC) Faults and Effects

NOTE: Among other things, a weak or broken spring and a sticky throttle plate are validated by the throttle body diagnostic mode.

| FAULT | EFFECT |
|--|--|
| Partial failure of TAS sensor (one internal sensor only) | Limp home mode. Engine speed limited to idle. ECM will use the remaining TAS sensor. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON. Driveability could be reset by releasing and reapplying the throttle. |
| Complete failure of TAS sensor (both internal sensors) | Limp home mode. Engine speed limited to 2500 RPM. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON. |
| Any throttle body failure | Limp home mode. Engine speed limited to 2500 RPM. Engine speed can still be increased up to 3200 RPM using the throttle lever. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON. |

NOTE: Refer to *DIAGNOSTIC AND FAULT CODES* and *INTELLIGENT THROTTLE CONTROL (iTC)* subsections for more informations.

Throttle Body (ETC) Access

- Refer to appropriate subsection to remove:
 - LH side panel
 - Drive belt guard
 - Air intake hose.

Throttle Body (ETC) Lubrication

No lubrication is required.

Electric Throttle Actuator (ETA) Test

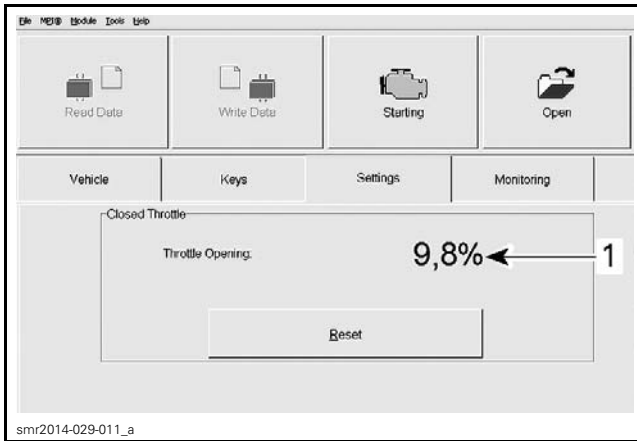
Electric Throttle Actuator (ETA) Test with B.U.D.S.

- Connect vehicle to the latest B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- Press the START/RER button to wake up the ECM.
- Install the tether cord on the engine cut-off switch.
- In B.U.D.S., select:
 - Read Data** button
 - Setting** page tab.

NOTE: Use the **Setting** page to confirm ETA movement. The Monitoring page will not read the actual ETA movement.

Subsection 03 (ELECTRONIC FUEL INJECTION)

5. Slowly depress the throttle lever from the idle to WOT. The ETA should go from almost 10% to 100%.



1. ETA position

If result is out of specification, carry out a *THROTTLE POSITION SENSOR INITIALIZATION*. Refer to *THROTTLE POSITION SENSOR (TPS)* in this subsection.

NOTE: The ETA is reset at the same time as the TPS.

After the reset, test ETA again.

If the result is still out of specification, check wire continuity between ECM and throttle body before assuming the ETA is at fault.

Throttle Body (ETC) Inspection

1. Remove parts required to access throttle body, refer to *THROTTLE BODY (ETC) ACCESS*.
2. Carry out the following:
 - Inspect throttle body for cleanliness.
 - Ensure throttle plate opens fully and smoothly.
 - Check for corroded or damaged wiring or damaged ETC connectors.

Throttle Body (ETC) Dynamic Tests

1. Remove the parts required to access the throttle body (ETC), refer to *THROTTLE BODY (ETC) REMOVAL*.
2. Remove the air inlet hose from the throttle body.
3. Observe the throttle plate with the engine stopped.

NOTE: The throttle plate should be in the rest position (slightly opened).

WARNING

Keep your fingers out of the throttle plate area while the ECM turns on. The throttle actuator will cycle. This could cause serious finger injuries as throttle plate quickly moves.

4. As you observe the throttle plate, have someone press the START/RER button to wake up the ECM.

NOTE: The throttle plate should cycle quickly from the rest position to a partially open position (approximately 15°), then back to the rest position.

5. Install the tether cord on the engine cut-off switch.

NOTE: The throttle plate should cycle again.

6. As you observe the throttle plate, have someone gradually and evenly pull in the throttle lever, then release it in the same way.

NOTE: The throttle plate should open then close according to throttle lever position however, the movement of the throttle plate may not be linear with the displacement of the throttle lever.

If any test failed, proceed with the *THROTTLE BODY (ETC) STATIC TESTS*.

Throttle Body (ETC) Static Tests

WARNING

First ensure the ECM is off. Do not move the throttle plate using your fingers. Otherwise, should the START/RER button be pressed, the ECM would turn on and quickly cycle the throttle plate which could cause serious finger injury.

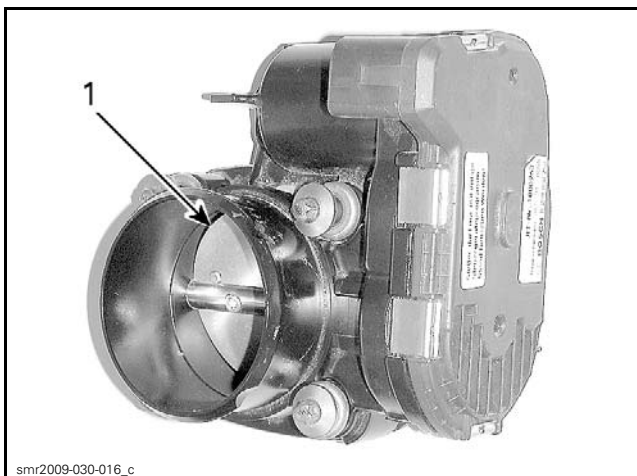
1. Using a blunt tool, push in on the throttle plate and ensure it opens smoothly within the throttle body.



1. Push here to open

NOTE: The throttle plate must open fully and return freely to the rest position (slightly opened) when released.

2. Push throttle plate closed as indicated in following illustration. It must close completely and return freely to the rest position (slightly opened) when released.



1. Push here to close

If the throttle plate does not move smoothly or does not return freely to the rest position, the problem is mechanical. Check for dirt accumulation on throttle plate shaft. It may also be an actuator or gear problem. Replace throttle body as necessary.

If throttle plate operates normally, the problem is electrical. Check electric throttle actuator (ETA) wiring continuity, throttle position sensor (TPS) and throttle accelerator sensor (TAS).

⚠ WARNING

If the throttle plate does not return to its rest position properly after a proper cleaning, replace the throttle body.

Throttle Body (ETC) Cleaning

1. Remove throttle body from intake manifold without disconnecting heating hoses. Refer to *THROTTLE BODY (ETC) REMOVAL* further in this subsection.

2. Check throttle body cleanliness using a flash-light. Fully open throttle plate and verify:

- Throttle body bore
- Throttle plate edge.

Look for:

- Dirt
- Oily surfaces
- Carbon and dirt deposits on throttle plate and the surrounding bore.

3. Clean as necessary.

4. Use a throttle body cleaner such as GUNK INTAKE MEDIC or an equivalent.

NOTICE Only use an appropriate throttle body cleaner that will not damage O-rings and EFI sensors.

⚠ CAUTION Use the product in a well ventilated area. Refer to product manufacturer's warnings.

5. To avoid getting dirt into engine, spray cleaner on a clean rag then rub rag against throttle plate and bore. A toothbrush may also be used.

⚠ CAUTION Ensure tether cord is removed and battery cables are disconnected so that nobody can activate the electrical system, otherwise the ECM would turn on and the throttle actuator (ETA) would cycle. This could cause serious finger injury as the throttle plate moves quickly.

6. Gently open throttle plate and hold fully open to clean all surfaces.

7. To remove residual dirt, spray cleaner on throttle plate and throttle bore.

8. Reinstall all removed parts.

Throttle Body (ETC) Removal

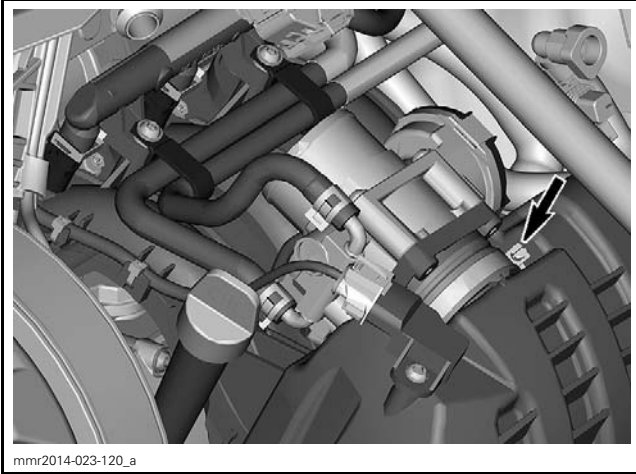
⚠ WARNING

When electrically disconnecting or removing the throttle body from the intake manifold, always remove the tether cord from the engine cut-off switch and disconnect the battery.

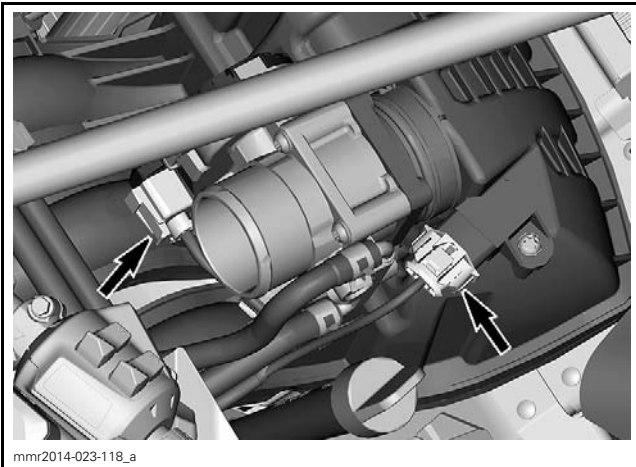
1. Remove parts required to access throttle body, refer to *THROTTLE BODY (ETC) ACCESS*.

Subsection 03 (ELECTRONIC FUEL INJECTION)

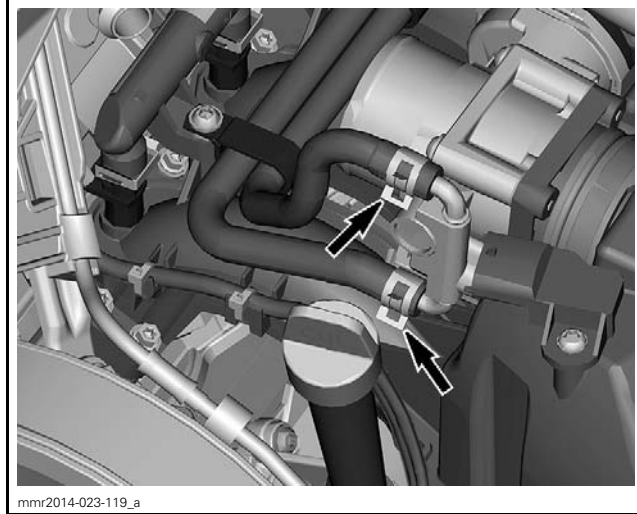
2. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
3. Loosen gear clamp and remove throttle body from intake manifold.



4. Disconnect MAPTS and ETC connectors.



5. Install a SMALL HOSE PINCHER (P/N 295 000 076) on each coolant hose connected to throttle body.
6. Disconnect coolant hoses from throttle body.



Throttle Body (ETC) Installation

Installation of the throttle body is the reverse of the removal procedure. However, pay attention for the following details.

1. Install coolant hoses on throttle body; replace clamps as required.
2. Refill and bleed cooling system as required. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Perform the *THROTTLE POSITION SENSOR INITIALIZATION* reset procedure. Refer to *THROTTLE POSITION SENSOR (TPS)* in this subsection.
4. Install all remaining removed parts, refer to applicable subsections.
5. Start engine and ensure proper idle and throttle control.

THROTTLE POSITION SENSOR (TPS)

TPS Description

NOTE: The TPS is part of the throttle body (ETC).

The throttle position sensor (TPS) is a double potentiometer that sends signals to the ECM that are proportional to the throttle plate angle.

NOTE: As a first troubleshooting step, always check for applicable fault codes using B.U.D.S. software.

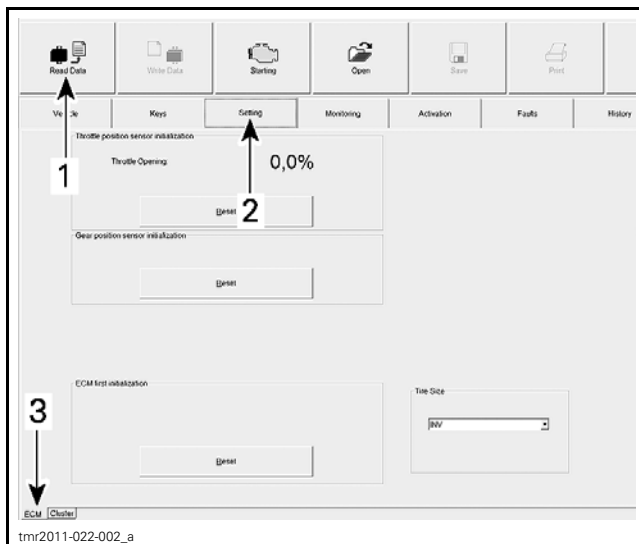
Throttle Position Sensor Initialization

NOTE: The TPS initialization procedure **must** be carried out whenever the throttle body (ETC) is replaced, unless an ECM first initialization reset is carried out.

This operation performs a reset of the TPS basic values in the ECM. This reset is very important as the TPS values are part of the basic parameters for all fuel mapping calculations and control of several settings such as for idle speed, LIMP HOME mode and maximum RPM of the engine.

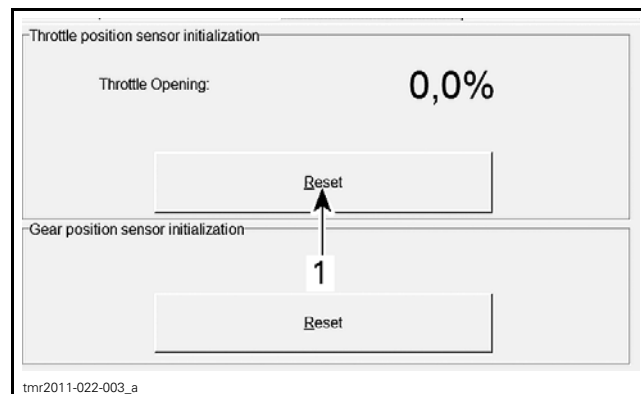
NOTICE An improperly set TPS may lead to improper idle speed (too low or too high), poor engine performance, poor engine starting and engine stop on deceleration, fault codes and possible engine damage. Emission compliance may also be affected.

1. Connect vehicle to the applicable B.U.D.S. software version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
 - Read Data button
 - Setting tab
 - ECM tab.



1. Read Data button
2. Setting tab
3. ECM tab

3. Ensure the throttle lever is fully released and at the idle position.
4. In the **Throttle position sensor initialization** field, click on the **Throttle Opening Reset** button.



THROTTLE POSITION SENSOR INITIALIZATION
1. Throttle Opening Reset button

A message will be displayed if the operation is successful.

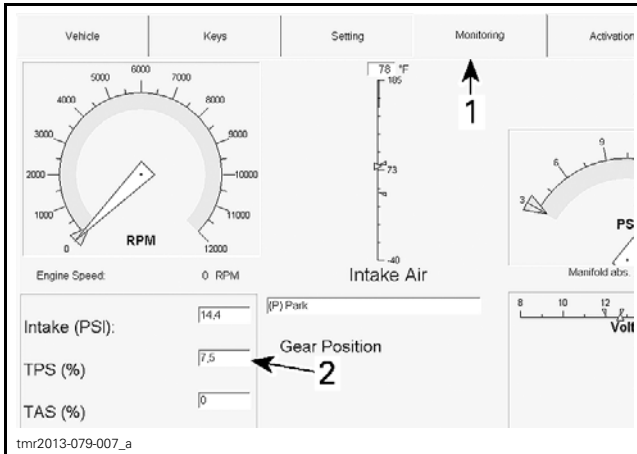
If an error occurred or the TPS is not within the allowed range while resetting, the ECM will generate a fault code and will not accept the setting.

5. If a fault message is displayed, follow the instructions in the message(s).
6. Check for fault codes.
7. If a fault code is generated,
 - Carry out the service actions.
 - Reset the fault.
 - Repeat the reset procedure.
8. Start engine and make sure it operates normally throughout its full engine RPM range.

TPS Wear Test

1. With the engine turned off, slowly press on the throttle lever and pay attention for smooth operation without physical stops.
2. Activate the electrical system to wake up the ECM.
3. Connect vehicle to the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select the following:
 - Monitoring tab
 - ECM tab.
5. Slowly and regularly move the throttle lever.
6. Observe the Throttle Opening indication movement in B.U.D.S.

Subsection 03 (ELECTRONIC FUEL INJECTION)



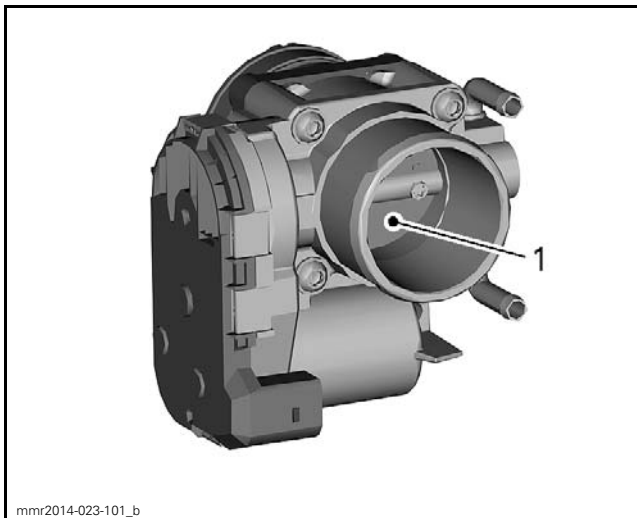
1. Monitoring tab
2. TPS indication

NOTE: The indication should move gradually and regularly as you move the throttle lever. If the TPS indication is erratic or suddenly drops off, it may indicate a worn TPS that needs to be replaced. An initial slight delay after the throttle lever is moved and before the indication starts to move is normal.

If the indication behavior is not as expected, proceed with the following steps.

7. Manually move the throttle plate in the throttle body using a blunt tool (without sharp tip).

⚠ CAUTION Do not move throttle plate with your fingers. Otherwise, if ECM should turn off, it would quickly close the throttle plate which could cause finger injury.



1. Push here

8. Check the indication movement again.

- If the indication moves as expected, check the throttle accelerator sensor (TAS). Refer to *THROTTLE ACCELERATOR SENSOR (TAS)* in this subsection.
- If the indication does not move as expected, perform the *TPS RESISTANCE TEST* in this subsection.

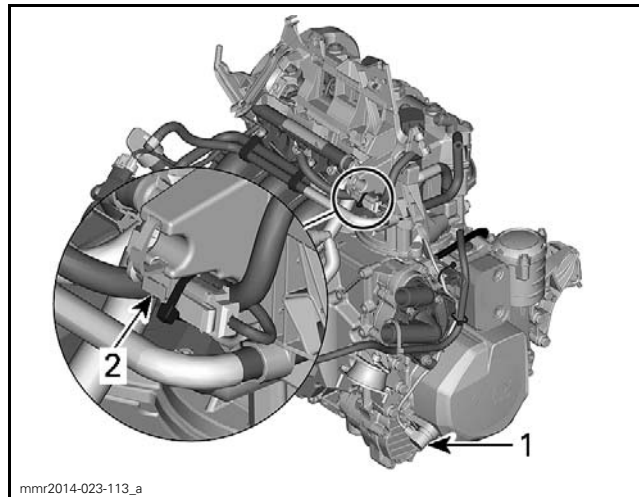
CRANKSHAFT POSITION SENSOR (CPS)

CPS TROUBLESHOOTING

When troubleshooting a CPS fault, take into account that a CPS fault can be triggered by bent or missing encoder wheel teeth.

Push START/RER button and crank engine. If engine does not start within 15 seconds check for fault codes using B.U.D.S.

CPS and CPS Connector Location



mmr2014-023-113_a
RH SIDE OF ENGINE

1. CPS location
2. CPS connector location


CPS Access

1. Refer to appropriate subsection to remove;
2. RH side panel
3. Upper body module (REV-XS)
4. Air intake silencer and gauge support assembly (REV-XR)
5. Muffler.


CPS Resistance Test at ECM connector

1. Remove parts required to access ECM-A connector, refer to *ECM CONNECTOR ACCESS* in this subsection.

- Disconnect ECM-A connector from the ECM and connect it to the ECM adapter.

| REQUIRED TOOL | |
|---------------------------------------|---|
| ECM ADAPTER TOOL (P/N 529 036 166) |  |

- Set multimeter to Ω .

| REQUIRED TOOL | |
|---|---|
| FLUKE 115 MULTIMETER (P/N 529 035 868) |  |

- Measure the resistance of the sensor as per following table.

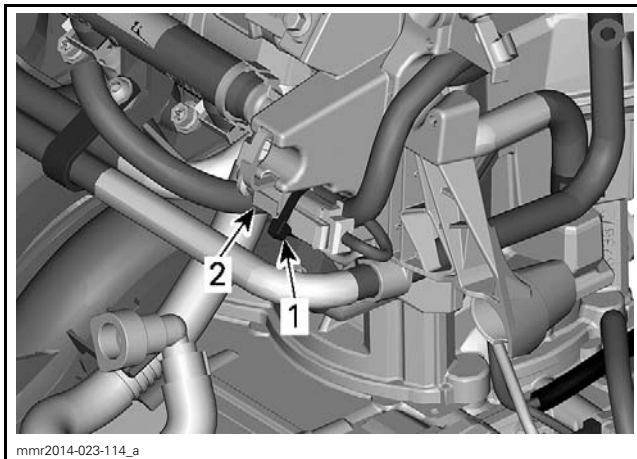
| ECM ADAPTER | | READING |
|-------------|----|------------------------|
| PIN | | Ω @ 20°C (68°F) |
| 1H | 2K | 775 - 950 Ω |

If resistance is as specified, test continuity of wiring between ECM-A and CPS connectors. Refer to *WIRING DIAGRAM* subsection.

If resistance value is not as specified, reconnect ECM-A connector to the ECM and refer to *CPS RESISTANCE TEST AT CPS CONNECTOR*.

CPS Resistance Test at CPS Connector

- Cut locking tie securing CPS connector to ECM support and disconnect CPS connector.



- Locking tie
- CPS connector

- Probe CPS connector terminals as per following table.

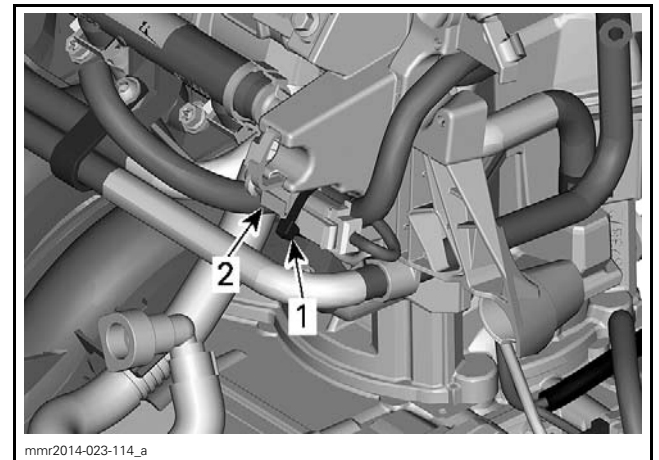
| CPS | | READING |
|-----|---|------------------------|
| PIN | | Ω @ 20°C (68°F) |
| 1 | 2 | 775 - 950 Ω |

If resistance is not within specifications, replace the CPS.

If resistance tests good, carry out a *CPS OUTPUT VOLTAGE TEST*.

CPS Output Voltage Test

- Remove fuse F1 (Ignition/Injection fuse), refer to *POWER DISTRIBUTION* subsection.
- Cut locking tie securing CPS connector to ECM support and disconnect the CPS connector.



- Locking tie
- CPS connector

- Probe CPS connector terminals while cranking engine as per following table.

| CPS | | READING |
|-----|---|----------------|
| PIN | | VOLTAGE |
| 1 | 2 | 1 - 2 Vac min. |

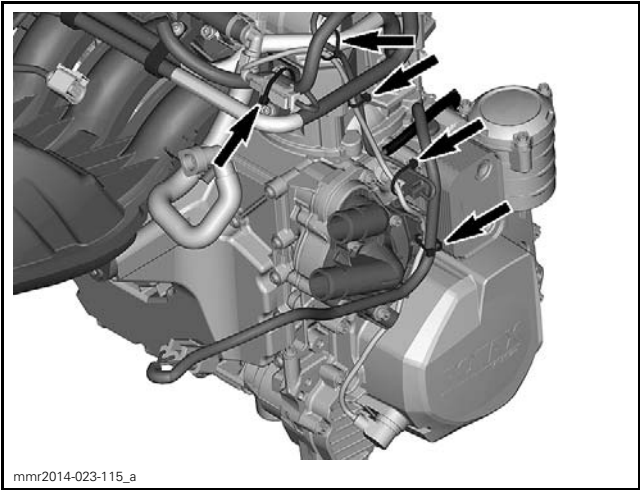
If voltage is out of specification, inspect wiring/connectors. Replace CPS if wiring is good.

If voltage is within specification, the problem may be related to the ECM.

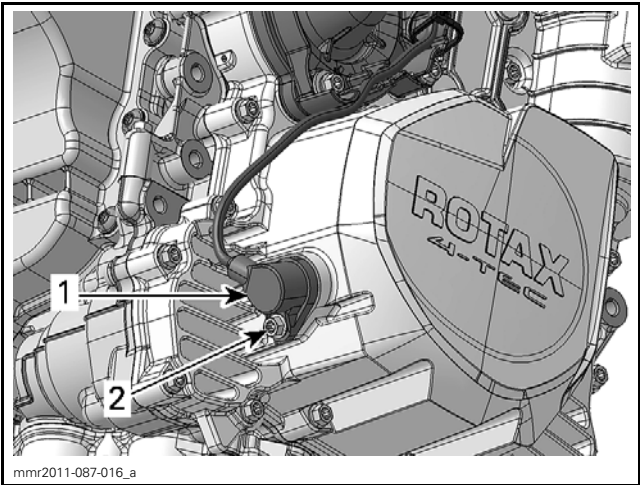
- Reconnect CPS connector and install all removed parts.

CPS Replacement

- Remove parts required to access the CPS, refer to *CPS ACCESS* in this subsection.
- Take note of factory CPS wire harness routing for reinstallation.
- Cut harness locking ties (5) and disconnect CPS connector.



4. Remove CAPS retaining screw and pull on CAPS to remove it.



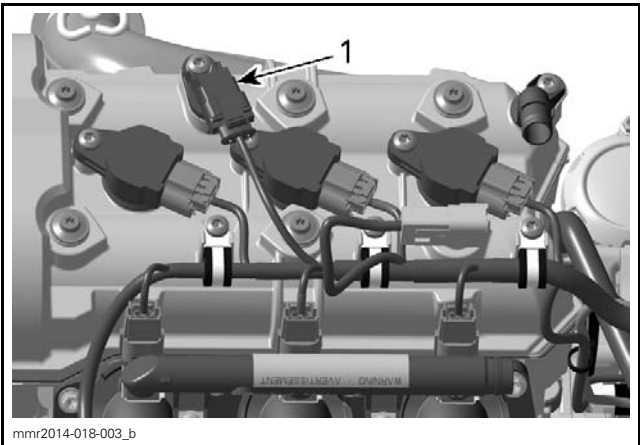
- 1. CAPS
- 2. Retaining screw

5. Install new CAPS.

| CAPS INSTALLATION | |
|-------------------|---|
| O-RING | SERVICE PRODUCT |
| | APPLY ENGINE OIL ON O-RING |
| RETAINING SCREW | TORQUE |
| | 9 N•m ± 1 N•m (80 lbf•in ± 9 lbf•in) |

6. Route and secure CAPS harness using harness clamp and locking ties as noted prior to removal.

CAMSHAFT POSITION SENSOR (CAPS)



- 1. CAPS

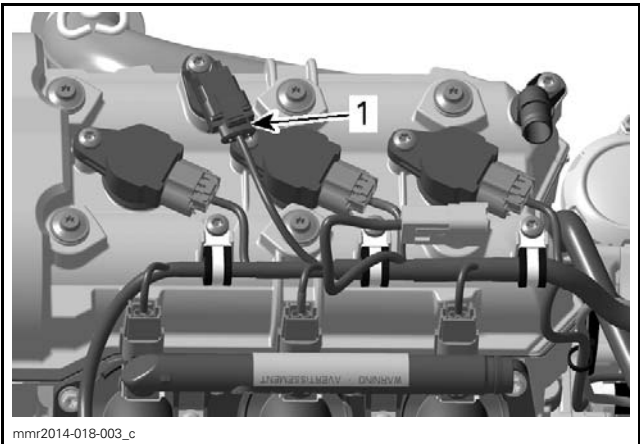
CAPS Access

Refer to appropriate subsection and remove:

- Side Panels
- Upper body module (REV-XS)
- Air intake silencer and gauge support assembly (REV-XR)

CAPS Voltage Test (Harness Side)

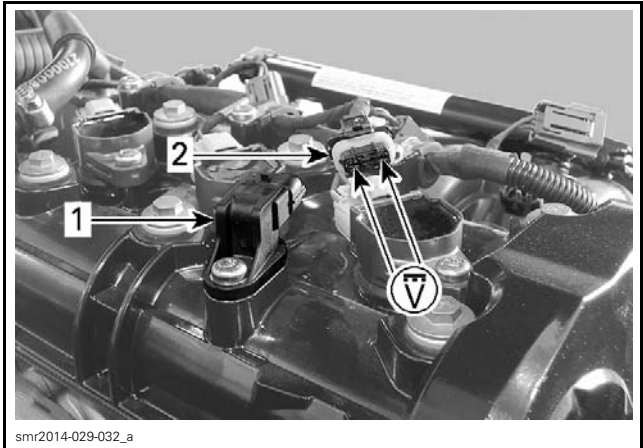
1. Remove the parts required to access the CAPS, refer to *CAPS ACCESS*.
2. Disconnect CAPS connector.



- 1. CAPS connector

3. Press the START/RER button to wake up the ECM.
4. Install tether cord on engine cut-off switch.
5. Probe harness connector terminals as per following table.

| CAPS | | READING |
|------|---|-----------------|
| PIN | | VOLTAGE |
| 3 | 1 | Battery Voltage |

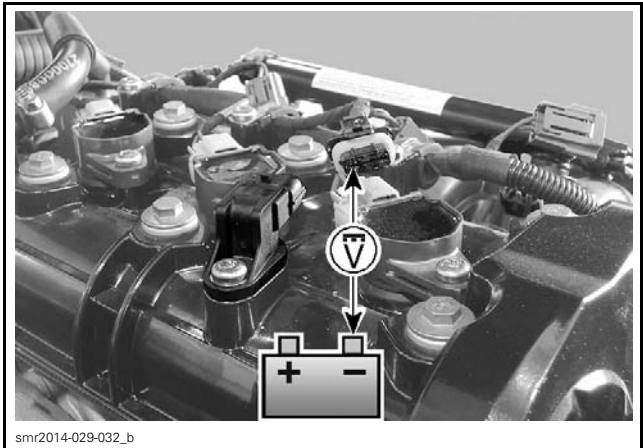


1. CAPS
2. CAPS connector

If battery voltage is read, proceed with *CAPS DYNAMIC TEST* further in this subsection.

If battery voltage is not read, probe circuit as per following table.

| CAPS | BATTERY | READING |
|------|----------------|-----------------|
| PIN | TERMINAL | VOLTAGE |
| 3 | Battery Ground | Battery Voltage |

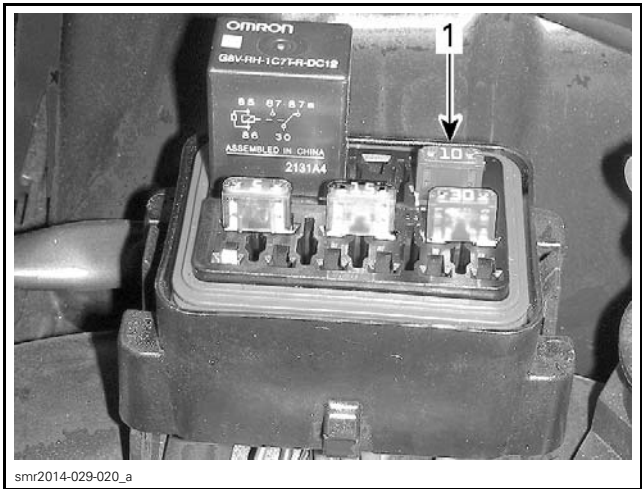


If voltage is read to battery ground, check continuity of ground circuit between CAPS pin 1 and ECM-A connector pin 4D. Repair or replace wiring and connectors.

If voltage is not read to battery ground, carry out a *CONTINUITY TEST OF CAPS POWER CIRCUIT*.

Continuity Test of CAPS Power Circuit

1. Remove cover from fuse box. Refer to *POWER DISTRIBUTION*.
2. Remove 10 amp ECM, GAUGE and CAPS fuse (F6).

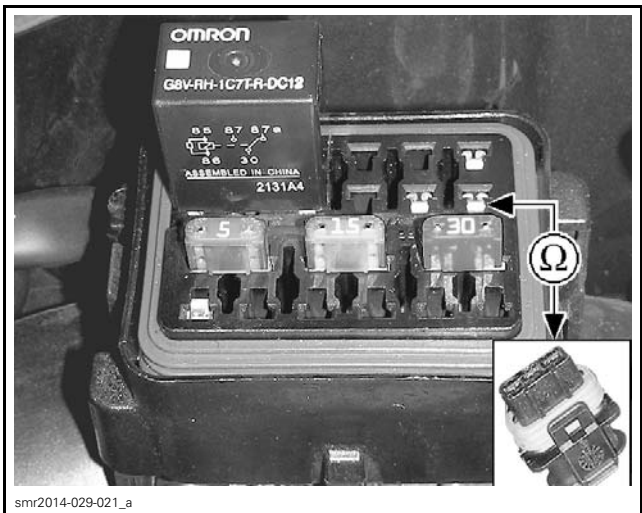


1. Pull out fuse (F1)

3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Ω .

4. Read resistance of the CAPS circuit as per following table.

| CAPS | FUSE BOX | READING |
|------|----------|---------------------|
| PIN | TERMINAL | Ω |
| 3 | 6B | Close to 0 Ω |



If continuity is good, wiring and connectors are functional.

Subsection 03 (ELECTRONIC FUEL INJECTION)

If a high resistance or an open circuit is measured, refer to *WIRING DIAGRAM* and check the following:

- Continuity from CAPS connector pin 3 to engine connector pin 4
- Continuity from engine connector pin 4 to fuse box contact 6B

Pay attention to connector pin contact and junction JT-1 (VT/GY).

Repair or replace wiring and connectors as required.

5. Reinstall all removed parts.

CAPS Dynamic Test

1. Remove the parts required to access the CAPS, refer to *CAPS ACCESS*.
2. Remove CAPS sensor from engine.
3. Back-probe connector and read voltage as follows.

NOTE: To safely probe wire terminals through the back of the connector, use the following tool or an equivalent.

| REQUIRED TOOL |
|--|
| FLUKE AUTOMOTIVE BACK PROBE PIN (P/N TP40) |



FLUKE AUTOMOTIVE BACK PROBE PIN P/N TP40

NOTICE Do not use sharp end probes. They could damage the connector seal.

Probes can be inserted at the end of the FLUKE SUREGRIP INSULATED TEST LEADS (P/N TL224).

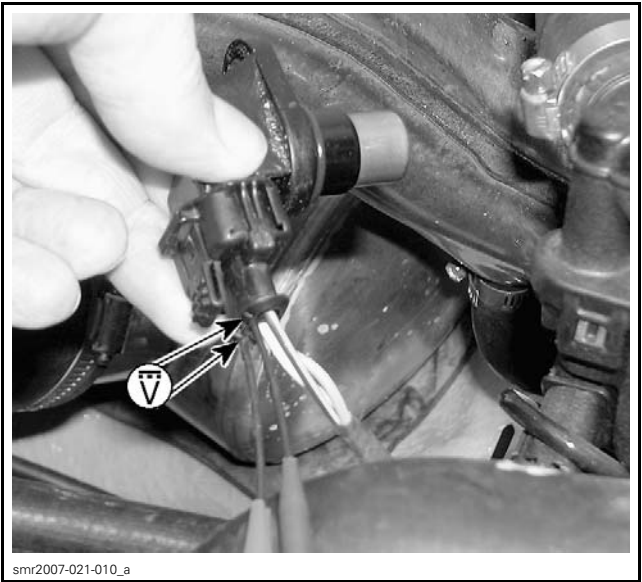


4. Briefly press the START/RER button to wake up the ECM.

5. Install the tether cord cap on the engine cut-off switch.

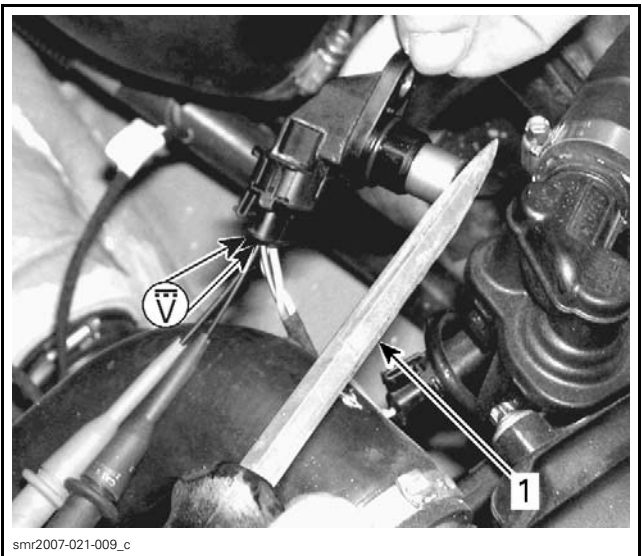
6. Read voltage as per following tables.

| CAPS | | CAPS CONDITION | READING |
|------|---|----------------|----------------|
| PIN | | SENSOR END | VOLTAGE |
| 3 | 2 | Free | Close to 0 Vdc |



TYPICAL

| CAPS | | CAPS CONDITION | READING |
|------|---|---------------------------|-----------------|
| PIN | | SENSOR END | VOLTAGE |
| 3 | 2 | Metallic Object on Sensor | Battery Voltage |



TYPICAL

1. Metallic object

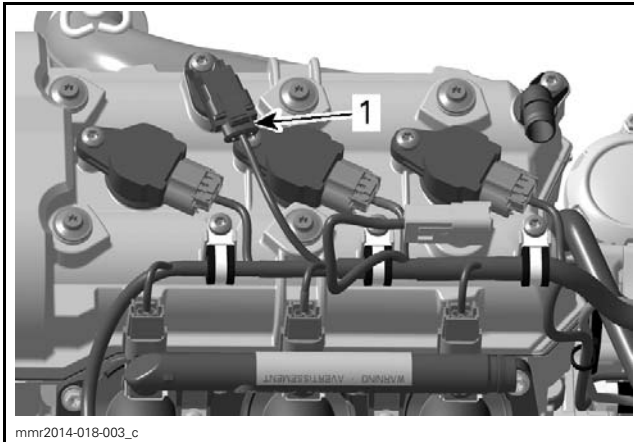
If voltage is as specified, repair or replace wiring and connectors between sensor and ECM.

If wiring is good, check ECM. Refer to *ENGINE CONTROL MODULE (ECM)*.

If battery voltage is not measured as specified, try a new CAPS.

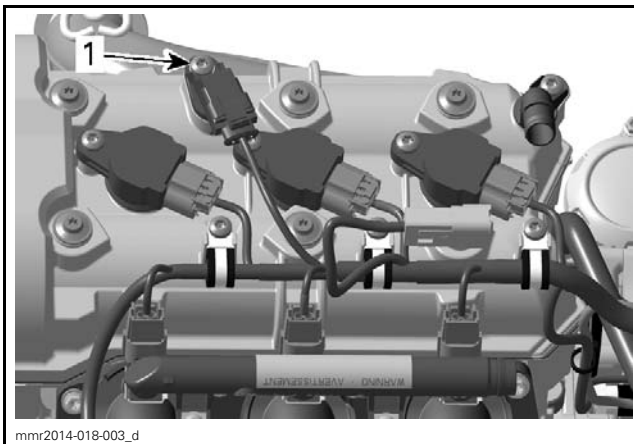
CAPS Replacement

1. Disconnect CAPS connector.



1. CAPS connector

2. Unscrew the CAPS retaining screw.



1. CAPS retaining screw

3. Pull CAPS from engine.

4. Install the new CAPS.

NOTICE Be sure to install new O-ring on the new CAPS.

| CAPS INSTALLATION | |
|-------------------|----------------------------|
| O-RING | SERVICE PRODUCT |
| | APPLY ENGINE OIL ON O-RING |

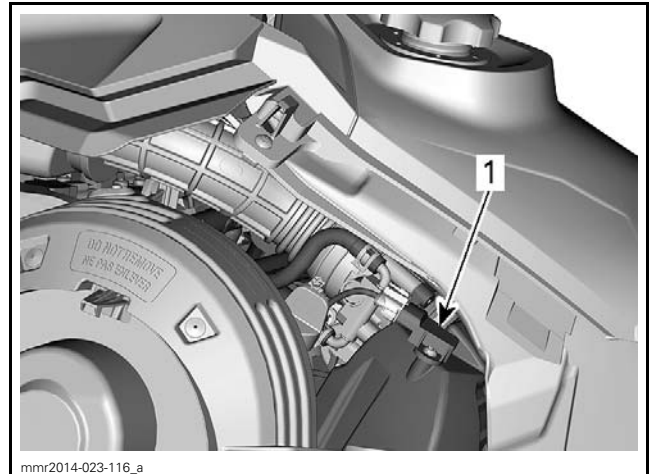
| CAPS INSTALLATION | |
|-------------------|---|
| CONNECTOR | SERVICE PRODUCT |
| | DIELECTRIC GREASE (P/N 293 550 004) |
| RETAINING SCREW | TORQUE |
| | 9 N•m ± 1 N•m (80 lbf•in ± 9 lbf•in) |

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR (MAPTS)

NOTE: This sensor is a multifunction device. It measures manifold absolute pressure and intake temperature for air flow calculations.

MAPTS Access

To access the MAPTS, remove the LH side panel.



MAPTS LOCATION

1. Manifold air pressure and temperature sensor (MAPTS)

MAPTS Pressure Function

Before the engine is started, when power is applied to the system, the sensor measures the ambient air atmospheric pressure. The ambient pressure is, at that moment, stored in the ECM. Thereafter, once the engine is started, it measures the air pressure in the intake manifold at operating RPMs.

The sensor must be correctly installed on the intake manifold. Otherwise, the MAPTS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. If this is the case, remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

MAPTS Quick Test (Pressure Function)

- 1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- 2. In B.U.D.S., select the following:
 - Read Data
 - Monitoring page tab
 - ECM page.



TYPICAL - MAPTS PRESSURE READING IN B.U.D.S.

- 3. Look for and take note of the MAPTS pressure reading while the engine is stopped.

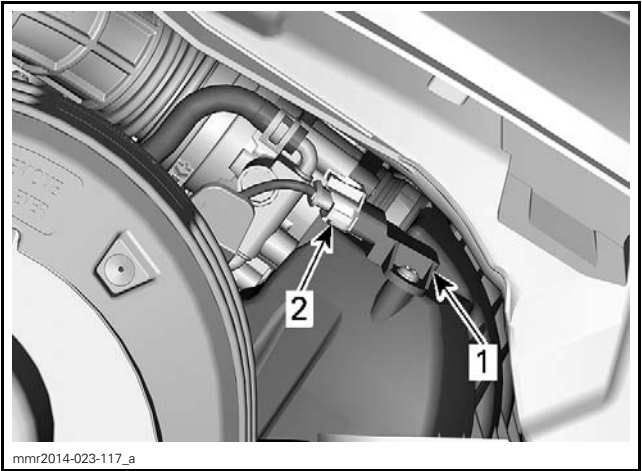
NOTE: The indicated intake air pressure in B.U.D.S. must be within 3.4 kPa (.5 PSI) of local atmospheric pressure when the engine is stopped.

| MAPTS PRESSURE FUNCTION QUICK TEST | | | |
|------------------------------------|--|--------------------------|--------------------------|
| RESULT | SERVICE ACTION | | |
| NO READING | Circuit Continuity Test of MAPTS Pressure Function | MAPTS Input Voltage Test | Repair or replace wiring |
| VALUE IS OUT OF RANGE | Replace MAPTS | | |

- 4. Perform the same test with a new MAPTS and compare both readings.

MAPTS Input Voltage Test

- 1. Remove parts required to access the MAPTS, refer to *MAPTS ACCESS*.
- 2. Remove electrical connector from MAPTS.



- 1. MAPTS
- 2. MAPTS connector to remove

- 3. Briefly push START/RER button.
- 4. Set multimeter to Vdc, measure for MAPTS input voltage as per following table.

| REQUIRED TOOL | | |
|---|---|---------|
| FLUKE 115 MULTIMETER (P/N 529 035 868) | | |
| MAPTS | | READING |
| PIN | | VOLTAGE |
| 1 | 3 | 5 Vdc |

If voltage test is good, replace the MAPTS.
If voltage test is not good, carry out the *MAPTS CIRCUIT CONTINUITY TEST (PRESSURE FUNCTION)*.

MAPTS Circuit Continuity Test (Pressure Function)

- 1. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
- 2. Disconnect the ECM-A connector from the ECM and connect it to the ECM adapter tool.

| REQUIRED TOOL | |
|---------------------------------------|--|
| ECM ADAPTER TOOL (P/N 529 036 166) | |

- 3. Set multimeter to Ω and check continuity of the following circuits.

| REQUIRED TOOL | |
|---|--|
| FLUKE 115 MULTIMETER (P/N 529 035 868) | |

| ECM ADAPTER | MAPTS | READING |
|-------------|-------|---------------------|
| PIN | | Ω |
| 4B | 3 | Close to 0 Ω |
| 4G | 4 | |
| 2H | 1 | |

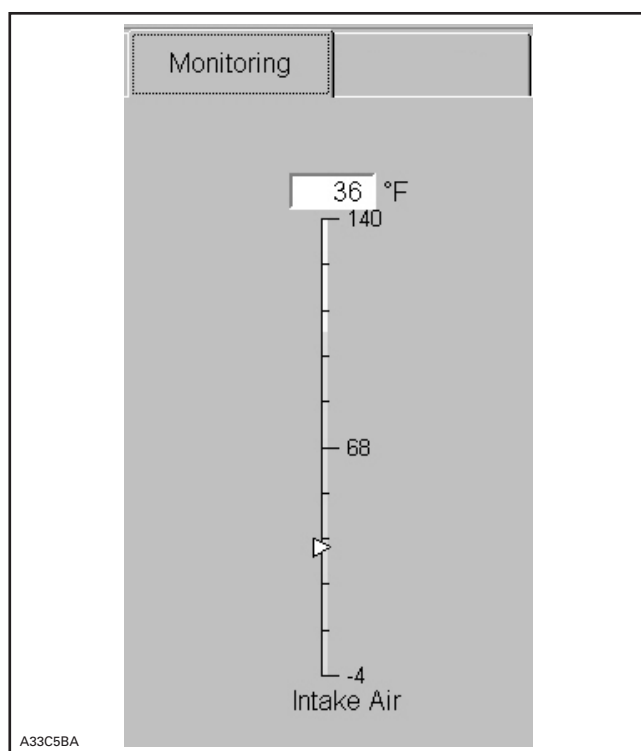
If resistance is not within specification, repair or replace the wiring harness between ECM connector and the MAPTS. Refer to *WIRING DIAGRAM*.

MAPTS Temperature Function

The MAPTS also monitors the temperature of the air in the intake manifold.

MAPTS Quick Test (Temperature Function)

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
 - Read Data
 - Monitoring page tab
 - ECM page.
3. Look for the **Intake Air** temperature reading while the engine is stopped.



TYPICAL - MONITORING PAGE TAB, ECM

NOTE: If the complete vehicle is at room temperature, B.U.D.S. should display the ambient air temperature at the intake manifold.

4. Perform the same test with a new MAPTS and compare both readings.


If the engine's MAPTS temperature reading is significantly different than the new MAPTS, replace it.

NOTE: Both sensors must feel same ambient air temperature.

If there is no reading, carry out a *MAPTS RESISTANCE TEST (TEMPERATURE FUNCTION)*.

MAPTS Resistance Test (Temperature Function)

1. Disconnect the MAPTS connector.
2. Test MAPTS resistance at the sensor as per following tables.

| REQUIRED TOOL | |
|---|---|
| FLUKE 115 MULTIMETER (P/N 529 035 868) |  |

| MAPTS | READING | |
|-------|----------|---|
| PIN | Ω | |
| 1 | 2 | Refer to MAPTS TEMPERATURE SENSOR TABLE |


| MAPTS TEMPERATURE SENSOR TABLE | | |
|--------------------------------|------|----------------|
| TEMPERATURE | | Ω |
| °C | °F | MAPTS |
| - 40 | - 40 | 40528 to 56935 |
| - 10 | - 14 | 8103 to 10919 |
| 20 | 68 | 2193 to 2863 |
| 80 | 176 | 294 to 368 |
| 120 | 248 | 98 to 122 |

If resistance is not within specification, replace the MAPTS.

If resistance tests good, **reconnect** the MAPTS and proceed with the following steps.

3. Disconnect the ECM-A connector.
4. Install ECM-A connector on the ECM adapter tool.

Subsection 03 (ELECTRONIC FUEL INJECTION)

| REQUIRED TOOL | |
|---------------------------------------|---|
| ECM ADAPTER TOOL (P/N 529 036 166) |  |

5. Using a multimeter, recheck resistance value as per following table.

| ECM ADAPTER | | READING |
|-------------|----|---|
| PIN | | Ω |
| 2H | 3H | Refer to MAPTS TEMPERATURE SENSOR TABLE |

| MAPTS TEMPERATURE SENSOR TEST RESULTS | | | |
|---------------------------------------|---|--------------------------|--------------------------|
| RESULT | SERVICE ACTION | | |
| NO READING | Circuit Continuity Test of MAPTS Temperature Function | MAPTS Input Voltage Test | Repair or replace wiring |
| INCORRECT RESISTANCE VALUE | Check condition of connector pins, replace MAPTS | | |
| CORRECT RESISTANCE VALUE | Try a new ECM | | |

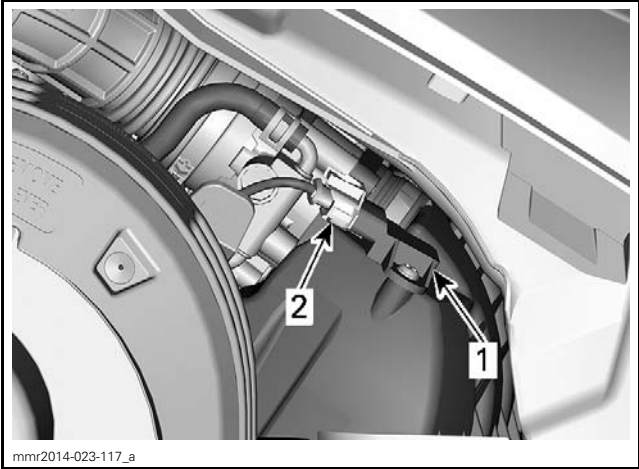
MAPTS Circuit Continuity Test (Temperature Function)

| ECM ADAPTER | MAPTS | READING |
|-------------|-------|---------------------|
| PIN | | Ω |
| 2H | 1 | Close to 0 Ω |
| 3H | 2 | |

Repair or replace wiring as required.

MAPTS Replacement

1. Disconnect MAPTS connector and remove the MAPTS from the intake manifold.



1. MAPTS
2. MAPTS connector

2. Install new MAPTS as per following table.

| MAPTS RETAINING SCREW | |
|-----------------------|---|
| Tightening torque | 4.5 N•m \pm 0.5 N•m (40 lbf•in \pm 4 lbf•in) |

COOLANT TEMPERATURE SENSOR (CTS)

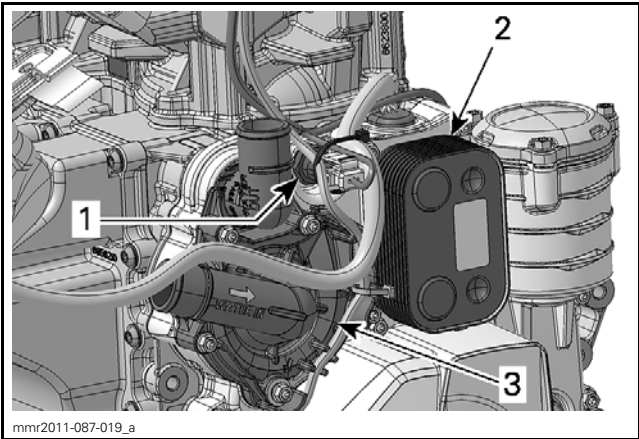
Overheat Warning

The CTS will cause the engine overheat warning to come on when the coolant temperature is above 110°C (230°F).

CTS Access

The CTS is located on the RH side of the engine, between the water pump and oil cooler.

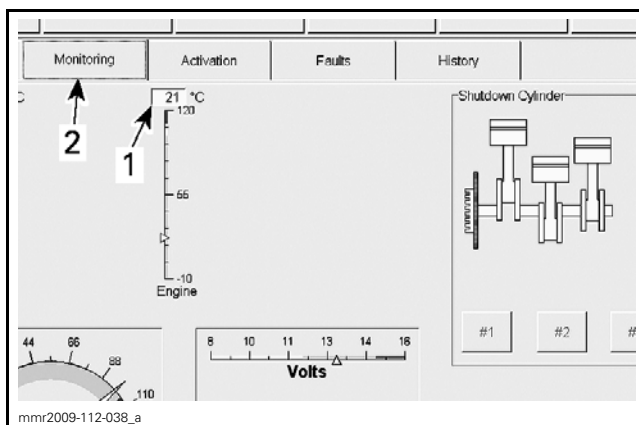
To access the CTS, remove the RH side panel.



- RH SIDE OF THE ENGINE
1. Coolant temperature sensor (CTS)
2. Oil cooler
3. Water pump

CTS Quick Test

1. Connect the vehicle B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
 - **Read Data** button
 - **Monitoring** page tab
 - **ECM** page.
3. Look for the engine temperature indication.



1. Engine temperature
2. Monitoring tab

The engine temperature gauge in B.U.D.S. should provide an indication of the actual engine coolant temperature. Otherwise, perform the *CTS RESISTANCE TEST*.

CTS Resistance Test

1. Disconnect the CTS connector.
2. Test the resistance of the sensor as per following tables.

| CTS | | READING | |
|-----|---|---------------------------------------|--|
| PIN | | Refer to CTS TEMPERATURE SENSOR TABLE | |
| 1 | 2 | | |


| CTS TEMPERATURE SENSOR TABLE | | | |
|------------------------------|------|-------|--------|
| TEMPERATURE | | Ω | |
| °C | °F | LOW | HIGH |
| - 40 | - 40 | 38400 | 52600 |
| - 10 | 14 | 8200 | 10,600 |
| 0 | 32 | 5900 | 6900 |
| 20 | 68 | 2200 | 2800 |
| 80 | 176 | 295 | 350 |
| 120 | 248 | 105 | 120 |

NOTE: To test sensor at various temperatures, remove sensor and use a heat gun, ice and a thermometer.


If resistance is out of specification, replace the CTS.

If resistance test is good, proceed with the following steps.

3. Reconnect the CTS connector.
4. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
5. Disconnect the ECM-A connector.
6. Install ECM-A connector on adapter tool.

| REQUIRED TOOL | |
|---------------------------------------|---|
| ECM ADAPTER TOOL (P/N 529 036 166) |  |

7. Recheck resistance from the ECM connector as per following table.

| REQUIRED TOOL | |
|---|---|
| FLUKE 115 MULTIMETER (P/N 529 035 868) |  |

| ECM ADAPTER | | READING | |
|-------------|----|---------------------------------------|--|
| PIN | | Refer to CTS TEMPERATURE SENSOR TABLE | |
| 1A | 2J | | |

If resistance value is correct, refer to *ECM REPLACEMENT*.

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

CTS Replacement

1. Drain coolant, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Cut locking ties of wiring harnesses and move wiring aside for access.

NOTE: Take note of wiring and locking tie position before removal.

3. Disconnect CTS connector.
4. Remove CTS from engine.
5. Install new CTS and torque as specified.

Subsection 03 (ELECTRONIC FUEL INJECTION)

| CTS | |
|-------------------|--|
| Tightening torque | 16 N•m ± 2 N•m (142 lbf•in ± 18 lbf•in) |

6. Reinstall remaining removed parts.
- NOTE:** Ensure to reinstall wiring harness as noted prior to removal.
7. Refill and bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.