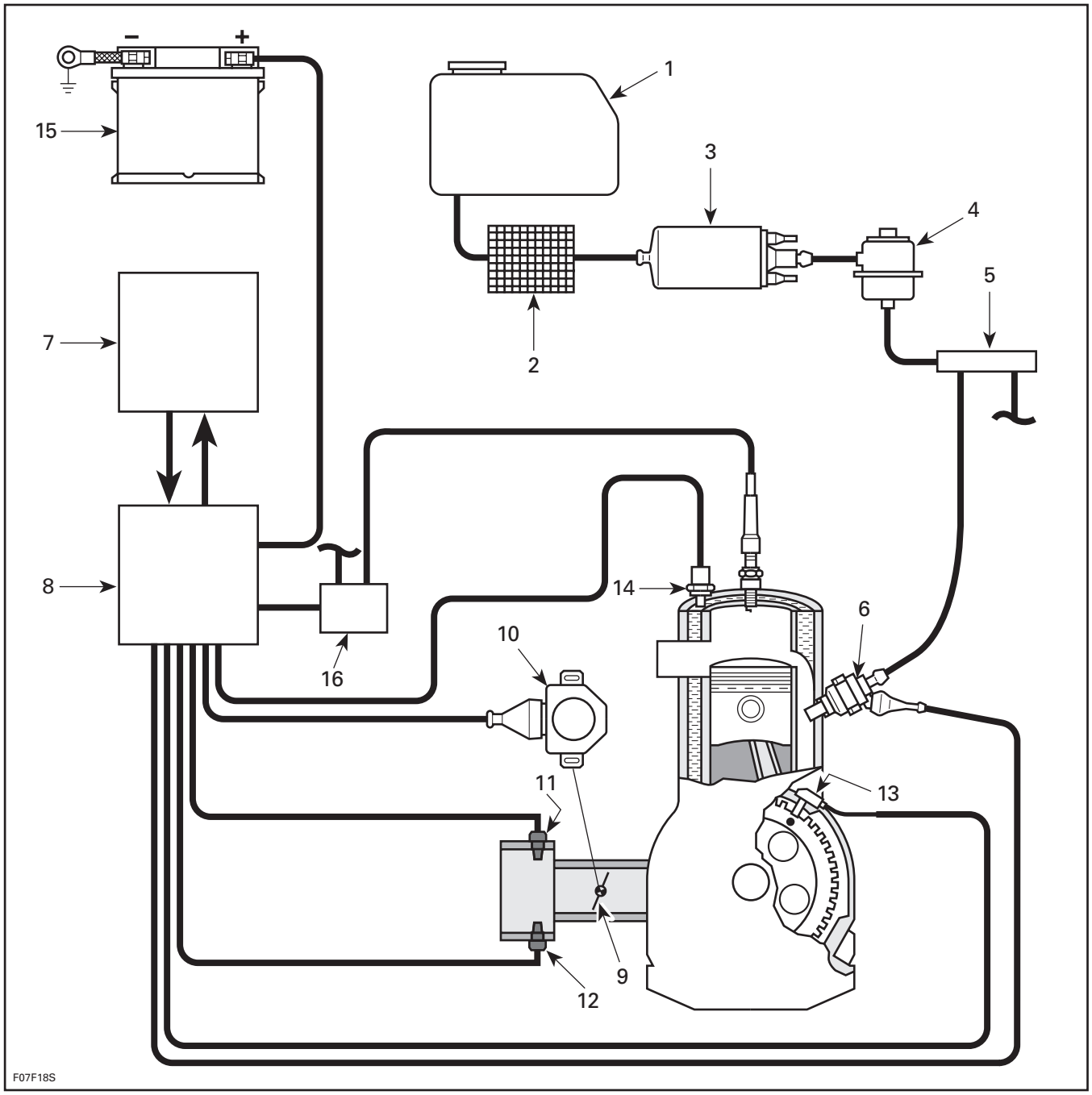
OVERVIEW



DESCRIPTION OF THE FUEL INJECTION SYSTEM

1. *Fuel tank*
2. *Fuel filter*
3. *Fuel pump*
4. *Regulator*
5. *Fuel rail*
6. *Fuel injector*
7. *Electronic Control Unit (ECU)*
8. *Multi-Purpose Electronic Module (MPEM)*
9. *Throttle plate*
10. *Throttle Position Sensor (TPS)*
11. *Air Pressure Sensor (APS)*
12. *Air Temperature Sensor (ATS)*
13. *Crankshaft Position Sensor (CPS)*
14. *Water Temperature Sensor (WTS)*
15. *Battery*
16. *Ignition coil*

The Rotax Fuel Injection (RFI) is a semi-direct electronic fuel injection system.

Fuel is injected into each cylinder through the rear transfer port. With this design, the injector is not exposed to high combustion pressure, temperature and contaminants.

NOTE: To reduce emissions, the RFI engine runs on one cylinder only (MAG side) at idle speed.

This system delivers the following benefits:

– easier cold engine starting (no choke)
– easier hot engine starting
– improved idling
– better throttle response
– better fuel economy
– no fuel valve.

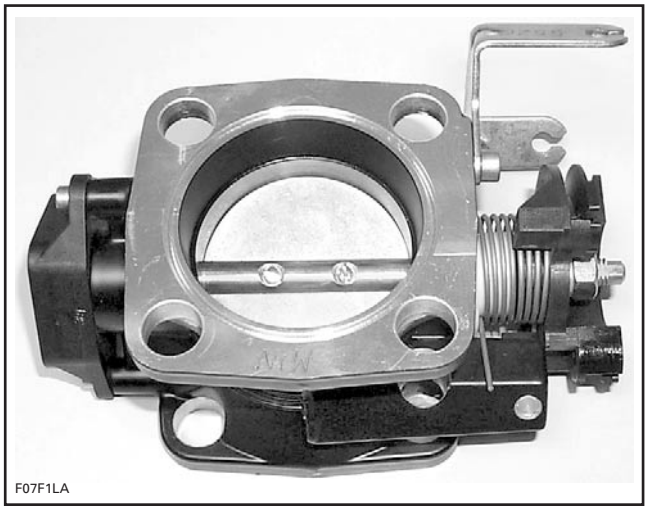
This system has the advantage of optimizing the engine power, fuel economy and emission controls under all engine operating conditions by managing both the fuel injection duration and ignition timing.

The Rotax Fuel Injection (RFI) is composed of the 3 following basic systems:

1) air induction
2) fuel delivery
3) electronic management.

AIR INDUCTION

A single throttle body (56 mm) breath through the air intake silencer to provide a sufficient amount of air for the engine operation.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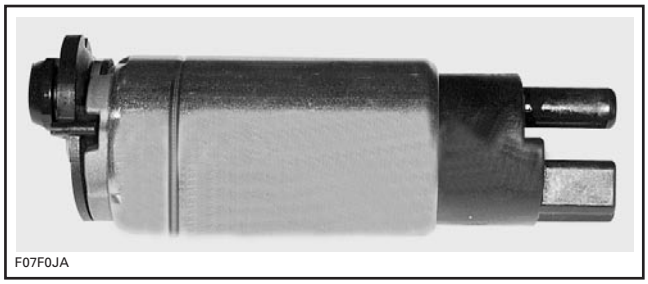
THROTTLE BODY

FUEL DELIVERY

FUEL PUMP

An electric fuel pump provides fuel pressure and flow rate to the system.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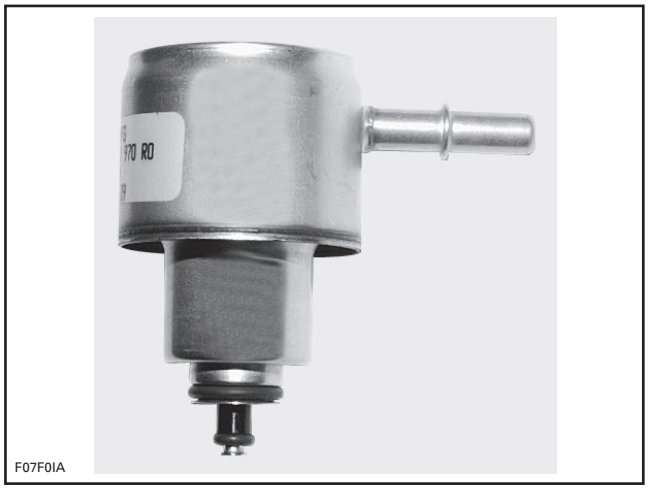
FUEL PUMP

FUEL PRESSURE REGULATOR

A regulator maintains a constant fuel pressure of 386 - 414 kPa (56 - 60 PSI).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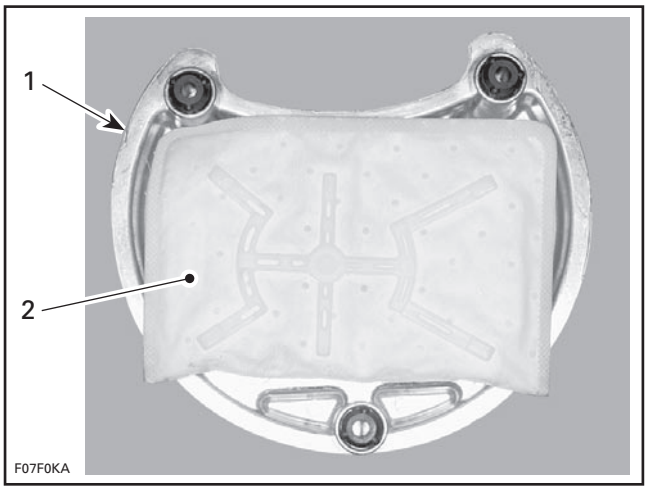
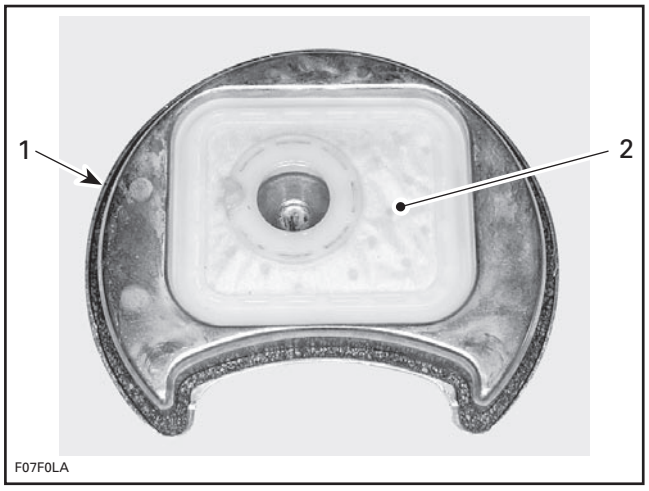
REGULATOR

FUEL FILTERS

A dual piece fuel filter protects the fuel pump, regulator and injectors.



1. Fuel pump assembly
2. External fuel filter

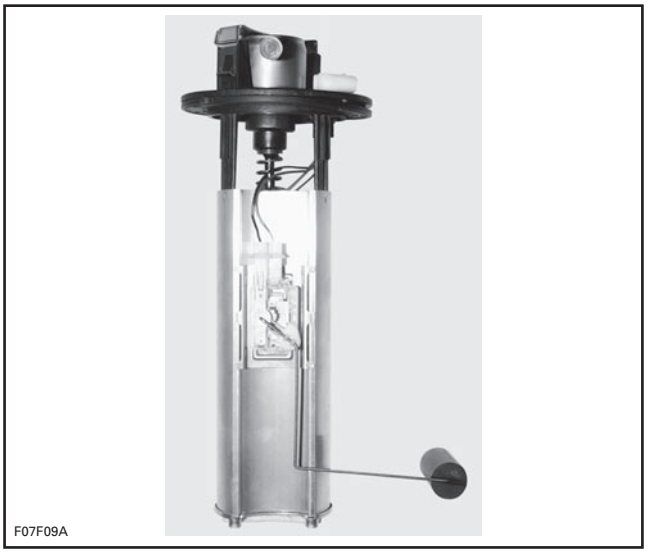


1. End cap of fuel pump assembly removed
2. Internal fuel filter

Under normal condition of use, the fuel filter does not need to be replaced.

FUEL PUMP MODULE

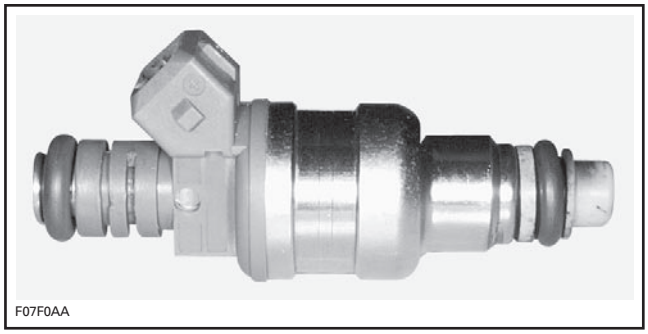
All these components are comprised in a single module mounted in the fuel tank. The fuel gauge sender is also mounted on this module.



FUEL PUMP ASSEMBLY

FUEL INJECTORS

The injectors inject a metered quantity of fuel from the fuel rail into the cylinder rear transfer port in accordance with the signal from the Electronic Control Unit (ECU).



INJECTOR

ELECTRONIC MANAGEMENT

ELECTRONIC CONTROL UNIT (ECU)

The electronic fuel injection is equipped with a Bosch Electronic Control Unit (ECU).

ELECTRONIC CONTROL UNIT (ECU)

The ECU is mounted behind the MPEM in the front of the watercraft, in a watertight box.

The ECU controls the following functions:

Basic Operating Function

Electronic Fuel Injection

The ECU receives the signals from 5 sensors which indicate engine operating conditions at millisecond intervals.

– Throttle Position Sensor (TPS)
– Crankshaft Position Sensor (CPS)
– Air Temperature Sensor (ATS)
– Water Temperature Sensor (WTS)
– Air Pressure Sensor (APS).

These signals are used by the ECU to determine the injection duration required for optimum air-fuel ratio.

Ignition Timing

The ECU is programmed with data for optimum ignition timing under all operating conditions. Using data provided by the sensors, the ECU controls the ignition timing for optimum engine operation.

Maximum Engine Speed

The ECU limits the maximum allowable engine speed. The RPM rev limiter is set at 7200 ± 50 RPM.

Fail-Safe Function

In the event of a sensor malfunction, the ECU will use a default operating mode to ensure driveability to shore. A message may be displayed on the Info Center to inform the operator.

Diagnostic Mode

The ECU is able to detect malfunctions in the sensor network. The malfunction is recorded in the memory of the ECU. The memory of the ECU can be checked using VCK (Vehicle Communication Kit) (P/N 529 035 981) or MPEM programmer tool.

MPEM (MULTI-PURPOSE ELECTRONIC MODULE)

The MPEM is also used with the Rotax Fuel Injection system.

MPEM

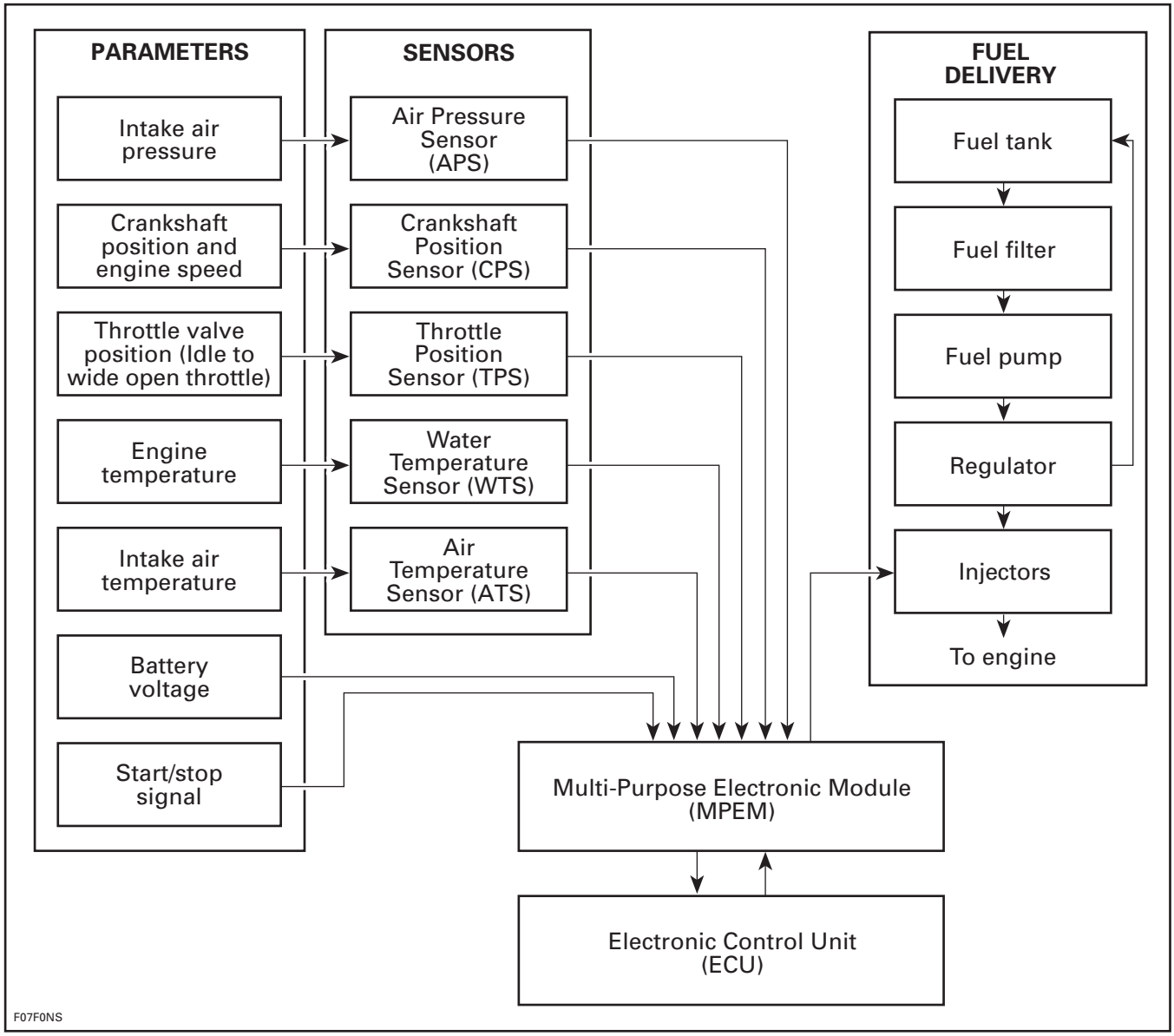
It is responsible of the following electrical functions:

– interpreting information
– distributing information
– start/stop function
– timer
– vehicle hours
– Digitally Encoded Security System (DESS).

The MPEM has a special safety feature to limit engine revolutions when the battery voltage is too low.

For example, when the battery voltage reaches 8.9 volts for at least 30 seconds, engine revolutions are limited to 4480 RPM.

When voltage reaches 7 volts for at least 30 seconds, the engine is automatically shut off by the MPEM.



SIGNAL MANAGEMENT

DIAGNOSTIC PROCEDURES

INTRODUCTION

The ECU is able to detect malfunctions in the sensor network. The malfunction is recorded in the memory of the ECU as fault codes.

SELF-DIAGNOSTIC MODE

When installing the safety lanyard cap on the DESS post, an audible signal should be heard. Refer to DESS (CARBURETED AND RFI ENGINES) for the summary of the coded signals and possible causes. To gain access to the ECU memory and fault codes, see ADVANCED DIAGNOSTIC below.

ADVANCED DIAGNOSTIC

There is two tools available that can be used to gain access to the ECU memory and read the fault codes.

VCK (Vehicle Communication Kit)

The VCK (Vehicle Communication Kit) (P/N 529 035 981) is the primary tool to diagnose fuel injection related problems.

B.U.D.S. is designed to allow sensor inspection, diagnostic options and resettings such as the Throttle Position Sensor (TPS) and the ignition timing setting.

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

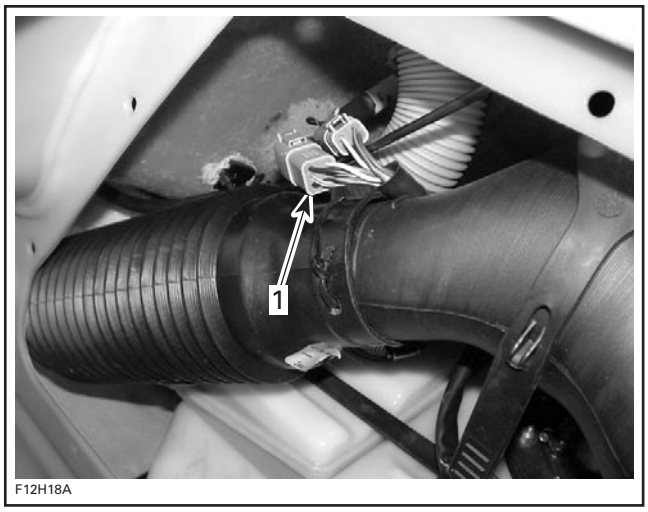
⚠ WARNING

If the computer you are using is connected to the 110 Vac 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.

Electrical Connections

DESS Post Connection Through the 6-Pin Connector

Disconnect the connector shown in the following picture and install RFI DESS adapter (P/N 278 001 978).



1. Connector to be disconnected

After all connections are done, connect the safety lanyard to the DESS post to activate the communication.

IMPORTANT: When using the software B.U.D.S., ensure that the protocol matching the connection used is properly selected in "MPI" under "Choose protocol" as per the following chart.

TYPE OF CONNECTION	ADAPTER TO USE	PROTOCOL TO CHOOSE
Through 6-pin connector	RFI DESS adapter (P/N 278 001 978)	DESS

MPEM Programmer

The MPEM programmer is the alternative tool to diagnose fuel injection related problems.

The latest software designed for the RFI model allows sensor inspection, diagnostic options and sensor resetting such as the Throttle Position Sensor (TPS).

NOTE: Make sure your MPEM programmer is updated with the latest software version. For a complete overview of the programmer, refer to the MPEM Programmer Guide (P/N 219 700 090).

Diagnostic Option Example Using MPEM Programmer

Turn on the programmer and enter your password.

Select **VEHICLE INFO** from the main menu and press **ENTER**.

1) CHECK KEYS
2) PROGRAM KEY
3) **VEHICLE INFO**
4) START VEH.
5) OTHERS

By selecting the **VEHICLE INFO** you will access a 9-line sub-menu. Select **BOSCH SYSTEM** from the sub-menu and press **ENTER**.

1) CUSTOMER NAME
2) DELIVERY DATE
3) VEH. SERIAL #
4) ENGINE PARAM.
5) PROGRAM KEY
6) HOUR INFO
7) MPEM INFO
8) **BOSCH SYSTEM**
9) SAVE + QUIT

By selecting **BOSCH MENU** you will enter a second sub-menu. Select **DIAGNOSIS** and press **ENTER**.

1) **DIAGNOSIS**
2) START VEHICLE

By selecting **DIAGNOSIS** the following message "**INITIALIZING IN PROCESS**" will be displayed a few seconds, then a new menu will appear on the screen.

Select **READ FAULT** and press **ENTER**.

1) BOSCH INFO
2) **READ FAULT**
3) ERASE FAULT
4) ADJUSTMENT
5) REAL TIME
6) END DIAGNOSIS

NOTE: Line no. 1 **BOSCH INFO** will display the identification of the watercraft and the MPEM/ECU.

By selecting **READ FAULT**, the MPEM programmer will display the number of faults in the ECU memory and the codes related with the fault(s).

The programmer will offer **PRESS ANY KEY**. If there is more than 1 fault in the ECU memory, the next fault code will be displayed.

NOTE: On this model, there is always at least the 04 FC fault code. Ignore this fault code. Also, when the engine is NOT operating, the fault code 02 01 03 will be displayed for the CPS (crankshaft position sensor). It should not be considered as a fault in the static mode.

Refer to the tables on next page for the explanation of the fault codes.

After reading the fault codes in the memory of the ECU, **PRESS ANY KEY** will return the programmer to the latest menu.

By selecting **ERASE FAULT** in the menu, it will allows you to erase the faults in the ECU memory.

NOTE: The programmer will not allow fault code erasing without first viewing in the **READ FAULT**.

FAULT CODE TABLES

ECU Faults

FAULT DETECTION	FAULT CODE		TYPE OF FAULT
	MPEM programmer	B.U.D.S.	
No fault detected	FF FF 88	N.A.	• No defect
Electronic Control Unit Internal memory	FF FF 00	P 0604	• Internal defect
	FF FF 1B	P 0605	• Not plausible = EEPROM defect
Electronic Control Unit EEPROM	FF FE 2B	P 1600	• EEPROM not programmed
EEPROM Data Setting	FF FD 10	P 1601	• Data in EEPROM out of range (1 of 3 bytes)
	FF FD 25	P 1602	• Data in EEPROM out of range (all 3 bytes different)

Input Signal Faults

FAULT DETECTION	FAULT CODE		TYPE OF FAULT
	MPEM programmer	B.U.D.S.	
Supply voltage to ECU	02 14 07	P 0562	• Voltage from the battery too low
	02 14 06	P 0563	• Voltage from the battery too high
Engine Water Temperature Sensor (WTS)	02 0A 1D	P 0117	• Sensor circuit shorted to ground
	02 0A 1E	P 0118	• Signal interruption or short circuit to battery
	02 0A 1B	P 0116	• Non plausible signal
Throttle Position Sensor (TPS)	02 06 1F	P 0122	• Sensor circuit shorted to ground
	02 06 1C	P 0123	• Sensor circuit shorted to battery
Crankshaft Position Sensor (CPS)	02 1F 06 02 1F 23	P 0219	• Signal exceeding RPM limits
Crankshaft Position Sensor (CPS)	02 01 03	P 0335	• No signal detected (fault code active when engine is not running and ignition is on)
	02 01 1B	P 0336	• Synchronization error (sensor/toothed wheel)
Air Intake Temperature Sensor (ATS)	02 0F 1D	P 0112	• Sensor circuit shorted to ground
	02 0F 1E	P 0113	• Signal interruption or short circuit to battery
Air Pressure Sensor (APS)	02 10 1D	P 0107	• Sensor circuit shorted to ground
	02 10 1E	P 0108	• Signal interruption or short circuit to battery

Output Signal Faults

FAULT DETECTION	FAULT CODE		TYPE OF FAULT
	MPEM programmer	B.U.D.S.	
Injector 1	04 E1 1C	P 0262	• Short circuit to battery
	04 E1 1D	P 0261	• Short circuit to ground
	04 E1 1E	P 1200	• Interruption or open circuit
Injector 2	04 E2 1C	P 0265	• Short circuit to battery
	04 E2 1D	P 0264	• Short circuit to ground
	04 E2 1E	P 1201	• Interruption or open circuit
Fuel pump	04 EB 1C	P 0230	• Short circuit to battery
Not applicable	04 FC	N.A.	• Not applicable
RAVE vacuum solenoid	04 DB 1C	P 0478	• Short circuit to battery
	04 DB 1D	P 0477	• Short circuit to ground
	04 DB 1E	P 0479	• Interruption or open circuit

COMPONENT INSPECTION

GENERAL

⚠ WARNING

The fuel system of a fuel injection system holds much more pressure than on a carbureted watercraft. Prior to disconnecting a hose or to removing a component from the fuel system, follow the recommendation described here.

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

⚠ 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. 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 bilge. Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Always disconnect battery prior to work on the fuel system. After performing a pressure test, use the valve on the fuel pressure gauge to release the pressure (if so equipped).

When the job is done, ensure that hoses from fuel rail going to fuel pump are properly secured in their support. Then, pressurize the fuel system. Perform the high pressure test as explained in this section and pressurize the fuel tank and fuel lines as explained in FUEL SYSTEM 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 safety lanyard on the DESS post. A pressure test must be done before connecting the safety lanyard. The fuel pump is started each time the safety lanyard is installed and it builds pressure very quickly.

CAUTION: Never use injector cleaning products. They may contain additive that could damage injector components. A copper wire brush may be used to clean the tip of the direct injectors if necessary.

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

It is important to check that the electrical system is functioning properly:

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

If all of the above mentioned items are functioning correctly, the following verifications can be performed to detect any faulty components.

NOTE: Troubleshooting should be performed using the VCK or MPEM programmer tool. See TROUBLESHOOTING in this subsection.

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 which is in good condition.

Never use a battery charger to replace temporarily the battery, as it may cause the MPEM 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, RAVE solenoid, ignition coil and starter solenoid) are permanently connected to the battery positive terminal, even when the safety lanyard is removed. Always disconnect 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.

⚠ WARNING

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

Before replacing a MPEM, always check electrical connections. Make sure that they are very tight and they make good contact and that they are corrosion- free. A "defective module" could possibly be repaired simply by unplugging and replugging the MPEM. The voltage and current might be too weak to go through dirty wire pins. Check carefully if posts show signs of moisture, corrosion or if they look dull. Clean pins properly and then coat them with silicon-based dielectric grease or other appropriate lubricant (except if otherwise specified) when reassembling them. If the newly replaced MPEM is working, try the old one and recheck if it works.

NOTE: Ensure that all electronic components are genuine -- particularly in the ignition system. Installing resistive caps, non-resistive spark plug cables (or modified length) or non-resistive spark plugs may lead to generate fault codes or bad operation.

NOTE: Use the VCK to diagnose fault codes. See TROUBLESHOOTING section.

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

Resistance Measurement

When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (69°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 (69°F). Use this table for resistance variation relative to temperature for temperature sensors.

TEMPERATURE		RESISTANCE (OHMS)		
°C	°F	NOMINAL	LOW	HIGH
- 30	- 22	12600	11800	13400
- 20	- 4	11400	11000	11800
- 10	14	9500	8000	11000
0	32	5900	4900	6900
10	50	3800	3100	4500
20	68	2500	2200	2800
30	86	1700	1500	1900
40	104	1200	1080	1320
50	122	840	750	930
60	140	630	510	750
70	158	440	370	510
80	176	325	280	370
90	194	245	210	280
100	212	195	160	210
110	230	145	125	160
120	248	115	100	125

CONVERSION CHART FOR TEMPERATURE SENSORS

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 ambient temperature. It does not validate the over temperature functionality. To test it, the sensor could be removed from the engine/muffler and heated with a heat gun while it is still connected to the harness to see if the MPEM will detect the high temperature condition and generate a fault code.

When working with injectors, the resistance value might test good while the complete current would not flow through the wire when pulsating current is supplied to the injector in its normal operation. A solution would be to use a jumper wire to directly supply the injector from the MPEM. If it now works, replace the defective wire. A Noid light (available from after-market tool/equipment suppliers) may also be used to validate the injector operation.

AIR INDUCTION SYSTEM

THROTTLE BODY

Check that the throttle plate moves freely and smoothly when depressing throttle lever.

FUEL DELIVERY

FUEL FILTER

To inspect the fuel filter, the fuel pump assembly has to be removed from the fuel tank. See REMOVAL in this subsection for the procedure.

FUEL PUMP

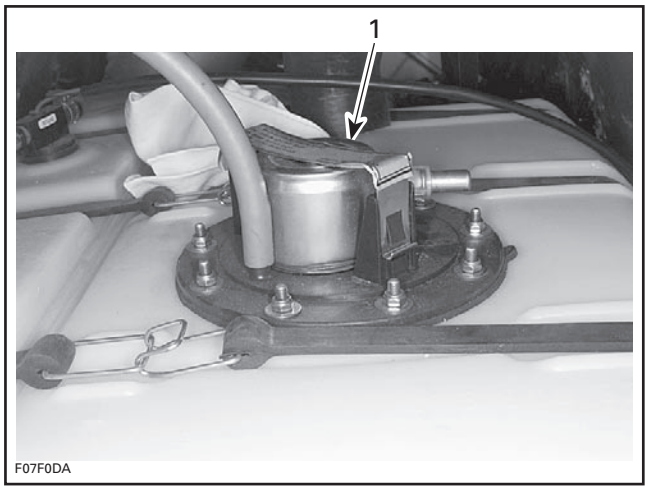
The fuel pump operation can be checked as follows.

Install the safety lanyard cap on the switch. The fuel pump should run for approximately 1 second and then shut off.

If not, check the electrical circuit and the 10 A fuse on the MPEM module.

REGULATOR

The regulator is mounted on top of the fuel pump assembly.



1. Regulator

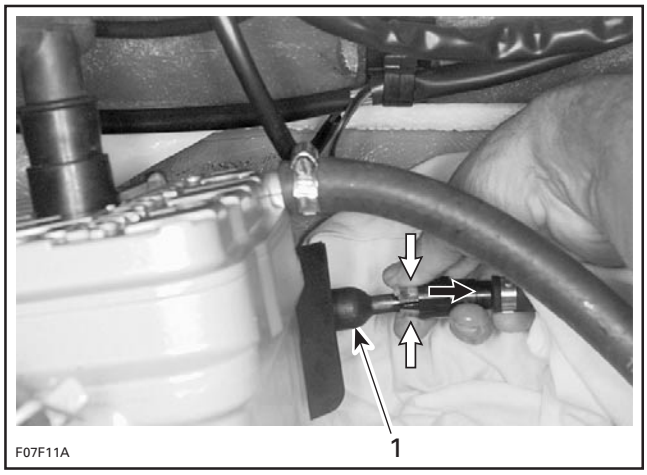
To inspect the regulator, a fuel pressure test must be done.

Check that battery voltage is above 12 volts.

Place a suitable container below the quick connect fitting of the fuel rail.

Cover the quick connect fitting with a shop towel.

Press on both tabs and disconnect the quick connect fitting.

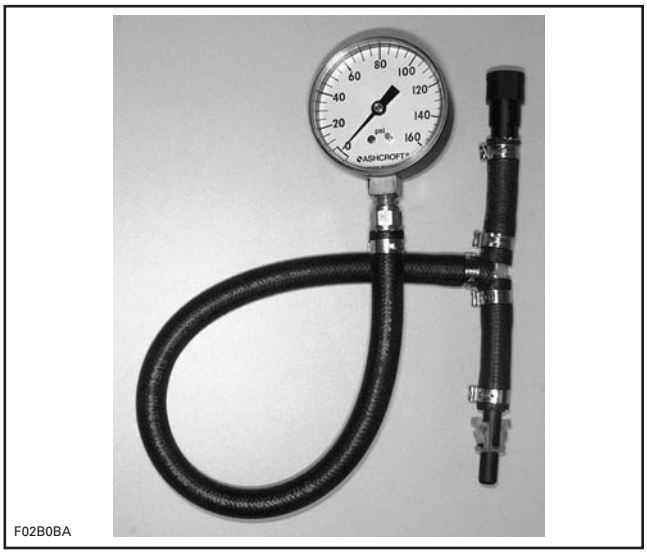


1. Fuel rail

⚠ WARNING

Fuel is under pressure. Wipe off any fuel spillage in the bilge.

Install a fuel pressure gauge (P/N 529 035 591) to the quick connect fitting of the fuel hose.



FUEL PRESSURE GAUGE (P/N 529 035 591)

Install the safety lanyard cap on the switch to activate the fuel pump. The fuel pressure should be between 386 - 414 kPa (56 - 60 PSI).

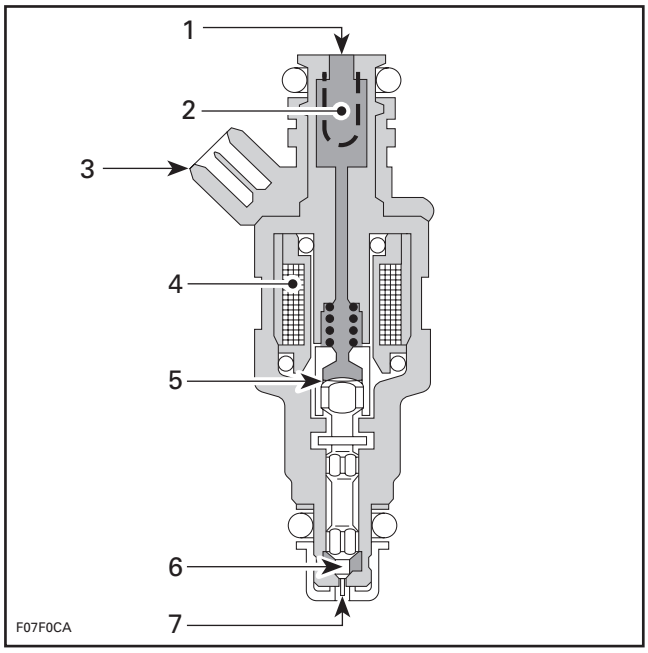
If the pressure is too high, replace the fuel pump module.

If the pressure is too low, check the following components:

– fuel hoses and connections
– fuel filter
– fuel pump
– regulator
– voltage at fuel pump (minimum 8 Vdc).

FUEL INJECTOR

To control the emission, RFI engine has been designed to work with only the MAG side injector at idle. While working at 2500 RPM and below, engine gradually goes from two cylinder to one at idle.



1. *Inlet side*
2. *Filter*
3. *Wiring terminal*
4. *Coil*
5. *Plunger*
6. *Needle valve*
7. *Injection side*

Touch the injector while cranking the engine to feel the operation of the injector.

If there is no signal detected from the injector, disconnect the plug connector from the injector and check the signal from the MPEM.

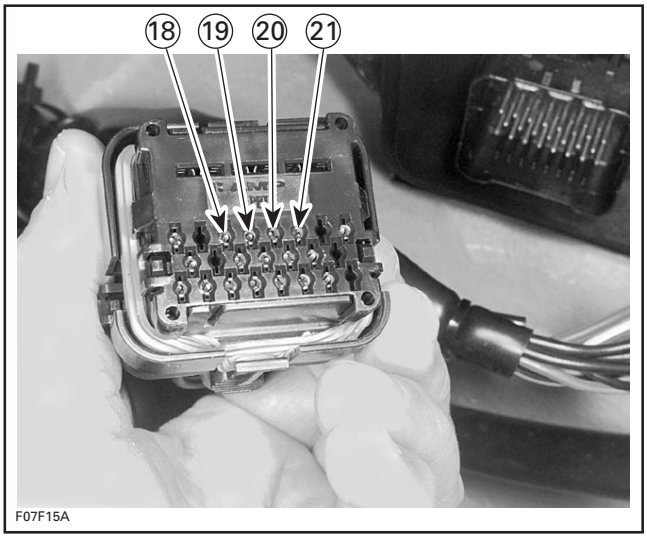
To check the signal, verify voltage at the plug connector. There should be at least 6 Vdc while cranking engine.

Check the resistance of the fuel injector circuits.

Disconnect the AMP plug connector #4 on the MPEM.

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

INJECTOR	CONTACT LOCATION
Injector no. 1	18 and 20
Injector no. 2	19 and 21



The resistance should be between 2.3 Ω and 2.5 Ω at temperature of 20°C (68°F).

If resistance value is incorrect, check wiring harness between AMP plug connector and fuel injectors for damaged wires or bad connections. Repair if necessary.

Recheck resistance value at AMP plug connector #4.

If not within specification, replace the fuel injector.

Leakage Test (fuel injectors)

To perform a leakage test, the injectors and fuel rail have to be removed from engine. See REMOVAL in this subsection for the procedure.

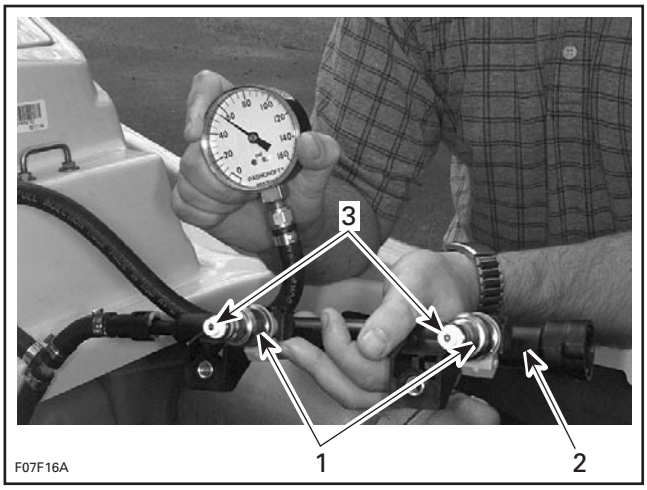
NOTE: Do not detach injectors from fuel rail.

Reconnect the wire connector of the injector.

Place each injector in a clean bowl.

Install the safety lanyard cap on the switch to activate the fuel pump.

Check for fuel leakage from the injector nozzle. There should be less than 1 drop of fuel per minute.



1. Fuel injectors
2. Fuel rail
3. Injector nozzles

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

LEAK TEST (SUPPLY AND VENTILATION CIRCUITS)

Refer to FUEL SYSTEM.

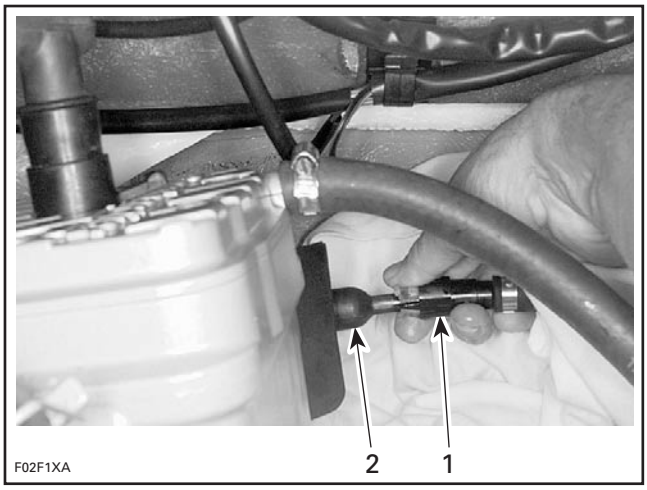
HIGH PRESSURE TEST (FUEL PUMP CIRCUIT)

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

⚠ WARNING

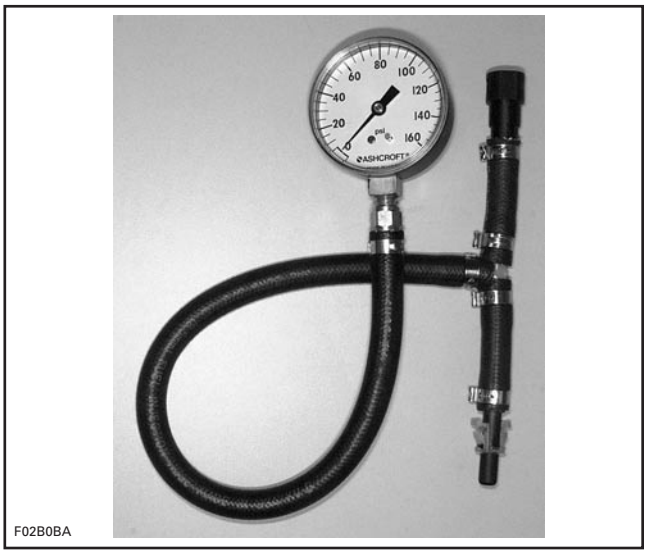
The fuel hose may be under pressure. Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to release the pressure. Wipe off any fuel spillage inside bilge.

Press on both tabs and pull quick connect fitting to disconnect the fuel hose from fuel rail.



1. Quick connect fitting
2. Fuel rail

Install fuel pressure gauge (P/N 529 035 591) between fuel rail and fuel hose from fuel tank.



FUEL PRESSURE GAUGE (P/N 529 035 591)

Install the safety lanyard cap on the switch to activate the fuel pump.

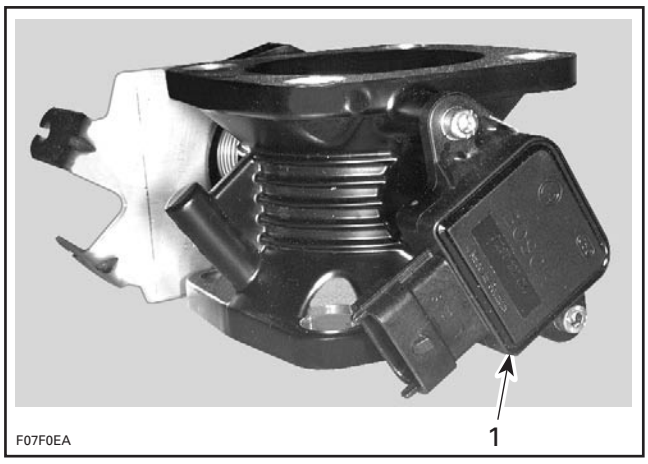
The fuel pump should run for approximately 1 second and the fuel pressure should be between 386 - 414 kPa (56 - 60 PSI).

Check hose connections at fuel pump and at fuel rail.

ELECTRONIC MANAGEMENT

THROTTLE POSITION SENSOR (TPS)

Check the resistance value of the throttle position sensor.



TYPICAL
1. Throttle position sensor (TPS)

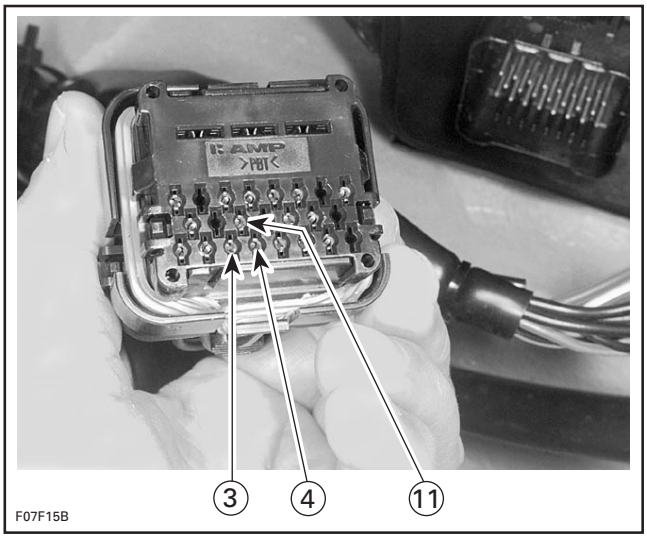
Disconnect the AMP plug connector #4 on the MPEM.

Using a multimeter, check the resistance between terminal 3 (PURPLE/BROWN wire) and terminal 4 (BLACK/BROWN wire) on the AMP plug connector.

The resistance should be between 1.6 kΩ and 2.4 kΩ.

Check also the resistance between terminal 4 (BLACK/BROWN wire) and terminal 11 (WHITE/BROWN wire) with the throttle plate in idle position.

The resistance should be between 710 Ω and 1380 Ω.



If resistance is below specifications, replace the throttle position sensor (TPS).

If resistance is above specifications, disconnect the connector of the throttle position sensor and check resistance of wiring harness and terminals between AMP plug connector and TPS sensor connector.

If there is an open circuit, repair or replace the defective wire or terminal.

Reconnect the throttle position sensor connector and recheck resistance values at AMP plug connector #4.

If not within specification, replace the throttle position sensor.

NOTE: Whenever the TPS is replaced or removed, the TPS closed position must be reset.

Voltage Test

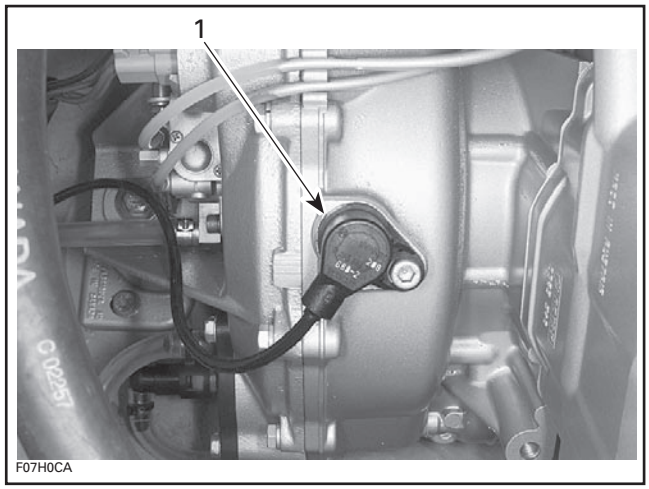
If the sensor resistance value is good, check the voltage output from MPEM to throttle position sensor.

Disconnect plug connector from throttle position sensor and connect a voltmeter between the PURPLE/BROWN wire and the BLACK/BROWN wire in the wiring harness.

Depress the start/stop button with the safety lanyard removed to activate the timer. There should be 5 Vdc.

CRANKSHAFT POSITION SENSOR (CPS)

Check the resistance of the crankshaft position sensor.

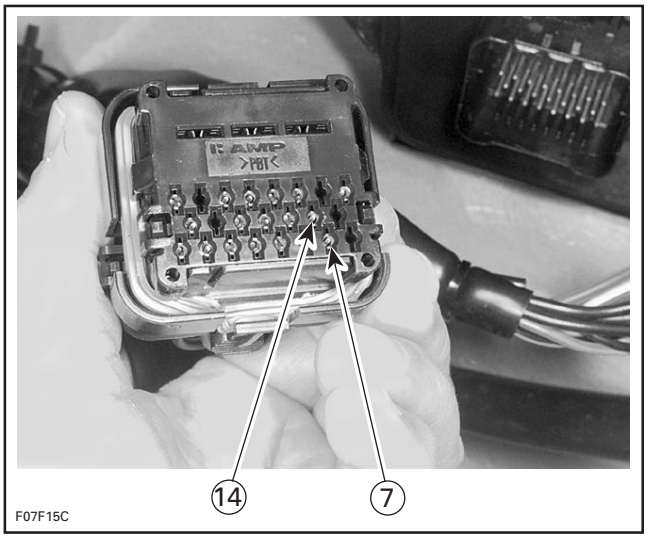


1. Crankshaft position sensor (CPS)

Disconnect the AMP plug connector #4 from the MPEM module.

Using a multimeter, check the resistance between terminal 7 (GREY/YELLOW wire) and terminal 14 (GREY/RED wire) on the plug connector.

The resistance should be between 774 Ω and 946 Ω at temperature above 20°C (68°F).

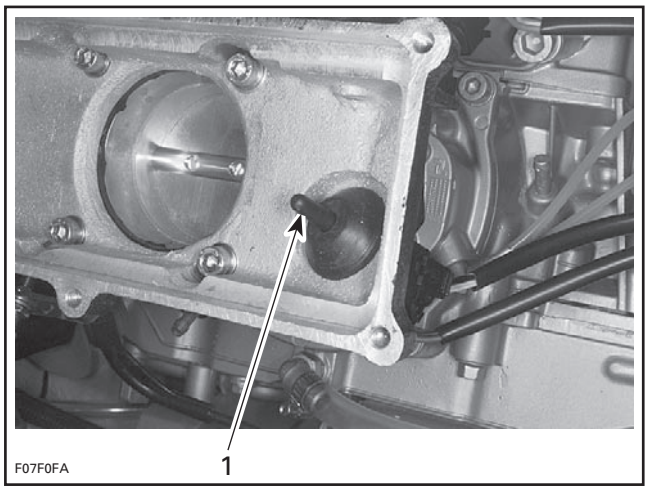


If not within specification, replace the crankshaft position sensor.

AIR TEMPERATURE SENSOR (ATS)

NOTE: When testing the resistance of the air temperature sensor (ATS), it is important to check the ambient temperature. The resistance values for the sensor will be different according to the temperature.

Check the air temperature sensor resistance.

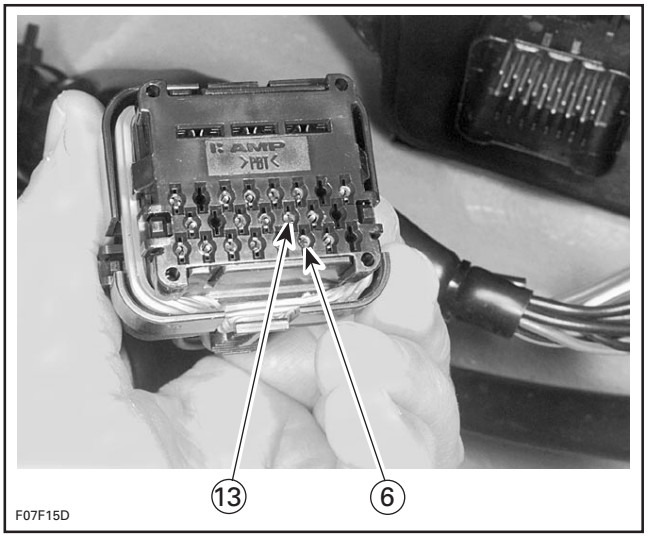


1. Air temperature sensor (ATS)

Disconnect the AMP plug connector #4 from the MPEM module.

Using a multimeter, check the resistance between terminal 6 (BLACK/WHITE wire) and terminal 13 (WHITE/GREY wire) on the plug connector.

The resistance should be between 2.280 kΩ and 2.736 kΩ at temperature of 19°C to 21°C (66°F to 70°F).



If resistance is below specifications, replace air temperature sensor (ATS).

If resistance is above specifications, disconnect the connector of the air temperature sensor and check resistance of wiring harness and terminals between AMP plug connector and ATS sensor connector.

If there is an open circuit, repair or replace the defective wire or terminal.

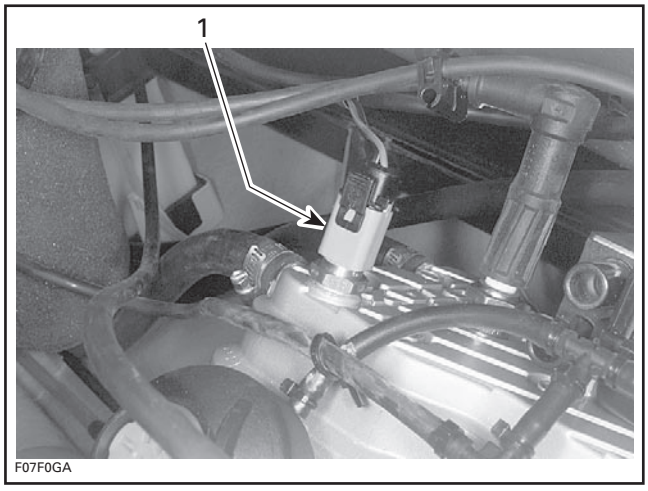
Reconnect the air temperature sensor connector and recheck the resistance between terminal 6 and terminal 13 in the AMP plug connector #4.

If not within specification, replace the air temperature sensor.

WATER TEMPERATURE SENSOR (WTS)

Resistance Test

Check the water temperature sensor resistance.

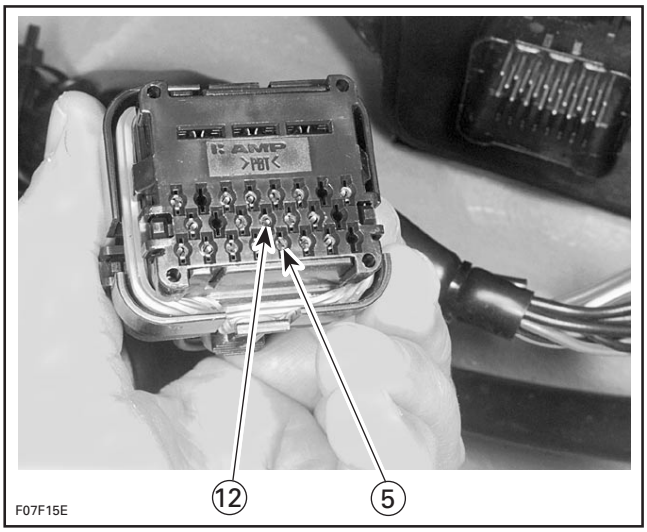


1. Water temperature sensor (WTS)

Disconnect the AMP plug connector #4 from the MPEM module.

Using a multimeter, check the resistance between terminal 5 (BLACK/ORANGE wire) and terminal 12 (TAN/ORANGE wire) on the plug connector.

The resistance should be between 2.280 kΩ and 2.736 kΩ at temperature of 19°C to 21°C (66°F to 70°F).



If not within specification, continue with the following tests.

Operation Test

Remove WTS from engine and keep it connected.

Place the WTS in a metal container filled with water and heat with a heat gun. Use a thermometer to monitor the temperature. Keep the container outside and away from bilge as much as possible.

⚠ WARNING

Do not use an open flame in the bilge area. Fuel vapors may be present and this may lead to an explosion.

Heat up above 94°C (201°F) then start engine.

CAUTION: Do not run the engine longer than 1 minute. However, if this necessary, plug the WTS hole and use the flush kit to cool the engine.

At this temperature, the overheat beeper should sound. Otherwise, check the following.

Stop engine.

Disconnect the WTS.

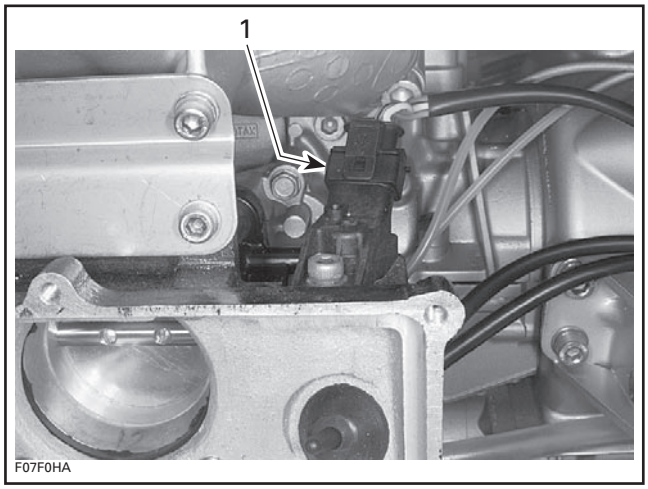
Remove safety lanyard and press the start/stop button to power up the system and check for 5 V on the TAN/ORANGE wire.

If there is not 5 V, check the wiring harness and pin #12 on the #4 AMP plug connector.

Remove the TAN/ORANGE wire from the #12 position on the AMP plug connector, install a test connector (a female connector with about 25 mm (1 in) of wire) then reconnect the AMP plug connector. Press the start/stop button, and check for 5 V on the test wire. If none is present, replace the MPEM.

On the WTS connector, check for continuity to ground on the BLACK/ORANGE wire when the system is not powered up, and within 5 - 12 ohms when the system is powered up. Otherwise, check the wiring harness and pin #5 on the #4 AMP plug connector. Remove the BLACK/ORANGE wire from the #5 position on the AMP plug connector, install a test connector (as described above) then reconnect the AMP plug connector. Repeat the same tests as above, if the tests are not within specs, replace the MPEM.

AIR PRESSURE SENSOR (APS)

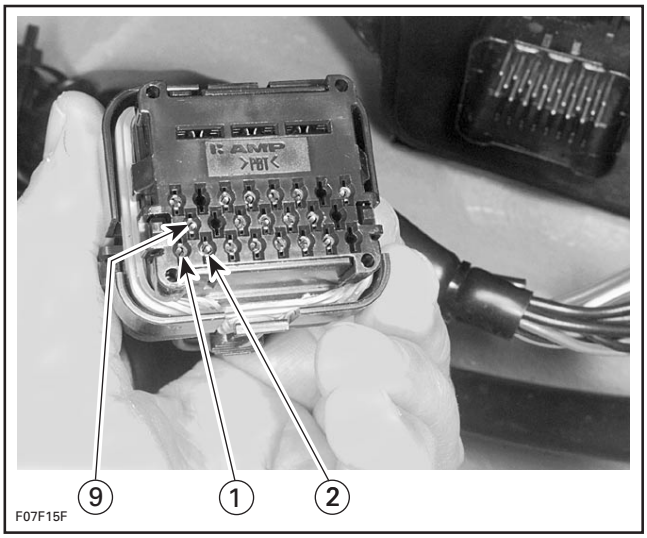


1. Air pressure sensor (APS)

Check the air pressure sensor resistance.

Disconnect the AMP plug connector #4 from the MPEM module.

Using a multimeter, check the resistance between terminal 9 (WHITE/BLUE wire) and terminal 2 (BLACK/BLUE wire) on the plug connector.



The resistance should be between 3.4 kΩ and 8.2 kΩ.

Check also the resistance between terminal 2 (BLACK/BLUE wire) and terminal 1 (PURPLE/BLUE wire) of the plug connector.

The resistance should be between 2.4 kΩ and 8.2 kΩ.

If not within specification, disconnect the connector of the air pressure sensor and check resistance of wiring harness and terminals between AMP plug connector and APS sensor connector.

Reconnect the air pressure sensor connector and recheck the resistance value between terminals in the AMP plug connector #4.

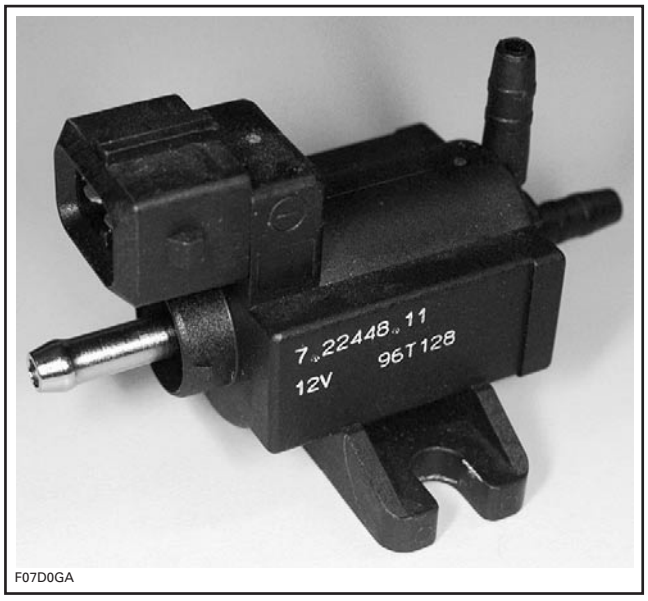
If not within specification, replace the air pressure sensor.

Voltage Test

If the sensor resistance value is within specifications, disconnect the plug connector from the APS sensor and check the voltage between the PURPLE/BLUE wire and the BLACK/BLUE wire in the wiring harness from the MPEM.

Install safety lanyard. There should be 5 Vdc.

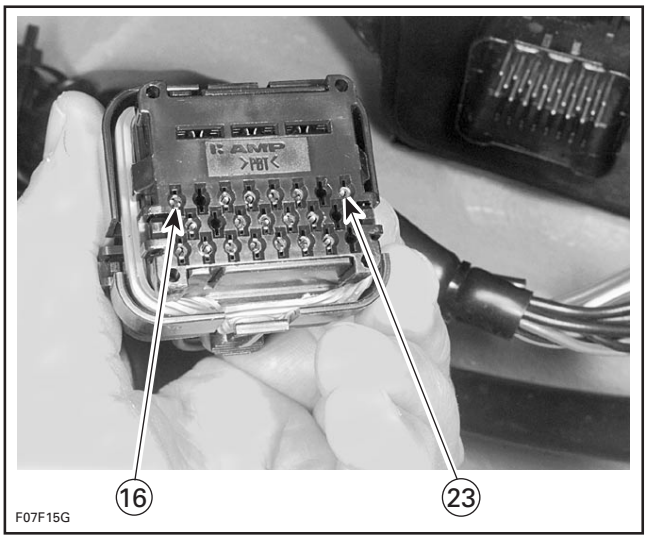
RAVE SOLENOID



RAVE SOLENOID

Disconnect the AMP plug connector #4 from the MPEM module.

Check resistance value between terminal 16 and terminal 23 on the plug connector.



The resistance value should be 30 Ω.

RFI SENSORS RESISTANCE VALUES

COMPONENT	TERMINAL NUMBER	WIRE COLOR	RESISTANCE VALUE	VOLTS
Air pressure sensor	1 and 2	PU/BL and BK/BL	2.4 k - 8.2 k ohms	5 Vdc between PU/BL and BK/BL
	9 and 2	WH/BL and BK/BL	3.4 k - 8.2 k ohms	
Throttle position sensor	3 and 4	PU/BW and BK/BW	1.6 k - 2.4 k ohms	5 Vdc between PU/BW and BK/BW
	4 and 11	BK/BW and WH/BW	710 - 1380 ohms	
Water temperature sensor	5 and 12	BK/OR and TA/OR	2280 - 2736 ohms	N.A.
Air temperature sensor	6 and 13	BK/WH and WH/GY	2280 - 2736 ohms	N.A.
Crankshaft position sensor	7 and 14	GY/YL and GY/RE	774 - 946 ohms	N.A.
Rave solenoid	16 and 23	PU/GY and BK/GY	30 ohms	N.A.
Injector no. 1	18 and 20	BL/PU and BL/BK	2.3 - 2.5 ohms	6 Vdc at the plug connector
Injector no. 2	19 and 21	GR/PU and BK/GR	2.3 - 2.5 ohms	

N.A.: Not Applicable

TROUBLESHOOTING SUMMARY

ENGINE DOES NOT START

If the engine does not start, the following items should be verified in this order:

– fuses
– ignition (spark)
– fuel pump
– check fault codes in the ECU memory.

FLOODED ENGINE FEATURE

If the engine does not start and it is flooded, proceed as follows:

Remove spark plug cables and connect them on the grounding device.

Remove spark plugs and dry them using a rag.

Cover spark plug holes with a rag.

Depress and hold the throttle lever at full throttle position.

Install the safety lanyard cap on the switch. WAIT 2 SECONDS THEN press the start/stop button to crank the engine for approximately 10 seconds.

NOTE: Proceeding in this order, no fuel is injected and the accumulated fuel in the engine will be expelled.

Reinstall spark plugs and connect cables.

Start engine normally without applying the throttle.

SPARK PLUG INSPECTION

Whenever replacing the spark plugs, always use NGK BR8ES with the resistor feature. The spark plug gap is set to 0.5 - 0.6 mm (.02 - .024 in).

To check for ignition, attach an inductive timing light to the high tension lead while turning the engine with the starter.

Reversed high tension cables will not allow the RFI to run. The spark plugs spark independently on each piston stroke. Reversed high tension cables will cause backfires.

ECU FAULT CODES

Fault codes in the ECU memory will identify potential problems with the RFI system. When checking fault codes without engine in operation, the CPS fault code will always appear. Also, the 04 FC fault code will always appear.

Disconnecting the battery will erase the fault codes in the ECU memory.

ENGINE STARTS BUT RUNS POORLY

If the engine starts but runs poorly, the following items should be verified in this order:

– Check spark plug condition.
– Check fault codes in the ECU memory.
– Check fuel pressure.
– Check TPS. Reset, if necessary.

If some work has been performed on the unit, make sure injector wire connectors were not mixed. It is also possible that the RAVE solenoid connector be mixed with one of the injector connector. Refer to the wiring diagram for wire colors and positions.

ENGINE RUNS ONLY ON ONE CYLINDER

In normal conditions engine runs only on one (MAG side) cylinder at idle. For more information about this function, refer to OPERATION AT LOW SPEED OR IDLE in section COMPONENT INSPECTION.

If both cylinder are working while engine is at idle speed, the following items should be verified.

– Check ECU parameters.
– Check TPS. Reset, if necessary.

NOTE: Engine should run on both cylinders with 3 percent or more of throttle opening. Use the VCK (Vehicle Communication Kit) with B.U.D.S. software to validate.

ENGINE CANNOT REACH MAXIMUM REVOLUTIONS

Check battery voltage. When voltage is too low, the MPEM limits the engine revolutions.

Recharge or replace battery.

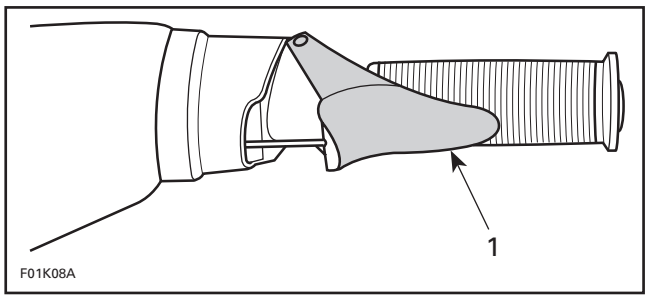
The RAVE system is not functioning properly. The sliding valves do not open. Check pressure hoses and check valve from crankcase to RAVE solenoid.

Check RAVE solenoid.

ADJUSTMENT

THROTTLE CABLE ADJUSTMENT

Fully depress throttle lever. Lever must touch handlebar grip without causing strain to cable or brackets.



1. Must touch handlebar grip

Ensure throttle plate is fully open.

Adjust cable to obtain a gap of 0.75 mm (.030 in) between throttle lever stopper and bracket on throttle body.

THROTTLE POSITION SENSOR (TPS)

CAUTION: TPS adjustment cannot be done on RFI models. TPS adjustment is preset and interfering with preset adjustment may lead to serious engine damage.

NOTE: Resetting should be done each time the throttle position sensor (TPS) is loosened or removed.

Resetting of TPS is very important. The setting of the TPS will determine the basic parameters for all fuel mapping.

Resetting of the TPS can be performed using the VCK or MPEM programmer.

CLOSED TPS

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

To perform the resetting, proceed as follows:

Using VCK

Use the VCK (Vehicle Communication Kit) (P/N 295 035 981) with B.U.D.S. software. Look under the SETTING section to perform the Closed TPS resetting. Reset the TPS value to provide the zero scale value to ECU.

Using MPEM Programmer

Access the BOSCH SYSTEM in the MPEM programmer. Then, select ADJUSTMENT in the submenu.

CAUTION: Never attempt to adjust the idle speed through the throttle body tamper proof screw. If so, it would impair the idle speed stability. Besides, no adjustment could be performed to correct the idle speed. The throttle body would need to be replaced. Also take into account that it might change the engine emission level and the engine might not meet the EPA/CARB requirements.

Choose CLOSE TPS in the ADJUSTMENT menu.

The screen will display the actual adjustment of the TPS in degrees and it will also offer to adjust it.

Reset the TPS value to provide the zero scale value to ECU.

NOTE: Make sure the throttle lever is not depressed and the throttle stopper is in contact with the tamper proof screw of the throttle body.

Selecting "YES" will instantly readjust the close throttle position adjustment to the new setting.

NOTE: If the ECU is replaced, the TPS closed position must be reset.

IDLE SPEED

NOTE: Idle speed is factory adjusted on all RFI models. So there is no mechanical idle speed adjustment to perform. ECU takes care of this.

Idle speed in water is 1550 ± 100 RPM.

REMOVAL AND INSTALLATION

MPEM/ECU

NOTE: When MPEM or ECU are replaced, the safety lanyard(s), the TPS closed position and the ignition timing setting must be reprogrammed/reset. Refer to their specific section for adjustment.

THROTTLE POSITION SENSOR (TPS)

Remove the air intake silencer.

Remove the flame arrester.

Remove the air temperature sensor to ease removal of the TPS.

Disconnect the connector of the TPS.

Loosen 2 Allen screws retaining the TPS.

Remove TPS.

NOTE: Resetting should be done using VCK or MPEM programmer each time the TPS is loosened, removed or changed.

AIR TEMPERATURE SENSOR (ATS)

Remove the air intake silencer.

Remove the flame arrester.

Disconnect the connector of the ATS.

Pull the ATS from the grommet retaining it.

AIR PRESSURE SENSOR (APS)

Remove the air intake silencer.

Disconnect the connector of the APS.

Loosen Allen screw retaining the APS.

Remove the APS.

At installation, apply Loctite 243 (blue) on screw threads.

WATER TEMPERATURE SENSOR (WTS)

Disconnect the connector of the WTS.

Loosen the WTS from the cylinder head.

At installation, apply Loctite 518 on threads of the WTS.

CRANKSHAFT POSITION SENSOR (CPS)

Disconnect the connector of the CPS.

Loosen Allen screw retaining the CPS.

Remove the CPS.

At installation, apply Loctite 243 (blue) on the Allen screw.

NOTE: Clean threads prior to installing screw.

FUEL PUMP ASSEMBLY

Open the front storage compartment cover.

Remove the storage basket.

Remove the glove box. For proper removal procedure, refer to HULL/BODY section.

Disconnect the wire connector from the fuel pump assembly.

Disconnect fuel vent hose from fuel pump assembly.

Cover the quick connect fitting with a shop towel.

Press on both tabs and disconnect the quick connect fitting.

⚠ WARNING

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

Loosen nuts retaining the fuel pump assembly to the fuel tank.

1. Loosen nuts

CAUTION: While pulling out the fuel pump, pay attention to fuel sensor float arm. Float arm can get stuck and bend which can reduce the fuel sensor capabilities.

Remove fuel pump assembly from fuel tank.

REGULATOR

The regulator is not serviceable. Replace the fuel pump assembly if the regulator is defective.

FUEL FILTER

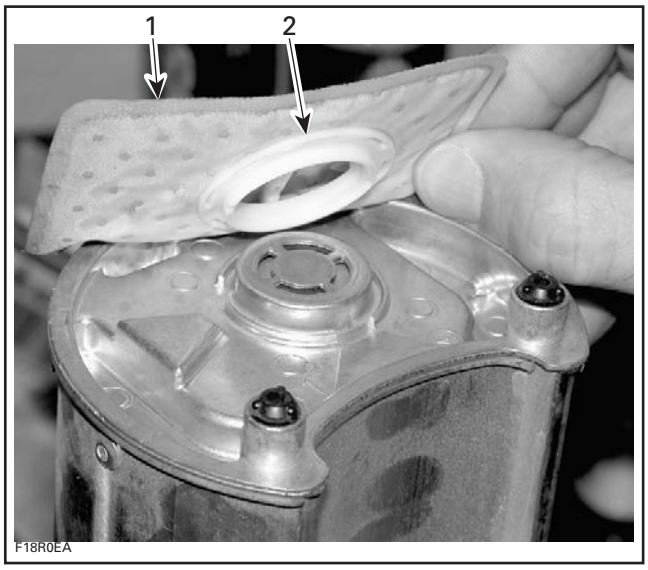
Replacement

NOTE: The filter does not require replacement under normal operating conditions. Replace only if permanently clogged or damaged.

The fuel pump assembly has to be removed from the fuel tank to have access to the fuel filter. Refer to the section above for more detail.

Remove fuel pump.

Turn fuel pump up side down. Using a small flat screwdriver, remove the fuel filter by prying the inner plastic ring.



1. Fuel filter
2. Inner plastic ring

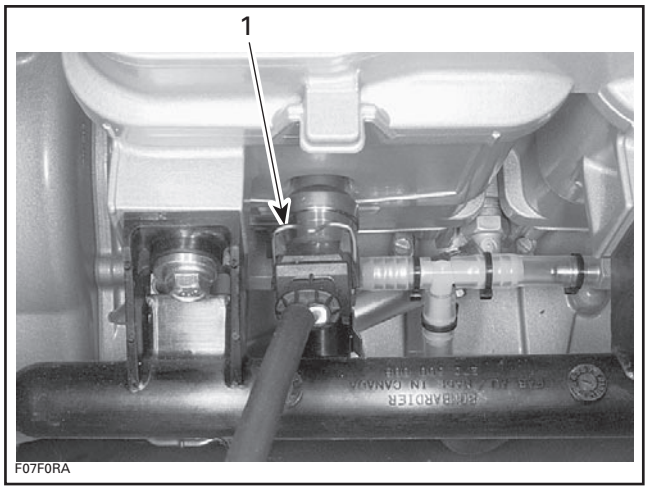
FUEL INJECTORS

Place a suitable container below the quick connect fitting of the fuel rail.

Cover the quick connect fitting of the fuel rail with a shop towel.

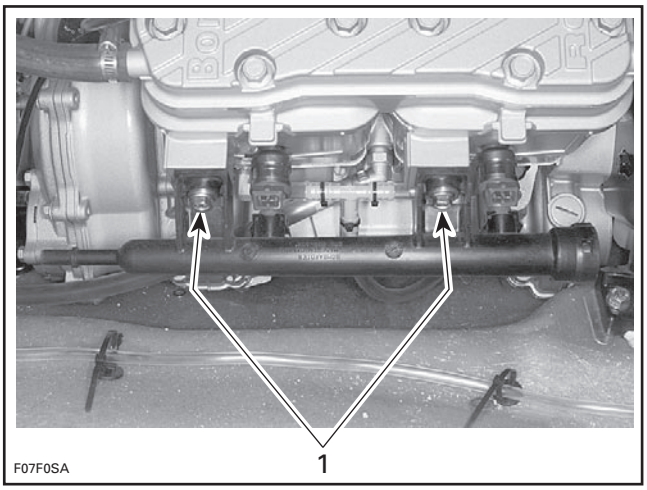
Press on both tabs and disconnect the quick connect fitting.

Disconnect the wire connectors of both fuel injectors.



1. Press retaining clip to unlock the connector

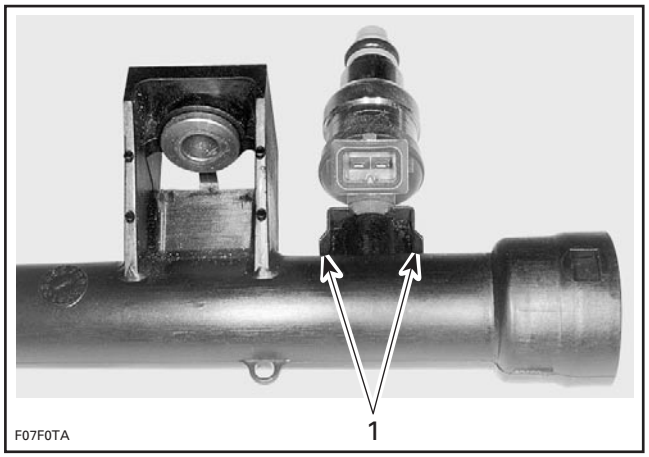
Loosen both screws retaining the fuel rail to the cylinders.



1. Loosen screws retaining the fuel rail

Remove the fuel rail with both fuel injectors.

To remove the fuel injector from the fuel rail, pry off the retaining clip.



1. Pry the clip

– Carefully inspect O-rings condition before re-installing fuel injectors. Replace O-rings with new ones if damaged.

When reinstalling the fuel injector, install the retaining clip to the injector, then insert the injector into the fuel rail.

Apply a thin layer of injection oil to O-rings of fuel injectors to ease fuel rail installation.

– Check injectors to ensure there is no leak.

⚠ WARNING

If a leak is present, immediately stop the engine. Do not use engine until the leak is repaired.