CHAPTER 4
ELECTRONIC FUEL INJECTION (EFI)

⚠ WARNING

Gasoline is extremely flammable and explosive under certain conditions.

⚠ Always stop the engine and refuel outdoors or in a well ventilated area.

⚠ Do not smoke or allow open flames or sparks in or near the area where refueling is performed or where gasoline is stored or used.

⚠ Do not overfill the tank. Do not fill the tank neck.

⚠ If you get gasoline in your eyes or if you swallow gasoline, see your doctor immediately.

⚠ If you spill gasoline on your skin or clothing, immediately wash it off with soap and water and change clothing.

⚠ Never start the engine or let it run in an enclosed area. Gasoline powered engine exhaust fumes are poisonous and can cause loss of consciousness and death in a short time.

⚠ WARNING

Battery electrolyte is poisonous. It contains acid!
Serious burns can result from contact with the skin, eyes, or clothing.

ANTIDOTE:

EXTERNAL: Flush with water.
INTERNAL: Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.
EYES: Flush with water for 15 minutes and get prompt medical attention.
Batteries produce explosive gases. Keep sparks, flame, cigarettes, etc. away. Ventilate when charging or using in closed space. Always shield eyes when working near batteries.
KEEP OUT OF REACH OF CHILDREN.

ROM Identification / Charge Coil Test Specifications

Model	System Type	ROM ID	ROM PN	Battery Charge Coil Test Position/Resistance
1996 500 EFI/SKS/RMK	II	1996 500 V1	4040061	Gry to Brn/W .2 to .4 ohms Brn/W to Gry/W .2 to .4 ohms
1996-1997 RXL	I	1996 650 V1	4040065	Gry to Brn/W .2 to .4 ohms Brn/W to Gry/W .2 to .4 ohms
1997 500 EFI	II	1997 500 V1	4040073	Gry to Brn/W .2 to .4 ohms Brn/W to Gry/W .2 to .4 ohms

Electronic Fuel Injection (EFI)
Operation

EFI Operation

Machines equipped with Polaris Electronic Fuel Injection (EFI) have many advantages over normal carburetor equipped models. The most noticeable improvements will be ease of throttle operation, better cold weather starting and improved cold engine drive away. The EFI system also compensates for temperature and altitude, and with minor adjustments will perform well over a wide range of temperatures and altitudes.

To assist technicians in understanding EFI, we have divided it into three separate systems. Following is a short description of these three systems:

System I

- Battery
- Battery charging
- How the EFI is "powered up" or energized

System II

- Fuel handling
- Fuel filtering
- Fuel pressure regulation

System III

- Electronic Control Unit (ECU)
- ECU inputs from various sensors
- Control of fuel to the cylinders by injector operation

The following information is a more detailed explanation of these three systems. It's very important during diagnosis that each system be checked. Failure to do so may result in a repeat failure.

Basic Operation - System I
Battery, Battery Charging and Powering Up

The battery is the heart of the EFI system, its condition is critical to all EFI functions. Long off-season storage periods, high vibrations, and extreme temperature variations which are encountered in snowmobile applications make periodic battery inspection and service essential.

If the battery is partially shorted or in a low state of charge, or if connections offer high resistance, the result might be a lean fuel condition.

NOTE: Type II systems will compensate or "fail safe" for low battery voltage or a charging problem.

EFI models have two separate alternators or charging systems. One is used for lighting and accessories, the other for battery charging and EFI operation. The battery size and alternator size have been designed to provide adequate output for the EFI system. On machines equipped with electric start a larger battery will be required to provide adequate cold cranking amperage.

EFI Accessory Note

CAUTION:

At no time should any accessories be added to the battery or battery side of the charging system. To do so may overload the system, discharge the battery and cause substandard EFI operation.

There are two basic types of EFI systems:

TYPE I (RXLs)

The Type I system is used on all RXLs. Powering up requires both key and auxiliary (engine stop) switch to be in the "Run" position. At that time, a circuit is completed between the battery positive terminal and the brown relay which passes through the switches and the circuit breaker. The brown relay then connects the battery directly to the Electronic Control Unit (ECU) via the fuse link, causing the ECU to begin to function. The ECU connects itself to the battery via a self shut-off relay, which serves to maintain power to the ECU for approximately ten minutes after power is cut off by the key or auxiliary switches. The ECU is kept on for a short time in order to help prevent flooding of the engine during a restart.

When the ECU is first powered up, the fuel pump will run for approximately five seconds in order to build pressure in the fuel rail. If the engine is stopped by the switches and then restarted within the ten minute period, the fuel pump will not repeat the five second run, since the ECU was kept powered up by the self shut-off relay.

If the engine is stopped with the switches in the "Run" position, the ECU will remain powered up until the battery is drained.

TYPE II (500s)

The Type II system is used on all 500 EFI models. The Type II system is similar to the Type I system in the way that it maintains power to the ECU after the engine stops, but is different in the way that it powers down. The Type I system depends on the operator to turn off at least one of the switches before the ECU will power down. The Type II system will power down regardless of the position of the switches in the event that the engine stops unexpectedly. This preserves battery power.

The key switch on these models only grounds the ignition in order to stop the engine. There is no battery power connected to the switch in these models, unless electric start is used.

This system uses an Alternator Controlled Switch (ACS). Mounted on the battery box, it incorporates the voltage regulator/rectifier. The ACS senses the rotation of the crankshaft by recognizing output from the engine's alternator. The alternator signal causes the ACS to connect the battery to the ECU. The operator simply pulls on the rope and the system powers up automatically.

CAUTION:

When servicing the fuel system on models with an ACS it is very important to first disconnect the battery. Turning the engine over without disconnecting the battery could cause the fuel pump to run and create a dangerous fuel spill.

Battery Maintenance

Battery maintenance is of the utmost importance to ensure satisfactory EFI operation. Partially shorted batteries can cause an additional load on the charging system and in turn leave the EFI system with too little to supply the relays, ECU, fuel pump, injectors, etc. When this type of machine enters your service area, be sure to thoroughly clean, inspect and test the battery.

CAUTION:

It is extremely important that the battery condition and state-of-charge be maintained at the highest level possible or serious performance and driveability problems will arise. Battery testing procedures are covered below.

Off season storage for snowmobiles, especially EFI equipped machines, requires the battery to be removed. In the summer months higher temperatures and higher levels of humidity, along with a small drain applied from the EFI system, will in a very short time discharge the battery. Once the battery is discharged, the plates will become sulfated (turn white), and the battery will no longer accept a charge. Batteries which are not disconnected, removed and kept charged will need to be replaced at the beginning of each season. **Never substitute any battery of lesser quality when replacement is required.** Batteries may be maintained by using the Polaris Battery Tender. The battery tender can be connected indefinitely, and will automatically maintain battery charge. The electrolyte level should be monitored monthly during periods of non-use.

Battery Tender

Polaris Battery Tender

PN 2871076

Battery Service

Conventional battery service techniques apply to this battery. Maintain the specific gravity of the electrolyte to between 1.270 and 1.300. The open circuit voltage must be maintained between 12.7 and 12.9 volts DC (at room temperature), at lower temperatures, slightly lower values are acceptable. Voltage readings should always be taken with a Fluke™ digital volt meter. The select monitor will place a load on the battery and on Type I units the monitor will incorrectly read voltage less than 10 VDC.

Specific Gravity - 1.270-1.300

Open Circuit Voltage 12.7-12.9 v DC

Fluke Meter PN 2870659

Battery Charging System Testing

1. Set digital meter to DC volts and check battery voltage. Must be 12.4 volts or more (no load). **NOTE:** The select monitor on some models will not accurately read voltage below 12.0 and therefore should not be used. Does DC voltage read correctly? No→ Yes ↓	Remove the battery. Service and test as outlined earlier in the engine electrical section. Before continuing, the battery must be in good serviceable condition and fully charged. **IMPORTANT:** Replace battery if questionable. Yes - See Block 2
2. Start engine and increase to at least 4000 RPM. Battery voltage should increase to 13.6 to 14.6 volts. **NOTE:** If battery is low on charge, the reading will be low. A fully charged battery will reach the higher number more quickly. Is voltage reading correct? No→ Yes↓	Check battery charging coil. Disconnect coil leads. Refer to specifications for resistance values and connections. **NOTE:** These coils are open to ground, between any wire and ground should show open circuit. AC amperage testing will show approximately 7 amps at 4000 to 6000 RPM. Are tests within specification? Yes - See Block 3 No↓
3. Charging system is testing OK. Check for any possible loose connections between rectifier, regulator and battery. Are there any loose connections? No↓	Replace battery charge coil and/or flywheel. Re-test system. See Block 1.
4. Replace regulator rectifier and re-test system.	

ELECTRONIC FUEL INJECTION (EFI)
Power Up Testing

Refer to appropriate wiring diagram in Chapter 10.

Type I (RXLs)

1. Check battery voltage. Must be 12.2 or higher. Use digital volt meter. Does it read correctly? No→ Yes↓	Charge, service, test and/or replace battery.
2. Check EFI brown relay. Y/BK wire should read 12.2 volts or more with switches turned on. Does it read correctly? No→ Yes↓	Check circuit breaker, key switch, kill switch, connections and wires. Check relay ground black wire.
3. Check brown relay. Relay should connect R/Y from fuse link to R/BK (ECU) and R/BLU (select monitor). Does it? No→ Yes↓	Replace relay and repeat tests.
4. Check self shut-off relay and wires from relays to ECU. Are tests OK? No→ Yes↓	Replace wires and/or relays.*
5. Replace ECU.	

Type II (500s)

1. Check battery voltage using digital fluke meter. Must read 12.2 or higher. Is voltage within specification? No→ Yes↓	Charge, service, and test battery; or replace battery. Continue testing if needed. See battery service.
2. Check voltage to ECU R/GN Pin #106. Should be 12.2 or higher. Is voltage within specification? No→ Yes↓	Check circuit from battery through circuit breaker and to ECU. Repair and/or replace faulty wiring or components. Continue to step 3.
3. Check voltage to ECU O/BK wire Pin #11. Should be 12.2 volts while engine is being turned over. Is voltage within specification? No→ Yes↓ See Also Block 5	Check for an AC signal from battery charge coil to ACS Gry - GryW wires. Is signal OK? Repair circuit if necessary. No - See Block 4 Yes↓
4. Check battery charge coil and connecting wires. Replace coil and/or repair wires. Continue tests.	Check for battery voltage at ACS (red wire). Is voltage present? Repair circuit if needed. Yes↓
	Replace ACS. Is system now OK? No↓
	Replace ECU and retest.*
5. Check self-shut-off relay and circuit, OK? No→ Yes↓	Repair relay circuit.*
6. Replace ECU and retest.	

NOTE: Use only resistor spark plug caps on ignition coil high tension leads. Non-resistor caps may affect ECU operation.

Fuse Link

The fuse link is attached to the ignition switch harness with a tie strap. It can be identified by the light green and brown wires in 2 prong white connectors. The fuse link is the circuit protection device in Type I electrical systems. If a system overload (such as a dead short) occurs, the fuse wire will open the circuit preventing further damage. If this link is open, find and correct the problem and then replace the fuse link. Never attempt to replace the fuse link with a conventional fuse. Use only an OEM fuse link.

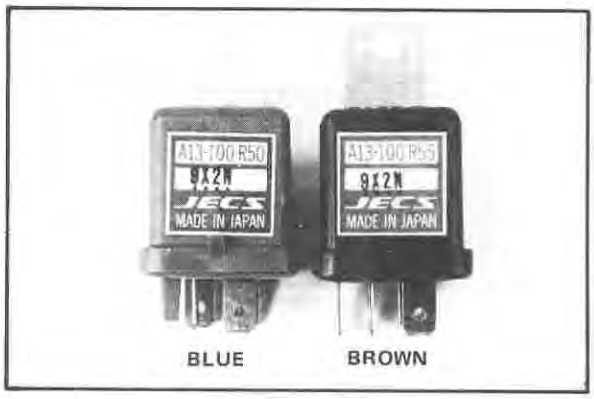
Fuse Link PN 3084113

Inspection

Service of the fuse link is limited to verification of whether or not the wire is continuous. Remove fuse link from machine. Measure resistance on the light green wire and the brown wire. Replace the fuse link if resistance is greater than .5 Ω. Type II systems (500s) use a self-setting circuit breaker, located near the battery.

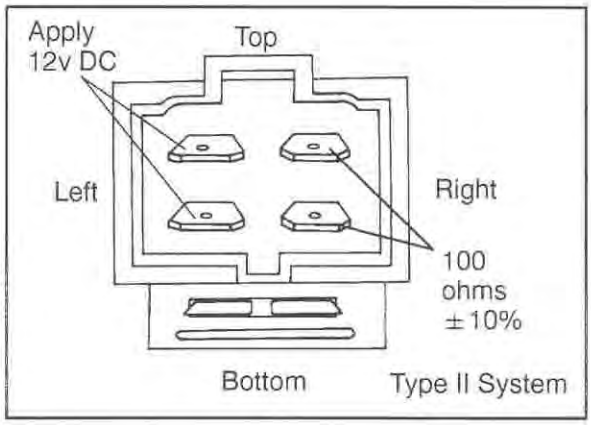
Relay Coils

The system relay coils for Type I systems are mounted on the front side of the right footrest assembly. The relays for Type II systems are mounted on the ECU. Their function is to control a major current carrying circuit with a smaller, low current carrying control circuit. When the ECU or ignition switch closes the low current coil circuit within the relay, the magnetism in the coil closes the contact points, allowing current to pass through the relay and power up to the ECU, fuel pump, etc. Type I systems incorporate two blue relays (black on Type II systems), one controlling the fuel pump and the other the self shut-off time delay relay. The Type I system also uses a brown relay to control the main power input to the ECU.



Relays can be tested by measuring pull-in coil resistance and volt drop across the main contacts. Coil resistance should be between 65 and 70 ohms measured between the two pins marked "coil" on relay base. When relay is energized, volt drop across relay contacts should be less than .1vDC, measured in parallel with relay. On the bench, the relay can be checked by hooking the marked relay coil terminals to a 12v battery and checking resistance of relay contacts. The resistance must be less than .2 ohms.

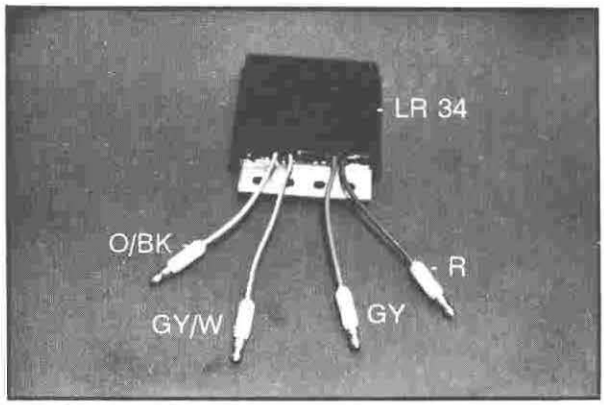
Type II style EFI relays are tested by placing 12 volts to contact left side as shown in the diagram at right. Measuring volt drop across contacts .1vDC. Measure resistance of right side contact. This should be 100 ohms ± 10%.



Electronic Fuel Injection (EFI)
Alternator Controlled Switch (ACS) - Type II Systems

Shown in the photo at right is the 500 EFI system ACS. The ACS has two functions: 1) Rectifies AC voltage from alternator to DC voltage for battery charging; 2) Connects the ECU with 12vDC battery voltage when an AC signal from the alternator indicates that the engine's crankshaft is turning.

NOTE: Even if the key switch and kill switch are in the "off" position, the ACS will power up the system if the crankshaft is turned. (See also page 4.6, Power up testing.)



Test Procedure

With ignition in the "on" or "run" position, crank engine over slowly. You will hear the fuel pump run for approximately five seconds. This tells you the ACS is working. If the fuel pump doesn't cycle when cranking, disconnect ECU wire harness and reconnect to reset ECU. Crank engine again. If fuel pump won't start working, unplug the harness at the ECU and check Orange/Black wire PIN #11 on the ECU harness. Battery voltage should be present when cranking engine. **NOTE:** 500s have a five wire ACS LR36. The extra wire is for a center tap alternator.

You can also use the select monitor to determine if the ECU is getting power. If the select monitor display lights up the ECU is getting power. Check the ACS wire at the ECU plug.

CAUTION:

Take care not to distort the pin with the tester lead. If no voltage is present, reset ECU and check Orange/Black lead at ACS unit. If no voltage is present, check for alternator output or loose connections. If alternator output is OK, replace ACS.

Cold Starting

On Type I systems, during cold starting the ECU will select a special "start-up" mode. This will occur any time the engine is being cold started, for example, any Type I system which has had the key off long enough for the self shut-off timer to power down the system will go to the start up mode. After turning on the ignition key to reset the system, the fuel pump will run from three to five seconds to pressurize the fuel rail. When the ECU sees the first ignition pulse it provides a longer than normal "prime" pulse to the injectors to inject enough fuel into the engine for starting.

On Type II systems, there is no ready light or ignition key reset. The pump may or may not run for the 3-5 second period depending on how long the engine has been off. In all systems, the "prime" pulse only occurs if the pump runs for the 3-5 second period.

Once the engine is running the ECU provides a rich mixture while the engine is warming up. It uses the engine temperature sensor(s) as an indicator of when the engine is warm, and will begin decreasing the fuel air ratio accordingly. If the key is turned off, the ECU provides power to the self shut-off relay for a period of ten seconds to ten minutes, depending upon the system type, and will not repeat the fuel system pressurizing and prime pulse during that time. Once the self shut-off sequence has expired, the engine will have had sufficient time to cool and the ECU will again repeat the cold start sequence.

In Type I systems only, during times of severely hard running or in very warm weather, if the engine crankcase should approach a temperature which might result in engine damage the ECU will provide additional fuel to the engine for cooling. When the crankcase temperature sensor indicates a temperature of approximately 100°C (212°F), the ECU will lengthen the pulse time and cause an over-rich condition which will cool the engine. As soon as the engine temperature returns to normal, the ECU will return to the original map.

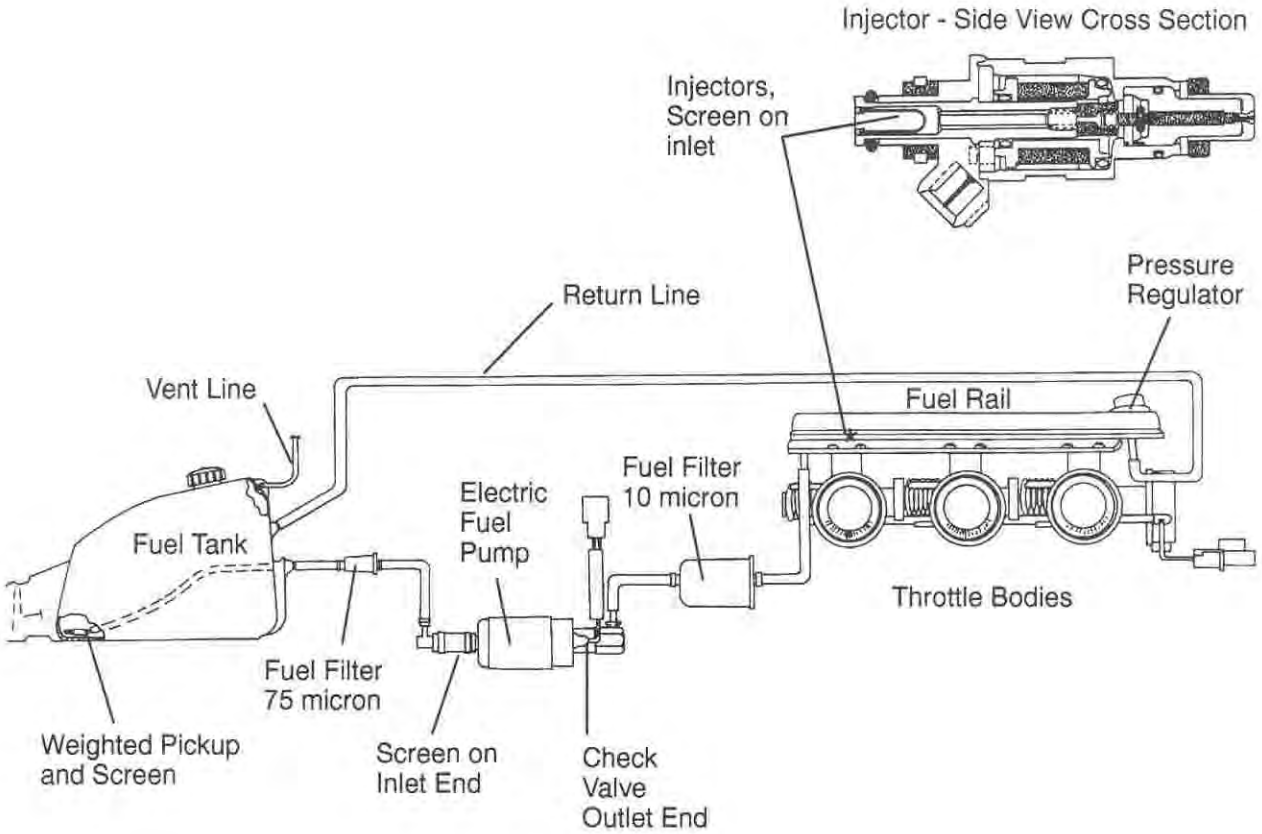
In Type II systems, the engine is protected against overheating by the engine coolant sensor. If the engine coolant reaches 85°C (185°F) the "temp" light on the dash will begin to flash. If the engine coolant temperature continues to increase, the light will begin to blink faster. At this point the ECU adds fuel to enrich the mixture and help prevent engine damage. Fuel will continue to be added until the light stops blinking.

If the engine should become flooded during starting, it can be cleaned out by holding the throttle wide open while turning the engine over. If the engine is not running, and the throttle is open more than 60°, no fuel will be injected. The engine will start and will begin receiving fuel from injection when the engine exceeds 800 RPM, or when the throttle position goes under 60°. The engine should then clean out and run normally.

The fuel system consists of all the parts responsible for storing, cleaning, delivering, pressurizing and injecting fuel into the engine. They are: fuel tank, fuel pick-up, fuel hose, primary filter, fuel pump, secondary filter, fuel rail, injectors, throttle bodies, pressure regulator and fuel return hose.

Fuel is picked up from the bottom of the fuel tank by the fuel pick-up hose and filter. It then travels through a hose to the primary (75 micron) filter, located under the air box. Once leaving the primary filter, it travels to the electric fuel pump, located under the mag end throttle body.

The electric fuel pump is responsible for the movement of the fuel in the entire system. Connected to the battery by a relay, the pump runs continuously whenever the engine is started. Also located at the outlet end of the pump is a check valve which holds pressure in the system when the pump has stopped.

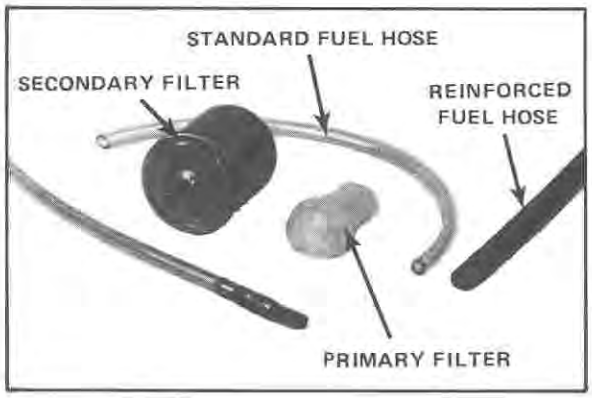


After leaving the pump, the fuel goes through the secondary 10 micron filter for further purification. The secondary filter is located under the mag end throttle body. Cleanliness is essential to the operation of the system, and its importance cannot be overstressed.

The fuel is then stored under pressure in the fuel rail, ready for discharge into the throttle bores. The pressure regulator provides consistent pressure and maintains specific pressure in the rail. The pressure regulator is pre-set to maintain rail pressure at 35-37 PSI. Any pressure greater than this is relieved or returned to the tank by a return line. The return line must be free of kinks or obstructions to prevent excess fuel rail pressure which may cause a rich condition. Refer to fuel pressure test page 4.11.

Tank, Hose And Filters

The fuel tank is the reservoir for the fuel. It contains a flexible hose with a weighted pickup and a course screen which drops to the lowest part of the tank regardless of machine attitude. Fuel travels through the fuel hose to the primary (75 micron) filter located under the airbox and then to the fuel pump. The fuel hose changes to a reinforced rubber hose on the pressure side of the pump, which carries fuel to the secondary (10 micron) filter located under the throttle bodies, and then to the fuel rail.



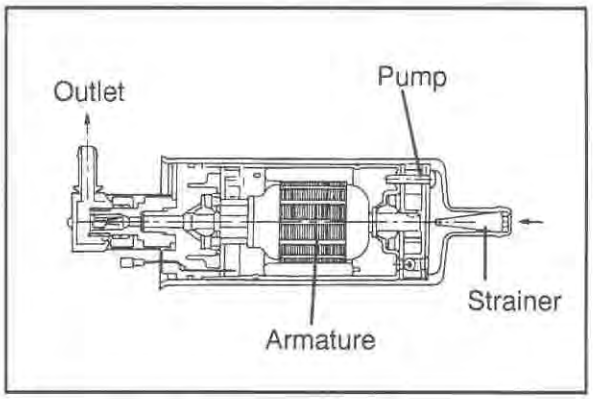
The fuel tank, hoses, and filters require little maintenance or service. Periodically inspect tank and hose condition. Ensure that the pickup is clean and properly positioned and vent tube is properly routed and not kinked or pinched. Replace any hose showing signs of deterioration. Replace primary and secondary filters at 5000 mile (8000 km) intervals, every two years, or more often if contamination of any kind is present in the system. Use OEM parts only. If for any reason, at any engine RPM, the fuel system should fail to deliver a sufficient quantity of fuel to meet engine requirements and have some fuel returning to the tank, the fuel hoses must be checked for obstructions and/or the fuel filters replaced. If the problem does not rectify itself, proceed to fuel pump testing.

CAUTION:

Whenever inspection reveals worn, damaged or defective parts, replacement is necessary in order to avoid serious damage to the machine or injury to the operator.

Fuel Pump

The electric fuel pump is located on the bulkhead underneath the mag end throttle body. The 12v pump receives fuel from the fuel tank, then sends it through the small strainer in the pump inlet nozzle, through the roller vane type pump, through the outlet check valve and on to the injector rail. The pump is completely filled with fuel during operation. This provides cooling, corrosion protection and lubrication.



CAUTION:

Never run the pump without a sufficient supply of fuel or pump damage will result. The pump is cooled and lubricated by fuel.

The pump outlet pressure can reach as much as 70 psi. It is regulated. however, to between 35 and 37 PSI by the fuel rail pressure regulator. Located near the outlet end of the pump is a check valve. The pressure regulator also acts as a check valve. There will be high pressure fuel between these two valves.

The fuel pump is a sealed unit. No internal repair of the pump components can be performed. Pump condition can be verified by an amp draw test, an output volume test and an output pressure test.

Amp Draw Test

Install a DC ammeter in series with the purple pump power feed wire. The draw should be 2.5 amps. A draw at or slightly less than that value indicates the pump is electrically sound. No draw indicates either no power present or an open circuit in either the pump or its ground. A draw greater than that value indicates either a stuck or defective pump. A pump which is stuck due to long periods of non-use can occasionally be freed by striking with a soft face hammer. If this does not free the pump, it must be replaced.

Amp Draw -

2.5 amps

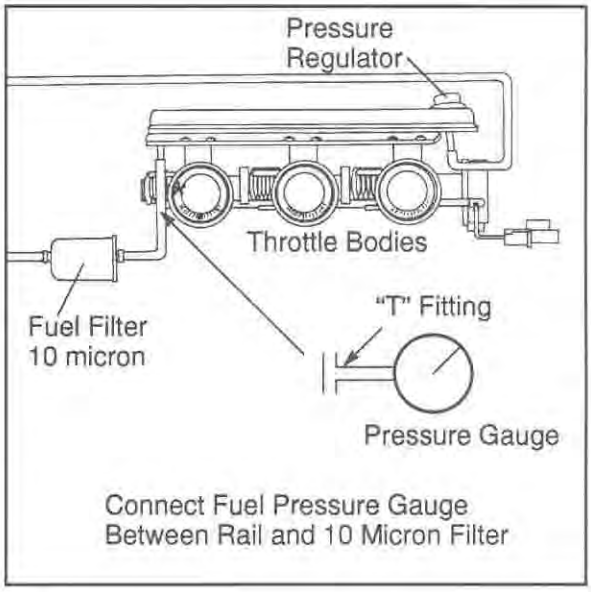
Output Volume Test

The output volume of the fuel pump and delivery system can be verified with an output volume test. To perform test, start machine and make sure delivery side of system is filled and pressurized to the pressure regulator. With machine turned off, disconnect fuel return hose and place it into a 200 milliliter graduated container. Activate ECU to cycle pump for approximately five seconds. The measured output during this time period should not be less than 90 to 100 milliliters.

NOTE: Battery voltage less than 12.6vDC or restrictions in the fuel lines or filters will cause output to be less than recommended amount.

Fuel Pressure Test

Install EFI fuel System pressure tester in fuel line on PTO end of rail. **NOTE:** Use caution when removing hose. The rail may contain pressurized gas if engine has been recently run. Activate dealer mode using select monitor service harness plug, by connecting gray and black test loads together or by jumping gray and black wire terminals at diagnostic plug, then turning on ignition switch. With pump running, system pressure should be between 35 and 37 psi. A pressure reading of higher than normal indicates a faulty pressure regulator or an obstructed fuel return hose. A pressure reading lower than normal indicates a faulty pressure regulator, a bad pump, or a restriction in fuel hoses or filters between tank and rail. If pressure starts out normal and then gradually lowers, suspect the fuel tank vent and/or any of the fuel filters or hoses which may restrict fuel delivery to the pump.



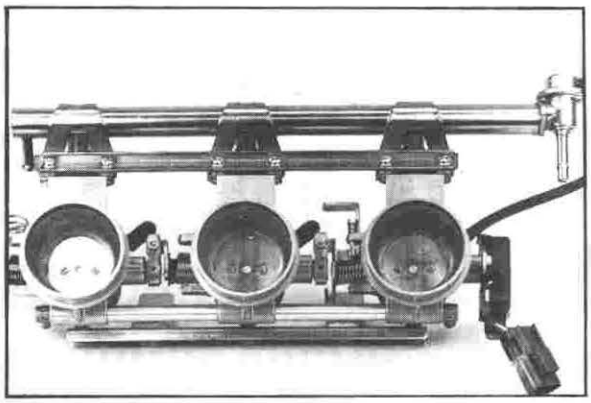
Connect Fuel Pressure Gauge Between Rail and 10 Micron Filter

EFI Fuel System Pressure Tester

PN 2870982

Fuel pressure can also be checked with the gauge in place and with the engine running. Pressure should be checked at both idle and at operating RPM. A plugged filter or restricted fuel pickup hose may show good pressure at idle but restrict flow at operating RPM.

Fuel Rail



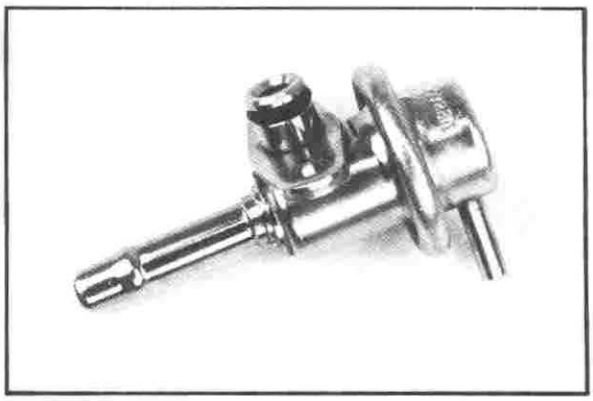
The fuel rail is the fuel distribution manifold for the injectors. The injectors slip into fittings on the underside of the rail which are sealed with O-Rings around the injectors. The rail stores fuel under pressure so that simply opening the injectors will allow fuel to pass from the fuel rail through the injectors and into the throttle body. Pressure in the fuel rail is controlled by the pressure regulator.

The fuel rail requires little if any service. Periodically inspect seal between rail and injectors and rail and regulator. If any leakage exists, replace O-Rings and recheck for leaks.

Return Hose

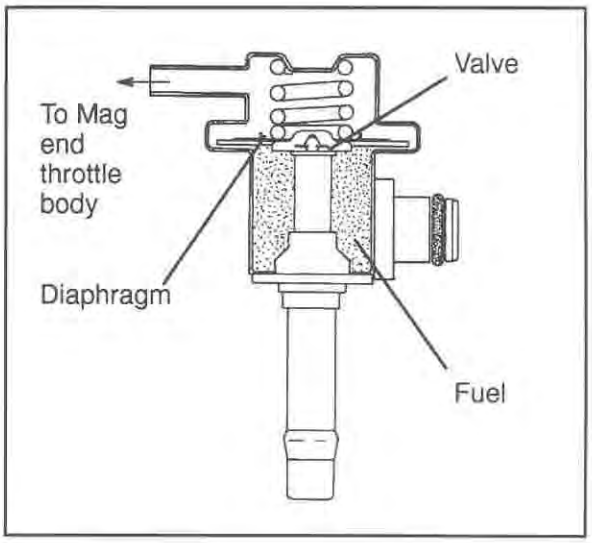
The return hose runs between the bottom of the pressure regulator and the top of the fuel tank. It provides a path for excess fuel from the fuel rail to return to the fuel tank. If this hose should become obstructed in any way, the excessive fuel pressure in the rail will cause a rich operating condition.

Pressure Regulator

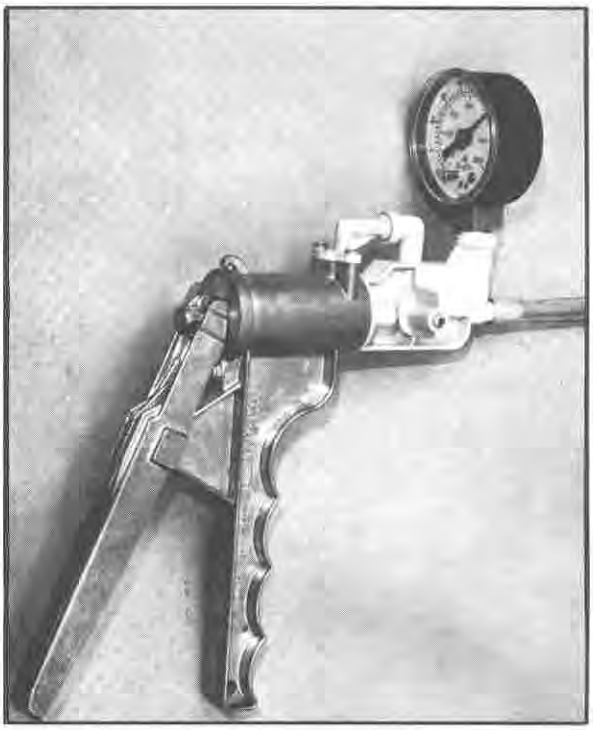


The fuel pressure regulator is mounted on the fuel rail, opposite the fuel entry point. Its function is to maintain a consistent fuel pressure within the rail by allowing pressure above the desired level to bleed off the rail, through the regulator, and back to the tank by way of the return hose. When the fuel pressure on the bottom of the regulator diaphragm reaches between 35 and 37 psi, it overcomes the spring on the other side of the diaphragm and pushes it up. This opens the valve to the return hose allowing fuel to escape, maintaining the specified pressure.

The regulator can also vary pressure consistent with engine load, atmospheric pressure, etc. A manifold pressure tube runs between the mag end throttle body and the top of the diaphragm. As the throttle is opened, the pressure in the throttle bore rises. This additional pressure enters the cavity above the diaphragm, assisting the regulator spring and raising the pressure in the rail, allowing more fuel through the injectors while they are open due to the higher pressure. The opposite is true during deceleration. High engine vacuum while the butterflies are closed is applied to the top of the diaphragm, allowing the fuel to compress the spring and open the regulator valve at a lower pressure. These pressure changes are very small and tend only to maintain a specific pressure differential between the throttle bodies and the fuel rail, and not to vary mixture ratios while driving.



In addition to checks made under fuel pump service, the pressure regulator span can also be checked. With a fuel pressure gauge on the fuel line and a Mity Vac™ pump installed on the regulator, activate the system as was done to check the fuel pump. The fuel pressure at atmospheric pressure should read between 35 and 37 psi; with five inches (mercury) of vacuum it should be between 33 and 35 psi; with ten inches (mercury) of vacuum it should read between 30 and 32 psi; and with five pounds of pressure it should be between 42 and 44 psi. Consistent readings outside the span indicate a bad regulator, bad hoses or filter, bad fuel pump, or an inaccurate test gauge. Verify the problem and correct it before any additional work is done to the system.

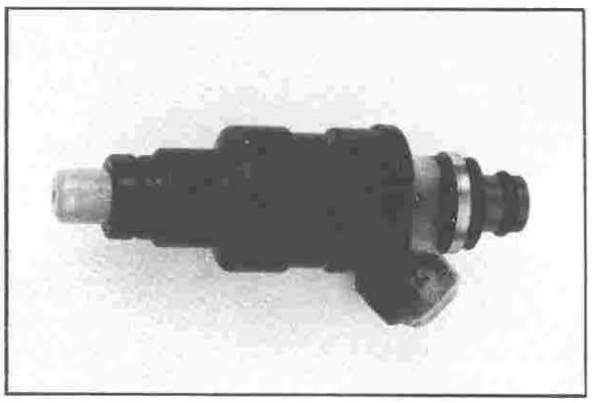


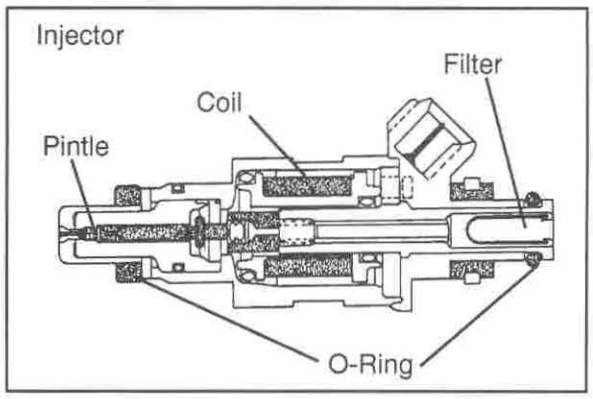
Mity Vac

PN 2870975

Injector

The injector is an extremely close tolerance solenoid type valve which opens and closes electrically. It allows fuel to pass from the fuel rail through the injector body and into the throttle body. The quantity of fuel is controlled by the *length of time* each injector is open, and constant fuel rail pressure.





1. Check battery voltage. Must be 12.2 or higher and be capable of handling pump load. If not, the fuel rail pressure test will be low. No → Yes↓	Charge, service, test and/or replace battery. See battery service section.	
Connect fuel pressure gauge and test as earlier outlined. Must read 35 to 37 psi. Pressure reading high→ Pressure reading low↓	Check for pinched or kinked pressure regulator return line. Is line OK? No → Yes↓	Clean or replace return line.
Inspect pump pickup lines, filters and volume test pump. Is volume OK? No → Yes↓	Replace pressure regulator.	
Replace pump.		

NOTE: It is very important to inspect fuel tank pick up screen and tank for floating plastic particles. It's possible to have particles collect around screen as pump is running and float away after pump has stopped running.

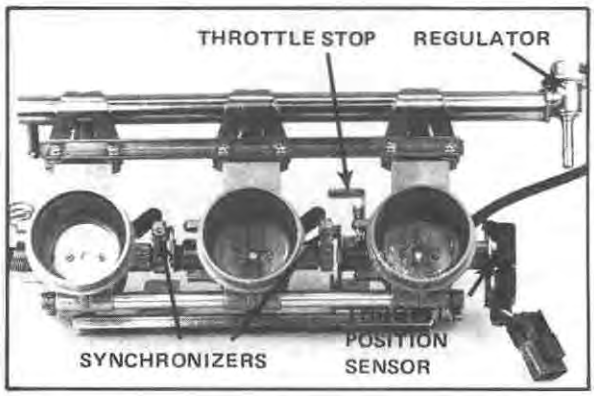
Injectors cannot be disassembled for service or cleaning. If a cylinder is not functioning properly and fuel supply is suspected as the cause, determine if an injector problem exists and whether it is mechanical or electrical. Switch the harness leads from the injector in question with an adjacent injector. If the problem moves to the adjacent injector, it is electrical. Refer to injector electrical service, page 4.29. If the problem stays with the same injector, it is a mechanical problem, and injector replacement is necessary.

If one of the cylinders fills with fuel and the rail empties after shutdown, remove airbox and open throttles. Install a 1″ (2.5 cm) wide strip of cardboard above butterfly and close throttles. Turn on ignition to pressurize rail. Wait two minutes and remove cardboard. Some wetting is OK, but a soaked cardboard indicates a defective injector.

Some of the mechanical problems which will necessitate injector replacement are: internal and external leakage, partial or total fuel blockage, open injector coil, and physical damage to the pintle and pintle case.

Throttle Body

The throttle body assembly replaces carburetors in a fuel injected engine. It consists of one throttle body unit for each cylinder. Air flow is controlled by a throttle plate or butterfly type throttle shutter. On top of each unit one injector is held in place by the fuel rail. The throttle position sensor is mounted on the mag end of the throttle body assembly. Engine idle RPM is controlled by the throttle stop screw mounted between the mag and center throttle bore units. To synchronize the throttle assembly, synchronize the adjuster between each pair of throttle body units.



Throttle Body Synchronization

Since each cylinder and throttle bore operates independently and the only common factor is that they all get the same quantity of fuel, it may be necessary to periodically synchronize the throttle butterflies to coordinate the fuel/air quantities. This is best accomplished by removing the throttle body and visually synchronizing the butterflies on the bench.

Procedure

1. Loosen synchronizer jam nut between mag and center cylinder.
2. Turn adjuster until center and PTO butterflies are farther open than mag side.
3. While shining a flashlight into bore on engine side, view through air box side of mag throttle bore. Back out throttle stop screw until butterfly just closes at top of bore (no light shining through).
4. Moving flashlight to center bore, adjust synchronizer jam nut until center butterfly just closes at top of bore.

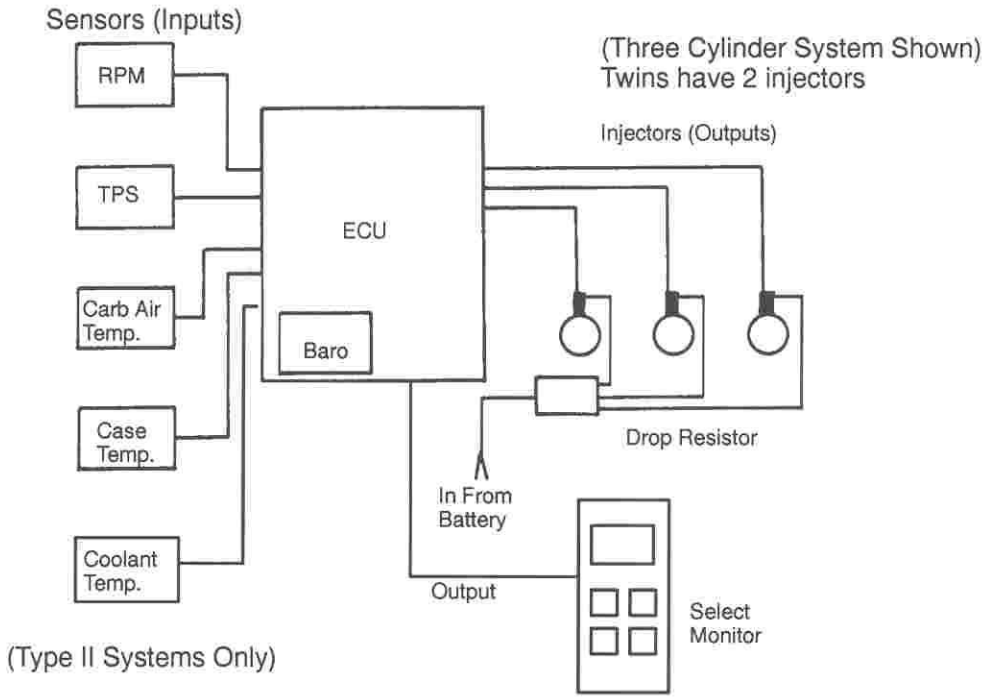
NOTE: Make sure the PTO butterfly does not hold the center open while adjusting.

5. Once center and mag butterflies are set to a just closed position, synchronize PTO butterfly the same way by adjusting synchronizer jam nut between center and PTO throttle bores until PTO butterfly is just closed.
6. Open and close throttle three or four times by pulling up on cable attaching point on throttle shaft.
7. Recheck all three butterflies to verify synchronization and readjust if necessary. Make sure that all synchronizer jam nuts are tight.
8. Reinstall throttle body assembly on engine. The method for adjusting the throttle position sensor is covered on page 4.24.

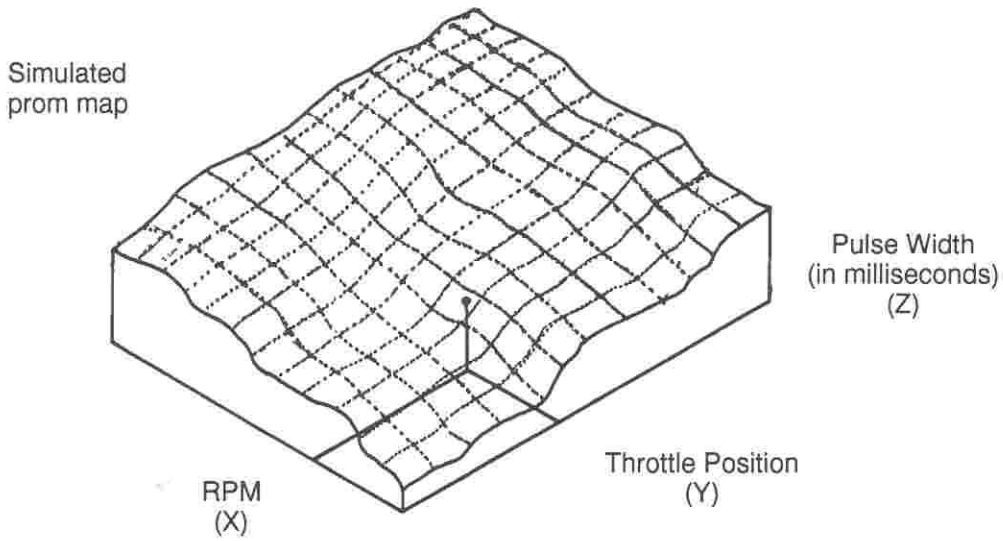
NOTE: The same procedure can be used on twin cylinder engines.

Electronic Fuel Injection (EFI)
System III - Electronics Operation

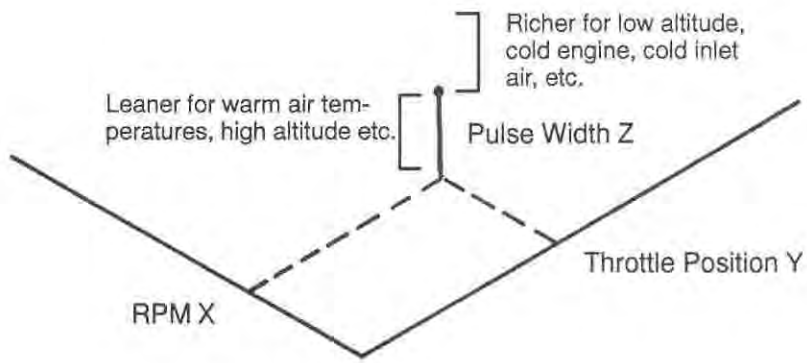
The Electronic Control System is the mixture control part of the system. It uses sensor inputs to control the fuel/air ratio. The illustration below shows the components of the basic Electronic Control System.



The electronic control unit delivers a low voltage signal to each sensor. Depending on variations in air temperature, throttle position, etc., each sensor will vary the amount of that signal passing through it to ground, depending on its position and temperature. The ECU reads the information and from that determines actual air temperature, throttle position, etc. This information is then plotted on a map which is pre-programmed on the PROM (Programmable Read Only Memory) or "chip". Based on the two primary inputs; RPM (X) and throttle position (Y), the ECU can select a specific injector open time (Z). This value is the distance between the base plane and the map at the point where X and Y cross. The value is converted to milliseconds and referred to as pulse width.



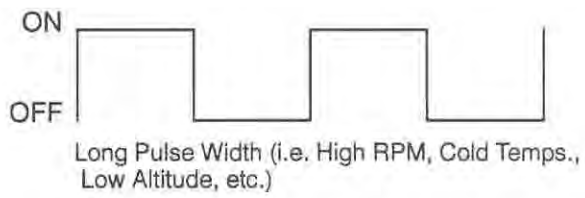
Input from the other sensors either adds or subtracts a percentage from the pulse width to tailor the fuel/air ratio for the specific altitude, air temperature and engine temperature. See Ill. 1.



Ill. 1

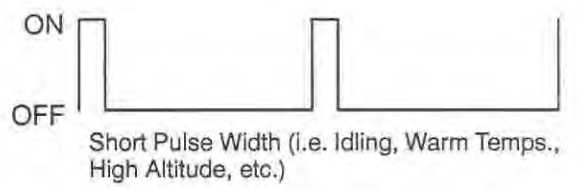
The illustrations at right depict pulse widths in milliseconds output by the ECU. Ill. 2 shows a situation where the air temperature is low, the machine is at low altitude with a cold engine, wide open throttle and high RPM.

The ECU determines the engine's fuel requirements and selects a relatively long pulse width which allows more injector open time for fuel to enter the engine.



Ill. 2

If the same engine were at high altitude on a warm day at low RPM and throttle settings, the ECU would select a pulse width closer to Ill. 3, indicating a shorter injector open time and less fuel entering the engine. In this way the system can ultimately vary the mixture for all temperatures, loads and altitudes by varying the amount of time the injectors are open per revolution.



Ill. 3

Select Monitor

The select monitor is designed to provide easy, accurate diagnostic and service information to the technician. When installed on the machine it will provide both dynamic and static displays of the function of critical fuel system control components. It also has the ability to display the contents of the ECU memory. With this tool, electrical service of the EFI system should be quick and easy.

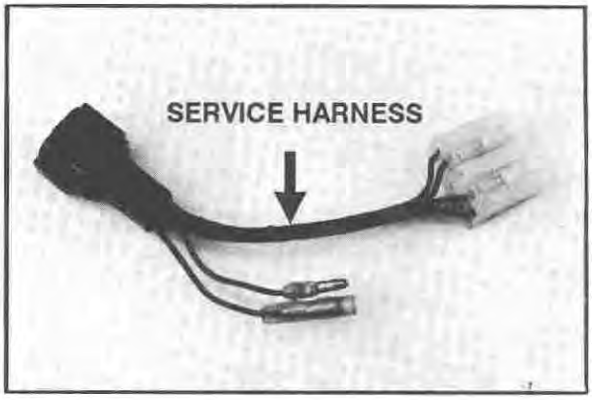
Select Monitor

PN 2870969

Remove protective plug from diagnostic plug in machine harness next to ECU. Connect select monitor to instrument harness, to service harness, and to diagnostic plug in. Install program cartridge into select monitor. Turn on ignition switch and place handlebar kill switch into run position. Turn on select monitor switch. On most models the monitor display will now light up.

Type I (RXL) models will stay powered up with switches on. On Type II (500) systems, the time will be limited unless the engine is running. The ECU will remain powered for approximately one minute at or above room temperature.

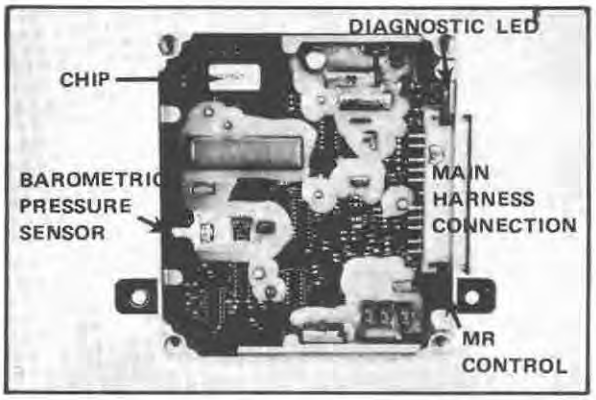
There are two ways to search for information with the monitor. You can scroll through the different modes in order until the correct information is found, or you can select the specific mode letter and number and advance to the specific information that you want.



Electronic Control Unit

The Electronic Control Unit (ECU) is the brain of the EFI system. It is a digital computer which holds the memory chip for the read out of basic injector opening duration on a three dimensional map. There are two ECU systems used, Type 1 for the RXL and Type 2 for the 500 EFI snowmobiles. Each system receives the same type of information from the sensors. The ECU incorporates a number of special features. Some of these features are:

- adjustable low speed mixture control
- automatic cold engine start up enrichment
- engine over temperature protection
- flooded engine clean out mode
- fail safe feature
- LED self diagnostic system



In the event that any sensor should give inaccurate or no information, the ECU will then flash a coded light sequence to identify the affected sensor.

NOTE: It is important to note that the ECU will not identify mechanical problems. Only sensor inputs are monitored. For example, low fuel pressure or lack of fuel will not be diagnosed.

The ECU can only tell if a sensor reading is within a specific range. For example, a failure code will not be indicated if throttle position shows 3.9° when the throttle is actually wide open. Use display of throttle position to ensure the readings reflect actual conditions. This same concept applies to the temperature sensors and the barometric sensor.

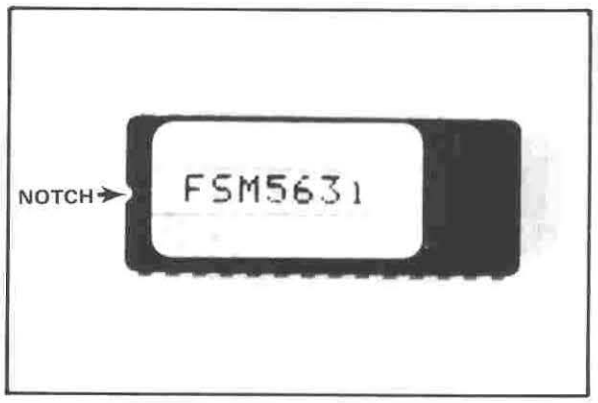
ECU Part Numbers

Type I w/o chip	2410028
Type I w/o chip Elect. Start	2410029
Type II w/o chip	2410030

Select Monitor Cartridge	3084414
Select Monitor Cable	3084417

ROM Chip Removal and Installation

The chip can be removed and replaced with the appropriate chip puller and installation tool. You will need to supply a ROM removal tool and dielectric grease. Note the location of the indicator notch when replacing the chip (see photo at right). The system will not function with the chip in backwards or with the chip pins not properly in their sockets. See the specification section in this chapter for chip information.



ROM Removal Tool -

Digi-Key PN: K158-ND
Phone # 1-800-344-4539

Polaris Dielectric Grease

PN 2871044

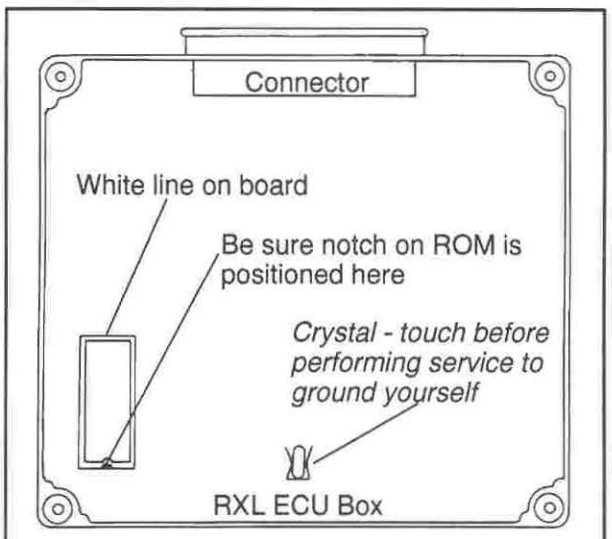
CAUTION:

The computer chip and the ECU are extremely sensitive to static electricity. The handling of either component in a static electricity environment will cause irreversible damage. Work on a metal bench or other static dissipating surface. It is very important that you ground yourself by touching the crystal inside the ECU before any internal service work begins on the ECU assembly. See Ill. 1 and 2. If the ECU has not been removed from the machine, be sure to unplug it before proceeding.

1. Disconnect main harness connector from ECU. Remove phillips head cover screws and cover.
2. *Touch the crystal located inside the ECU box to ground yourself before proceeding.* See Illustrations 1 and 2.

CAUTION:

The chip and the ECU are very sensitive to static electricity. Working inside the ECU without grounding yourself may cause irreversible damage to either or both components.



Ill. 1

3. In the event you are removing an old chip for replacement, place ROM removal tool over ROM chip. Pull up on triggers to securely grasp chip and pull chip out.

4. Check charts on page 4.1 to be sure you are installing the correct ROM.

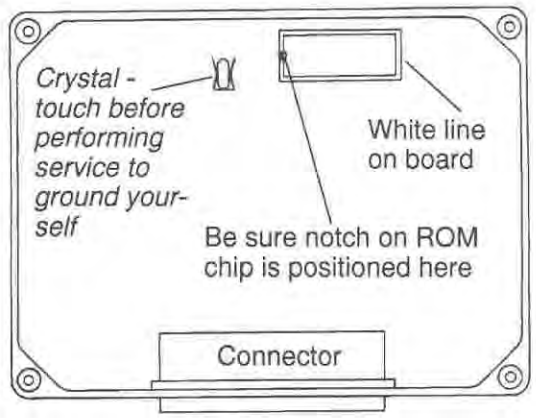
5. Coat the pins of the ROM with a light coating of dielectric grease.

6. Carefully insert the ROM, making sure the notch on the end of the ROM matches the notch indication mark drawn in white on the circuit board. See illustrations 1 and 2.

CAUTION:

If the chip is installed with the notch incorrectly positioned the chip will be ruined and the machine will fail to run.

7. Align cover gasket, positioning cover rubber bumper above chip. Reinstall cover screws and reconnect wire harness. Install select monitor and check functions.



500 ECU Box

Ill. 2

Troubleshooting EFI System

When key switch is turned to the on position, voltage is supplied to ECU and the select monitor. **NOTE:** Some models will require the engine to be turned over.

After the ECU is powered up, it will run the fuel pump for five seconds, read the sensors and do a self diagnosis of the complete system. The ECU does not check the Air Temperature Sensor (ATS) until the engine RPM is above 1000.

With a good understanding of how each component functions, the test procedures given in this manual, and the use of the select monitor, you will be able to service and diagnose the Polaris fuel injection system. All information and specifications are based on the latest product information available.

Select Monitor Scrolling

With the ignition on and the monitor hooked up and turned on as described earlier, the display should show the year and the mode (F00). By pressing the ▲ key, the display will proceed to (F01), which is the model. Press the ▲ again and the (F02) will appear, which is battery voltage. By pressing the ▲ or ▼ keys, you can either scroll forward or backward through the modes.

If you know the mode you want, simply press "F" followed by the two digit mode number, and enter. The monitor will display the mode number and the registered information.

The following chart shows the modes, what the readings are for, and what an approximate reading should be.

Mode	Description	Normal Reading
F00	Model Year	Year of machine (not always correct)
F01	Engine Code	Polaris code number 30 for Triples; 20 for Twins
F02	Battery Voltage	12.2 or above at room temperature
F03	Engine RPM	Idle: 2000 to 2200 3 Cylinder; 1600 Twins
F04	Throttle Valve Angle (Whole Range)	0° to 77° large steps
F05	Intake Air Temp in C°	Room temperature (engine cold)
F06	Intake Air Temp in F°	Room temperature (engine cold)
F07	Crankcase Temp in C°	Room temperature (engine cold)
F08	Crankcase Temp in F°	Room temperature (engine cold)
F09	Barometric Sensor	Barometric pressure in millimeters of mercury
F14	Throttle Valve Angle (Low End)	0° to 35.9° small steps
F21	MR (Idle Mixture) Position	2.5 or more than 4.0 for Alt. See page 4.27.
F22	Water Temp Sensor in C°	Same as ATS or CTS Cold or 30° to 90° running
FA0	Ignition Key Diagnostic	KY + No. 3 LED (with key on)
FA1	Dealer Mode	DM + No. 5 LED (with DM activated)
FA2	Relay Check	FP,SD,SS + No. 1,2, and 3 LED when operating
FB0	Existing Trouble Codes	Faults presently existing
FB1	Memory Trouble Codes	Faults that are intermittent
FC0	Memory Clear	----

The ECU determines the amount of fuel to be injected by accurately calculating the engine's need for fuel delivery. To do this, the ECU memory chip reads the three dimensional map discussed on page 4.16. Various sensors such as air temperature sensor, coolant temperature sensor, barometric pressure sensor, battery voltage, and MR setting in the ECU are also inputs to control fuel delivery.

Select Monitor Readings

Mode	Description	Normal Reading
F100	Model Year	Year of machine
F01	Engine Code	Polaris code number 30 for Triples Polaris code number 20 for Twins
F02	Battery Voltage	12.2 or above

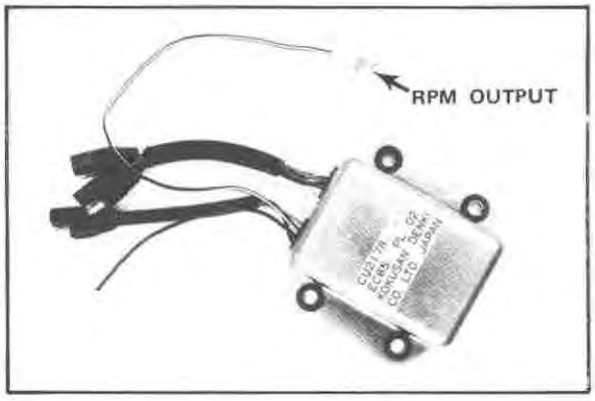
Type I systems will indicate a high battery voltage on the select monitor if the actual voltage is below approximately 10vDC. If you suspect a low battery, use a Fluke meter to directly measure the battery voltage. This will not occur in Type II systems. The select monitor accurately reads low battery voltage.

Fluke Meter PN 2870659

RPM Sensor

The ECU receives an engine RPM signal from the CDI box. This signal is one of the main inputs and is very critical to proper operation. If the ECU does not see this signal, the injectors will not open and the fuel pump will only cycle for the initial five seconds when the ECU is powered up.

The ignition switch and auxiliary kill switch are connected in series with the ECU CDI signal. If these switches are leaking partial voltages to ground, the ECU will not function properly. Whenever CDI or intermittent running problems are occurring, the switches should be suspected. These switches will also fail more often when humidity is high. To troubleshoot the switches, disconnect or isolate them from the circuit.

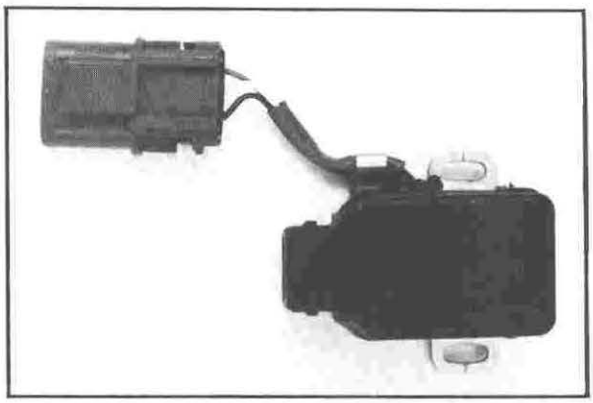


Select Monitor Readings

Mode	Description	Normal Reading
F03	Engine RPM	Cranking 300-500

Throttle Position Sensor (TPS)

Throttle position is one of the two main inputs used to calculate fuel/air ratio. The throttle position sensor is a rheostat type variable resistor which is mounted on the end of the throttle shaft. The resistance value of the sensor is relatively low at idle. As the throttle is opened, the resistance goes up proportionately to the butterfly angle. The ECU passes a specific current through the sensor and experiences more current flow at idle. This flow lessens as the throttle is opened. From this information, the ECU can determine butterfly angle and control fuel delivery accordingly.



The throttle position sensor can be checked on the bench with an ohmmeter. With the butterflies closed, the resistance between the black and white wire, measured at the plug, should be between 400 and 700 ohms. With the throttle wide open, the resistance should be approximately 4.5 k ohms.

Some minor variations in resistance values will be experienced due to throttle position sensor location, but radical differences or failure to see a consistent progressive increase or decrease in the resistance as the throttle is opened and closed indicate a defective position sensor.

The sensor can also be checked with the select monitor using mode F04. It should read between 3° - 4° when the throttle is closed and consistently, progressively increase with throttle opening to more than 74° at wide open throttle. The throttle position sensor can be replaced by removing the two mounting screws and gently prying it off the end of the throttle shaft.

TPS Adjustment

During periodic inspection, or when replacing the TPS, it must be synchronized to the throttle butterflies. The sensor must be positioned to the positive side of 0° with the butterflies totally closed. To adjust the sensor, disconnect the throttle cable from the throttle flipper and back out the throttle stop screw until the butterflies are totally closed. Connect the select monitor to the system diagnostic plug. Turn on the ignition switch and the monitor on/off switch. Scroll the monitor to mode F04 or F14 and verify the sensor positioning.

NOTE: F14 is a low end scale for sensor adjustment. This is the desirable scale, but because of programming may not work on all models.

Loosen the sensor mounting screws and rotate the sensor until the reading on the monitor is .1° on F14, or the point where the reading "breaks over" between 0° and a positive number on F04. Tighten the mounting screws, open and close the throttle a few times and recheck the reading. Readjust if necessary.

Select Monitor Readings

Mode	Description	Normal Reading
F04	Throttle Valve Angle-Range	0° to 77° Large Steps See TPS Adjustment
F14	Throttle Valve Angle Low End Not Used on All Systems	0° to 35° Small Steps Depending on Position

Intake Air Temperature Sensor (ATS)

The air temperature sensor is mounted in the air box. Its function is similar to the crankcase temperature sensor in that its temperature will vary the resistance across the sensor. It has a reduced thermal capacity for quicker response. Cold air will cause high resistance and warmer air will lower the resistance.

The ECU sends current to the sensor and, depending on its temperature, a certain amount will pass through to ground. By measuring how much passes through, the ECU can calculate air inlet temperature and vary fuel/air ratio accordingly.

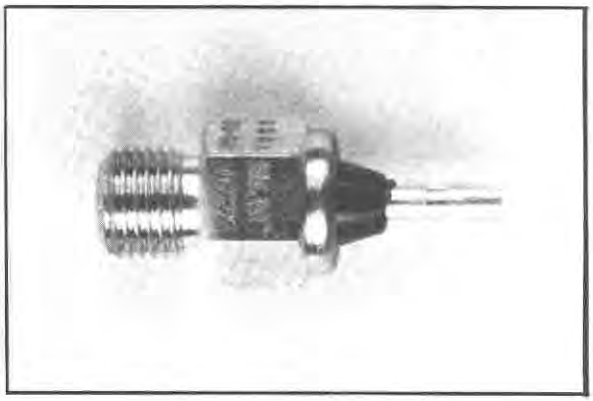
The intake air temperature sensor can be tested in a manner similar to the crankcase temperature sensor. Determine the approximate temperature of the sensor, measure the resistance between the two lead ends at the plug and compare the reading to the graph shown on the bottom of page 4.28.

An easier and more accurate method is to use the select monitor to indicate what air temperature reading the ECU receives from the sensor. If the air box and underhood area have not been warmed due to recent running of the engine, the air temperature sensor should read room temperature on the select monitor. Radical differences between room temperature and the indicated reading indicate a problem with the sensor, wiring, battery, or ECU. Verify and repair any problem before attempting to operate the machine.

Select Monitor Readings

Mode	Description	Normal Reading
F05	Intake Air Temp °C	Room Temp "Engine Cold"
F06	Intake Air Temp °F	Room Temp "Engine Cold"

Crankcase Temperature Sensor (CTS)



The crankcase temperature sensor is screwed into the upper crankcase half below the mag throttle bore. This thermistor type semi conductor varies in resistance depending on its temperature. The ECU delivers an electrical current to the sensor. When the sensor is cold, its resistance is high and little current passes through the sensor to the engine ground. As the sensor heats up its resistance lowers, allowing more current to pass through. The ECU measures the current flow through the sensor and knows the temperature of the engine crankcase and can vary fuel ratio according to case temperature.

The CTS is used on all Type I (RXL) systems. Type II (500) systems do not use a crankcase temperature sensor.

Select Monitor Readings

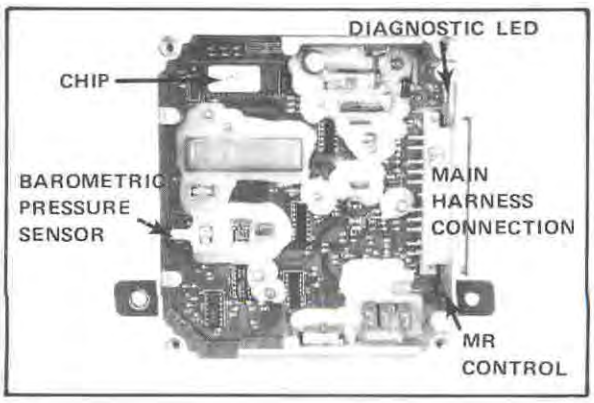
Mode	Description	Normal Reading
F07	Crankcase Temp °C	Room Temp "Engine Cold"
F08	Crankcase Temp °F	Room Temp "Engine Cold"

Barometric Pressure Sensor (BPS)

The barometric pressure sensor is located inside the ECU. Its function is to read atmospheric pressure. This information is then used by the ECU to determine fuel/air ratio, depending on pressure changes during a given day, or for any altitude change. The barometric pressure sensor is an integral part of the ECU and cannot be replaced separately.

No service can be performed on the barometric pressure sensor. However, the barometric sensor reading can be checked with the select monitor. The monitor reads millimeters of mercury. To arrive at air pressure in inches of mercury, divide this number by 25.4. Compare the reading to an accurate barometer.

NOTE: Readings reported by the radio or television are corrected to sea level. The select monitor is an actual reading. Any changes to the stock machine which affect the air pressure around the ECU will cause the barometric sensor reading to be inaccurate.



Select Monitor Readings

Mode	Description	Normal Reading
F09	Barometric Sensor	Barometric Pressure in Millimeters of Mercury

MR Adjustments

On Type I (RXL) systems, the fuel/air ratio at engine RPMs below 3500 can be adjusted slightly richer or leaner than the standard program mixture by adjusting the MR control. This adjustment is made to improve idle quality and drive away. It affects the same carb area as an air screw.

To adjust the MR control, remove the rubber plug. Install the select monitor, power up the system and press F-21. A correct reading on the monitor is between 2 and 3, with 2.5 being the most desirable. (The production setting is 2.5). Turning the MR screw clockwise will increase the observed number and richen the mixture. Turning the screw counterclockwise will lower the number and lean the mixture. The leanest setting is 0 and the richest will approach 5.

NOTE: At high altitudes, a higher number will result in earlier drive-away after startup.

Adjusting the MR control screw on Type II (500) systems will only affect cold starts and cold drive-away. (It is designed to assist the driver when using poor or summer grade fuels.) If a lean condition is suspected, change the number to a higher value. If a rich condition is suspected, change to a lower number. Approximately two minutes after starting, this adjustment has little effect; after 10 minutes it has no effect.

Select Monitor Readings

Mode	Description	Normal Reading
F21	Mixture Enrichment	2.5

MR Adjustments For Altitude And Temperature

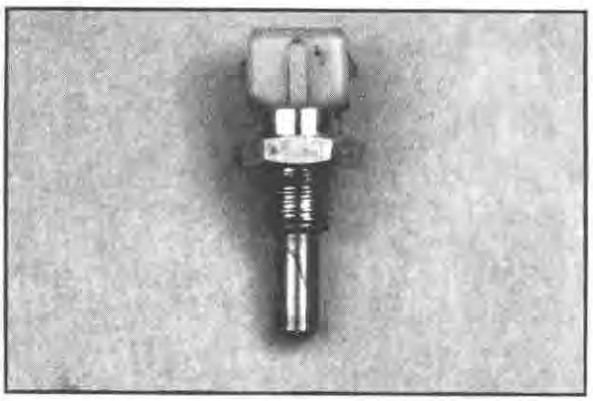
The following tables list MR screw settings for various temperatures and altitudes. Whenever performing MR adjustments, take the operator's riding location and weather conditions into account before making an adjustment. Numbers anywhere within the ranges listed should provide acceptable operation.

Type I Systems - RXL
Production Settings 2.5

Ambient Temperature	Below +20°F (-6°C)	+20° to +50°F (-6° to 10°C)	Above +50°F (10°C)
0-3000 Ft. or 0-900 m	2.5	3.0-3.5	3.5-4.5
3000-6000 Ft. or 900-1800 m	3.0-3.5	3.5-4.0	3.5-4.5
6000-9000 Ft. or 1800-2700 m	3.5-4.5	4.0-4.5	4.5
9000-12000 Ft. or 2700-3700 m	3.5-4.5	4.0-4.5	4.5

Type II System

Type II EFI systems incorporate an engine coolant temperature sensor. This sensor is positioned in the engine water jacket where it is able to receive and relay reliable engine top end temperature to the ECU. This sensor also controls the temperature light and "fail safe" mode. The "TEMP" light will come on and begin to blink slowly when the coolant reaches an unsafe temperature. If the temperature continues to increase, the light will begin to blink faster; at this time the EFI system will increase the fuel being supplied to the engine.



This increase in fuel will cause a decrease in engine performance which is designed to protect the engine in an overheat condition. The increased fuel will continue until the engine coolant reaches a safe temperature and the light goes out. Correcting this problem may be as simple as driving the machine slower and/or driving in a snow condition which allows more snow to be thrown onto the heat exchangers. If this condition continues, check the cooling system, coolant level, water pump belt tension, etc.

To check sensor function, connect a select monitor and advance to mode F22. With engine cold, observe reading. It should be near the readings of the ATS and CTS in degrees centigrade. Start engine and observe temperature increase as engine warms up. If readings vary greatly or fluctuate from other sensor readings, check harness and connectors for condition and repair as necessary. If no other problems can be found, and incorrect readings continue, replace sensor.

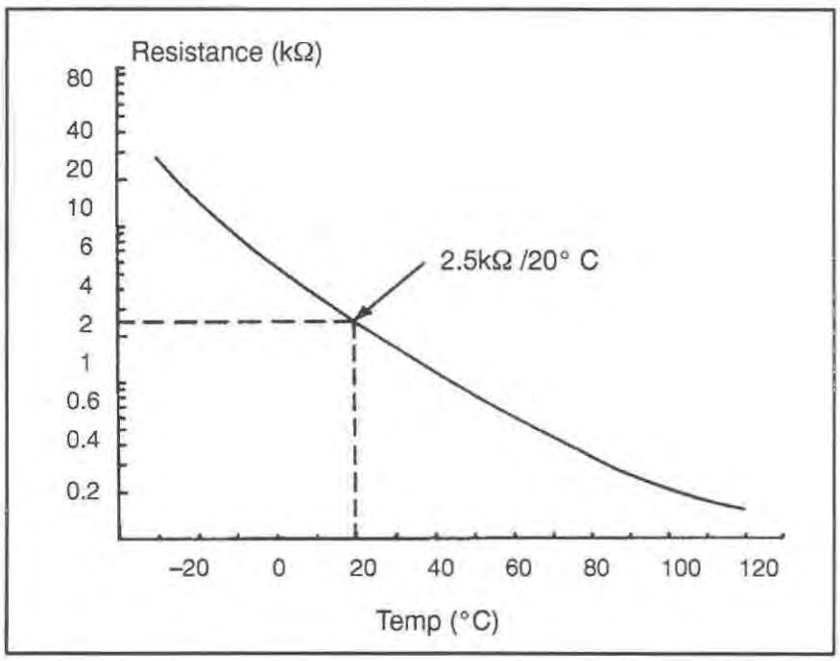
Select Monitor Readings

Mode	Description	Normal Reading
F22	Water Temp C°	Cold Engine Room Temp

To bench test a temperature sensor, measure resistance between sensor wire terminal and sensor shell; then compare reading to the graph shown below. An easier and more accurate method is to use the select monitor to indicate what temperature reading the ECU receives from the sensor. If the engine has not recently run, the sensor should read at or near room temperature. A radically different reading from room temperature could indicate a problem with sensor, wire to sensor, any of sensor connections, battery, or ECU. Verify and repair any problem before attempting to operate machine.

The sensor's resistance curve is shown at right. Resistance of the sensor is high when it is cold, and lowers as its temperature increases. This creates low current flow through the sensor at low temperatures and high current flow as the temperature increases.

NOTE: The formula for converting °F to °C is (°F = °C x 1.8 + 32)

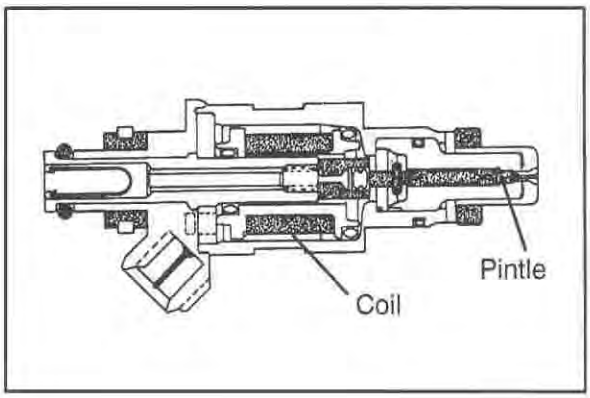


Fuel Injectors

Variation in the amount of fuel delivered per stroke to suit varying load and speed conditions can be obtained by controlling the discharge duration of the injector.

The injector is a solenoid-actuated constant stroke plunger consisting of a solenoid, plunger, needle valve and housing. The ECU will determine the duration time the injector is energized to deliver fuel.

The resistance between the two pins on the injector (isolated) should be 2 to 2.5 ohms. There should be no continuity to ground.



CAUTION:

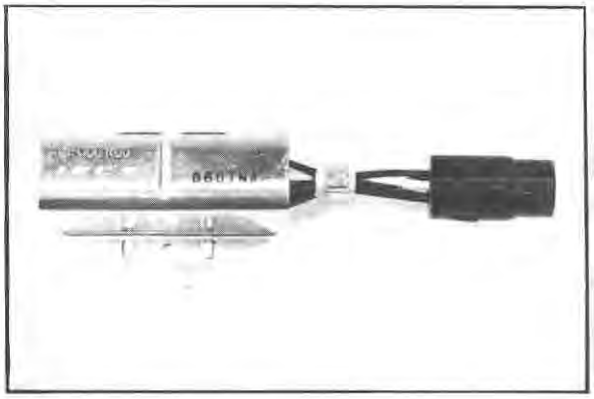
Since the operating voltage is approximately 5 volts DC on the injectors, never attempt to test them with any higher voltage or the injector will be destroyed.

Select Monitor Readings

Mode	Description	Normal Reading
FBO-21	Type One System RXL Type Two System 500 EFI	Mag Side Injector
FBO-22	Type One System Type Two System	Center of PTO Injector on Twin Cylinders
FBO-23	Type One System	PTO Injector

Dropping Resistor

The dropping resistor is mounted on the engine side of the battery box. The three cylinder system consists of four individual resistors wired in parallel with a common voltage feed (only three are used). The twin cylinder has two resistors wired parallel, also with a common voltage feed. They are used to drop or reduce the voltage going to the injectors to approximately 5 volts. Voltage from the battery travels through one of the resistors, through an injector and into the ECU. A failure of any injector or resistor will cause one cylinder to quit operating. The ECU will then flash the trouble code for that injector.



NOTE: The ECU can only determine electrical failure. If an injector failure code is flashing, the problem could be anywhere in the electrical circuit for that injector. The ECU will not find a plugged or leaky injector.

The dropping resistor may be tested with an ohmmeter between the white terminal and each of the black terminals at the resistor plug. The resistance is 6 ohms ± 10%. Replace the resistor if any of the readings are outside of the spec. Clean the terminals if they become corroded. The injector's operating power comes through these resistors. Any suspected injector electrical problem must first be traced through the dropping resistor.

ECU Diagnostics

If any of the main sensors should malfunction while the machine is being driven, the ECU will sense a problem and proceed to an over-rich "fail safe" mode. An open or shorted circuit in any of the sensor circuits will show the ECU a reading outside what it normally sees and the ECU will determine that a problem exists. Without this feature, certain kinds of failures could cause the mixture to be leaner than the required ratio and cause engine damage. This feature is important for engine protection. Once the sensor problem is determined and corrected, the ECU will return to the original map.

If any of the injectors or sensors should malfunction during operation, the ECU will record this information and start flashing a Light Emitting Diode (LED) code informing the mechanic/owner which component failed. The LED is on the right of the ECU, in front of the main plug. See ECU photo below.

If the problem still exists and is ongoing, the LED will continuously flash the code. If the problem occurred but the machine is now operating properly (intermittent), it will be stored in the memory and can be drawn out of the ECU by connecting the gray and black wires together at the diagnostic plug.

The LED will then begin blinking long followed by short light pulses; then a pause and the long and short pulses again. The long pulses are the first digit in the code and the short pulses are the second digit. Compare the code to the trouble code chart on page 4.31 to determine the problem. Remember that the problem can exist in the sensor, the power feed to the sensor, the sensor ground, connectors, or the part of the injector or sensor circuit inside the ECU.

Select Monitor Readings

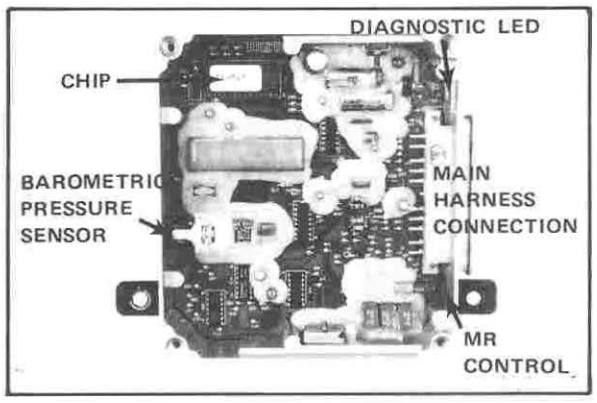
Mode FB0 is for existing problem diagnosis. Press buttons F, B, 0 and enter. If there is an existing problem, a code number and the abbreviation of the problem component will appear. See the chart on page 4.31 for an explanation of the code numbers. The LED will also display this code. For example, if the LED displays one long and two short pulses, this is a code 12.

Mode FB1 is for retrieving trouble codes from the ECU memory. If a problem happened sometime during the machine's operation, but everything is operating properly at the present time, the ECU memory will verify which component was at fault. This helps find intermittent problems such as a wiring open or short. Press the F, B, 1 and enter buttons. If the display shows one of the codes, check that component and its circuit. If nothing appears, there is nothing in memory.

NOTE: If the ECU power is disconnected at any time, this memory will be erased.

Mode FC0 is used for erasing problem codes which are stored in the ECU's memory. To erase the problem codes, certain steps must be followed in a particular order.

1. Select the mode for the component which indicated a failure.
2. Press F, C, 0, and enter on the monitor.
3. The display will ask "Memory clear? 0-yes and 1-no". By pressing 0 and enter the memory will be erased. Indication of the memory being cleared will be a display of "Please key off".



Mode	Description	Normal Reading
FB0	Existing Trouble Codes	Faults Presently Existing
FB1	Memory Trouble Codes	Faults Which Are Intermittent
FC0	Memory Clear	Used to Remove Stored Information

Monitor Code First Number = Long Dash— Second Number = Short Dash-	L.E.D. CODE	System		Abb.	Component
		Type One	Type Two		
— –	11	X	X	THV	Throttle Position Sensor
— – –	12	X		T Case	Crankcase Temperature Sensor
— – – –	13	X	X	T Air	Intake Air Temperature Sensor
— – – – –	14	X	X	ALT	Barometric Pressure Sensor
— – – – –	14		X	TW	Water Temperature Sensor
— – – – – –	15		X	ALT	Barometric Pressure Sensor
— — –	21	X	X	Inj 1	Mag Side Injector
— — – –	22	X	X	Inj 2	Center Injector or PTO on Twins
— — – – –	23	X		Inj 3	PTO Injector
— — — –	31		X	VB	Low Battery Voltage
— — — – –	32		X	VB	Low Charging System Output
— — — – – –	33		X	CDI	CDI Output

The FA modes are for testing the input and output functions from the ignition switch and the relays.

Type I System

With the select monitor on mode FA0, the display should show KY. Whenever the ignition switch and the handlebar kill switch are in the run position, the number 3 LED should also light. Cycle the switches a few times and make sure the LED goes off when the switches are turned off and comes on when the switches are returned to the run position.

Advance the monitor to mode FA1. Connect the gray and black dealer mode wires together on the monitor's service harness. The monitor display should read DM (Dealer Mode), and the number 5 LED should be lit. During dealer mode operation, the fuel pump will cycle on and off in one second intervals and any stored problem code will flash on the ECU's LED.

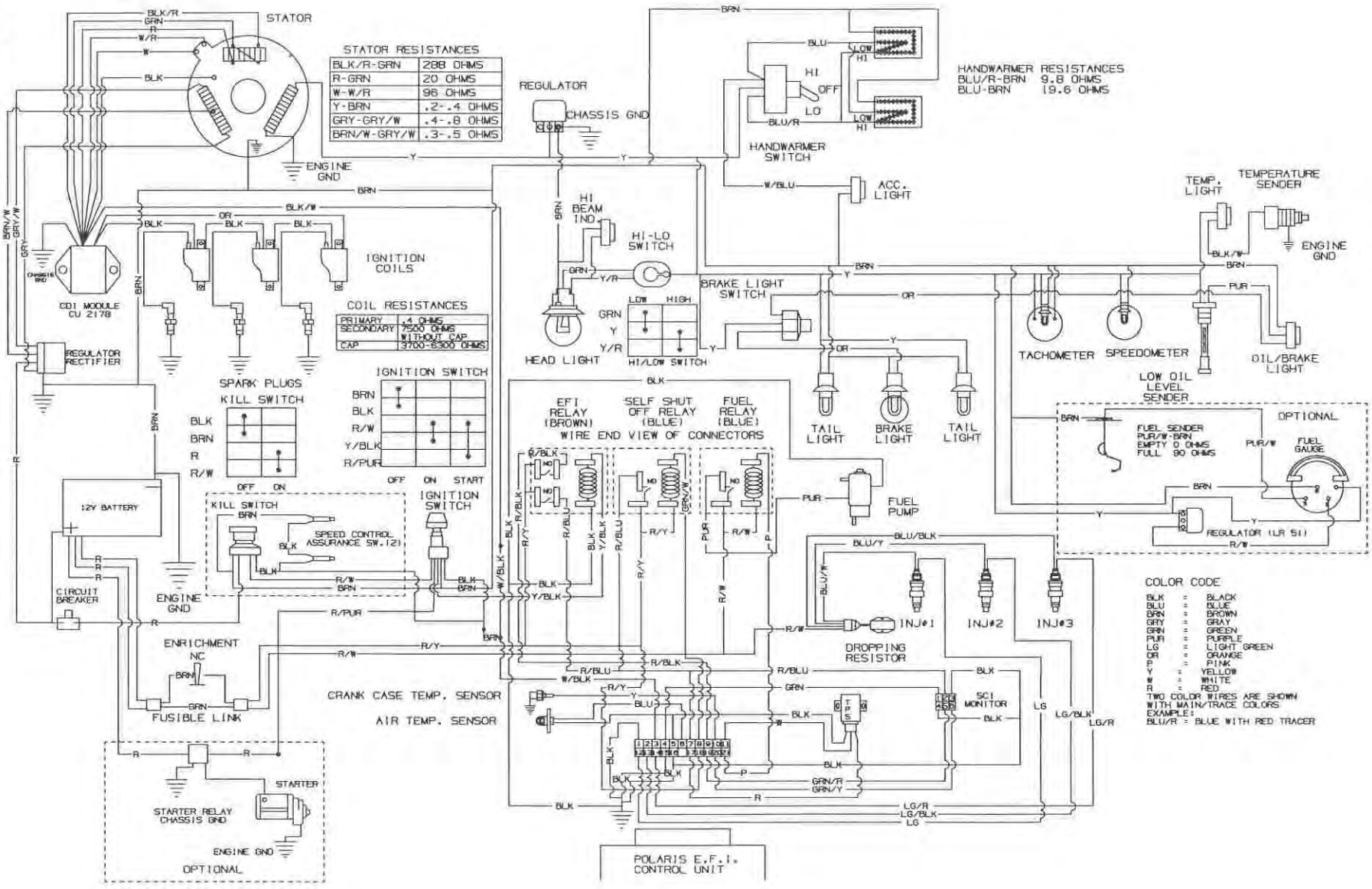
Advance the monitor to mode FA2 and the letters FP (fuel pump), SD (self diagnostics) and SS (self shut-off) will appear on the display. When the EFI system is in the normal run mode, the number 1 LED will be lit when the fuel pump is required to run. This will be for five seconds when the key is initially turned on, and whenever the ECU senses engine ignition pulses. The number 3 LED will be lit when the key is turned on and will go out ten minutes after the switch is turned off. When the dealer mode wires are connected together at the service harness, the ignition key is cycled off and on, and the select monitor returns to mode FA2, the number 3 LED will not be lit. The number 2 LED will flash any problem codes which are in memory in the ECU and the number 1 LED will flash off and on in one second intervals.

Type II System

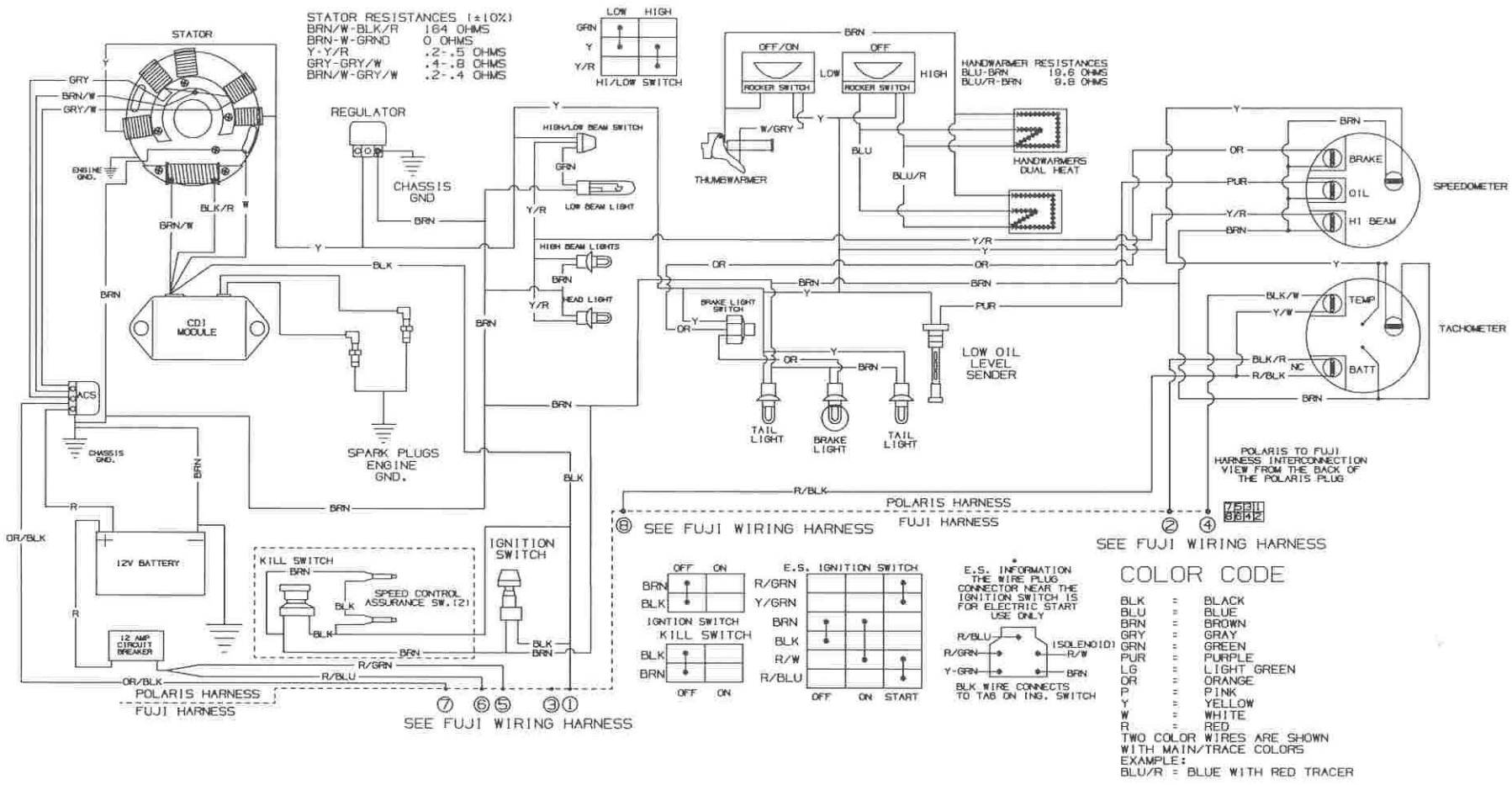
With the select monitor on mode FA0, the monitor should show an ST and DM on the left, and a KY on the right of the display. The number 1 and 5 LEDs will light when the key is rotated to the start/reset position. The number 6 LED will light when the gray and black dealer mode wires are connected together on the service harness. The fuel pump relay will only cycle on and off for three one second runs each time the system is reset while in dealer mode.

Due to the different operational method used in the Type Two system, there is not an FA1 or FA2.

96 RXL


STATOR
STATOR RESISTANCES
BLK/R-GRN 288 OHMS
R-GRN 20 OHMS
W-W/R 96 OHMS
Y-BRN .2-.4 OHMS
GRY-GRY/W .4-.8 OHMS
BRN/W-GRY/W .3-.5 OHMS
REGULATOR
CHASSIS GND
ENGINE GND
HANDWARMER RESISTANCES
BLU/R-BRN 9.8 OHMS
BLU-BRN 19.6 OHMS
HANDWARMER SWITCH
ACC. LIGHT
TEMP. LIGHT
TEMPERATURE SENDER
HI BEAM IND.
HI-LO SWITCH
IGNITION COILS
CDI MODULE CU 2178
COIL RESISTANCES
PRIMARY .4 OHMS
SECONDARY 7500 OHMS WITHOUT CAP
CAP 3700-5300 OHMS
REGULATOR RECTIFIER
BRAKE LIGHT SWITCH
HEAD LIGHT
HI/LOW SWITCH
TACHOMETER
SPEEDOMETER
OIL/BRAKE LIGHT
LOW OIL LEVEL SENDER
SPARK PLUGS
KILL SWITCH
IGNITION SWITCH
EFI RELAY (BROWN)
SELF SHUT OFF RELAY (BLUE)
FUEL RELAY (BLUE)
WIRE END VIEW OF CONNECTORS
TAIL LIGHT
BRAKE LIGHT
TAIL LIGHT
OPTIONAL
FUEL SENDER PUR/W-BRN EMPTY 0 OHMS FULL 90 OHMS
FUEL GAUGE
REGULATOR (LR 51)
FUEL PUMP
12V BATTERY
KILL SWITCH
SPEED CONTROL ASSURANCE SW.(2)
IGNITION SWITCH
CIRCUIT BREAKER
ENGINE GND
ENRICHMENT NC
FUSIBLE LINK
CRANK CASE TEMP. SENSOR
AIR TEMP. SENSOR
INJ#1
INJ#2
INJ#3
DROPPING RESISTOR
SCI MONITOR
STARTER
STARTER RELAY CHASSIS GND
ENGINE GND
OPTIONAL
POLARIS E.F.I. CONTROL UNIT
COLOR CODE
BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
LG = LIGHT GREEN
OR = ORANGE
P = PINK
Y = YELLOW
W = WHITE
R = RED
TWO COLOR WIRES ARE SHOWN WITH MAIN/TRACE COLORS
EXAMPLE:
BLU/R = BLUE WITH RED TRACER

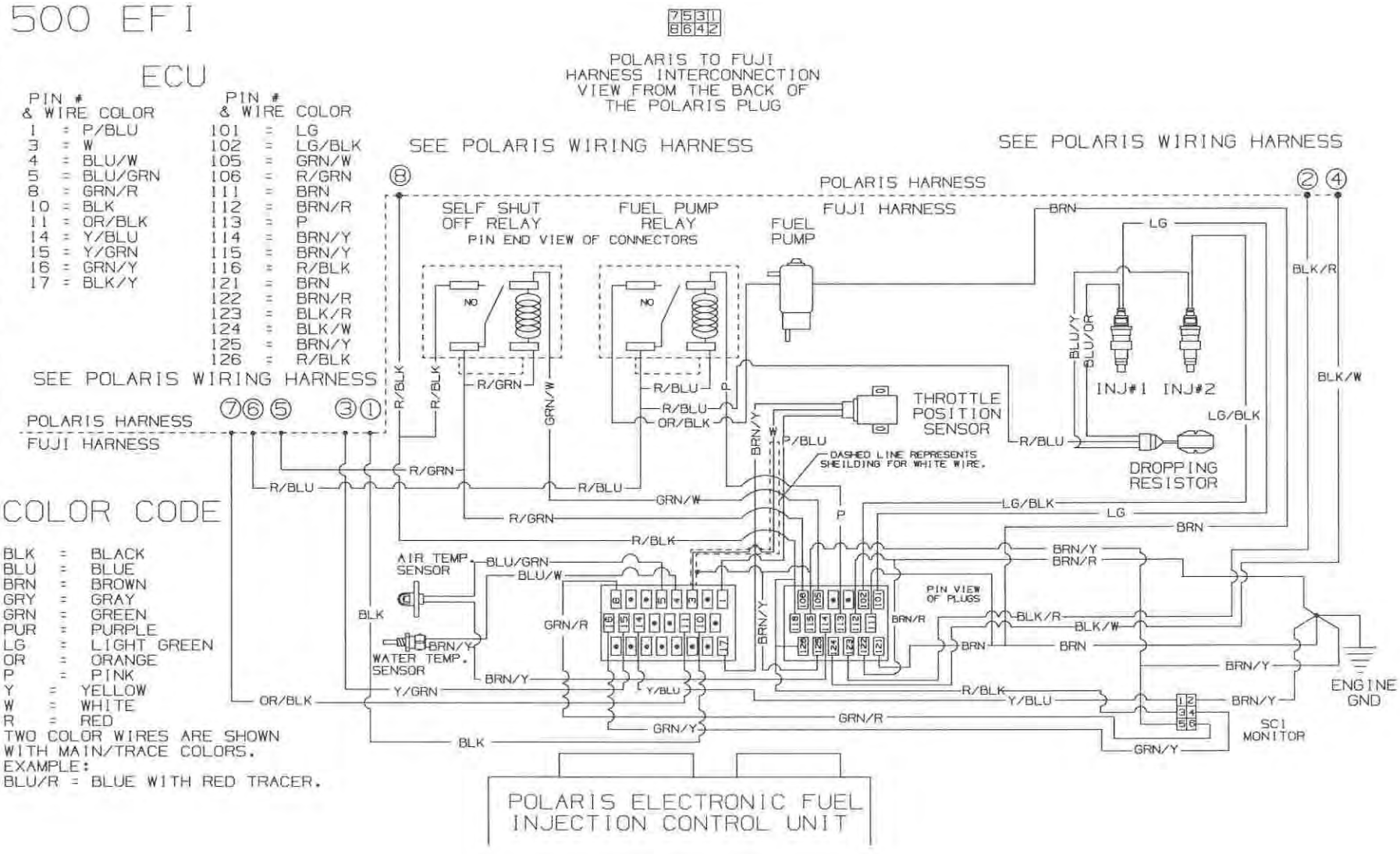
Electronic Fuel Injection (EFI)
1996 Wiring Diagram - 500 EFI /SKS / RMK (Page 1 of 2)



500 EFI

ECU

PIN # & WIRE COLOR		PIN # & WIRE COLOR	
1	= P/BLU	101	= LG
3	= W	102	= LG/BLK
4	= BLU/W	105	= GRN/W
5	= BLU/GRN	106	= R/GRN
8	= GRN/R	111	= BRN
10	= BLK	112	= BRN/R
11	= OR/BLK	113	= P
14	= Y/BLU	114	= BRN/Y
15	= Y/GRN	115	= BRN/Y
16	= GRN/Y	116	= R/BLK
17	= BLK/Y	121	= BRN
		122	= BRN/R
		123	= BLK/R
		124	= BLK/W
		125	= BRN/Y
		126	= R/BLK



COLOR CODE

BLK	=	BLACK
BLU	=	BLUE
BRN	=	BROWN
GRY	=	GRAY
GRN	=	GREEN
PUR	=	PURPLE
LG	=	LIGHT GREEN
OR	=	ORANGE
P	=	PINK
Y	=	YELLOW
W	=	WHITE
R	=	RED

TWO COLOR WIRES ARE SHOWN WITH MAIN/TRACE COLORS.
EXAMPLE:
BLU/R = BLUE WITH RED TRACER.