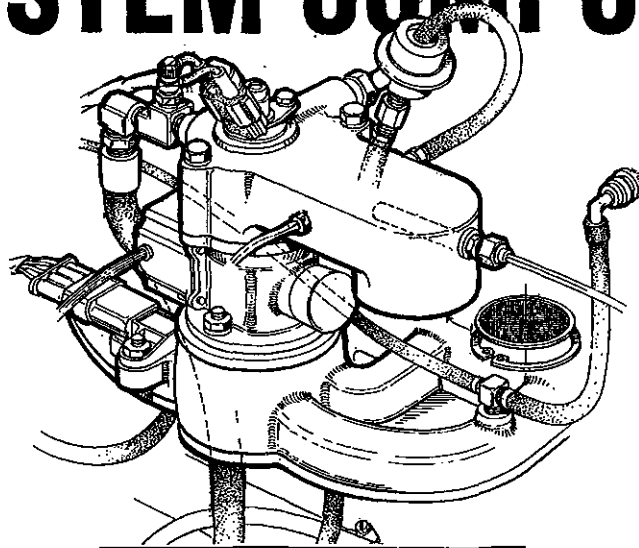




# TROUBLESHOOTING GUIDE FOR EFI SYSTEM COMPONENTS



MAY 2006



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# GENERAL DESCRIPTION

## ENGINE OPERATING SYSTEM DESCRIPTION

The engine/generator is equipped with an electronic speed-regulated, fuel injected control system. Engine speed is maintained constant by varying the amount of air induced past a throttle plate into the intake manifold. The throttle plate position is controlled by a rotary proportional actuator energized from a closed loop control circuit whose signal input is from a magnetic pickup-type speed sensor.

Fuel is metered to the engine intake manifold by a central port-type fuel injector system where the amount of fuel injected is primarily determined by the engine speed, the engine load, the engine temperature and the intake air temperature. Fuel is delivered to the engine by a high pressure fuel pump. The fuel pressure drop across the injector is maintained constant by a fuel pressure regulator which is ported to the intake manifold to compensate for pressure variations as a result of engine load changes.

Air-fuel management as well as engine operational functions are performed by an embedded electronic control unit (ECU). Engine/generator control functions (starting and stopping) are inputted from a remote control panel or from the engine START/OFF switch to the ECU. The ECU then sets the required operational parameters necessary for the running of the engine.

The output driver in the ECU which controls the relays (K1, K2) and the control panel indicator lamp(s) is one which has internal current limiting capability of its outputs, and will turn itself off should such an over-current condition occur. Therefore, the engine status indicator lamps are of the 12V LED type.

The ROM of the MCU contains the program from which the engine is controlled. The MCU measures and monitors the status of the engine through various inputs and then sets accordingly the outputs which control the engine. The MCU has direct control of the amount of the fuel injected as well as some control of the throttle position. The actual position of the throttle plate actuator for speed control however, is determined by a proportional, integral and derivative (PID) analog closed loop control circuit. The MCU monitors the engine speed and will shut down the engine in case an overspeed condition should ever occur. In addition, the ECU has a safety backup overspeed circuit in the unlikely event that the MCU fails to respond.

This manual provides detailed testing procedures of the operating system and its components including a troubleshooting chart and wiring schematics of four EFI generators.

## THROTTLE BODY

The throttle body, mounted on the intake manifold, is an assembly of the principal components of the EFI (Electronic Fuel Injection System).

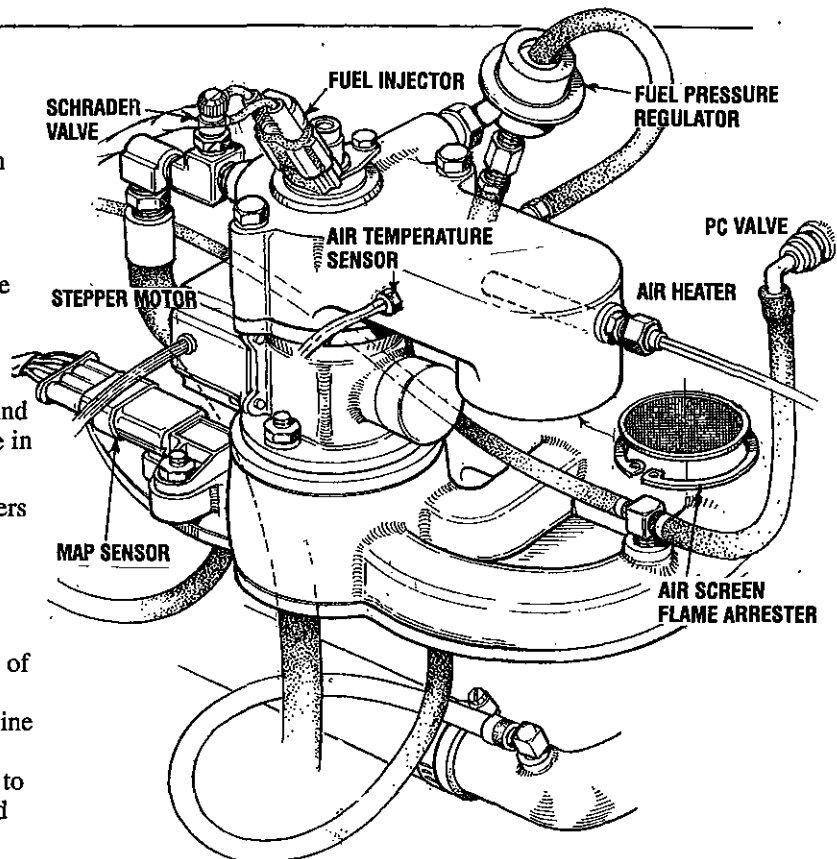
The EFI is controlled by the ECU (Electronic Control Unit) which interprets data from sensors that monitor the vital parts of the engine. The ECU uses this continuous flow of data to determine the appropriate injector pulse rate and throttle opening position.

A high pressure fuel pump supplies fuel to the area around the injector and the regulator maintains the fuel pressure in that area at 35 - 40 PSI.

The injector is a solenoid operated pintle valve that meters fuel into the intake manifold depending on engine operating conditions and generator amperage load as determined by the ECU.

Air flow into the intake manifold is through the flame arrester/air filter and is controlled by the ECU operation of the throttle plate via the actuator (stepper motor). The throttle plate positioning for proper air flow into the engine is accomplished through the ECU interpretation of the engine operating conditions. The Schrader valve is used to monitor the fuel pressure at the fuel injector and to bleed air after fuel system servicing.

On some models an air intake heater is positioned in the intake to heat the incoming air during a cold start.



# CONTROL CIRCUIT OPERATION

## DESCRIPTION

When the engine start/stop switch and the remote start/stop switch are in their center positions and the green LED is not illuminated and the generator is not running, the ECU and all the engine electrical components are in an off state.

When the start switch is actuated (momentarily depressed), the ECU is powered up and a start is assumed. The green LED will illuminate. The K2 run relay will energize turning on the ignition and the fuel pump. After a time delay of approximately 4 seconds, the K1 relay will energize, which in turn energizes the starter solenoid and an engine cranking sequence will result - starting the engine.

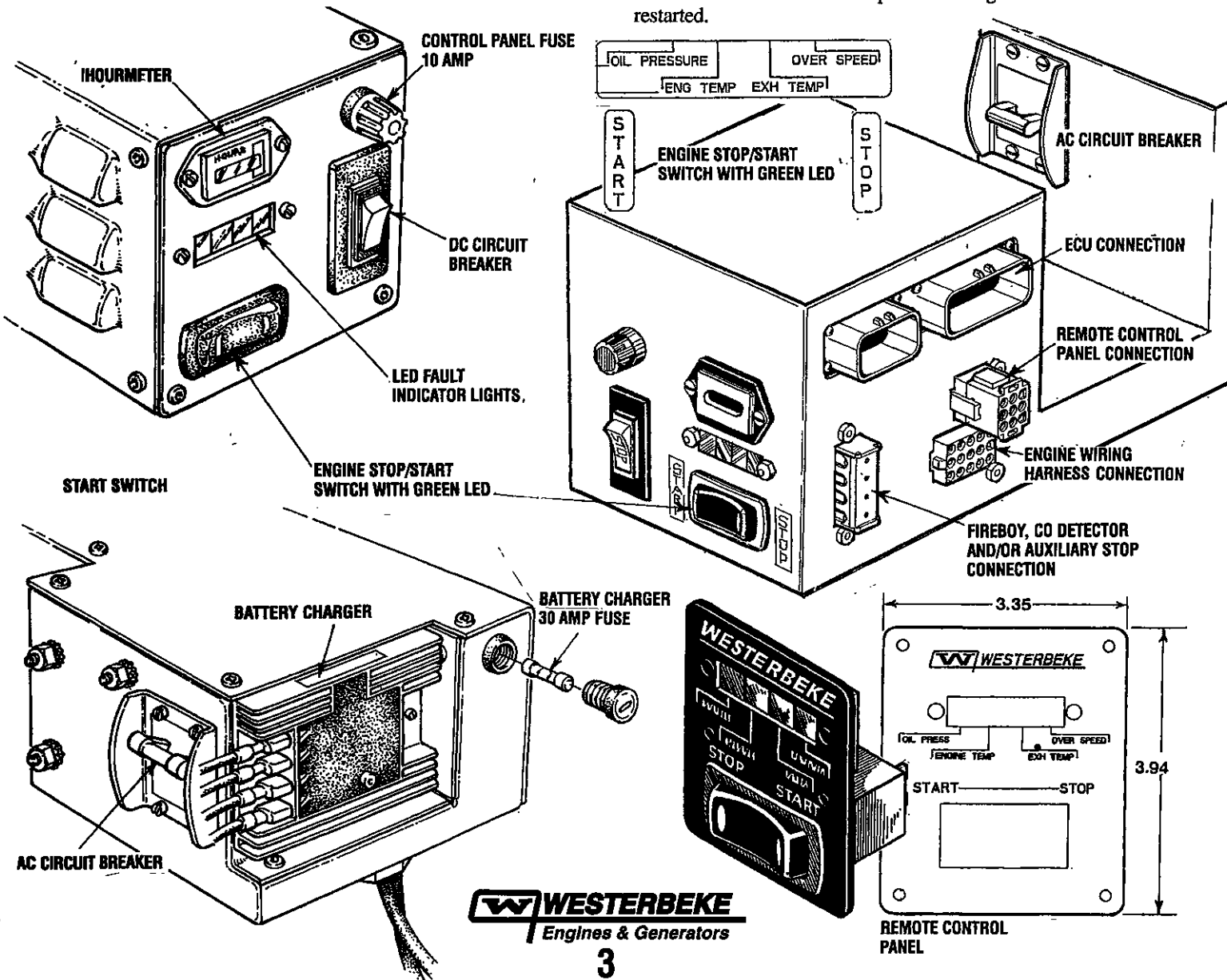
Should the engine fail to start within approximately 10-12 seconds, the start sequence will be terminated and the ECU will go to the off state and the green LED light will go out.

When the engine starts, the starter will automatically disengage (start relay K1 is de-energized). The green LED light on the switch is on and circuit power to the ECU is latched on. The generator will come up to speed and the engine is now under the control of the ECU.

When a stop is initiated by momentarily depressing the stop switch, the ECU will take this command and then de-energize the K2 run relay. This removes DC power to the ignition, the fuel pump, and the injector, shutting down the engine. Once the ECU senses zero rpm engine speed (no MPU AC signal) it then releases the latch, which holds the circuit power on. The green LED light will go out and the ECU will revert to an off state.

Should a fault occur to initiate an engine shutdown as a result of low oil pressure, high water injected exhaust elbow temperature, high engine antifreeze coolant temperature, high engine rpm or low engine rpm, the ECU will acknowledge this as a valid stop command. The stop sequence will be as previously described except that the circuit power will remain on and the fault LED board will register the faulty cause by illuminating the related fault LED. This fault LED will remain on and will not allow the engine to be restarted.

To reset the ECU and turn off the fault LED, the stop switch must be momentarily depressed. The reset action must be initiated before the ECU will permit the engine to be restarted.



# ELECTRONIC CONTROL UNIT (ECU)

## DESCRIPTION

The ECU (Electronic Control Unit) is factory programmed and requires no adjustments by the generator operator. It controls all starting, operating and safety shutdown features on the engine.

The Gain Pot is set at #50 midpoint for optimum system response.

Program dipswitches are in the OFF position and should not be disturbed.

The vacant program connector is used by the factory to input the operating program into the ECU.

The electrical connections from the engine electrical harness are made to the ECU through two plug connections, one 23 pin and one 35 pin and may therefore vary in number according to the generator model. For further details, consult the engine circuit wiring diagram in this manual.

The ECU is normally set for operation at 60 Hz unless specified otherwise, and is internally configured for a 2 pole or 4 pole generator. If it is necessary to replace the ECU, make sure it is configured by label for the generator in use.

## ECU ADJUSTMENTS

### Stability Trim

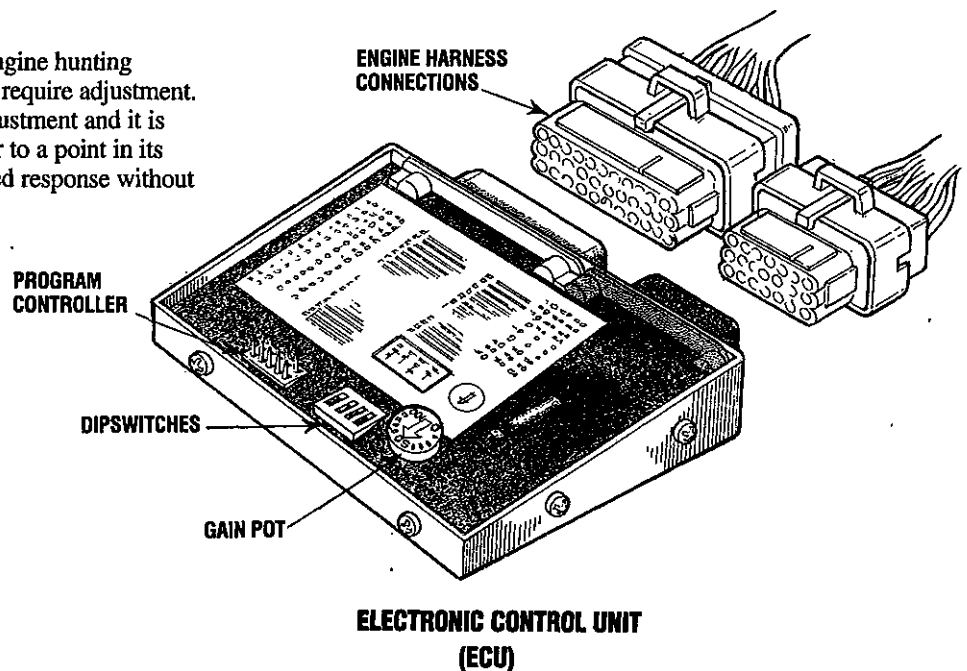
When changing engine speed, or if an engine hunting condition should occur, the gain pot may require adjustment. There is no specific set point for this adjustment and it is normally set to the middle of its range or to a point in its range which obtains optimal engine speed response without any tendency of hunting.

## Setting Engine Speed

The engine speed can be set for operation at either 50 or 60 Hz. Corresponding engine speeds for a 2 pole generator would be 3,000 or 3,600 rpm; for a 4 pole generator, 1,500 or 1,800 rpm.

1. Set up whatever equipment is to be used to measure engine speed or generator output frequency.
2. Start up and run the generator at the current operating speed and frequency.
3. Adjust the GAIN setting between 40 - 60 for best system reaction to AC amperage load changes.

**NOTE:** A higher GAIN adjustment can induce unstable engine operation. In such cases, lessen the GAIN adjustment.



## REPLACING THE ECU

Remove the control box cover. Before attempting to remove the ECU, disconnect its power by removing the fuse from the front of the control panel. With the engine harness connections unplugged, unscrew the four side screws and remove the ECU from its holder.

## INSTALLING THE NEW ECU

To install the new ECU, reverse the above procedure.

# ELECTRICAL TROUBLESHOOTING GUIDE

*The following test procedures will require the use of a multimeter and the engine's wiring diagram (in this manual). Also refer to the relay testing page. WESTERBEKE recommends that these tests be performed by a qualified technician.*

PROBLEM	TESTING (12 VDC is battery + voltage measured to ground)	INSPECTION/SOLUTION
Engine does not crank.....	Test for B+ (12v) at the circuit breaker to the PC board terminal T4. If OK ↓	Check for bad connections at the engine harness connector P1, the red wire, or at the battery + on the starter. Check the connections at the PC board terminal 4 and at the circuit breaker.
	Test for B+ (12v) at the circuit breaker to the panel fuse end and to the PC board terminal T2. If OK ↓	Look for a bad connection from the circuit breaker to the fuse or at the PC board terminal T2. Replace the circuit breaker.
	Test for B+(12v) from the fuse end to the PC board terminal T1. If OK ↓	Inspect the connections at the fuse or PC board terminal T1. Replace the fuse.
	Test for B+(12v) at the relay K1 terminal 30. If OK ↓	Check for a bad connection at the engine harness connector P1, pin 3. The red/white wire or at K1, K2, terminal 30.
	Test for B+ (12v) at the start/stop switch terminals 2 and 10. If OK ↓	Look for bad connections at the panel connector S2, pin 1, white/black/red wire to the terminal PC board or at the start/stop switch terminals 2 and 10.
	Test for B+ (12v) at the start switch terminal 1 when the switch is activated. If OK ↓	Replace the start switch.
	Test for B+ (12v) at relay K1, terminal 86. If OK ↓	Check for bad connections at the panel connector S2, pin 3, green wire to the PC board. Then check the engine harness connection at the connector P1, pin 7-grey wire. Inspect connections on jumpers on the terminal strip TS1 or between any external contacts connected to TS1. Replace the PC board.
	If OK ↓ Test for B+(12v) at relay K1 terminal 85. Activate the start switch and after a few seconds the voltage should drop below .5 volts. If OK ↓	Inspect for a bad connection at relay K1 terminal 8 orange wire or at ECU connector P2, pin2. Replace the ECU
	Activate the start switch, after 4-5 seconds B+(12v) should be present at terminal 87 on relay K1. If OK ↓	Look for a bad connection at relay K1.
	Activate the start switch, after 4-5 seconds check for B+(12v) at the start solenoid. If OK ↓	Look for a bad connection at relay K1, terminal 85 orange wire or at the ECU connector P2 pin. Replace the ECU.
	Inspect the starter.	Check the connections at relay K1 terminal 87. yellow/red wire or at the start solenoid. Replace the starter.

# ELECTRICAL TROUBLESHOOTING GUIDE

The following test procedures will require the use of a multimeter and the engine's wiring diagram (in this manual). Also refer to the relay testing page. WESTERBEKE recommends that these tests be performed by a qualified technician.

PROBLEM	TESTING (12 VDC is battery + voltage measured to ground)	INSPECTION/SOLUTION
Engine cranks but fails to start...	<p>Test for B+ (12v) at terminals 30 and 86 on the K2 Relay If OK ↓</p> <p>Test for B+ (12v) at relay K2, terminal 86 and activate the start switch. Voltage should be less than 5 volts. If OK ↓</p> <p>Activate the start switch, test for B+(12v) at relay K2, terminal 87.</p> <p><b>NOTE:</b> For other possible causes (failure to start) such as fuel pump, speed sensor (MPU), ignition, etc, refer to these sections in this manual.</p>	<p>Check for bad connections at both terminals. Replace the K2 relay.</p> <p>Inspect the connections at relay K2, terminal 86, the green wire, or at the ECU connector P2, pin 19. Replace the ECU.</p> <p>Replace the K2 relay.</p>
Engine starts, runs but shuts down.....	<p>Test for voltage across the oil pressure sensor terminals, with the engine running voltage should be less than 1.0 volts. If OK ↓</p> <p>Test for voltage across the exhaust temperature switch, when the engine shuts down, it should read zero (0) volts. If OK ↓</p> <p>The engine temperature sensor maybe faulty.</p>	<p>Faulty oil pressure sensor. Replace sensor/switch.</p> <p>Faulty exhaust temperature switch. Replace switch. Loss of coolant thru exhaust elbow. High exhaust temperature.</p> <p>Test sensor, refer to component testing in this manual.</p>

# EFI GENERATOR ELECTRICAL TESTING VALUES

DEVICE AND CONDITION	GENERATOR MODELS			
	All Models	5.0/6.5Kw	8,10,12.5.14Kw	20/22Kw EFI
Speed Sensor-Voltage (while cranking) (AC Volts)		1.33	0.98	1.26
Speed Sensor-Resistance (at rest) (in Ohms)	950-1000Ω			
<b>Distributor-Voltages (in AC volts)</b>				
Red (ECU) and Black/White (+)		0.55	0.447	0.253
Red (ECU) and Blue (-)		0.44	0.44	0.177
Blue (-) and Black/White (+)		0	0	0
Black/White (+) and Engine Ground		0.072	0.011	0
Blue (-) and Engine Ground		0	0	0
Red (ECU) and Engine Ground		0.60	0.45	0.277
<b>Distributor-Resistance (in Ohms)</b>				
Red (ECU) and Black/White (+)	None (open)			
Red (ECU) and Blue (-)	None (open)			
Blue (-) and Black/White (+)	None (open)			
Black/White (+) and Engine Ground	None (open)			
Blue (-) and Engine Ground	None (open)			
Red (ECU) and Engine Ground	None (open)			
<b>Map Sensor-Voltages (in DC Volts)</b>				
Pin 4 (sig) to Ground (at rest)		0	0	0
Pin 4 (sig) to Ground (prime delay in start mode)		4.089	4.05	4.056
Pin 4 (sig) to Ground (running 1800 rpm no AC load)		1.73*	1.25*	1.300*
Pin 3 (+5V) to Ground (at rest)		0	0	0
Pin 3 (+5V) to Ground (prime delay in start mode)		4.997	4.997	4.999
Pin 3 (+5V) to Ground (running 1800 rpm no AC load)		5.005*	5.003*	5.014*
<b>Map Sensor-Resistance (in Ohms)</b>				
Pin 1 (grnd) to Pin 2	1.9Ω			
Pin 1 (grnd) to Pin 3	5.9Ω			
Pin 1 (grnd) to Pin 4	5.3Ω			
Intake Heater Element in Ohms	1.5 - 2.5Ω			
Air Temperature Sensor (room temp.)in Ohms	10,000Ω			
Water Temperature Sensor (room temp.)in Ohms	10,000Ω			
Oil Pressure Sensor (at rest)in Ohms	245Ω			
<b>Stepper Motor (at rest)in Ohms</b>				
Black and Green	2.61Ω			
Red and Blue	2.61Ω			
<b>Stepper Motor-Resistance (in Ohms)</b>				
Purple: Part #42221				14.55Ω
Blue: Part #48921			14.55Ω	
Black: Part #49556		12.50Ω		
K1, 2, or 3 Relay (between terminal 86 and 86)in Ohms			86Ω	86Ω
<b>Mando Alternator-part #39139 (in DC Volts)</b>				
B+ (typical at rest)			12.7	12.7
B+ (typical while running)			14.1	14.5
At Excitation (typical while running)			13.4	13.6
At Excitation (at rest)			0	0
<b>Fuel Pump in Ohms</b>				
Low Pressure	1.5 - 2.0Ω			
High Pressure	9.0 - 13.0Ω			

Note: \* Approximate Voltages

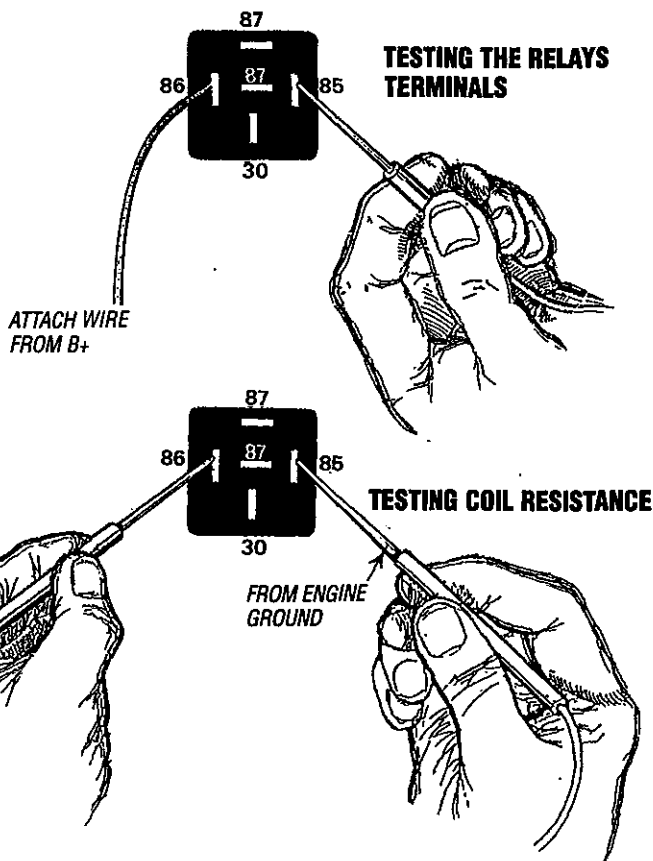
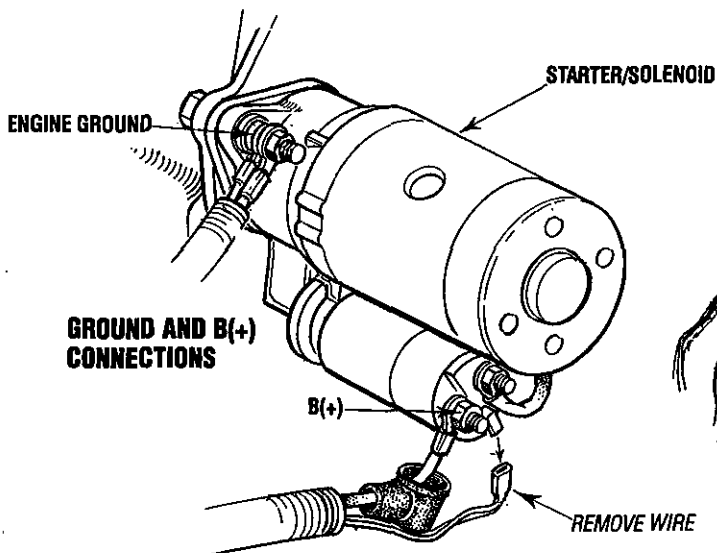


# COMPONENT TESTING

## GENERAL

All DC voltage measurements are made to the engine battery negative ground point unless specified otherwise. In making test measurements, make sure that a good ground for the meter is established, preferably the point where the negative battery is connected to the engine. Battery positive voltage is indicated as B+ and should measure no less than 11.5 volts.

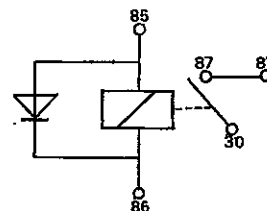
AC voltage measurements should be made with a true RMS AC meter to insure accuracy.



## RELAYS

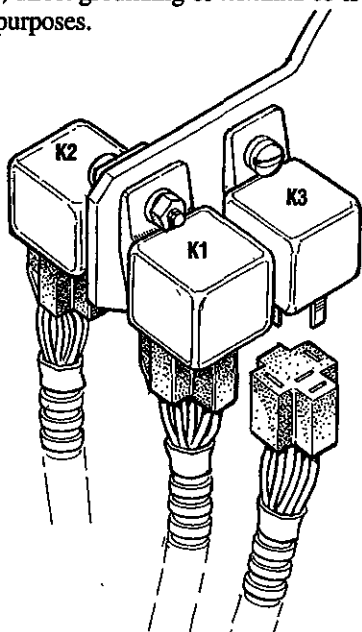
**NOTE:** K1, K2, and K3 Relays are not used on the 5.0 and 6.5 Kw EFI.

The relays used in the control system have coils which are polarized by the fact that they have internal free wheeling suppression diodes across them. Relay coil terminal 86 must be maintained (+), terminal 85(-). The relay coil is rated 12V DC, and the coil resistance is typically 85 ohms. With B+ on terminal 86, direct grounding of terminal 85 is permissible for testing purposes.



### RELAY INTERNAL DIAGRAM

REFER TO THE TROUBLESHOOTING CHART IN THIS MANUAL FOR ADDITIONAL RELAY TESTS



### RELAYS

TYPICAL RELAY ARRANGEMENT

# COMPONENT TESTING

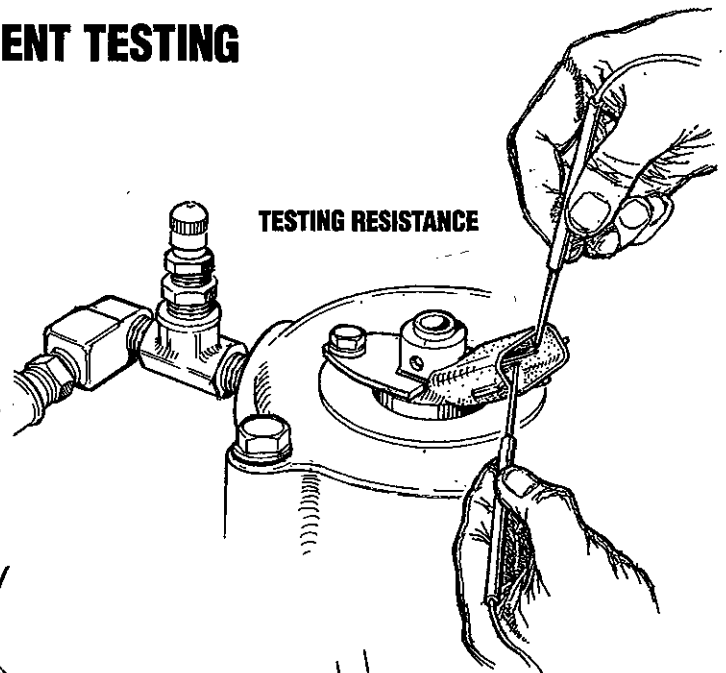
## STEPPER MOTOR

The throttle plate rotary stepper motor operates on a low DC voltage supplied from the ECU. There are two independent operating coils in the stepper motor. Each coil resistance is typically 2.61 ohms.

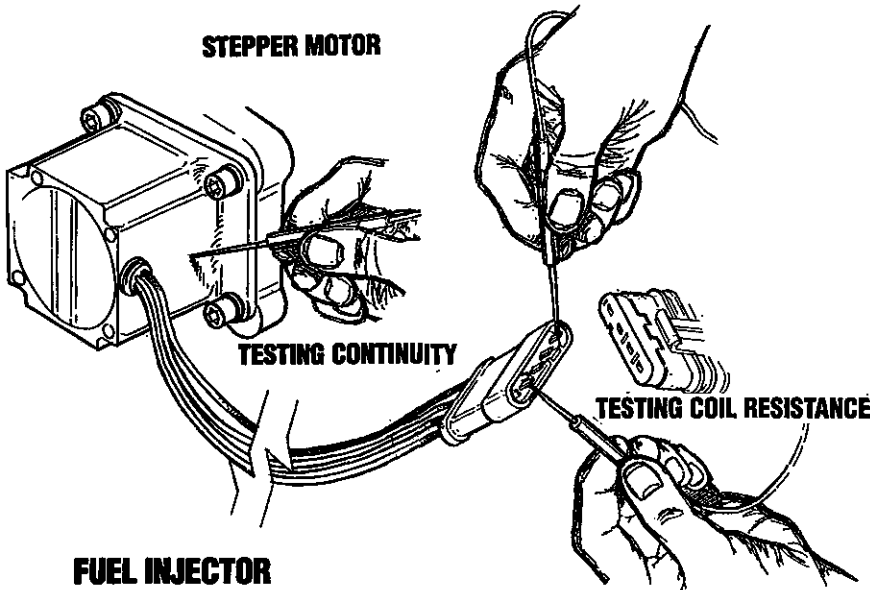
A resistance value test only should be performed on the stepper motors two coils. Do not apply 12VDC to these coils as it will damage the coils.

Check the resistance value of each coil between coil #1 (blue and red) and coil #2 (black and green).

There should be no continuity found between any of the coil connectors and the metal case of the stepper body.

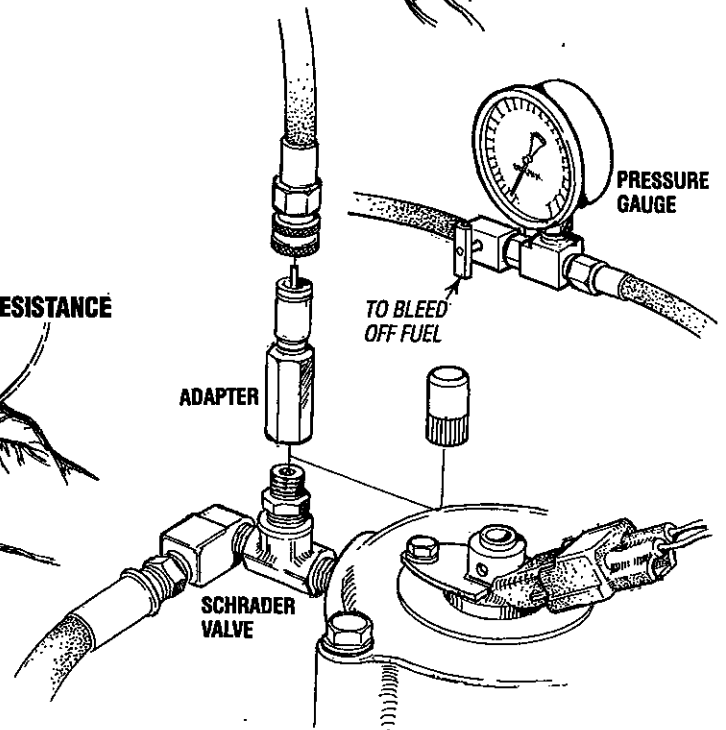


## STEPPER MOTOR



## FUEL INJECTOR

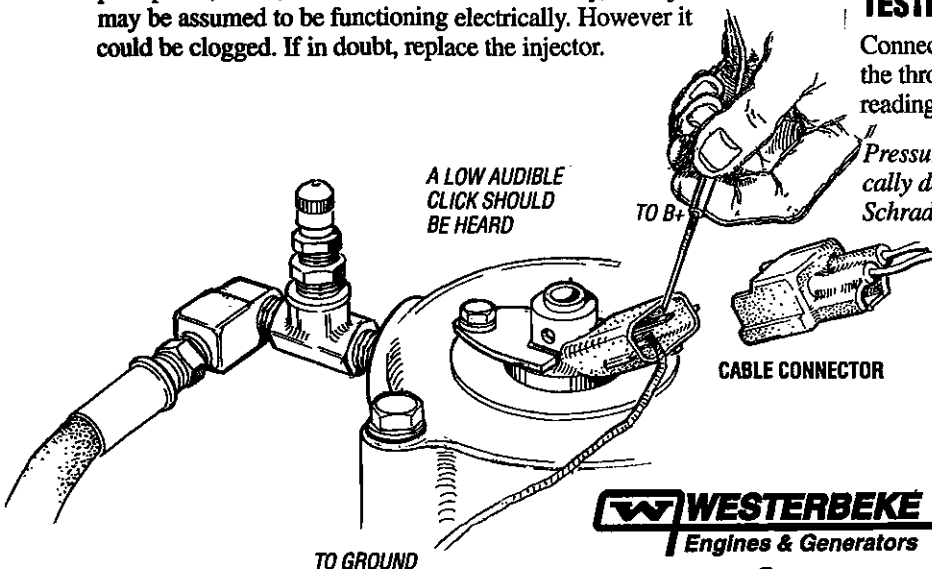
The fuel injector has no polarity and operates on 12 VDC. The coil resistance is typically in the order of 14 to 16 ohms. The positive wire to the injector is supplied power through the contacts of relay K2, which is off when the engine is not running. To test the injector, disconnect its cable connector and connect a ground wire to one of its input pins. Connect a wire from a point of B+ and repeatedly touch the other input pin. When touched, a low audible click should be perceptible; if not, resistance test the coil. If okay, the injector may be assumed to be functioning electrically. However it could be clogged. If in doubt, replace the injector.



## TESTING SYSTEM FUEL PRESSURE

Connect a fuel pressure test gauge to the Schrader valve on the throttle body as shown and run the engine. Pressure readings should indicate 35 - 40 psi.

Pressure gauge kit MT 337B "SNAP -ON-TOOL" is specifically designed for fast accurate testing of fuel pressure for Schrader test ports.



# COMPONENT TESTING

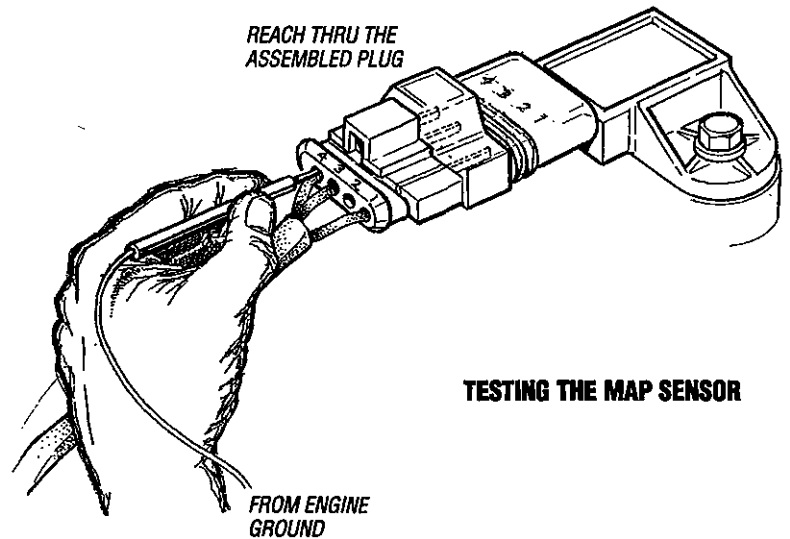
## MAP SENSOR

The Manifold Absolute Pressure (MAP) sensor is a solid state pressure transducer which measures the intake manifold pressure (vacuum). It derives its operating power (+5V, Pin 4; Gnd, Pin 1) from the ECU and receives power only when the ECU is in an *on* state. Its output (Pin 3) is measured to ground.

Typical output voltages are as follows:

Map Sensor -- Voltages	EFI	EFI	EFI
	Generators	Generators	Generators
	5.0/6.5Kw	8,10,12.5 15Kw	20/22.5Kw
Pin 4 (sig) to Grnd (at rest)	0 VDC	0 VDC	0 VDC
Pin 4 (sig) to Grnd (prime delay in start mode)	4.089 VDC	4.05 VDC	4.058 VDC
Pin 4 (sig) to Grnd (running 1800 rpm no AC load)	1.73 VDC (typical)	1.25 VDC (typical)	1.300 VDC (typical)
Pin 3 (+5V) to Grnd (at rest)	0 VDC	0 VDC	0 VDC
Pin 3 (+5V) to Grnd (prime delay in start mode)	4.997 VDC	4.997 VDC	4.999 VDC
Pin 3 (+5V) to Grnd (running 1800 rpm no AC load)	5.005 VDC (typical)	5.003 VDC (typical)	5.014 VDC (typical)

Map Sensor -- Resistances	EFI Generators All Models
Pin 1 (grnd) to Pin 2	1.9Ω
Pin 1 (grnd) to Pin 3	5.9Ω
Pin 1 (grnd) to Pin 4	5.3Ω



TESTING THE MAP SENSOR

# COMPONENT TESTING

## TESTING OXYGEN SENSORS

Two oxygen sensors are used in the EFI system. A narrow band sensor on the exhaust inlet side of the catalyst and a wide band sensor on the exhaust discharge side of the catalyst. These sensors monitor engine operation that the ECU interprets and adjusts air/fuel ratios accordingly.

## TESTING THE OXYGEN SENSORS IN A STATIC MODE

**Narrow Band Sensor:** Unplug the sensor from the engine harness. Locate the 2 white pin leads, measure across these two pins with an ohm meter.

**Resistance Value 2.0 - 4.0 OHM (approximately)**

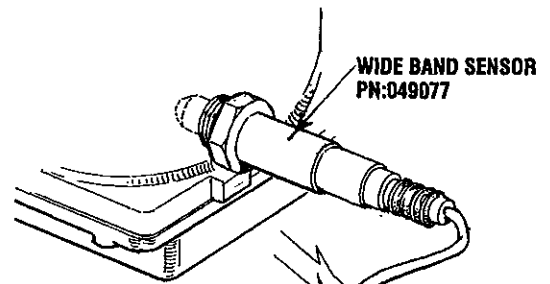
There should be no continuity between either of the two white lead pins and the black or grey lead pins.

**Wide Band Sensor:** Unplug the sensor from the engine harness. Locate the red pin lead and the vacant black pin lead. Measure across these two pins with an ohm meter.

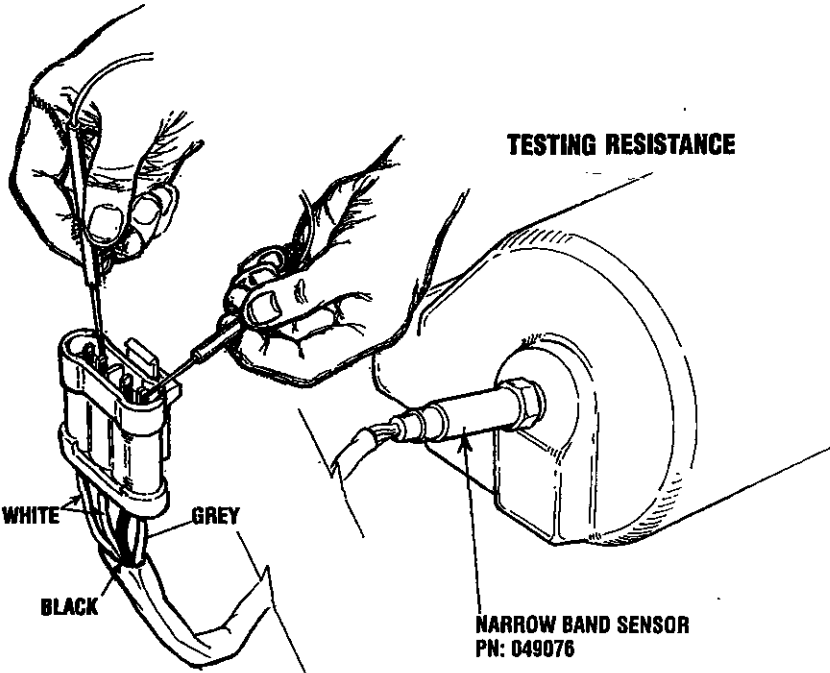
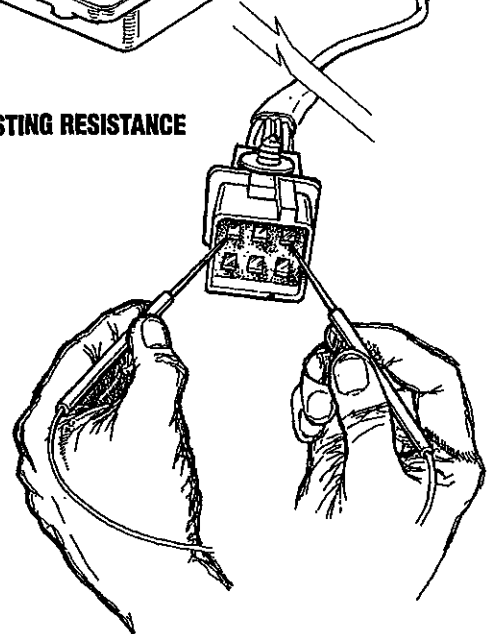
**Resistance Value 110.0 - 130.0 OHM (approximately)**

No continuity should be found between these two pins and any of the other four.

Sensors not meeting these tests are presumed faulty. Care should be taken when installing a replacement sensor. Do not scratch, damage, or handle the sensor end in any way.



TESTING RESISTANCE



# COMPONENT TESTING

## TESTING THE MAGNETIC PICK UP COIL

Test the magnetic pick-up AC voltage output while cranking. Voltages are listed below.

Test the magnetic pick-up coil winding in a static mode. Resistance values are shown below. If the AC output voltage is not present or lower than listed and the resistance value of the coil winding is correct, debris may be insulating the MPU tip end. Remove the MPU and examine and clean the tip end of debris.

Coil winding resistance being lower or not present would damage the MPU.

**NOTE:** Carefully follow the installation instructions provided with the new MPU.

**Speed Sensor Test Values Voltage (while cranking)**

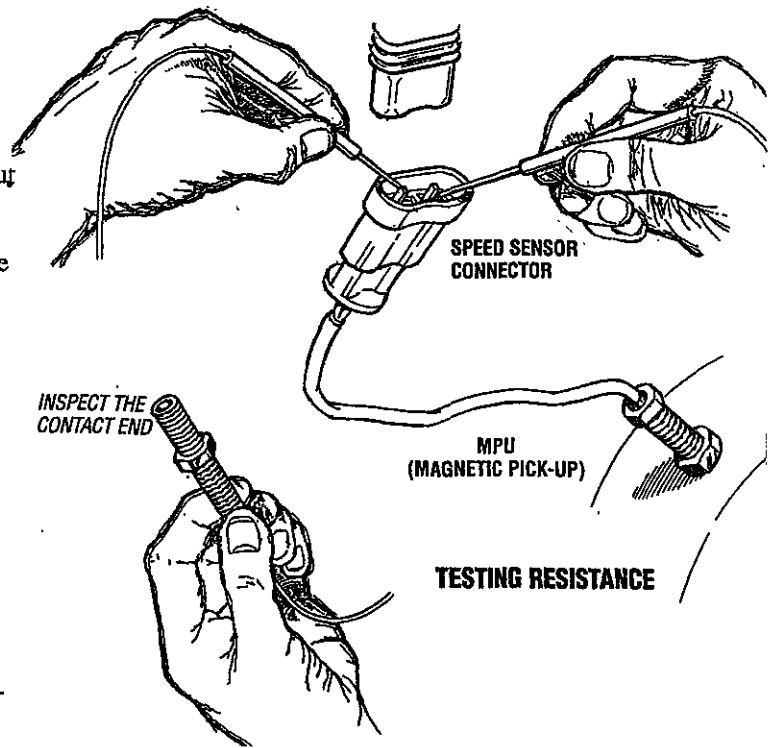
5.0, 6.5 Kw EFI - 1.33 VAC

8, 10, 12.5, 14 Kw EFI - 0.98 VAC

20, 22.5 Kw EFI - 1.26 VAC

**Resistance (at rest) - 950-1000Ω (all models)**

**NOTE:** The AC signal produced by the MPU will be greater the closer the MPU is positioned to the flat of the ring gear tooth and weaker the farther away from the tooth.



## TESTING THE FUEL PRESSURE PUMP

Testing the fuel pumps in a static mode. Check for integrity of the pump winding. Unplug each pump from the engine harness and check the resistance value of the winding.

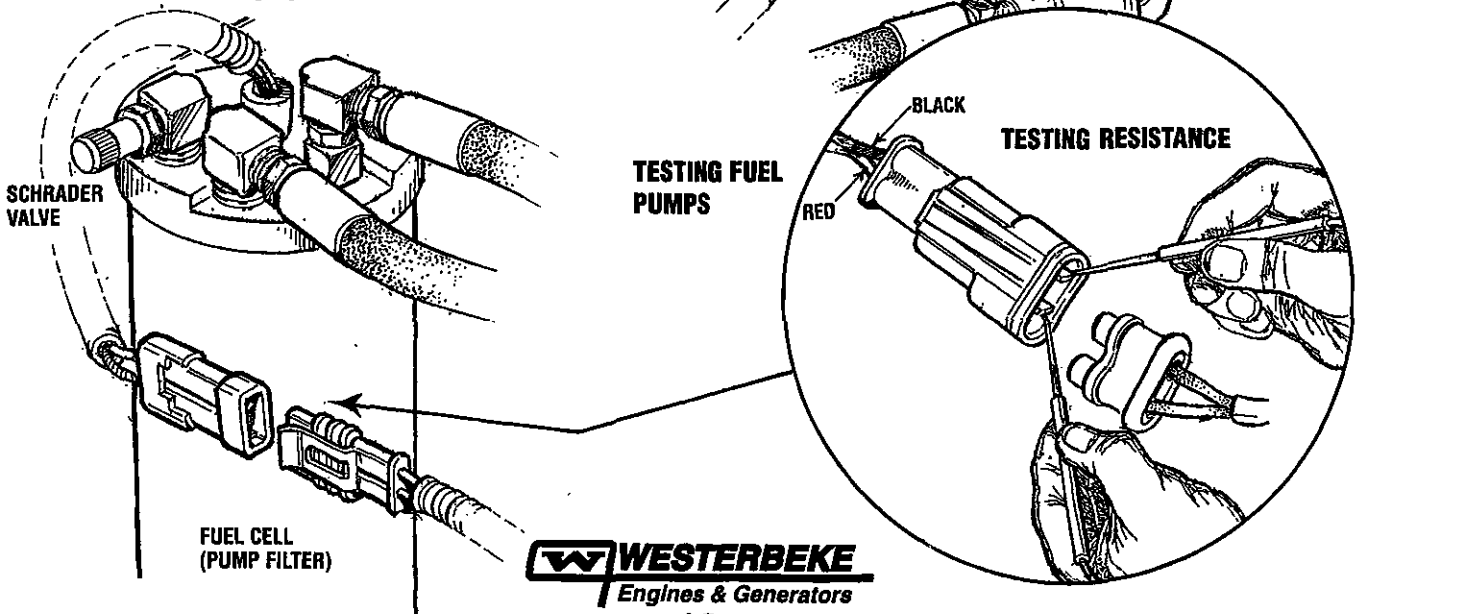
The lower pressure pump should produce 8-10 psi of pressure when operating measured at the Schrader valve on the fuel cell. The high pressure pump should produce 35-40 psi of pressure when operating measured at the Schrader valve on the throttle body.

**Fuel Pump Resistance (at rest) 3.5 - 14.5 Ohms**

**High Pressure 1.5 - 2.0 Ohms**

**Low Pressure 9.0 - 13.0 Ohms**

There should be no continuity between the metal case and either terminal of the plug connector.



# COMPONENT TESTING

## AIR, COOLANT, AND WATER HEATER TEMPERATURE SENSORS

These three sensors contain as their sensing elements identical negative temperature coefficient (NTC) thermistors whose internal resistance inversely changes to a change in temperature (i.e., temperature increase, resistance decrease). The thermistors nominal resistance value at 77° F (25° C) is 10,000 ohms. When the ECU is in an *on* state, the thermistors (-) lead is connected to ground, and its (+) lead is connected to the ECU and then through a fixed series 10,000 ohm resistor to the +5V power source. Therefore, the voltage at the thermistors (+) lead should be approximately +2.5 volts at a temperature of 77° F and decreases to a voltage of approximately +.25V at 220° F. The voltage - temperature relationship however, is not linear over this range and therefore it should only serve as an indicator that the thermistor is functioning.

**Resistance Values (at room temperature)**

**Air Temperature Sensor - 10,000Ω**

**Coolant Temperature Sensor - 10,000Ω**

Generally, the thermistor may be assumed to be good if there is a perceptual resistance change for a corresponding temperature over the indicated range, otherwise replace the sensor.

## INTAKE HEATER ELEMENT

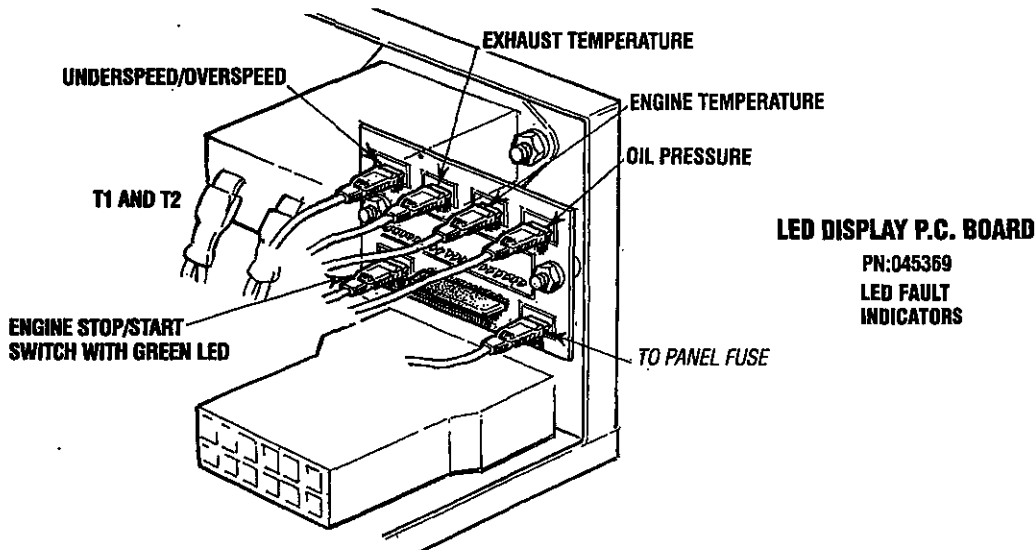
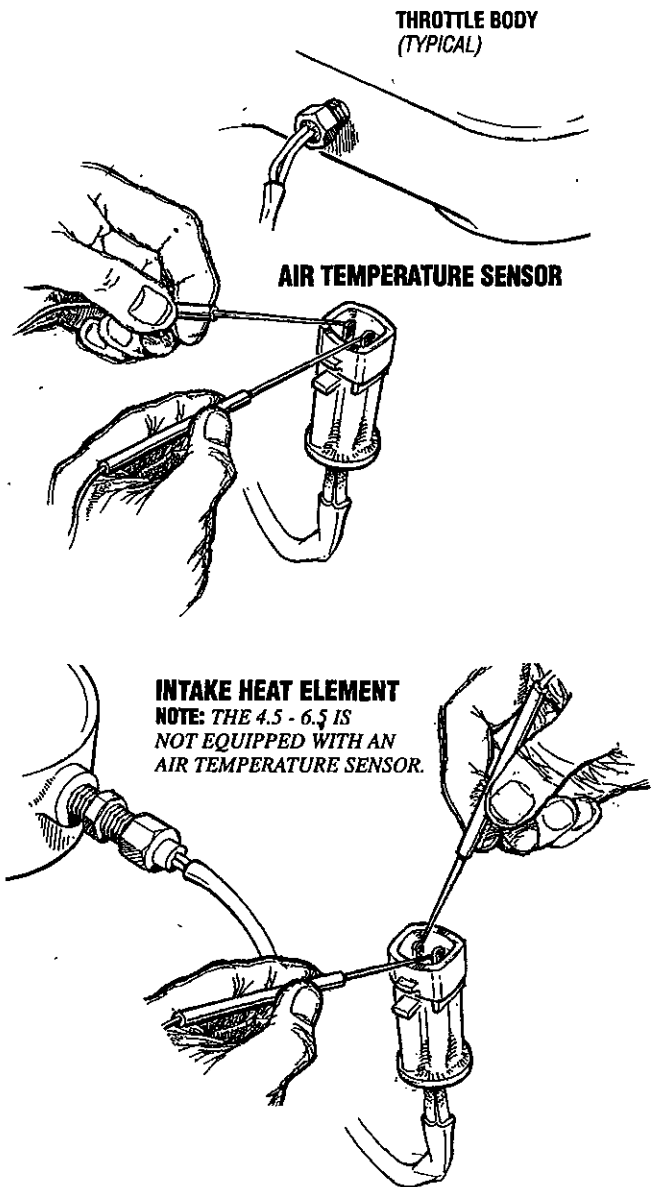
An intake heater is located in the air inlet area of the throttle body on all four cylinder models. the heater operates to warm incoming air on a cold engine start and in adverse cold operating conditions.

### Testing (static) the Heater Element

Unplug the heater from the engine harness. Put the ohmmeter probes across the two heater plug pin contacts.

**Resistance Value 1.5 - 2.5 OHM (approximately)**

There should be no continuity between either of the two pin contacts and the metal case of the element.



# COMPONENT TESTING

## BATTERY CHARGER ( 5.0 and 6.5 Kw EFI)

The battery charger is an encapsulated, solid-state unit that supplies a DC charging voltage to the generator's starting battery while the generator is operating.

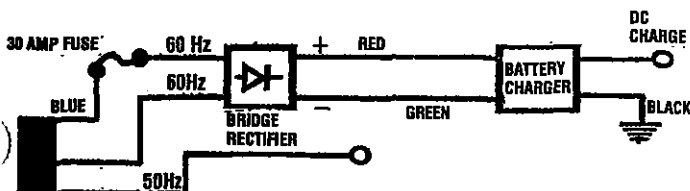
**Charging Voltage: 13.0 - 14.0 Volts DC**

**Charging Amperage: 0 - 17 Amps DC**

**NOTE:** The battery charging circuit is totally separate from the AC output of the generator. The generator output affects the circuit's output, but not the reverse.

A separate group of stator windings supplies AC voltage to a bridge rectifier which converts the AC current to supply the charging unit. The unit senses the needs of the starting battery and supplies a DC charge when one is needed. If you suspect that the unit is faulty (if the battery's charge is low), check the charging circuit and its components (see **TESTING THE BATTERY CHARGER**). Check all connections for cleanliness and tightness including the ground before replacing the charger.

**NOTE:** When the generator is first started, the charger will produce a low charging rate. This charging rate will rise as the generator is operated.

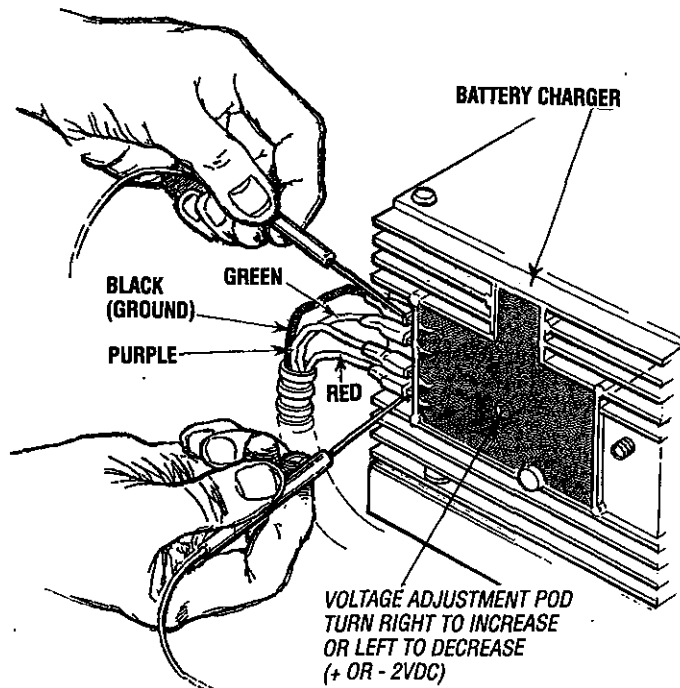


### Fuse Protection

A 30 amp fuse protects the windings from a failure of the bridge rectifier or the battery charger caused by a high amperage or a short circuit.

## Testing the Battery Charger

To test the battery charger, put a multimeter between the positive (+) and negative (-) leads to the battery. It should indicate 13.0V to 13.4V with the engine running. If only the battery voltage is indicated, check that the battery charger terminal connections are tight. With the unit running, test between the (+) and (-) on the battery charger (as illustrated) for 13.0V to 13.4V. If no charge is indicated, replace the charger.

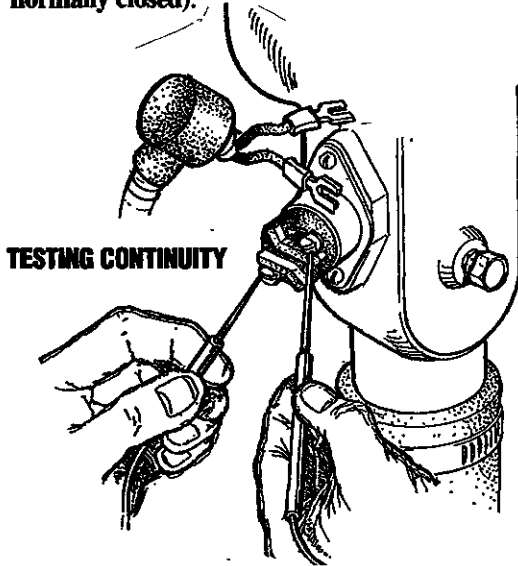


# COMPONENT TESTING

## TESTING THE EXHAUST TEMPERATURE SWITCH

An exhaust temperature switch is located on the water injected exhaust elbow. Normally closed, this switch will open and the ECU will interpret this as a high exhaust temperature and open the K2 run relay stopping the generator. The exhaust temperature LED on the panel will illuminate. The switch opens at 260 - 270°F (127 - 132°C). This switch resets (contacts close) at approximately 225°F (107°C).

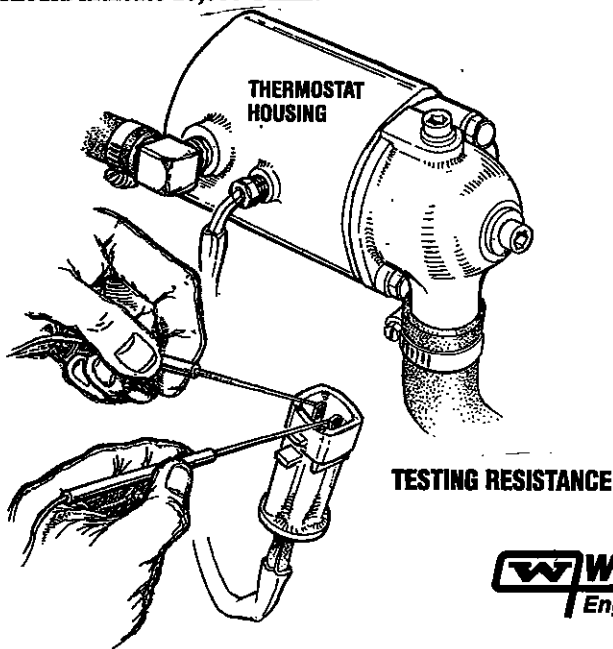
When testing, continuity should be found (switch is normally closed).



## COOLANT (WATER) TEMPERATURE SENSOR

A temperature sensor is located at the thermostat housing. This sensor sends a DC voltage to the ECU that it interprets as engine (antifreeze) coolant temperature. Should this voltage reach a set value, the ECU will interpret this as a high temperature and open the K2 run relay, stopping the generator. The overheat LED on the panel will then illuminate.

Test the sensor as shown. Resistance at room temperature should indicate 10,000 Ohms.

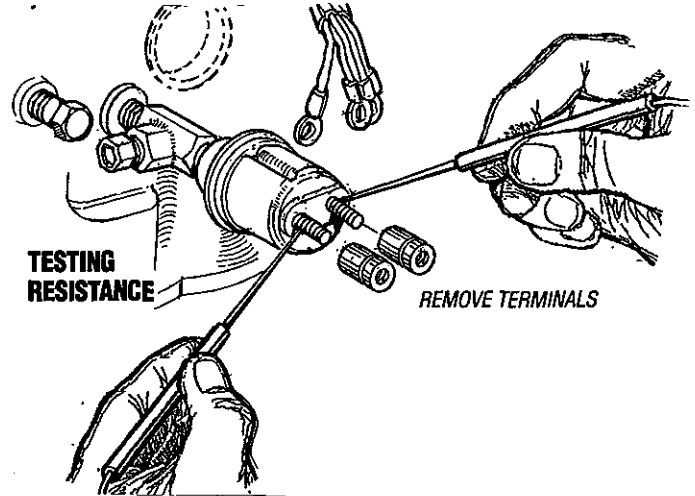


## TESTING THE OIL PRESSURE SENSOR

The oil pressure sensor sends a DC voltage to the ECU that the ECU interprets as oil pressure. Should this voltage fall below a certain level, the ECU will shut the generator down and illuminate the oil pressure LED.

Test the sensor by checking resistance (at rest):

Ohm Value - 240 - 270Ω



## ENGINE DC CIRCUIT BREAKER

The generator's engine DC circuit is protected by a rocker type DC 20 amp breaker mounted on the control box (this also serves as an Emergency Stop Switch). Excessive DC current draw or DC electrical overload anywhere in the instrument panel wiring or engine wiring will cause the breaker to trip to the OFF position. In this event, the DC power to the ECU will be interrupted, stopping the generator. No panel LED will illuminate. Check and repair the source of the problem. After repairing the fault, reset the breaker and restart the generator.

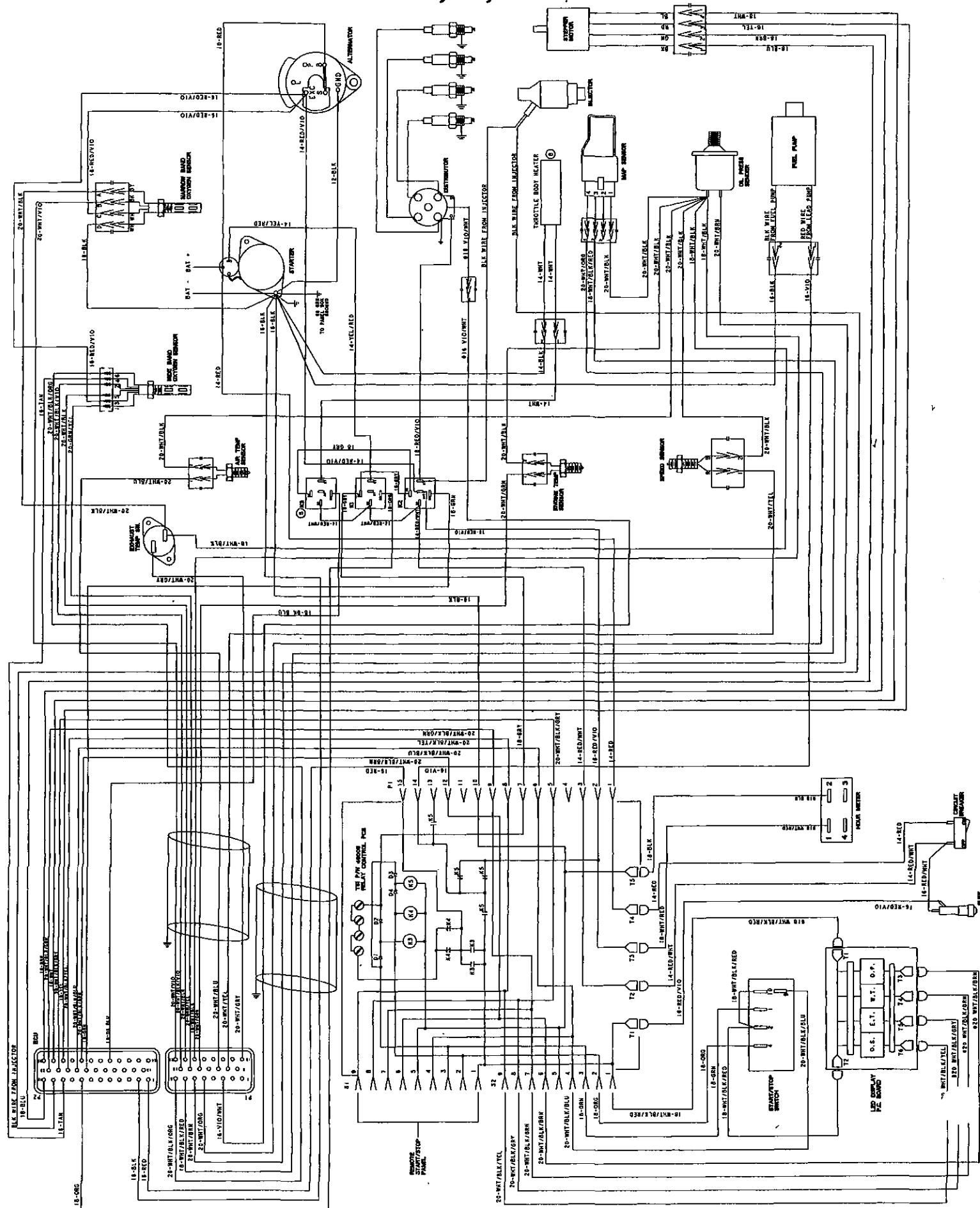
## HIGH/LOW RPM SHUTDOWN

The ECU monitors engine speed by the AC voltage produced by the MPU. Should this voltage reach a preset value, the ECU will interpret this as an engine overspeed (2175 rpm approximately) and open the K2 relay, stopping the generator. The panel Overspeed LED will illuminate. Should the MPU produce a low AC voltage that the ECU interprets as an underspeed condition, the ECU will open the K2 relay and stop the generator. The Overspeed LED will then blink.





# WIRING DIAGRAM 8, 10, 12.5 AND 14KW SBEG



# WIRING DIAGRAM 20 AND 25KW SBEG

