About this Group of the Manual

This section of the manual contains necessary information to diagnose the electronic control system.

Parts such as sensors, actuators, and connectors are serviceable and available.

To help diagnose electronic control system problems, Section 6, Group 210 DIAGNOSTIC SPECIFICATIONS contains useful information, such as ECU terminal identification and a system wiring schematic.

IMPORTANT: Under NO circumstances, should the Engine Control Unit (ECU) be opened.

NOTE: Instruction is given throughout the diagnostic charts to make resistance and voltage measurements in the ECU connector. Note that these measurements are always made in the harness end of the connector. Measurements should never be made in the ECU end of the connection.

RG41183,0000082 –19–23JAN04–1/1

Electrical Concepts

Tests will include making measurements of voltage and resistance and making checks for open circuits and short circuits. An understanding of the following concepts is required to use the diagnostic procedures:

- Voltage (volts)
- Current (amps)
- Resistance (ohms)
- Open Circuit
- Short Circuit

RG,RG34710,1553 –19–30SEP97–1/1

Using a Digital Multimeter

RG11126 –UN–19JUN00

Digital Multimeter

It is recommended that a digital multimeter (JT07306 or equivalent with an analog display) be used to make the required measurements in the diagnostic procedures. A knowledge of the operation of the particular meter used is assumed.

Instructions for measuring voltages take the following form:

- Measure voltage from Point A (+) to Point (B) (-)

In this example, the positive test lead from the volt-ohm input of the meter should be connected to Point A and the negative test lead from the common input of the meter should be connected to Point B.

Unless otherwise stated, all voltage measurements are direct current (D.C.).

In making a resistance measurement, be careful to use the correct resistance range on the meter. Disconnect appropriate connectors or turn off key switch, as directed by diagnostic procedures later in this group.

RG,RG34710,1554 –19–30SEP97–1/1

Electrical Circuit Malfunctions

Circuit Malfunctions

There are four major circuit malfunctions. They are:

1. High-resistance circuit
2. Open circuit
3. Grounded circuit
4. Shorted circuit

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DPSG,RG40854,37 –19–15DEC98–1/6

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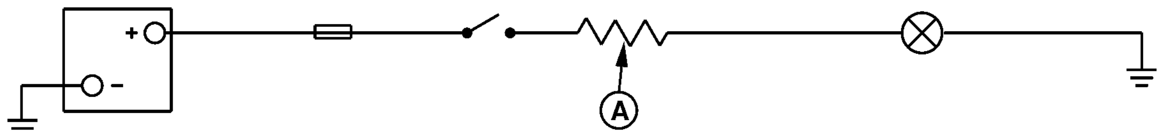

High Resistance Circuit

A—Unwanted Resistance

Definition of Circuit Malfunctions

1. **High Resistance Circuit:**

A circuit having unwanted resistance (A) that causes a voltage drop and reduces current flow.

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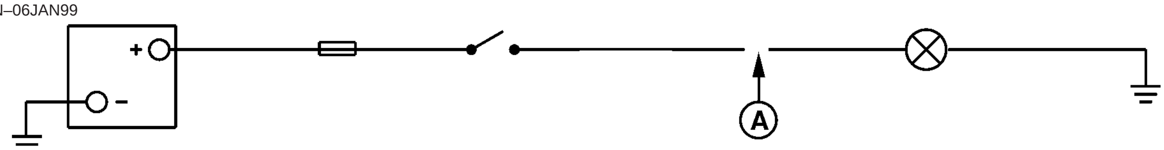

Open Circuit

A—Break or Separation in Circuit

2. **Open Circuit:**
A circuit having a break or a separation (A) that prevents current from flowing in the circuit.

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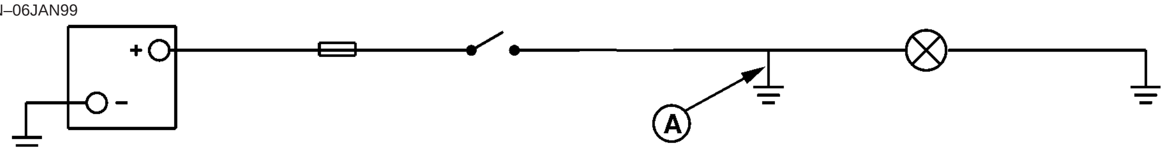

Grounded Circuit

A—Voltage Wire in Contact with Machine Frame

3. **Grounded Circuit:**
A voltage wire in contact with the machine frame (A), providing continuity with the battery ground terminal.

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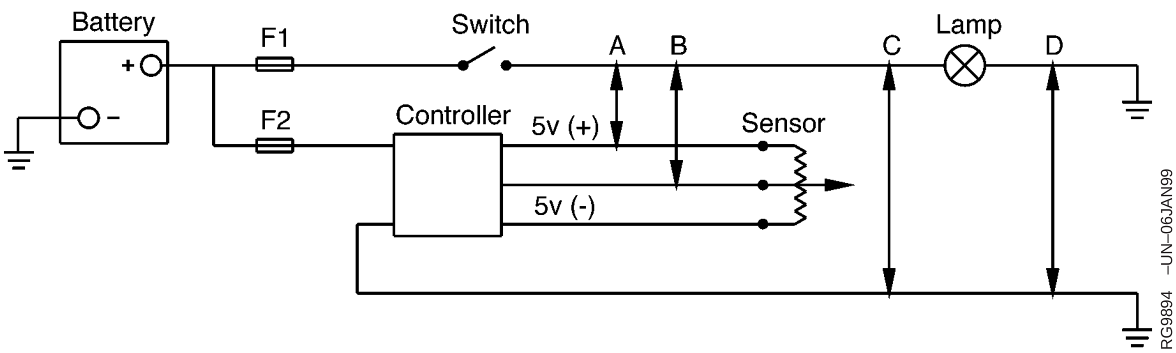


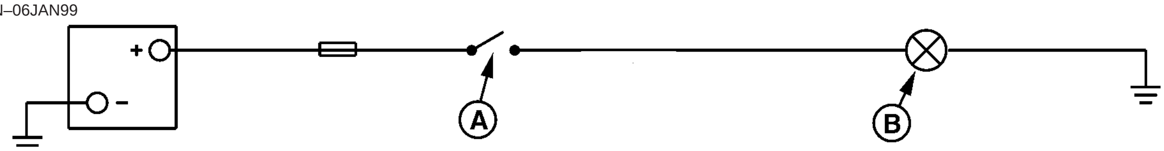
Shorted Circuit

4. **Shorted Circuit:**
   A wire-to-wire contact of two adjacent wires that provides unwanted continuity between the two wires. The following are types of short circuits:
   - Voltage wire shorted to another voltage wire (wires of equal or unequal voltage).
   - Voltage wire shorted to a sensor signal wire (wires of unequal voltage).
   - Voltage wire shorted to a ground wire (wires of battery voltage or regulated voltage, shorted to a ground wire connecting a component to the battery negative terminal).
   - Ground wire shorted to another ground wire (wires of zero voltage).

NOTE: This type of short does not create an observable malfunction. Therefore, no further explanation for trouble shooting is necessary.

DPSG,RG40854,37 –19–15DEC98–5/6

RG9895 –UN–06JAN99



Locations of Circuit Malfunctions

A—Controlling Switch **B—Load**

Locations of Circuit Malfunctions:

In a “Simple Electrical Circuit” the circuit malfunctions occur at only three locations. They are:

1. Before the controlling switch (A).

2. Between the controlling switch (A) and the load (B).

3. After the load (B).

Electrical components can become faulty with the same four circuit malfunctions. Sometimes component malfunctions can easily be confused with circuit malfunctions. Therefore, care must be exercised when isolating the cause of the problem.

Example: A component may not operate before disconnecting an electrical connection, but it operates after reconnecting the connector.

Reason: Oxidation of the terminals created “High Resistance” and a voltage drop that prevents the proper amount of current flow to the component. Disconnecting and reconnecting the connector, removed some oxidation and re-established good continuity through the connector.

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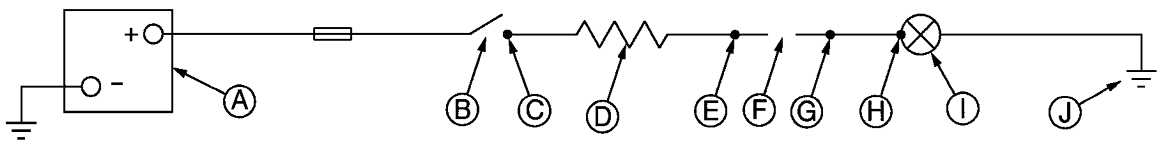
Troubleshooting Circuit Malfunctions

RG9896 –UN–06JAN99



Troubleshooting Circuit Malfunctions

A—Battery
B—Switch
C—Component Terminal
D—Unwanted Resistance
E—Circuit Connector
F—Open Circuit
G—Circuit Connector
H—Component Terminal
I—Load (Lamp)
J—Ground

1. **High Resistance Circuit:**

   A “High Resistance” circuit can result in slow, dim or no component operation (for example: loose, corroded, dirty or oily terminals, gauge of wire too small or broken strands of wire).

2. **Open Circuit:**

   An “Open” circuit results in no component operation because the circuit is incomplete (for example: broken wire, terminals disconnected, open protective device or open switch).

   Do the following to isolate the location of a “High Resistance” or “Open” circuit:

   a. With the controlling switch (B) closed (on) and the load (I) connected into the circuit, check for proper voltage at a location easily accessible between (C) and (H).

   - If voltage is low, move toward the voltage source (A) to locate the point of voltage drop.
   - If voltage is correct, move toward the load (I) and ground terminal (J) to locate the voltage drop.

NOTE: The example shows high resistance (D) between (C) and (E) and the open circuit (F) between (E) and (G).

   b. Repair the circuit as required.

   c. Perform an operational check-out on the component after completing the repair.

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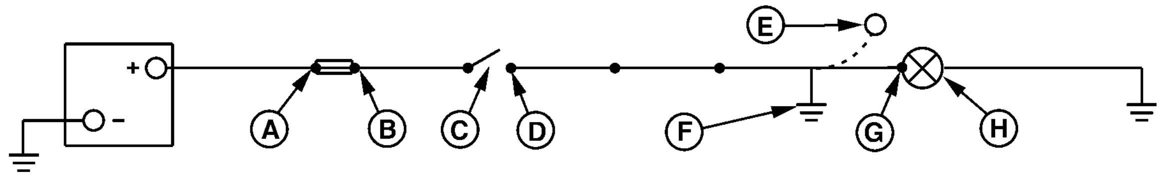

Ground Circuit

A—Fuse "A" Terminal
B—Fuse "B" Terminal
C—Switch
D—Component Terminal
E—Wire Terminal
F—Grounded Circuit
G—Component Terminal
H—Load (Lamp)

3. **Ground Circuit:**

A "Grounded" circuit (F) results in no component operation and the fuse or circuit breaker opens (for example: a power wire contacting the machine frame, chassis or component housing).

Do the following to isolate the location of a "Grounded" circuit:

a. Switch (C) must be open (off). Check for continuity to ground between (B) and (C).

- If there is continuity, there is a grounded circuit between (B) and (C). Repair the circuit.
- No continuity, go to step b.

b. Disconnect the load (H) at component terminal (G).

c. With the controlling switch (C) open (off), check for continuity to ground between (D) and (E).

- If there is continuity, there is a grounded circuit between (D) and (E). Repair the circuit.

NOTE: The example is grounded between (D) and (E) at (F).

- Perform an operational check-out on the component after completing the repair.

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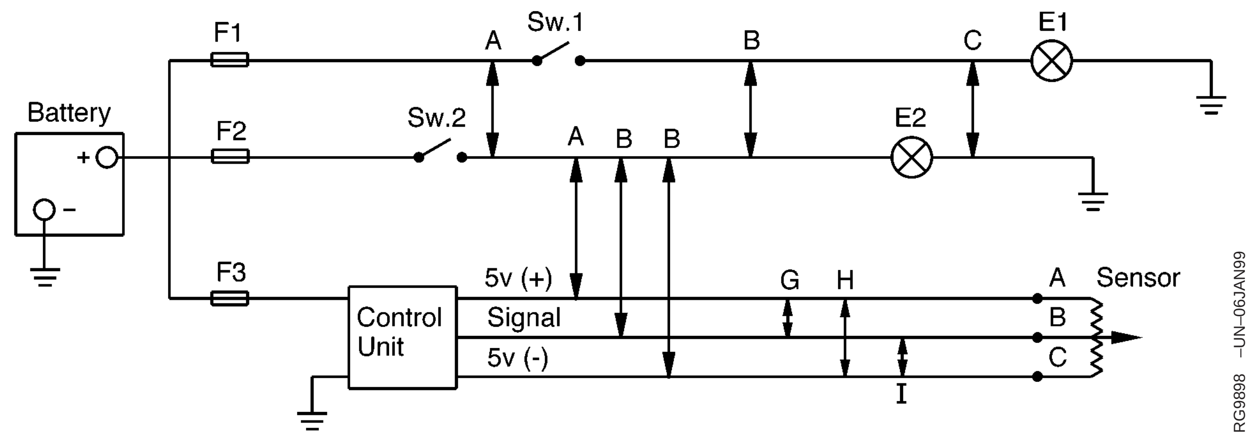


Shorted Circuit

4. **Shorted Circuit:**

Machines equipped with several electronic control devices contain wiring harnesses that can become shorted by one of the following ways shown above.

1. Battery wire from fuse (F1) is shorted at (A) to another battery wire after switch (Sw.2).
   - Result: Lamp (E1) is on all of the time.

2. Battery wire from fuse (F1) is shorted at (B) to another battery wire after switches (Sw.1 & 2).
   - Result: Both lamps (E1 & E2) operate on either switch (Sw. 1 or 2).

3. Battery wire from fuse (F1) is shorted at (C) to a ground wire.
   - Result: Fuse (F1) opens after closing switch (Sw. 1)

4. Battery wire from switch (Sw. 2) is shorted at (D) to a regulated voltage wire.
   - Result: The sensor signal voltage is distorted.[1]

5. Battery wire from switch (Sw. 2) is shorted at (E) to the sensor signal voltage wire.
   - Result: The sensor signal is distorted.[1]

6. Battery wire from switch (Sw. 2) is shorted at (F) to the sensor ground wire.
   - Result: Fuse (F2) opens after closing switch (Sw. 2) and the sensor signal is distorted.[1]

7. Controller regulated voltage wire is shorted at (G) to the sensor signal voltage wire.
   - Result: The sensor signal is distorted.

8. Controller regulated voltage wire is shorted at (H) to the sensor ground wire.
   - Result: The sensor signal is distorted.[1]

9. Sensor voltage wire is shorted at (I) to the sensor ground wire.
   - Result: The sensor signal is distorted.[1]

Do the following to isolate a “Shorted Circuit:”

a. Review the machine electrical schematic to identify the circuits for the component that does not operate.

b. Disconnect the components at each end of the circuits, to single out the affected wires.

c. To prevent damage to connector terminals, obtain mating connector terminals from repair parts. DO NOT force meter probes into connector terminals.

[1]*The sensor signal voltage goes out of range and a fault code may be restored. The controller may shut down or provide limited operation for its function.*

Continued on next page

DPSG,RG40854,38 –19–15DEC98–3/4

d. Connect the meter leads across two of the affected circuits. The meter should show no continuity between the two circuits. Repeat the check across another combination of two circuits until all affected circuits have been checked.

e. Then, connect a meter lead to each affected circuit one at a time and touch the other meter leads to all terminals in the connector. The meter should show no continuity between any two circuits.

   Example: A 37 pin connector contains three wires to a sensor. With one meter probe attached to each of the three wires, one at a time, touch the other meter probe to the remaining 36 wires. If there is continuity between any two wires, the circuit is shorted. Repair the circuit.

f. Alternate Method to Check for Shorted Circuit.

   With the components disconnected at each end of the suspected circuits, turn the key switch on. Connect one meter lead to a good frame ground. With the other meter probe, touch each of the suspected circuits one at a time. If there is a voltage reading, the circuit is shorted to another voltage wire. Repair the circuit.

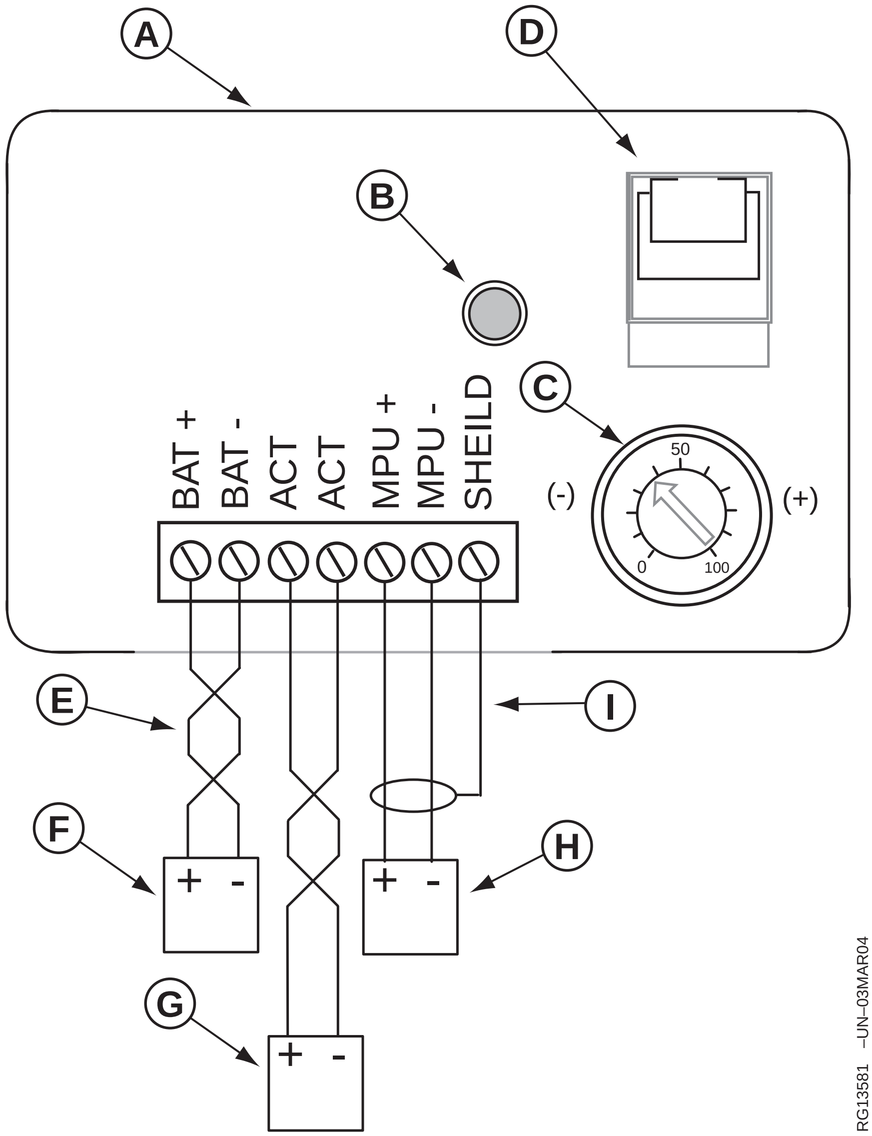
g. Repair the “Shorted Circuit” as follows:

   - Wires not in a loom: Wrap individual wires with electrical tape or replace the damaged wire and band as required.
   - Wires in a loom: If hot spots exist in shorted area of the harness, replace the harness. If hot sports are not noticeable, install a new wire of proper gauge between the last two connections. Use tie bands to secure the wire to outside of the harness.

h. Perform an operational check-out on the component after completing the repair.

DPSG,RG40854,38 –19–15DEC98–4/4

Engine Control Unit (ECU) Wiring



A—Engine Control Unit (ECU)
B—Light Emitting Diode (LED)
C—Gain Adjustment
D—COMM Port
E—14 GA Twisted Wire
F—Battery
G—Actuator
H—Magnetic Pickup Unit
I—Shielded Ground Connection

Continued on next page RG41183,000008C –19–03MAR04–1/2

ECU Terminal Description	
Name	**Description**
BAT+	Battery positive (Supply voltage range is 9VDC-30VDC)
BAT-	Battery negative
ACT	Actuator Drive output
ACT	Actuator Drive return
MPU	Magnetic Pickup Signal Input
MPU	Magnetic Pickup Ground
SHIELD	Ground connection for cable shielding

RG41183,000008C –19–03MAR04–2/2

Connecting Parameter Setup Tool (PST)

Refer to your John Deere Dealer web site for obtaining the latest version of software used for communicating with the electronic control unit (ECU).

The Universal PST software requires a computer with Microsoft® Windows 98se (Second Edition), NT4, 2000, or XP. The display resolution needs to be set to SVGA (800x600) or higher.

NOTE: The Universal PST software is not supported on Microsoft® Windows 95.

NOTE: Ensure computer serial port is configured to COMM 1.

1. Connect DB9 to RJ11 adapter to the serial port on computer. For computers without a serial port, a USB to serial port adapter will be required.

2. Connect the RJ11 cable to the DB9 adapter and to the diagnostic receptacle on the ECU.

3. Key ON, engine OFF, verify that the LED on the controller is on.

4. Start the Universal PST software and verify communications with the ECU.

RG41183,0000086 –19–12APR04–1/1

Parameter Reference

Proportional:
The proportional term is one of the interrelated PID terms that determine how well the ECU governs the engine's speed. A speed change creates a speed error (the difference between the target speed and the actual speed.) The proportional gain controls the size of the governor output response to a step change in the speed error.

Integral:
The integral term is one of the interrelated PID terms that determine how well the ECU governs the engine's speed. The integral term acts to drive speed error to zero. In a proportional-only control with constant load, there will be a constant speed error that inversely relates to the proportional gain of the system. The integral term is key to isochronous speed control. The term eliminates the difference between the programmed set speed and the actual speed. The integral gain changes the time it takes to drive the error is to zero.

NOTE: Integral is needed to eliminate speed offsets due to proportional gain and should never be left at zero.

Derivative:
The derivative term is one of the interrelated PID terms that determine how well the ECU governs the engine's speed. The derivative responds to the rate of change in the speed error. This parameter is primarily used to dampen very rapid oscillations resulting from large speed changes. The derivative responds to rapid engine acceleration or deceleration. If the engine speed approaches the target speed at a fast rate, the derivative acts to minimize or eliminate overshoot. A zero value is allowed but systems typically require some derivative gain to improve overall engine speed control.

Gain at Set Speed A:
This gain acts as the multiplier on the three PID terms (proportional, integral, and derivative) when Set Speed A is selected as the active target speed.

Gain Factor:
The gain factor parameter is used to obtain more range of adjustment from the PID terms. In other words, if any of the PID terms or the Gain terms reach their adjustment limits then this value can be modified to provide for more range of adjustment in the PID and Gain terms. For example, if the PID terms are set to 90, 80, and 50 respectively and the Gain Factor is set to 20, then doubling the Gain Factor by setting it to 40 allows the PID terms to be halved to 45, 40, and 25 respectively. These new settings are equivalent to the previous settings with respect to the governor's tuning response and now allow the PID terms to be adjusted higher if needed.

Speed Filter:
This parameter indicates the number of speed signal pulses to use when computing an average engine speed and is used to dampen out speed measurement variations that can make PID tuning difficult. But keep in mind the following.
—Too little filtering can make the governor overly sensitive and tuning difficult.
—Too much filtering will slow down the governor's response to speed changes.

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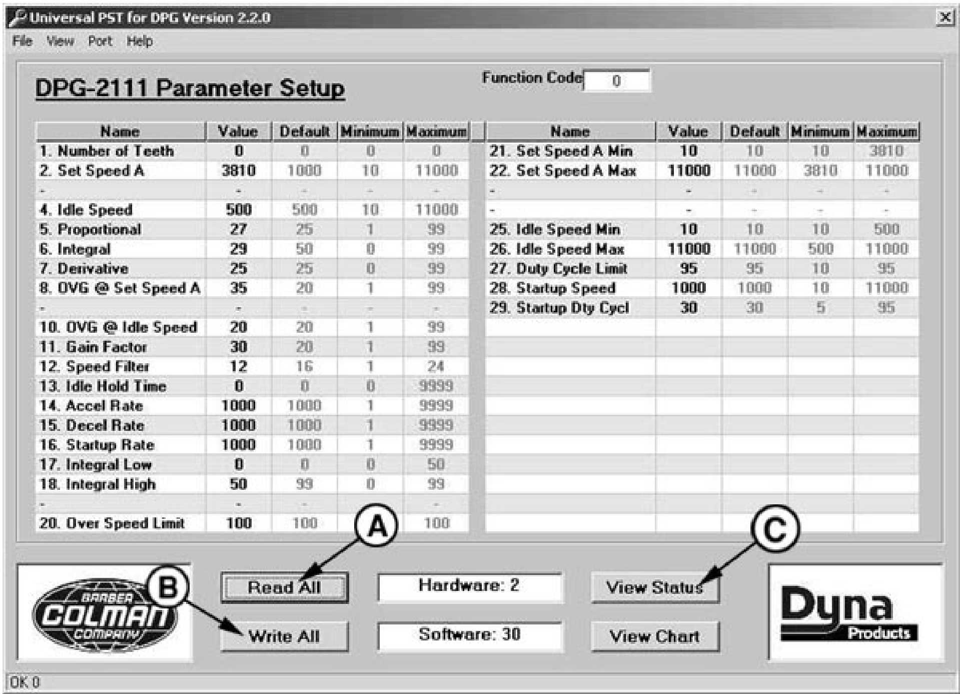
Viewing and Modifying ECU Parameters



RG13575 –UN–01MAR04

IMPORTANT: It is recommended that the current parameters in the ECU be saved to a data file prior to modifying existing parameters in the ECU.

Configuration parameters can be viewed with the Universal PST. To refresh the parameter table click on “Read All” (A). Parameters may be edited from this view by double clicking on the cell in the “Value” column. Type in the new value and then click once on a different row. The value will be changed on the screen but will not update in the ECU. Click on “Write All” (B) to have the parameters updated in the ECU.

Click on “View Status” (C) to display read only parameters in the Status view window.

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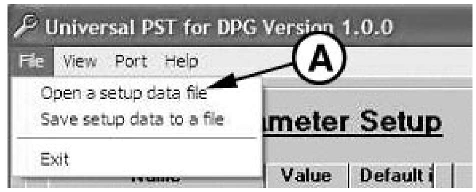
Reprogramming the ECU

RG13577 –UN–01MAR04



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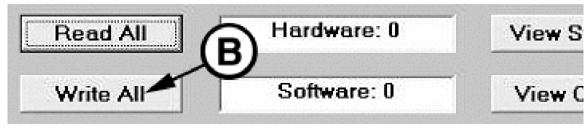

IMPORTANT: It is recommended that the current parameters in the ECU be saved to a data file prior to reprogramming an ECU.

The ECU can be reprogrammed from a file that contains parameter settings using the Universal PST.

1. Key ON, engine off connect to the ECU using Universal PST.

2. Open a previously saved setup data file by clicking on “File” and “Open a setup data file” (A). Select the correct file for the engine.

3. Click on “Write All” (B) and the software will update the ECU with the updated parameters.

RG41183,0000088 –19–29FEB04–1/1

Electronic Governor Calibration

Basic Adjustments

The controller is programmed at the factory with default parameter settings (See Electronic Governor Specifications, later in this book). These settings allow the controller to operate but will usually require some further adjustments to obtain the best performance. The parameters listed below are the primary settings that should be modified to get the governor tuned and the engine running at desired operation. It is recommended that these parameters be adjusted first and leave all other parameters at their default settings.

- Proportional
- Integral
- Derivative
- OVG @ Set Speed A
- Gain Factor (*See Note*)
- Speed Filter (*See Note*)

NOTE: Modify Gain Factor only if you run out of adjustment in a PID or OVG.

A Speed Filter setting of 24 is the default for 4 cylinder engines. 5 cylinder engines vary and should be referenced in the specifications chart.

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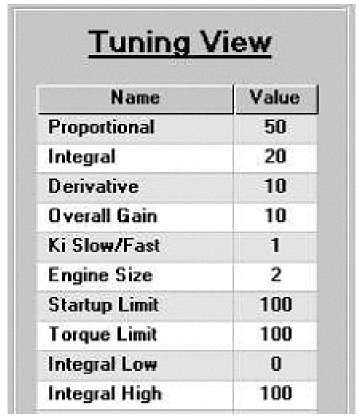
Tuning Procedure


Tuning View

Name	Value
Proportional	50
Integral	20
Derivative	10
Overall Gain	10
Ki Slow/Fast	1
Engine Size	2
Startup Limit	100
Torque Limit	100
Integral Low	0
Integral High	100

RG13578 –UN–01MAR04

1. Increase the proportional term until you get continuous oscillations greater than 2Hz.

2. Reduce the proportional term by 25% to 50%.

3. Now experiment with small value changes in the derivative to dampen out “ringing” in response to load transients.

4. Add some integral to eliminate any steady-state error in the engine’s speed and help decrease error recovery time.

5. The overall gain can be increased to improve response time while keeping the ratios of the PID (Proportional, Integrated, and Derivative) terms relative to each other constant.

RG41183,0000083 –19–16APR04–2/2

LED Status Indicators

The LED (Light Emitting Diode) is used as a status indicator. The following table describes the different faults depending on the status of the LED.

LED Status	Description
Off	The ECU is either not currently being powered, or is being reverse powered (check polarity of supplied power). If correctly powered then the controller is malfunctioning.
Blinking Slow (1/2 Hz)	The ECU is powered but not sensing a speed signal. OK if engine is not running. If the engine is running then this indicates a fault with the speed signal.
Blinking Fast (1 1/2 Hz)	The ECU is powered and an engine speed signal is being detected. If the engine is not running then this indicates electrical noise on the speed signal wires.
On and Not blinking	The ECU is powered and is malfunctioning. Replace the controller.

RG41183,0000085 –19–16APR04–1/1

Electronically Controlled Governor System Diagnostics

System	Solution
LED Display Does Not Light Up When Governor Is Powered	• BAT + and BAT – leads are reversed. Check wiring. • Battery voltage too low. Should measure between 9 and 30 VDC • Controller is defective. Replace it.
Unable to Modify Parameters	• The parameter's value is at the maximum value allowed. • The parameter's value is at the minimum value allowed. • Universal PST not communicating with the controller • Keypad Failure, replace unit.
Engine Does Not Start	• Actuator leads not connected or shorted. • No Fuel Source. Turn on fuel source. • Battery voltage is low. Charge or replace the battery. • Set speed is lower than crank speed. Increase the set speed. • Startup Rate setting is too low. The target speed ramps up too slow. • Startup Limit is too low, limiting the actuator drive signal too much. • Is the MPU speed signal present? It should read 2.0VRMS minimum. Adjust magnetic pickup (MPU) gap. Try reversing the MPU leads. • If a speed signal is present, measure actuator output duty cycle. If not greater than 5%, then restore all parameter values to factory default settings and crank the engine again. • Final target speed must be greater than crank speed before the governor will attempt to drive the actuator open.
Engine Over Speeds at Startup	• Increase the Proportional value. • Increase the appropriate Gain value. • Decrease the Startup Ramp Rate.
Engine Does Not Reach the Set Speed	• Improve PID tuning. • Integral too low or zero • PID values are too low. A tuning that is too soft can prevent the governor from delivering the needed actuator drive signal to reach the set speed. • PID values are too high. Tuning is too hot or over sensitive to small speed errors which causes the governor to make large rapid changes in actuator drive signal which creates an average signal that is inadequate. • The Integral Low Limit setting is too high. Return the value to the default setting of zero. • The Integral High Limit setting is too low. Return the value to the default setting of 99.
Engine takes too long to reach the set speed.	• Improve PID tuning. • Integral setting is too low. • Startup Rate setting is too low. • Accel Rate setting is too low. • Speed Filter setting is too high.

Continued on next page RG41183,000008A –19–02MAR04–1/2

System	Solution
Engine Does Not Track Speed Setting Changes	• Is the LED blinking fast (3Hz)? No = not sensing speed • Is the selected set speed parameter being modified? • A PID value or a Gain value is too high. • A PID value is too low or zero. • Accel Rate is set too low. • Decel Rate is set too low.
Sluggish Response to load changes	• Gain too low. • Improve PID tuning. • Speed Filter setting is too high.
Engine Instability With No-load	• Improve PID tuning. • Speed Filter setting is too low. • Fuel is restricted. Check actuator linkage. • Battery voltage is too low.
Engine Instability With Load	• Improve PID tuning. • Fuel is restricted. Check actuator linkage. • Battery voltage is too low.
Engine Unable to Carry Rated Load	• PID values may be too high causing the governor to over react and make large rapid changes in PWM duty cycle output to the actuator. • Improve PID tuning. • Fuel is restricted. Check actuator linkage.

RG41183,000008A –19–02MAR04–2/2