ESD2200 Series
Speed Control Unit

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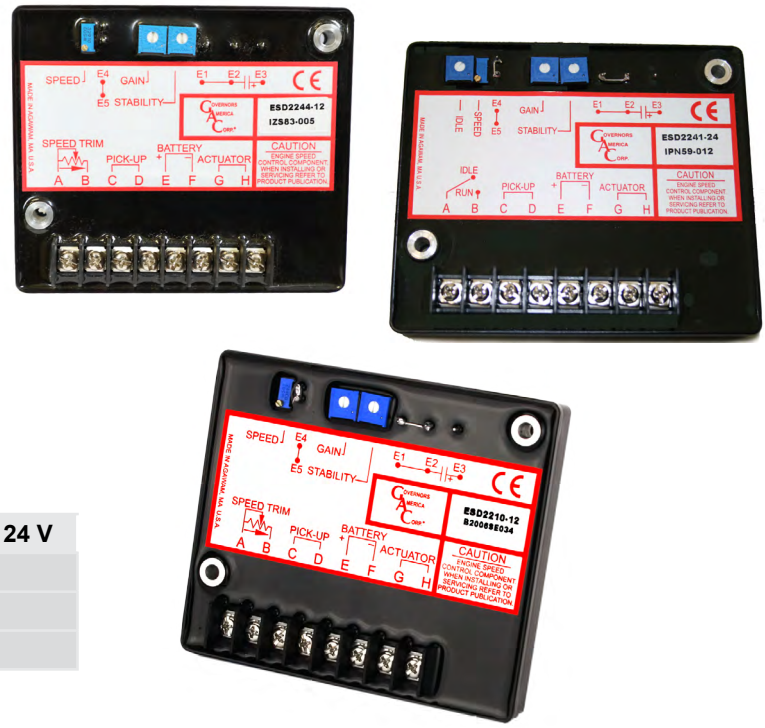
1 OVERVIEW

The ESD2200 Series speed control unit is an all-electronic device designed to control engine speed with fast and precise response to transient load changes.

This closed loop control, when connected to a proportional electric actuator and supplied with a magnetic speed sensor signal, will control a wide variety of engines in an isochronous or droop mode. It is designed for high reliability and it's hard potted to withstand the engine environment.

- 12 or 24 V DC
- Isochronous Operation
- Precise Speed Control
- Adjustable PID Functions
- 8:1 Speed Range Control
- Light Force Option Available



PART NUMBER	FEATURE / PRODUCT DETAILS	12 V	24 V
ESD2210	Standard Unit		
ESD2241	Standard Unit with Idle		
ESD2244	Light Force (Low-Current Optimized PID)		

2 SPECIFICATIONS

PERFORMANCE	
Isochronous Operation	± 0.25 % or better
Speed Range / Governor	1 - 7.5 KHz Continuous
Speed Drift with Temperature	±1% MAX
Speed Trim Range	± 250 Hz
Terminal A Sensitivity	130 Hz. ±15 Hz / V @ 5.1 K Impedance
INPUT / OUTPUT	
DC Supply	12-24 V DC ±30% Battery Systems Transient and Reverse Voltage Protected*
Polarity	Negative Ground (Case Isolated)
Power Consumption	60 mA continuous plus actuator current
Actuator Current @ 77 °F (25 °C)	10 A MAX Continuous
Speed Sensor Signal	1.0 - 50 V RMS

RELIABILITY	
Vibration	5 g @ 20-500 Hz
Testing	Functionally Tested
ENVIRONMENTAL	
Ambient Temperature	-40° to 85 °C (-40 to 185 °F)
Relative Humidity	up to 100 %
All Surface Finishes	Fungus-Proof and Corrosion-Resistant
PHYSICAL	
Dimension	See Section 3, Installation
Weight	12 ozf (347 gf)
Mounting	Any Position, Vertical Preferred
COMPLIANCE / STANDARDS	
Agency	CE, (EMC: EN55011, EN55014, EN55022, EN60034 & EN61000)

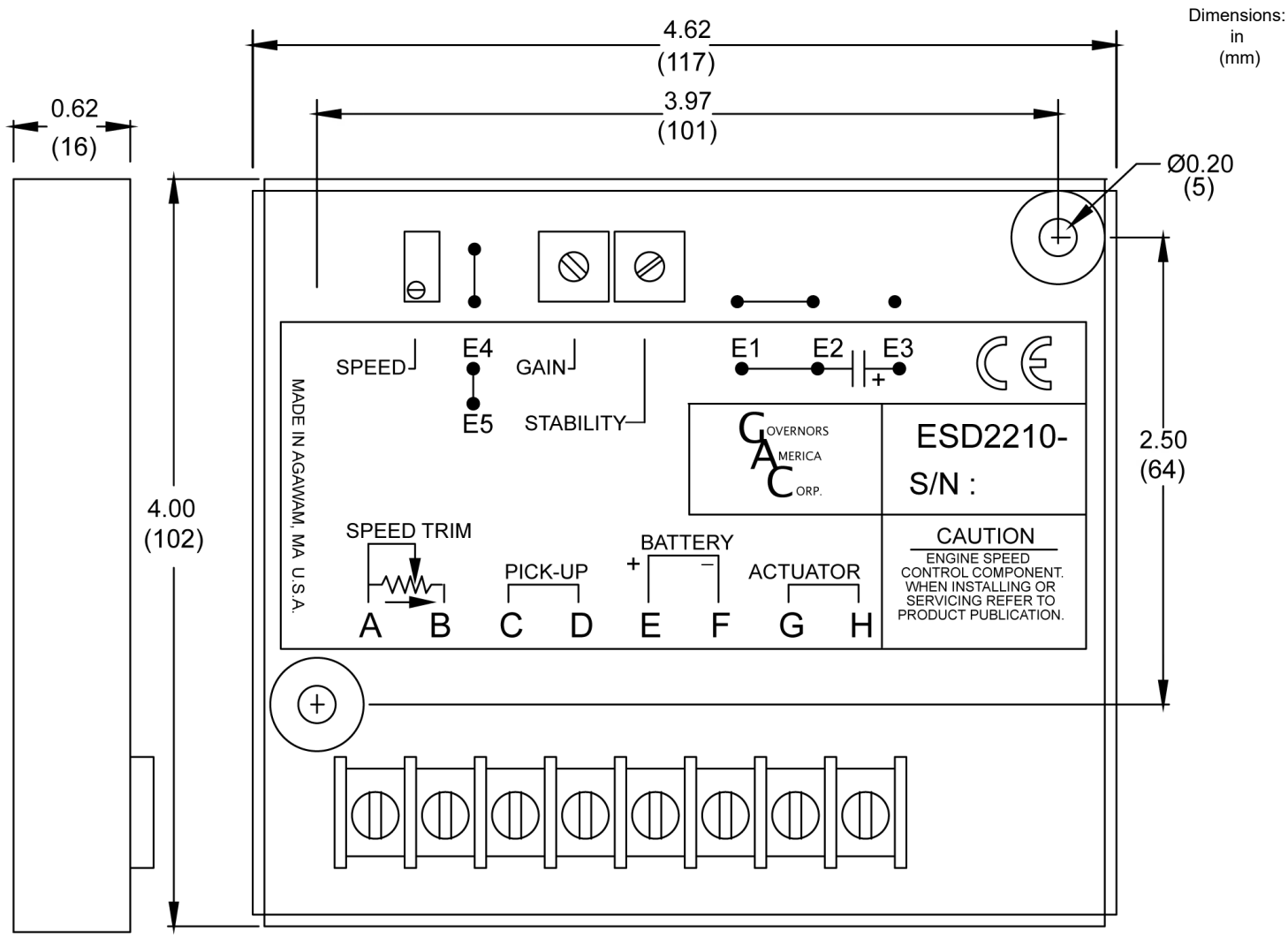
* Reverse voltage is protected against by a parallel diode. A 15 A fuse must be installed in the positive battery lead. See Section 4, Wiring.

3 INSTALLATION

Vertical orientation allows for the draining of fluids in moist environments.

Mount in a cabinet, engine enclosure, or sealed metal box.

Avoid Extreme Heat

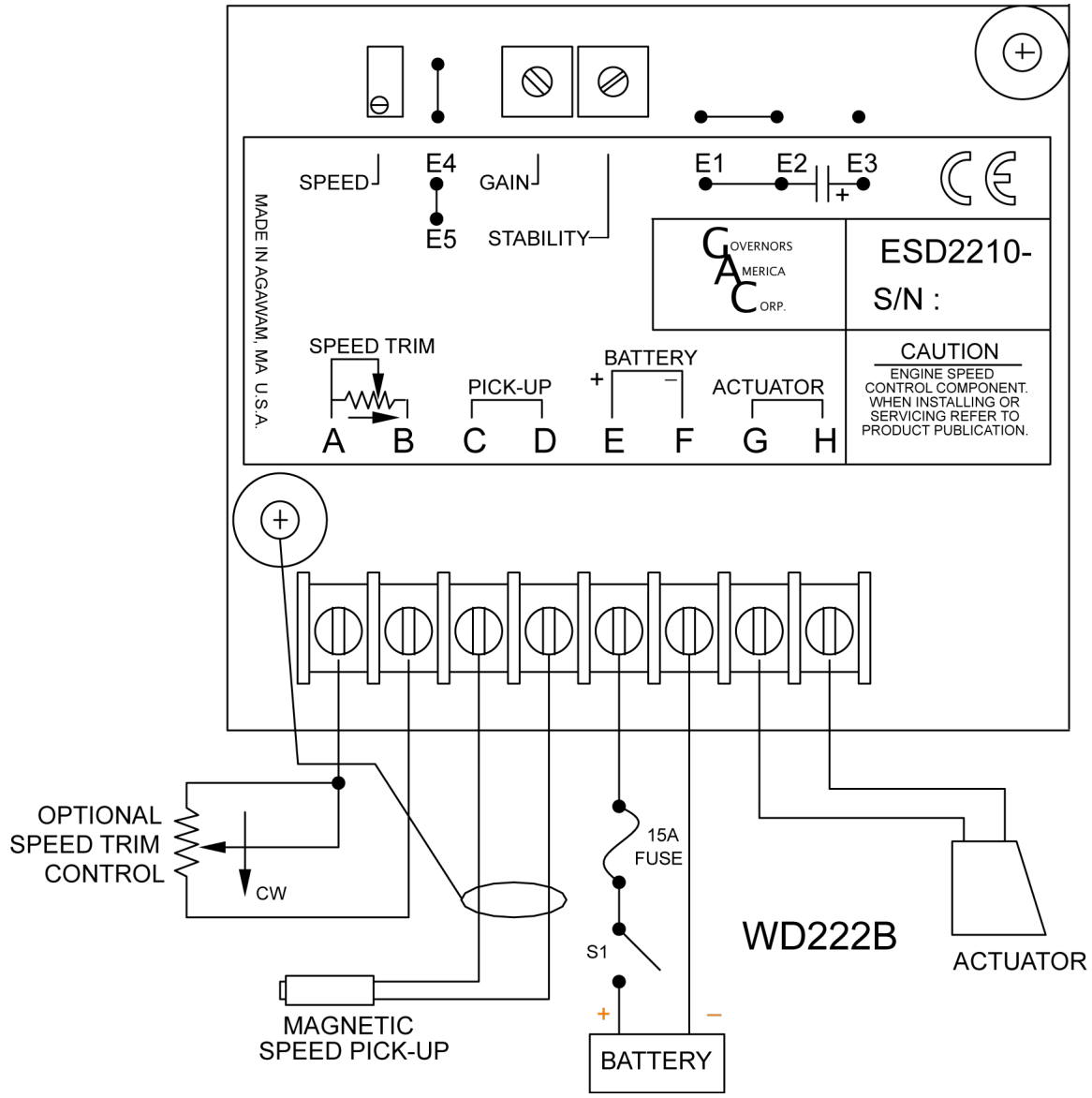


Use an overspeed shutdown device, independent of the governor system, to prevent loss of engine control which may cause personal injury or equipment damage.

Do not rely exclusively on the governor system electric actuator to prevent overspeed. A secondary shutoff device, such as a fuel solenoid must be used.

4 WIRING

ESD2210 and ESD2244 WIRING DIAGRAM

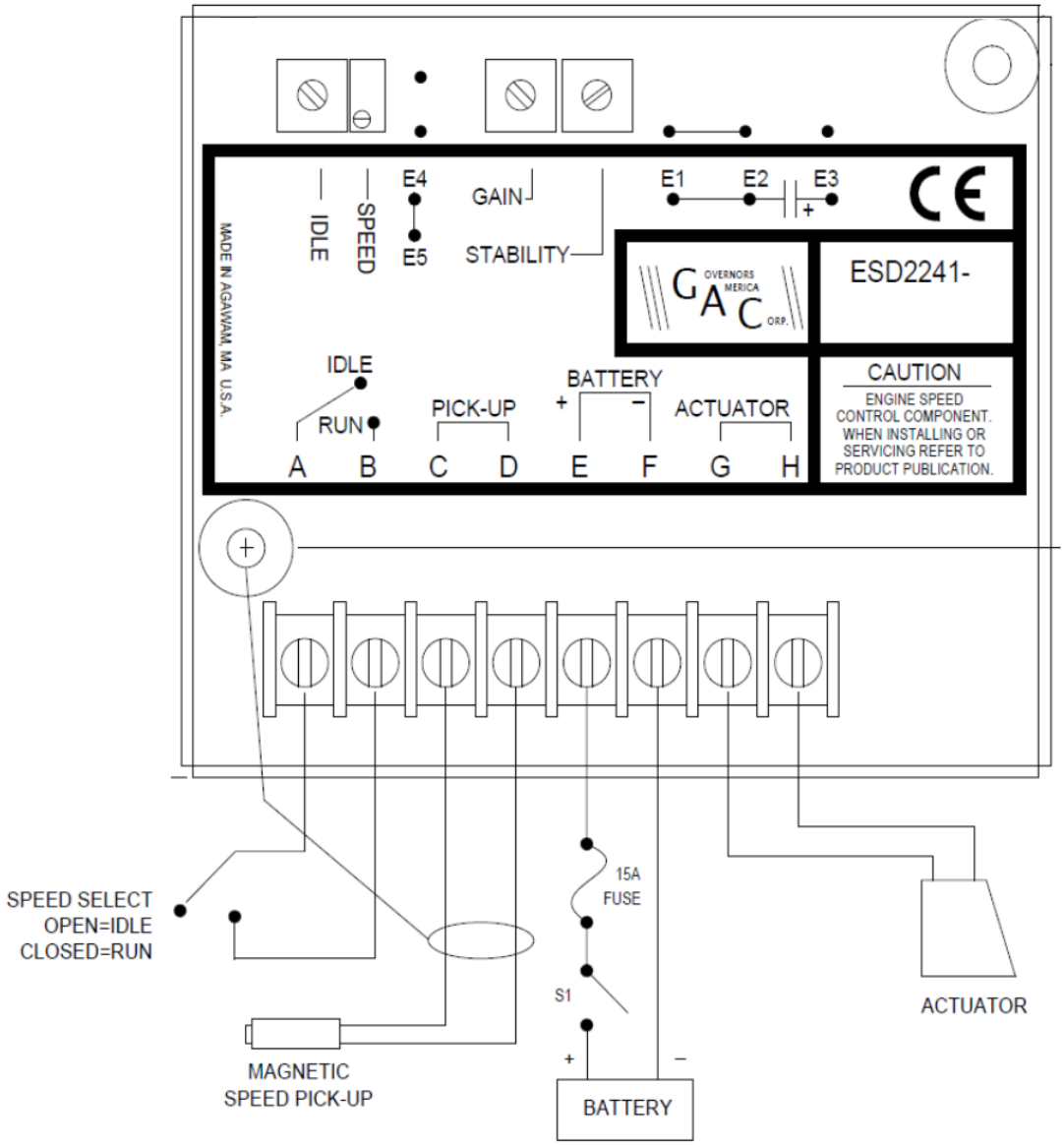


TERMINAL	DEFINITION	NOTES
A & B	Speed Trim	18 AWG (1.3mm sq) or larger wire
C & D	Magnetic Speed Pickup (D is ground)	Wires must be twisted and/or shielded for their entire length Gap between speed sensor and gear teeth should not be smaller than 0.02 in. (.51mm) Speed sensor voltage should be at least 1V AC RMS during crank
E & F	Battery Power (+/-)	16 AWG (1.3mm sw) or larger wire A 15 A fuse must be installed in the positive battery lead to protect against reverse voltage Battery positive (+) input is Terminal E
G & H	Actuator (+/-)	16 AWG (1.3mm sw) or larger wire

RECOMMENDATIONS	
1.	Shielded cable should be used for all external connections to the ESD control.
2.	One end of each shield, including the speed sensor shield, should be grounded to a single point on the ESD case.

4 WIRING (CONTINUED)

ESD2241 WIRING DIAGRAM



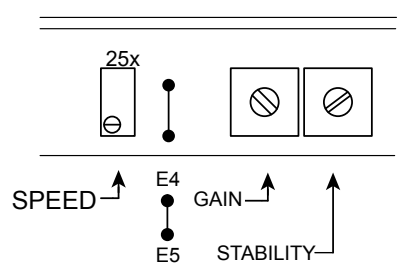
TERMINAL	DEFINITION	NOTES
A & B	Idle Switch	Open for Idle, Closed for Run Speed
C & D	Magnetic Speed Pickup (D is ground)	Wires must be twisted and/or shielded for their entire length Gap between speed sensor and gear teeth should not be smaller than 0.02 in. (.51mm) Speed sensor voltage should be at least 1 V AC RMS during crank
E & F	Battery Power (+/-)	#16 AWG (1.3mm sw) or larger wire A 15 amp fuse must be installed in the positive battery lead to protect against reverse voltage Battery positive (+) input is Terminal E
G & H	Actuator (+/-)	#16 AWG (1.3mm sw) or larger wire

RECOMMENDATIONS

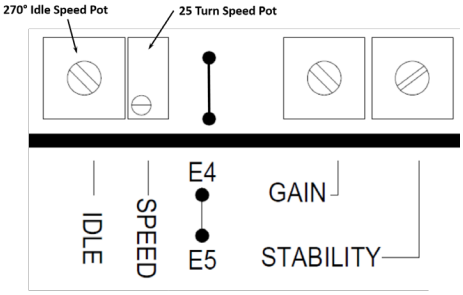
1. Shielded cable should be used for all external connections to the ESD control.
2. One end of each shield, including the speed sensor shield, should be grounded to a single point on the ESD case.

5 STARTING THE ENGINE

IMPORTANT Make the following adjustments before starting the engine.



ESD2210 and ESD2221



ESD2241

Gain	Middle Position
Stability	Middle Position
Speed Trim Control (Infused)	Middle Position

NOTE The governed speed set point is increased by clockwise rotation of the SPEED adjustment control. Remote speed adjustment can be obtained with an optional 5K Speed Trim Control.

The speed control unit governed speed setting is factory set at approximately engine idle speed (1000 Hz., Speed sensor signal or 600 RPM).

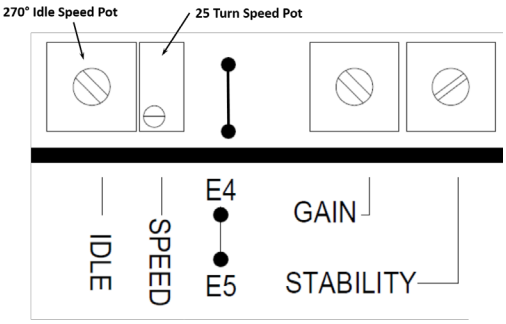
Crank the engine with DC power applied to the governor system. The actuator will energize to the maximum fuel position until the engine starts. The governor system should control the engine at a low idle speed. If the engine is unstable after starting, see Section 6, Adjusting for Stability.

6 ADJUSTING FOR STABILITY

Once the engine is running at operating speed and at no load, the following governor performance adjustments can be made to increase engine stability.

START FUEL ADJUSTMENT

1. Rotate the GAIN adjustment clockwise until instability develops.
2. Gradually move the adjustment counterclockwise until stability returns.
3. Move the adjustment one division further counterclockwise to ensure stable performance (270° pot).
4. Rotate the STABILITY adjustment clockwise until instability develops.
5. Gradually move the adjustment counterclockwise until stability returns.
6. Move the adjustment one division further to insure stable performance (270° pot).
7. Gain and stability adjustments may require minor changes after engine load is applied. Normally, adjustments made at no load achieve satisfactory performance.



NOTE If instability persists or further performance improvements are required, see Section 7, System Troubleshooting.

7 SYSTEM TROUBLESHOOTING

SYSTEM INOPERATIVE

If the engine governing system does not function, the fault may be determined by performing the voltage tests described in Steps 1 through 4. Positive (+) and negative (-) refer to meter polarity. Should normal values be indicated during troubleshooting steps, and then the fault may be with the actuator or the wiring to the actuator. Tests are performed with battery power on and the engine off, except where noted. See actuator publication for testing procedure on the actuator.

STEP	WIRES	NORMAL READING	PROBABLE CAUSE
1	E(+) & F(-)	Battery Supply Voltage (12, 24, or 32 V DC)	1. DC battery power not connected. Check for blown fuse. 2. Low battery voltage 3. Wiring error
2	A(+) & B(-)	0-3.9 with speed trim. 7.1-7.9 without speed trim.	1. Speed trim shorted or miswired. 2. Defective unit.
3	C(+) & D(-)	1.0 V AC minimum while cranking	1. Gap between speed sensor and gear teeth too great. 2. Improper or defective wiring to the speed sensor. Resistance should be between 30 to 1200 Ω. 3. Defective speed sensor.
4	H(-) & E(+)	0.8-1.5 V while cranking	1. Wiring error to actuator. 2. Defective speed control unit. 3. Defective actuator.
5	7(+) & 10(-) while cranking	8.4-9.4 V	1. SPEED adjustment set too low. 2. Wiring error to actuator. 3. Defective speed control unit. 4. Defective actuator.
6	6(+) & 2(-)	0.2-1.0 V while cranking	1. Wiring error to actuator 2. Defective speed control unit 3. Defective actuator

UNSATISFACTORY PERFORMANCE

SYMPTOM	NORMAL READING	PROBABLE CAUSE
Engine Overspeeds	1. Do Not Crank. Apply DC power to the governor system.	1. After the actuator goes to full fuel, disconnect the speed sensor at Terminal C & D. If the actuator is still at full fuel-speed then the speed control unit is defective. 2. If the actuator is at minimum fuel position and there exists an erroneous position signal, then check speed sensor cable.
	2. Manually hold the engine at the desired running speed. Measure the DC voltage between Terminals H(-) & E(+) on the speed control unit.	1. If the voltage reading is 1.0 to 1.5 V DC: a. SPEED adjustment is set above desired speed b. Defective speed control unit 2. If voltage reading is above 1.5 V DC then check for: a. actuator binding b. linkage binding 3. Set point of overspeed shutdown set too low. 4. If the voltage reading is below 0.8 V DC: a. Defective speed control unit
Actuator does not energize fully	1. Measure voltage between Terminals H(-) & E(+) on the speed control unit. Should be 0.8 to 1.5 V.	1. Replace the battery if weak or undersized. 2. Actuator wiring incorrect. 3. If the voltage is less than 1.5 V DC: SPEED set too low.
	2. Momentarily connect Terminals E to H. The actuator should move to the full fuel position.	1. Actuator or battery wiring in error 2. Actuator or linkage binding 3. Defective actuator
Engine remains below desired governed speed	1. Measure the actuator output, Terminals G & H, while running under governor control.	1. If voltage measurement is within 1.5 V DC of the battery supply voltage level, then fuel control is restricted from reaching full fuel position, possibly due to mechanical governor, carburetor spring, or linkage interference. 2. If not, increase speed setting.

7 SYSTEM TROUBLESHOOTING (CONTINUED)

INSTABILITY

INSTABILITY	SYMPTOM		PROBABLE CAUSE
Fast Periodic	The engine seems to jitter with a 3 Hz or faster irregularity of speed.	1.	Readjust GAIN and Stability afterward.
		2.	Turn off other electrical equipment that may be causing interference.
Slow Periodic	An irregularity of speed below 3 Hz.	1.	Readjust the GAIN and STABILITY
		2.	Adjust the DEAD TIME COMPENSATION by adding a capacitor from posts E2 to E3 (negative on E2). Start with 10 mfds and increase until instability is eliminated.
		3.	Check fuel system linkage during engine operation for: a. binding b. high friction c. poor linkage
Non-Periodic	Erratic Engine Behavior	1.	Increasing the GAIN should reduce the instability but not totally correct it. If this is the case, there is most likely a problem with the engine itself. Check for: a. engine mis-firings b. an erratic fuel system c. load changes on the generator set voltage regulator.
		2.	If throttle is slightly erratic, but performance is fast, then removing the jumper from E4 to E5 will tend to steady the system.

INSUFFICIENT MAGNETIC SPEED SIGNAL

A strong magnetic speed sensor signal will eliminate the possibility of missed or extra pulses. The speed control unit will govern well with 1.0 V RMS minimum speed sensor signal. A speed sensor signal of 3 V AC or greater at governed speed is recommended. Measurement of the signal is made at Terminals C and D.

The amplitude of the speed sensor signal can be raised by reducing the gap between the speed sensor tip and the engine ring gear. The gap should not be any smaller than 0.020 in (0.45 mm). When the engine is stopped, back the speed sensor out by 3/4 turn after touching the ring gear tooth to achieve a satisfactory air gap.