

## 1 OVERVIEW

The ESD2100 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 built ruggedly to withstand the engine environment.

- ◇ Multi-VDC
- ◇ Isochronous Operation
- ◇ Adjustable PID Functions
- ◇ Case Option Available
- ◇ Light Force Option Available



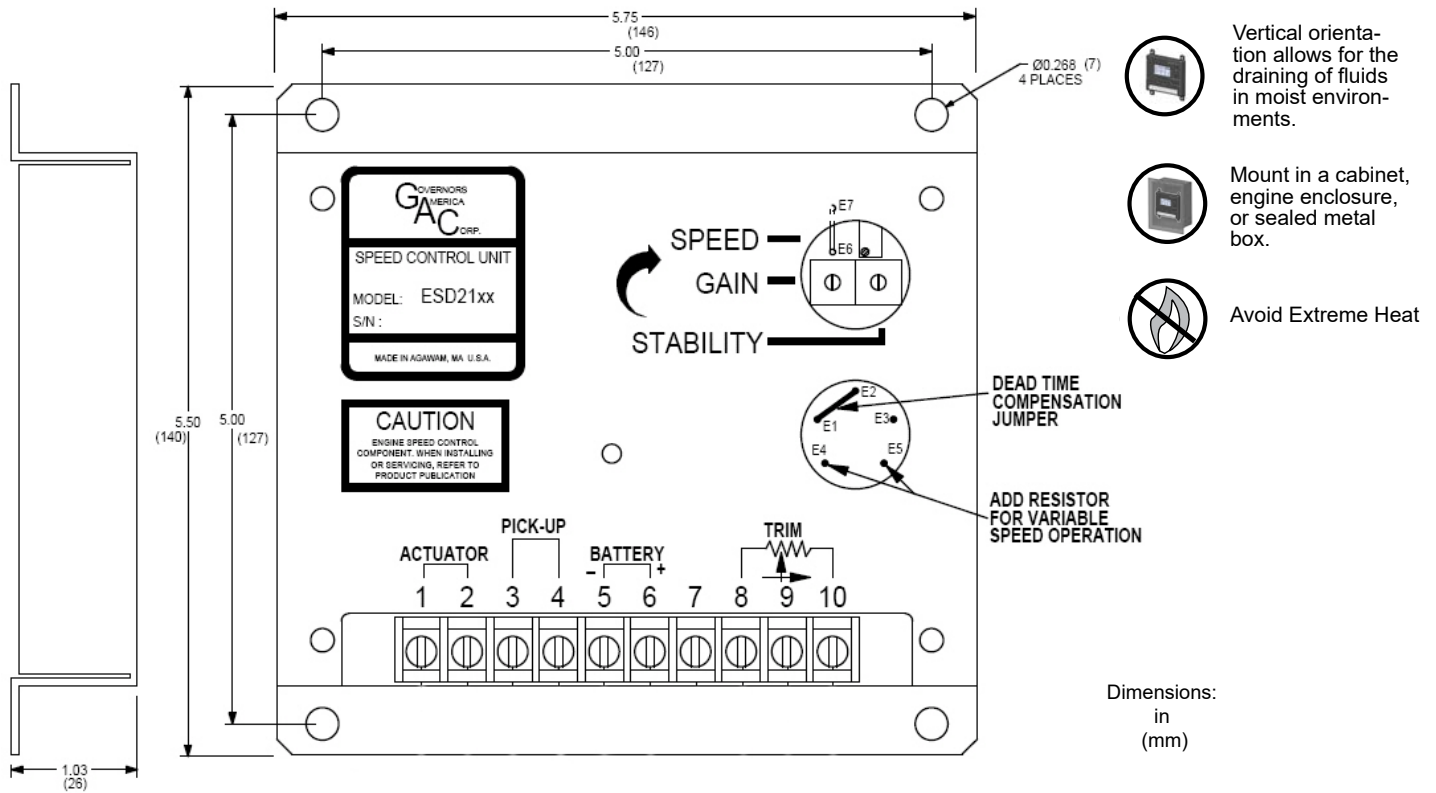
## 2 SPECIFICATIONS

PERFORMANCE	
Isochronous Operation	± 0.25 % or better
Speed Range / Governor	1 - 7.5 KHz Continuous
Speed Drift with Temperature	±1% MAX
Speed Trim Range	± 450 Hz
Remote Variable Speed Range	500 Hz - 6 KHz
Terminal 9 Sensitivity	120 Hz. ±15 Hz./V @ 250 K Impedance
INPUT / OUTPUT	
DC Supply	10 - 40 V DC 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 Peak
Speed Sensor Signal	0.5 - 50.0 V RMS

\* 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.

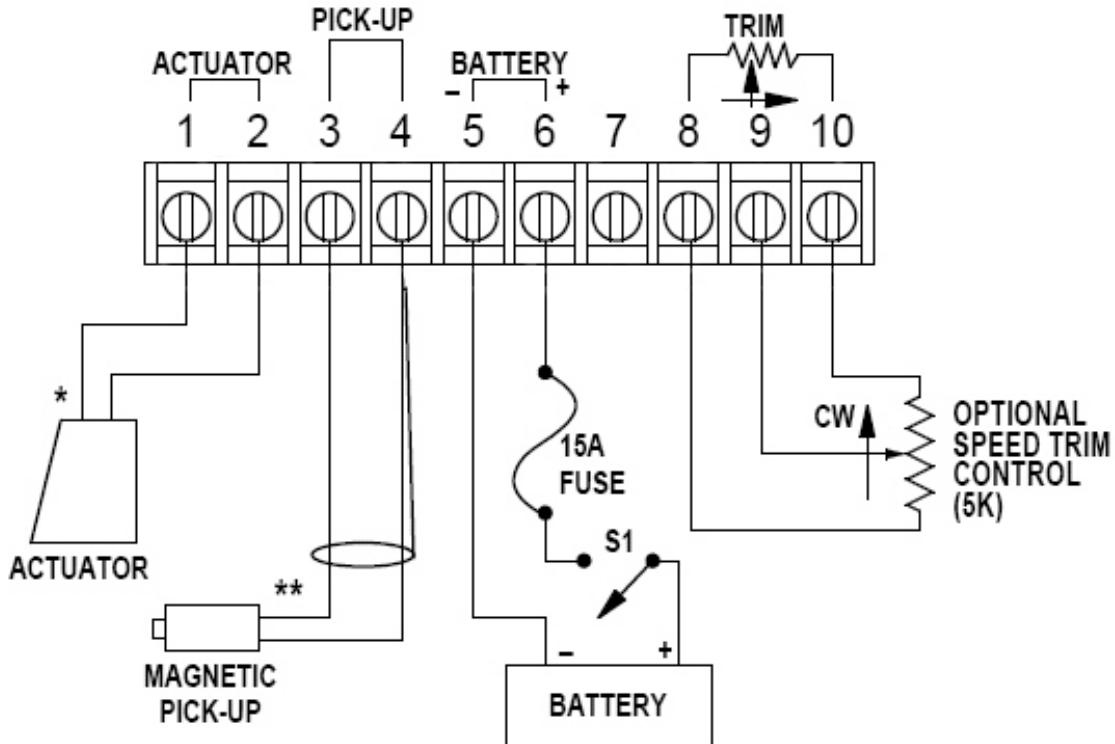
ENVIRONMENTAL	
Ambient Temperature	-40° to 85 °C [-40 to 185 °F]
Relative Humidity	up to 90 %
All Surface Finishes	Fungus-Proof and Corrosion-Resistant
PHYSICAL	
Dimension	See Section 3, Installation
Weight	1.2 lbf (545 gf)
Mounting	Any position, Vertical Preferred
RELIABILITY	
Vibration	5 g @ 20-500 Hz
Testing	Functionally Tested

### 3 INSTALLATION



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.

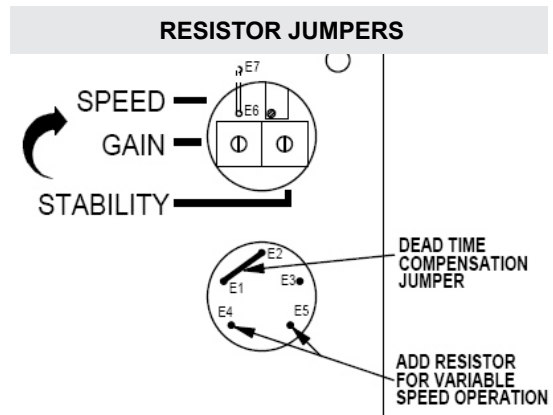


TERMINAL	DEFINITION	NOTES
1	Actuator	16 AWG [1.3 mm <sup>2</sup> ] or larger wire
2		
3	Magnetic Speed Pickup	<ul style="list-style-type: none"> <li>Wires must be twisted and/or shielded for their entire length</li> <li>Gap between speed sensor and gear teeth should not be smaller than 0.02 in (.51 mm)</li> <li>Speed sensor voltage should be at least 1 V AC RMS during crank</li> </ul>
4		
5	Battery Power (-)	16 AWG [1.3 mm <sup>2</sup> ] or larger wire
6	Battery Power (+)	A 15 amp fuse must be installed in the positive battery lead to protect against reverse voltage
7		
8	Speed Trim Control	Variable speed isochronous operation can be obtained by connecting a 5K potentiometer to Terminals 8, 9, and 10. To select the variable speed range, connect the appropriate resistor, R, to posts E4 and E5. See the Resistor Jumpers diagram below.
9		
10		

**RECOMMENDATIONS**

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

FREQUENCY RANGE (Hz)	RESISTOR
850	NONE
1280	2 M
1880	750 K
3400	300 K
5700	150 K



## 5 STARTING THE ENGINE

**IMPORTANT** Make sure the following adjustments are set before starting the engine.

Gain	Middle Position
Stability	Middle Position
Speed Trim Control	Middle Position

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, turn the GAIN and STABILITY adjustments counterclockwise until the engine is stable.

**NOTE** The governed speed set point is increased by clockwise rotation of the SPEED adjustment pot. Remote speed adjustment can be obtained with an optional 5K Speed Trim Control. See Section 4, Wiring.

## 6 ADJUSTING FOR STABILITY

Once the engine is at operating speed and at no-load, the following governor performance adjustments can be made:

### STABILITY ADJUSTMENT

1. Rotate the GAIN adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment one division further counterclockwise to ensure stable performance (270° pot).
2. Rotate the STABILITY adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment one division further to ensure stable performance (270° pot).
3. 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 cannot be corrected or further performance improvements are required, see Section 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 your actuator publication for additional testing and troubleshooting procedures.

STEP	WIRES	NORMAL READING	PROBABLE CAUSE
1	6(+) & 5(-)	Battery Supply Voltage (12, 24, or 32 V DC)	1. DC battery power not connected. Check for blown fuse, switch off power. 2. Low battery voltage 3. Wiring error
2	8(+) & 10(-)	6.5-7.1 V with speed trim 7.1-7.9 V without speed trim	1. Speed trim shorted or miswired. 2. Defective unit.
3	7(+) & 10(-)	1.8-2.6V	1. Low battery voltage 2. Defective Unit
4	3(+) & 4(-)	1.0 V AC RMS min. while cranking	1. Gap between speed sensor and gear teeth too great. Check Gap. 2. Improper or defective wiring to the speed sensor. Resistance between D and C should be 160 to 1200 Ω. See specific mag pickup data for resistance. 3. Defective speed sensor.
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 OF ABNORMAL READING
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 Orange and Green wires. 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 Terminal 2(-) & 6(+) on the speed control unit.	1. If the voltage reading is 0.2 to 1.0 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. If the voltage reading is below 0.2 V DC there is a chance of a defective speed control unit
Actuator does not energize fully while cranking	1. Measure the DC voltage between Terminals 2(-) & 6(+) on the speed control unit. Should be 0.2 to 1.0 volts. If not:	1. Actuator wiring incorrect  2. If the voltage is less than: a. 7 V for a 12 V system, or b. 14 V for a 24 V system, Then:  3. Check or replace battery.
	2. Momentarily connect Terminal 2 to 6. 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, Terminal 1 & 2, 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. Speed parameter set too low

**INSTABILITY**

INSTABILITY	SYMPTOM	PROBABLE CAUSE OF ABNORMAL READING
Fast Periodic	The engine seems to jitter with a 3Hz or faster irregularity of speed.	<ol style="list-style-type: none"> <li>1. Readjust the Gain and Stability for optimum control.</li> <li>2. Turn off other electrical equipment that may be causing interference.</li> <li>3. Cutting jumper from E1 to E2 should reduce the tendency to jitter.</li> <li>4. If not, remove the jumper from E6 to E7</li> </ol>
Slow Periodic	An irregularity of speed below 3Hz.	<ol style="list-style-type: none"> <li>1. Readjust the Gain and Stability for optimum control.</li> <li>2. Adjust 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.</li> <li>3. Check fuel system linkage during engine operation for: <ol style="list-style-type: none"> <li>a. binding</li> <li>b. high friction</li> <li>c. poor linkage</li> </ol> </li> </ol>
Non-Periodic	Erratic Engine Behavior	<ol style="list-style-type: none"> <li>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: <ol style="list-style-type: none"> <li>a. engine mis-firings</li> <li>b. an erratic fuel system</li> <li>c. load changes on the generator set voltage regulator.</li> </ol> </li> <li>2. If the throttle is slightly erratic, but the performance is fast, removing the jumper from E6 to E7 will tend to steady the system.</li> </ol>

**INSUFFICIENT MAGNETIC SPEED SIGNAL**

A strong magnetic speed sensor signal eliminates the possibility of missed or extra pulses. The speed control unit will govern well with a 0.5VAC RMS speed sensor signal. However, a speed sensor signal of 3 V AC RMS or greater is recommended.

The amplitude of the speed sensor signal can be raised by reducing the gap between the tip of the speed sensor and the top land of a tooth on the engine's ring-gear. This gap should not be any smaller than 0.020 in. (0.45 mm).

With the engine stopped, turn the magnetic speed sensor CW until it touches the top land of a ring-gear tooth, then turn it CCW 3/4 turn. This will provide an acceptable gap.

If unsuccessful in solving instability, contact GAC for assistance.  
GAC@governors-america.com or call: 1-413-233-1888