ESD2300 Series
Speed Control Unit

+1 413 233 1888
www.governors-america.com

1 OVERVIEW

The ESD2300 Series speed control unit is an electronic speed control 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 hard potted to withstand the engine environment.

- 12 V DC
- Variable Speed Control
- Adjustable PID Functions
- Foot Pedal and Installation Kit
- Single Element Speed Switch

PRODUCT	DESCRIPTION	USE WITH FOOT PEDAL
ESD2349-12	12 V DC, Off Road, Variable Speed, Horizontal Foot Pedal	FP100
ESD2351-12	12 V DC, supports Horizontal and Vertical Foot Pedals	FP201* (Vertical) FP202** (Horizontal)
ESD2352-12	12 V DC, configured for use with Morse Foot Pedal	Not supplied by GAC

* Pedal with mounting hardware available as KT-FP201
** Pedal with mounting hardware available as KT-FP202

2 SPECIFICATIONS

PERFORMANCE	
Isochronous Operation	± 0.25 % or better
Speed Range / Governor	1 - 7.5 KHz Continuous
Speed Drift with Temperature	Typically < +0.5 %
Idle Range	500 to 5000 Hz with trim pot installed
INPUT / OUTPUT	
DC Supply Nominal	12 V DC; 8-20 V DC Transient and Reverse Voltage Protected
Polarity	Negative Ground (Case Isolated)
Power Consumption	60 mA continuous plus actuator current
Speed Signal Range	0.5 - 50 V AC
Actuator Current Range @ 77° F (25 °C)	MIN 2.5 A MAX 10 A
Speed Sensor Signal	0.5 - 50 V AC RMS

RELIABILITY	
Vibration	5 g @ 20-500 Hz
Testing	100% Functionally Tested
ENVIRONMENTAL	
Ambient Temperature	-40° to 85 °C (-40 ° to 180 °F)
Relative Humidity	up to 95 %
All Surface Finishes	Fungus Proof and Corrosion Resistant
PHYSICAL	
Dimension	See Wiring Diagram and Outline
Weight	1.2 lbf (0.544 kgf)
Mounting	Any position, Vertical Preferred
COMPLIANCE / STANDARDS	
Agency	CE and RoHS Requirements

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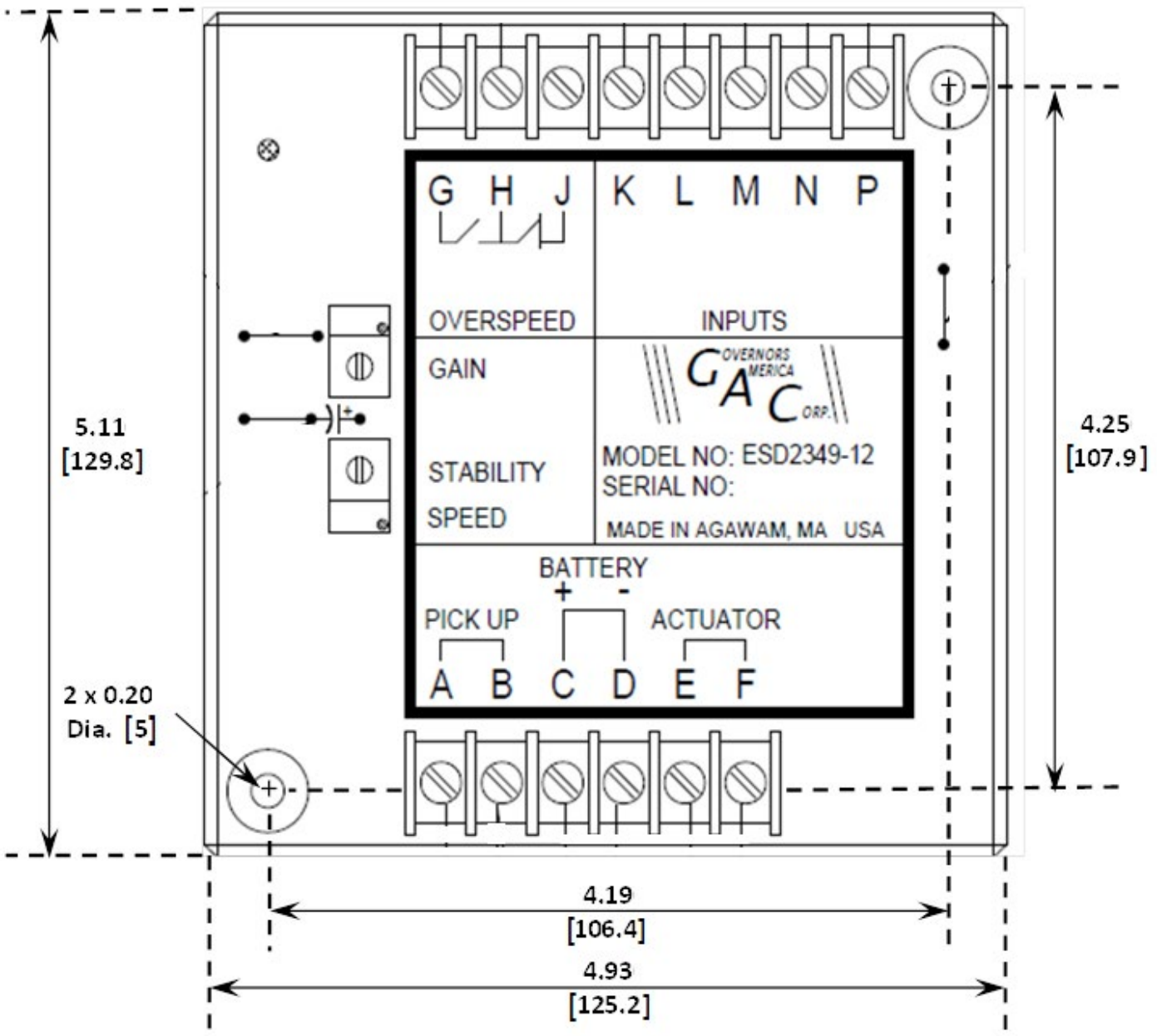
3 INSTALLATION



Dimensions: in
[mm]

Vertical orientation allows fluids to drain in moist environments.

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

Avoid Extreme Heat

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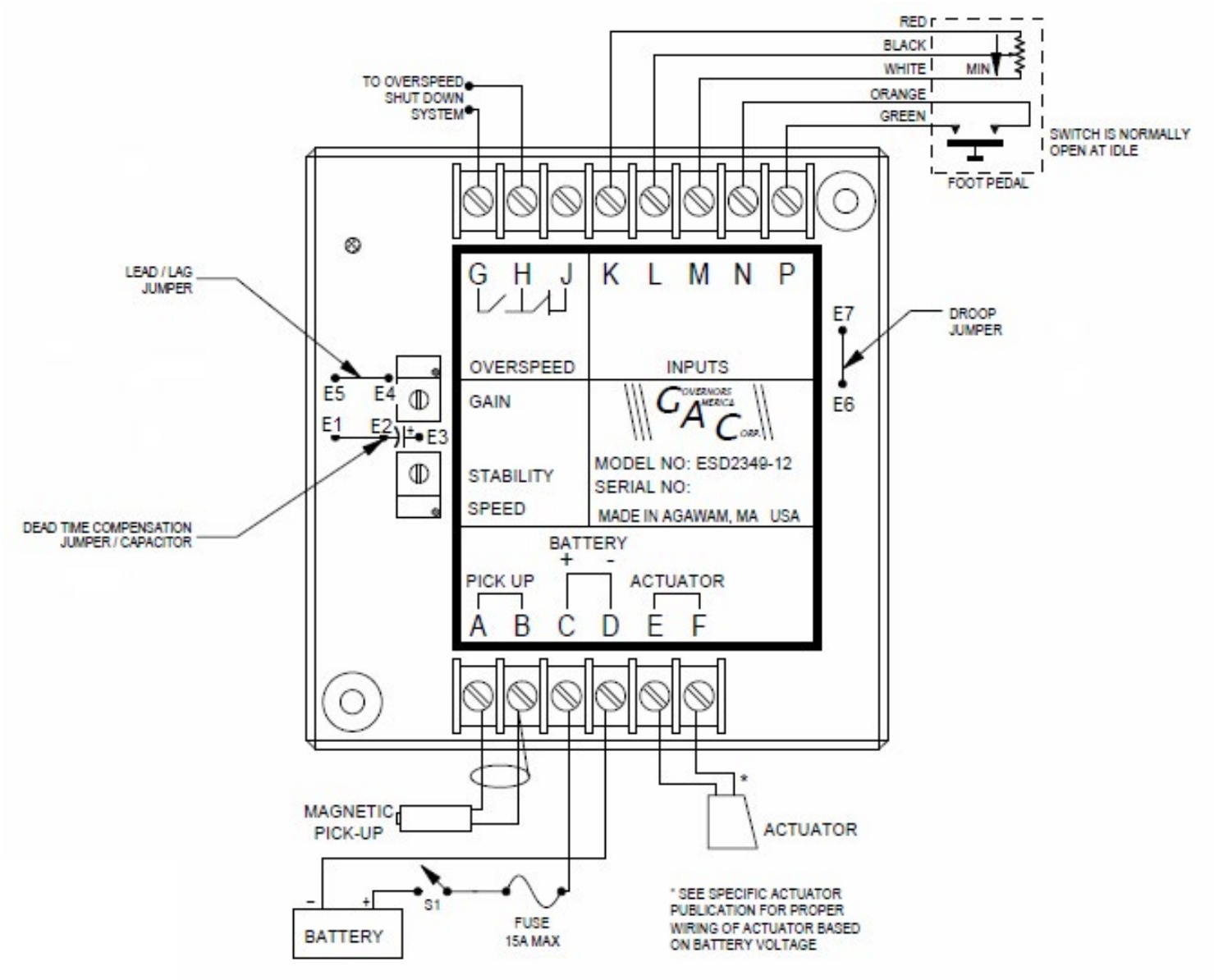
4 WIRING



TERMINAL	DEFINITION	NOTES
A & B	Magnetic Speed Pick-up	• Wires must be twisted and/or shielded for their entire length • Gap between the speed sensor and gear teeth should not be smaller than 0.025 in (0.64mm) and no larger than 0.035 in (0.89 mm) • Speed sensor voltage should be at least 1.0 V AC RMS during cranking
C & D	Battery Power 12VDC	• 16 gauge (1.3 mm^2) or larger wire • Install a 15 amp fuse in the positive battery lead to protect against reverse voltage • Battery positive (+) input is Terminal C
E & F	Actuator (+/-)	16 gauge (1.3 mm^2) or larger wire
G & H & J	Overspeed Shut Down System	Terminal G ─ Normally Open Terminal H ─ Common Terminal J ─ Normally Closed
K Through P	Foot Pedal	Terminal K ─ Supply ─ Red Terminal L ─ Sensor Signal ─ Black Terminal M ─ Ground ─ White

RECOMMENDATIONS

1. Use shielded cable 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.

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5 ADJUSTMENTS

BEFORE ENGINE STARTUP

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

GAIN	Middle Position
STABILITY	Middle Position

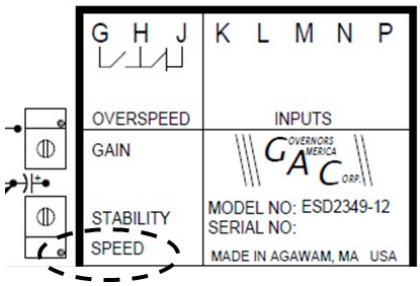
START THE ENGINE

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 ADJUSTING FOR STABILITY in this section.

SPEED CONTROLLER SPEED SETTING

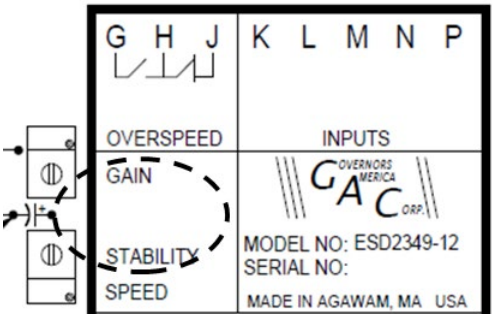
The governed speed set point is increased by turning the SPEED adjustment clockwise (25-turn potentiometer).



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.

PARAMETER	PROCEDURE
GAIN	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° potentiometer). 4. If instability persists, adjust the next parameter.
STABILITY	Follow the same adjustment procedure, steps 1 - 3, as the GAIN parameter.
Normally, adjustments made at no load achieve satisfactory performance. If further performance improvements are required, see Section 6, SYSTEM TROUBLESHOOTING.	



ENGINE OVERSPEED

The ESD2300 Series speed control unit includes a single element speed switch to sense and react to an overspeed condition. An internal relay and LED are activated when this occurs. This relay should be used to shut off the fuel or ignition to provide safe engine shut down. The speed switch feature includes a wide range of adjustment to set the trip point.

VARIABLE FOOT PEDAL OPERATION

The speed potentiometer is used to set maximum speed with the foot pedal depressed, or the minimum speed (idle) with the pedal released.

- ESD2349 uses GAC Foot pedal FP100 for Horizontal installations.
- ESD2351 uses GAC Foot Pedal FP201 for vertical mounting or FP202 for horizontal installations.
- ESD2352 is specially configured for compatibility with a Morse foot pedal. Morse foot pedals are not supplied by GAC.

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6 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 3. Positive (+) and negative (-) refer to meter polarity. Should normal values be indicated during troubleshooting steps, the fault may be with the actuator (device) 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 OF ABNORMAL READING
1	C(+) & D(-)	Battery Supply Voltage (12 V DC)	1. DC battery power not connected. Check for blown fuse. 2. Low battery voltage 3. Wiring error
2	A(+) & B(-)	1.0 V AC RMS min. while cranking	1. Gap between speed sensor and gear teeth is too large. Check Gap. 2. Improper or defective wiring to the speed sensor. Resistance should be 30 to 1200 Ω. See your specific magnetic pickup documentation for resistance information. 3. Defective speed sensor.
3	C (+) & F	0.5 - 1.5 V DC while cranking	1. Short/open in actuator / device wiring 2. Defective speed control unit 3. Defective actuator / device, see your Installation Manual System Troubleshooting section.

INSTABILITY

INSTABILITY	SYMPTOM	PROBABLE CAUSE OF ABNORMAL READING
Fast Periodic	The engine seems to jitter with a 3 Hz or faster irregularity of speed.	1. Readjust the GAIN and STABILITY for optimum control. 2. Remove the E1 to E2 jumper. Readjust GAIN and STABILITY. 3. 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. 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 likely a problem with the engine. Check for: a. engine mis-firings b. erratic fuel system c. load changes on the generator set voltage regulator.

If unsuccessful in solving instability, contact GAC for assistance.
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6 SYSTEM TROUBLESHOOTING

UNSATISFACTORY PERFORMANCE

SYMPTOM		NORMAL READING		PROBABLE CAUSE OF ABNORMAL READING
Engine Overspeeds	1.	Do Not Crank. Apply DC power to the governor system.	1. 2.	After the actuator (device) goes to full fuel/open, disconnect the speed sensor wires. If the device is still at full fuel, the speed control unit is defective. 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 F(-) & C(+) on the speed control unit.	1. 2. 3. 4.	If the voltage reading is 0.5 to 1.5 V DC: a. SPEED adjustment set above desired speed. b. Defective speed control unit. If the voltage reading is above 1.5VDC, actuator or linkage could be binding. Set point of the overspeed shutdown set too low. If the voltage reading is below 0.5 V DC, defective speed control unit.
Device does not energize fully.	1.	Measure the voltage at the battery while cranking.	1.	If the voltage is less than: a. 7 V for a 12 V system, or b. 14 V for a 24 V system, Check or replace battery.
	2.	Momentarily connect Terminals A and F. The device should move to the full fuel position.	1. 2. 3. 4.	Device or battery wiring in error. Device or linkage binding. Defective device. Fuse opens. Check for short in device or harness.
Engine remains below desired governed speed.	1.	Measure the device output, Terminals A & B, while running under governor control.	1. 2.	If voltage measurements is within 2 V DC or more of the battery supply voltage level, then fuel control restricted from reaching full fuel position. Possibly due to mechanical governor, carburetor spring, or linkage interference. SPEED parameter set too low.

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 volts RMS 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 A and B.

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.

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