ESD5100 Series Speed Control Unit

ISO 9001 CERTIFIED

GAC GOVERNORS AMERICA CORP.®

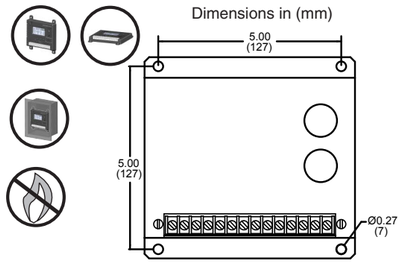
1 INSTALLATION

See Section 10 for more dimensions

Vertical orientation allows fluids to drain in moist environments.

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

Avoid Extreme Heat



2 WIRING

See Section 10 for the Wiring Diagram

TERMINAL	DEFINITION	NOTES
A & B	Actuator (+/-)	#16 AWG (1.3 mm 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 0.025 in. (.64mm) and no larger than 0.035 in. (.89 mm) Speed sensor voltage should be at least 1VAC RMS during crank
E & F	Battery Power (-/+)	#16 AWG (1.3mm sq) 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 F
G	Ground Signal	
H		Add jumper to increase droop range
J	Variable Speed Input	0 - 5V DC
K & L	Droop Select	Active When Closed
M & L	Idle Select	
N	Accessory Input	Load Sharing / Synchronizing,
P	Accessory Power Supply	+10 Volt

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.

3 ADJUSTMENTS BEFORE ENGINE STARTUP

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

GAIN	Middle Position
STABILITY	Middle Position
SPEED TRIM CONTROL	Middle Position

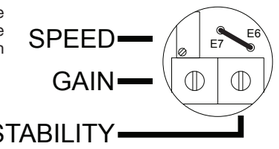
4 START THE ENGINE

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, refer to Section 6 ADJUSTING FOR STABILITY.

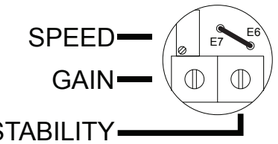
5 GOVERNOR SPEED SETTING

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.



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.

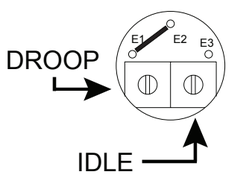


STABILITY ADJUSTMENT			
PARAMETER		**PROCEDURE**	
A.	GAIN	1.	Rotate the GAIN adjustment clockwise until instability develops.
		2.	Then, gradually move the adjustment counterclockwise until stability returns.
		3.	Finally, move the adjustment one division further counterclockwise to insure stable performance (270° potentiometer).
		4.	If instability persists, adjust the next parameter.
B.	STABILITY	1.	Follow the same adjustment procedure, steps 1 - 3, as the GAIN parameter.
NOTE	Normally, adjustments made at no load achieve satisfactory performance. If further performance improvements are required, refer to Section (8) SYSTEM TROUBLESHOOTING. Information can be found regarding the adjustment of the DIP switch positions on the ESD.		

7 ADDITIONAL FEATURES & OPTIONAL WIRING

Idle Speed Setting

After the governor speed setting had been adjusted, place the optional external selector switch in the IDLE position. The idle speed set point is increased by the clockwise rotation of the IDLE adjustment control. When the engine is at idle speed, the speed control unit applies droop to the governor system to insure stable operation.



Speed Droop Operation

Droop is typically used for the paralleling of engine driven generators. When in droop operation, the engine speed will decrease as engine load increases. The percentage of droop is based on the actuator current change from no engine load to full load.

1. Place the optional external selector switch in the DROOP position. DROOP is increased by clockwise rotation of the DROOP adjustment control.
2. After the droop level has been adjusted, the rated engine speed setting may need to be reset. Check the engines speed and adjust that speed setting accordingly.

NOTE Though a wide range of droop is available with the internal control, droop level requirements of 10% are unusual. If droop levels experienced are higher or lower than those required, contact GAC for assistance.

Accessory Input

The Auxiliary Terminal N accepts input signals from load sharing units, auto synchronizers, and other governor system accessories, GAC accessories are directly connected to this terminal.

NOTES

- Terminal N is sensative. Accessory connections must be shielded.
- When an accessory is connected to Terminal N, the speed will decrease and the speed adjustment must be reset.
- When operating in the upper end of the control unit frequency range, a jumper wire or frequency trim control may be required between Terminals G and J. This increases the frequency range of the speed control to over 7000 Hz (4200 RPM).
- If the auto synchronizer is used alone, not in conjunction with a load sharing module, a 3m ohm resister should be connected between Terminals N and P. This is required to match the voltage levels between the speed control unit and the synchronizer.

Accessory Supply

The +10 volt regulated supply, Terminal P, can be utilized to provide power to GAC governor system accessories. Up to 20 mA of current can be drawn from this supply. Ground reference is Terminal G.

CAUTION A short circuit on this terminal can damage the speed control unit.

Wide Range Remote Variable Speed Operation

A single remote speed adjustment potentiometer can be used to adjust the engine speed continuously over a specific speed range.

Select the desired speed range and corresponding potentiometer value. (Refer to TABLE 1 below) If the exact range cannot be found, select the next higher range potentiometer.

NOTE An additional fixed resistor may be placed across the potentiometer to obtain the exact desired range. Connect the speed range potentiometer as shown in DIAGRAM 1 below.

To maintain engine stability at the minimum speed setting, a small amount of droop can be added using the DROOP adjustment. At the maximum speed setting the governor performance will be near isochronous, regardless of the droop adjustment setting.

NOTE Contact GAC for assistance if difficulty is experienced in obtaining the desired variable speed governing performance.

TABLE 1

SPEED RANGE		POTENTIOMETER VALUE
900 Hz	540 RPM	1 K
2400 Hz	1440 RPM	5 K
3000 Hz	1800 RPM	10 K
3500 Hz	2100 RPM	25 K
3700 Hz	2220 RPM	50 K
NOTE	RPM values shown are for 100 teeth flywheel	

8 SYSTEM TROUBLESHOOTING

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 VAC speed sensor signal. A speed sensor signal of 3 volts VAC 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 0.025 in (0.64 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.

System Inoperative

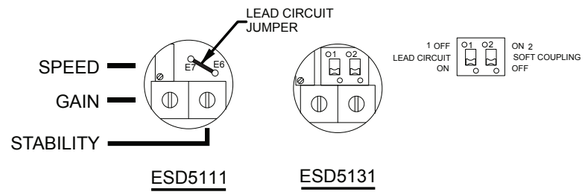
If the engine governing system does not function, the fault may be determined by performing the voltage tests described in Steps 1 through 4. Positive (+) and negative (-) refer to meter polarity. Should normal values be indicated during troubleshooting steps, and then the fault may be with the actuator 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 OF ABNORMAL READING
1	F(+) & E(-)	Battery Supply Voltage (12 or 24 VDC)	1. DC battery power not connected. Check for blown fuse. 2. Low battery voltage 3. Wiring error
2	C(+) & D(-)	1.0 VAC minimum 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 ohms. See specific mag pickup data for resistance. 3. Defective speed sensor.
3	P(+) & G(-)	10 VDC, Internal Suuply	1. Short on Terminal P. 2. Defective speed control unit.
4	F(+) & A(-)	1.0 - 2.0 VDC while cranking	1. SPEED parameter set too low 2. Short/open in actuator wiring 3. Defective speed control 4. Defective actuator, see Actuator Troubleshooting

Instability

Instability in a closed loop speed control system can be categorized into two general types. PERIODIC appears to be sinusoidal and at a regular rate. NON-PERIODIC is a random wandering or an occasional deviation from a steady state band for no apparent reason.

NOTE The ESD5131 Speed Control Unit was derived from the standard GAC ESD5111 Speed Control Unit. All specifications, installation procedures, and adjustments, except those noted are identical. The difference between the ESD5131 and the ESD5111 lies in the two DIP switches located under the upper access hole.



Switch 1 controls the “Lead Circuit” found in the ESD5111. The normal position is “ON.” Move the switch to the “OFF” position if there is fast instability in the system.

Switch 2 controls an additional circuit added in the ESD5131 that is designed to eliminate fast erratic governor behavior, caused by very soft or worn couplings in the drive train between the engine and generator. The normal position is “OFF.” Move to the “ON” position if fast erratic engine behavior due to a soft coupling is experienced.

Instability

INSTABILITY	SYMPTOM	PROBABLE CAUSE OF ABNORMAL READING
Fast Periodic	The engine seems to jitter with a 3Hz or faster irregularity of speed.	1. Turn off other electrical equipment that may be causing interference. 2. Readjust the GAIN and STABILITY for optimum control. 3. Remove the E6 to E7 jumper (This reduces sensitivity to high frequencies). 4. If system is still unstable, remove the E1 to E2 jumper and readjust GAIN and STABILITY.
Slow Periodic	An irregularity of speed below 3Hz.	1. Readjust the GAIN and STABILITY 2. Set DIP switches 1 and 2 to “ON” in the following order: First SW1, Second SW2, and Third SW1 & SW2. 3. Check fuel system linkage during engine operation for: a. binding b. high friction c. poor linkage 4. 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.
Non-Periodic	Erratic Engine Behavior	1. Increasing the GAIN should reduce the instability but not totaly 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 slghtly erratic, but performance is fast, then remove the jumper from E6 to E7.

If unsuccessful in solving instability, contact GAC for assistance.
info@governors-america.com or call 413-786-5600

Unsatisfactory Performance

SYMPTOM	NORMAL READING	PROBABLE CAUSE OF ABNORMAL READING
Engine Over-speeds	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. Manually hold the engine at the desired running speed. Measure the DC voltage between Terminals A(-) & F(+) on the speed control unit.	1. If the voltage reading is 1.0 to 2.0 VDC: a. SPEED adjustment is set above desired speed b. Defective speed control unit 2. If voltage reading is above 2.0 VDC then check for: a. actuator binding b. linkage binding 3. Set point of overspeed shutdown device set too low. 4. If the voltage reading is below 1.0 VDC: a. Defective speed control unit
Overspeed Shuts Down Engine After Running Speed is Reached		1. Speed adjustment set too high. 2. OVERSPEED set to close to running speed. 3. Actuator or linkage binding. 4. Speed control unit defective.
Overspeed Shuts Down Engine Before Running Speed is Reached	1. Check impedance between Terminals C & D. Should be 160 to 1200 Ohms	1. OVERSPEED set too low. Adjust 5-6 turns CW. 2. Erroneous speed sensor signal. Check wiring.
Actuator does not energize fully	1. Measure the voltage at the battery while cranking.	1. If voltage is less than 7V for a 12V system, or 14V for a 24V system, check or replace the battery.
	2. Momentarily connect Terminals A and F. The actuator should move to the full fuel position.	1. Actuator or battery wiring in error 2. Actuator or linkage binding 3. Defective actuator 4. Fuse opens. Check for short in actuator or harness.
Engine remains below desired governed speed	1. Measure the actuator output, Terminals A & B, while running under governor control.	1. If voltage measurement is within 2 VDC 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.

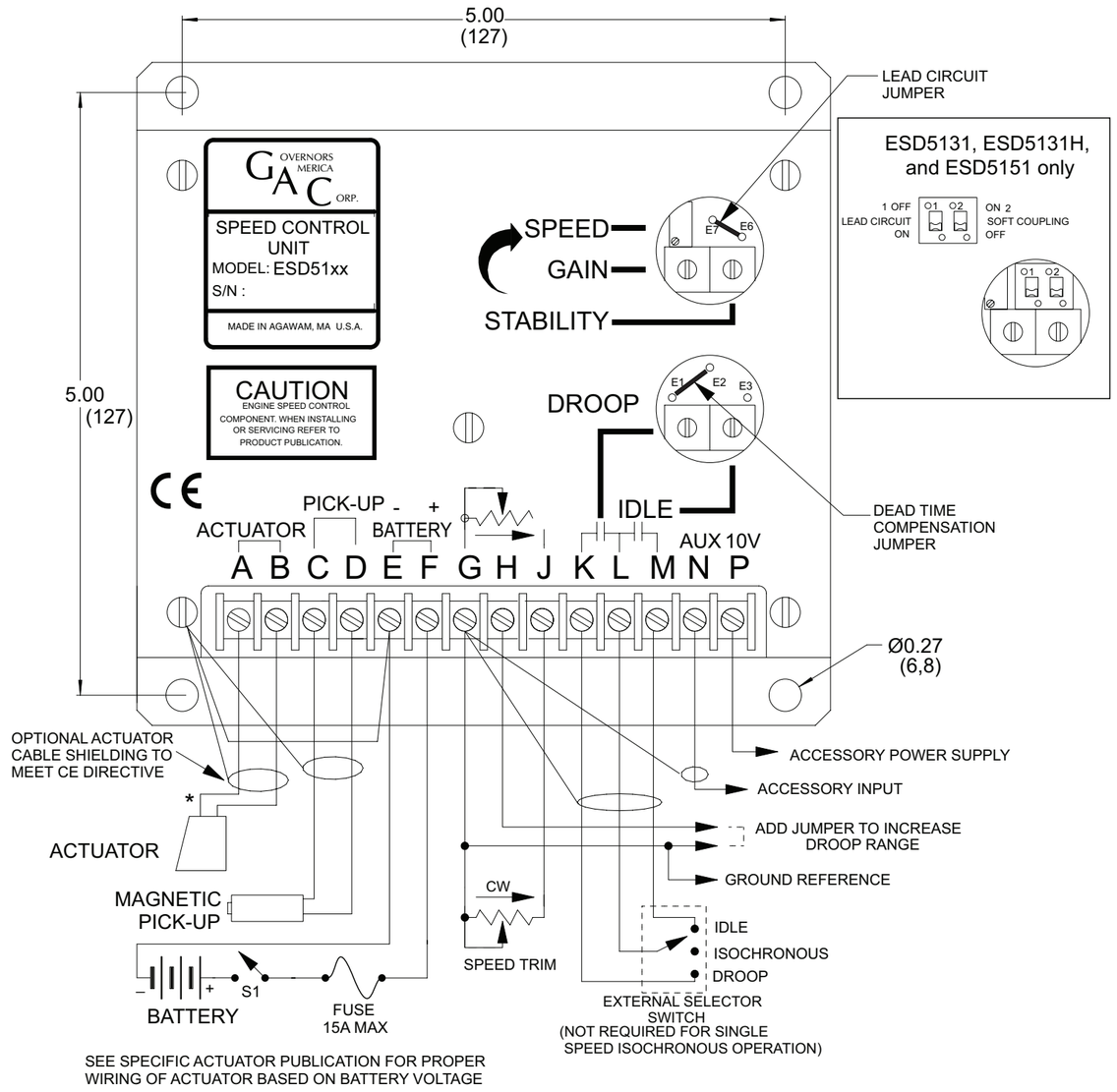
GAC Governors America Corp.®
720 Silver Street,
Agawam, MA 01001 USA
info@governors-america.com
www.governors-america.com

9 SPECIFICATIONS

CE RoHS

PERFORMANCE	
Isochronous Operation	± 0.25% or better
Speed Range / Governor	1 - 7.5 KHz Continuous
Speed Drift with Temperature	±0.5% Typical
Idle Adjust CW	Min. 1200 Hz below set speed
Idle Adjust CCW	Min. 4100 Hz below set speed
Droop Range	1 - 5% regulation
Droop Adj. Max. (K-L Jumpered)	875 Hz., ±75 Hz per 1.0 A change
Droop Adj. Min. (K-L Jumpered)	15 Hz., ±6 Hz per 1.0 A change
Speed Trim Range	± 200 Hz
Remote Variable Speed Range	500 Hz - 3.7 KHz
Terminal Sensitivity J L N P	 115 Hz., ±15 Hz/Volt @ 5.0 K Impedance 735 Hz., ±60 Hz/Volt @ 65 K Impedance 148 Hz., ±10 Hz/Volt @ 1 M Impedance 10 VDC Supply @ 20 mA Max
INPUT / OUTPUT	
DC Supply	12 - 24 VDC Battery Systems Transient and Reverse Voltage Protected
Polarity	Negative Ground (Case Isolated)
Power Consumption	100 mA (No Actuator Current)
Actuator Current Range	10 A Continuous @ 77°F (25°C)
Speed Signal Range	0.5 - 50 VAC
RELIABILITY	
Vibration	1G @ 20 - 100 Hz
ENVIRONMENTAL	
Ambient Temperature	-40° to 85°C (-40 to 185°F)
Relative Humidity	up to 95%
All Surface Finishes	Fungus Proof and Corrosion Resistant
COMPLIANCE / STANDARDS	
Agency	CE and RoHS Requirements
PHYSICAL	
Dimension	See Wiring and Outline Diagram
Weight	1.2 lb. (0.545 kg)
Mounting	Any position, Vertical Preferred

10 WIRING DIAGRAM & DIMENSIONS



SEE SPECIFIC ACTUATOR PUBLICATION FOR PROPER WIRING OF ACTUATOR BASED ON BATTERY VOLTAGE