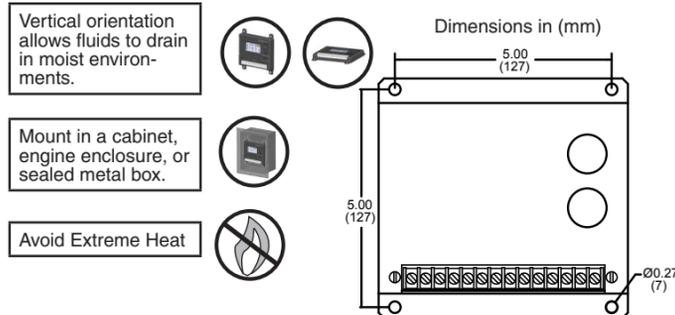


1 INSTALLATION

See Section 10 for more dimensions



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

- 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.

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 |

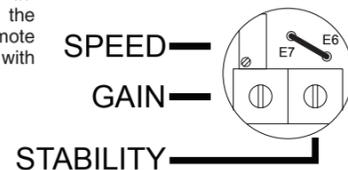
4 START THE ENGINE

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.

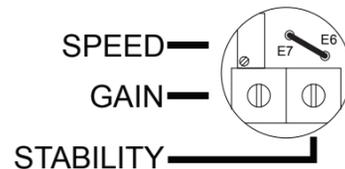
5 GOVERNOR SPEED SETTING

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.

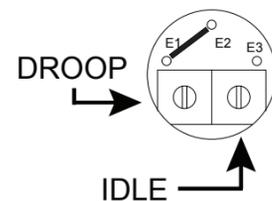


| PARAMETER | | PROCEDURE |
|-----------|-----------|---|
| A. | GAIN | <ol style="list-style-type: none"> Rotate the GAIN adjustment clockwise until instability develops. Then, gradually move the adjustment counterclockwise until stability returns. Finally, move the adjustment one division further counterclockwise to insure stable performance (270° potentiometer). If instability persists, adjust the next parameter. |
| B. | STABILITY | <ol style="list-style-type: none"> 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. |
| | <ol style="list-style-type: none"> Place the optional external selector switch in the DROOP position. DROOP is increased by clockwise rotation of the DROOP adjustment control. 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 sensitive. 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 resistor 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

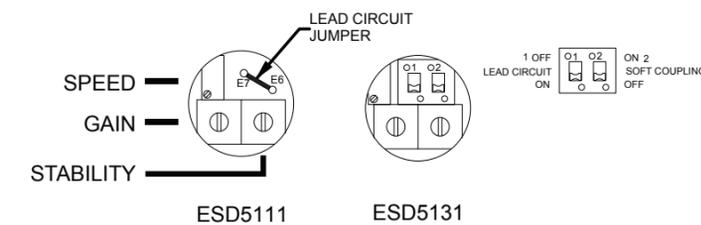
If the engine governing system does not function, the fault may be determined by performing the voltage tests described in Steps 1 through 4. Positive (+) and negative (-) refer to meter polarity. Should normal values be indicated during troubleshooting steps, and then the fault may be with the actuator 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) | <ol style="list-style-type: none"> DC battery power not connected. Check for blown fuse. Low battery voltage Wiring error |
| 2 | C(+) & D(-) | 1.0 VAC minimum while cranking | <ol style="list-style-type: none"> Gap between speed sensor and gear teeth too great. Check Gap. 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. Defective speed sensor. |
| 3 | P(+) & G(-) | 10 VDC, Internal Supply | <ol style="list-style-type: none"> Short on Terminal P. Defective speed control unit. |
| 4 | F(+) & A(-) | 1.0 - 2.0 VDC while cranking | <ol style="list-style-type: none"> SPEED parameter set too low Short/open in actuator wiring Defective speed control 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. | <ol style="list-style-type: none"> Turn off other electrical equipment that may be causing interference. Readjust the GAIN and STABILITY for optimum control. Remove the E6 to E7 jumper (This reduces sensitivity to high frequencies). If system is still unstable, remove the E1 to E2 jumper and readjust GAIN and STABILITY. |
| Slow Periodic | An irregularity of speed below 3Hz. | <ol style="list-style-type: none"> Readjust the GAIN and STABILITY Set DIP switches 1 and 2 to "ON" in the following order: First SW1, Second SW2, and Third SW1 & SW2. Check fuel system linkage during engine operation for: <ol style="list-style-type: none"> binding high friction poor linkage Adjust the DEAD TIME COMPENSATION by adding a capacitor from posts E2 to E3 (negative on E2). Start with 10 mfd. and increase until instability is eliminated. |
| Non-Periodic | Erratic Engine Behavior | <ol style="list-style-type: none"> 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"> engine mis-firings an erratic fuel system load changes on the generator set voltage regulator. If throttle is slightly 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 | <ol style="list-style-type: none"> Do Not Crank. Apply DC power to the governor system. Manually hold the engine at the desired running speed. Measure the DC voltage between Terminals A(-) & F(+) on the speed control unit. | <ol style="list-style-type: none"> 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. If the voltage reading is 1.0 to 2.0 VDC: <ol style="list-style-type: none"> SPEED adjustment is set above desired speed Defective speed control unit If voltage reading is above 2.0 VDC then check for: <ol style="list-style-type: none"> actuator binding linkage binding Set point of overspeed shutdown device set too low. If the voltage reading is below 1.0 VDC: <ol style="list-style-type: none"> Defective speed control unit |
| Overspeed Shuts Down Engine After Running Speed is Reached | | <ol style="list-style-type: none"> Speed adjustment set too high. OVERSPEED set to close to running speed. Actuator or linkage binding. Speed control unit defective. |
| Overspeed Shuts Down Engine Before Running Speed is Reached | <ol style="list-style-type: none"> Check impedance between Terminals C & D. Should be 160 to 1200 Ohms | <ol style="list-style-type: none"> OVERSPEED set too low. Adjust 5-6 turns CW. Erroneous speed sensor signal. Check wiring. |

| SYMPTOM | NORMAL READING | PROBABLE CAUSE OF ABNORMAL READING |
|---|--|--|
| Actuator does not energize fully | <ol style="list-style-type: none"> Measure the voltage at the battery while cranking. Momentarily connect Terminals A and F. The actuator should move to the full fuel position. | <ol style="list-style-type: none"> If voltage is less than 7V for a 12V system, or 14V for a 24V system, check or replace the battery. Actuator or battery wiring in error Actuator or linkage binding Defective actuator Fuse opens. Check for short in actuator or harness. |
| Engine remains below desired governed speed | <ol style="list-style-type: none"> Measure the actuator output, Terminals A & B, while running under governor control. | <ol style="list-style-type: none"> 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. SPEED parameter set too low. |



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9 SPECIFICATIONS

| 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 115 Hz., ±15 Hz/Volt @ 5.0 K Impedance L 735 Hz., ±60 Hz/Volt @ 65 K Impedance N 148 Hz., ±10 Hz/Volt @ 1 M Impedance P 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

