ECC328
Generator Frequency Sensing Speed Control Unit

INSTALLATION

The ECC328 Speed Control unit is hard potted and rugged enough to be placed in a control cabinet or engine mounted enclosure with other dedicated control equipment. If water, mist, or condensation may come in contact with the controller, it should be mounted vertically. This will allow the fluid to drain away from the speed control unit.

Extreme heat should be avoided.

WARNING

An overspeed shutdown device, independent of the governor system, should be provided 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.

WIRING

Basic electrical connections are shown in the Wiring Diagram, Fig. 1. Battery and actuator connections should be #16AWG or larger. Long cables require an increased wire size to minimize voltage drops. The battery positive (+) input, Terminal F, should be fused for 15A.

Connection to the generator: The two input Terminals, D and E, should be connected to the generator's AC windings. These connections can be either line to line or line to neutral. Terminal E should be connected to the neutral if this connection is chosen. See the wiring diagram for various connections to the generator.

ADJUSTMENTS

Before Starting the Engine

Check to insure that the GAIN, STABILITY, and external SPEED TRIM controls are set to their mid positions.

Start the Engine

The ECC328 control is factory set to operate at approximately 60 Hz generator frequency.

Crank the engine with DC power applied to the governor system. The actuator will energize (within 1.5 VDC of battery voltage) and force the fuel control to its maximum fuel position until the engine starts. The governor system should then control the engine at near rated speed.

If the engine is unstable after starting, turn the GAIN and STABILITY pots CCW until the engine speed is stable.

Governor Speed Setting

The governed speed set point can be increased by the CW rotation of the SPEED adjustment.

The remote speed adjustment (optional) can be used as a SPEED TRIM control. See Fig. 1.

Governor Performance

Once the engine is at operating speed and at no load, the following governor performance adjustments should be made.

A. Rotate the GAIN adjustment CW until instability develops. Gradually move the adjustment CCW until stability returns. Move the adjustment 1/8 of a turn further CCW to insure stable performance.

B. Rotate the STABILITY adjustment CW until instability develops. Gradually move the adjustment CCW until stability returns. Move the adjustment 1/8 of a turn further CCW to insure stable performance.

C. Normally, adjustments made at no load result in satisfactory performance across the entire load range. GAIN readjustment might be required after load is applied to the engine, if a non-linearity exists in the fuel control. A strip chart recorder or storage oscilloscope with appropriate electronics can be used to measure generator frequency to further optimize the governor's performance.

If instability cannot be corrected, or further performance improvements are required, refer to the Instability section under SYSTEM TROUBLESHOOTING.

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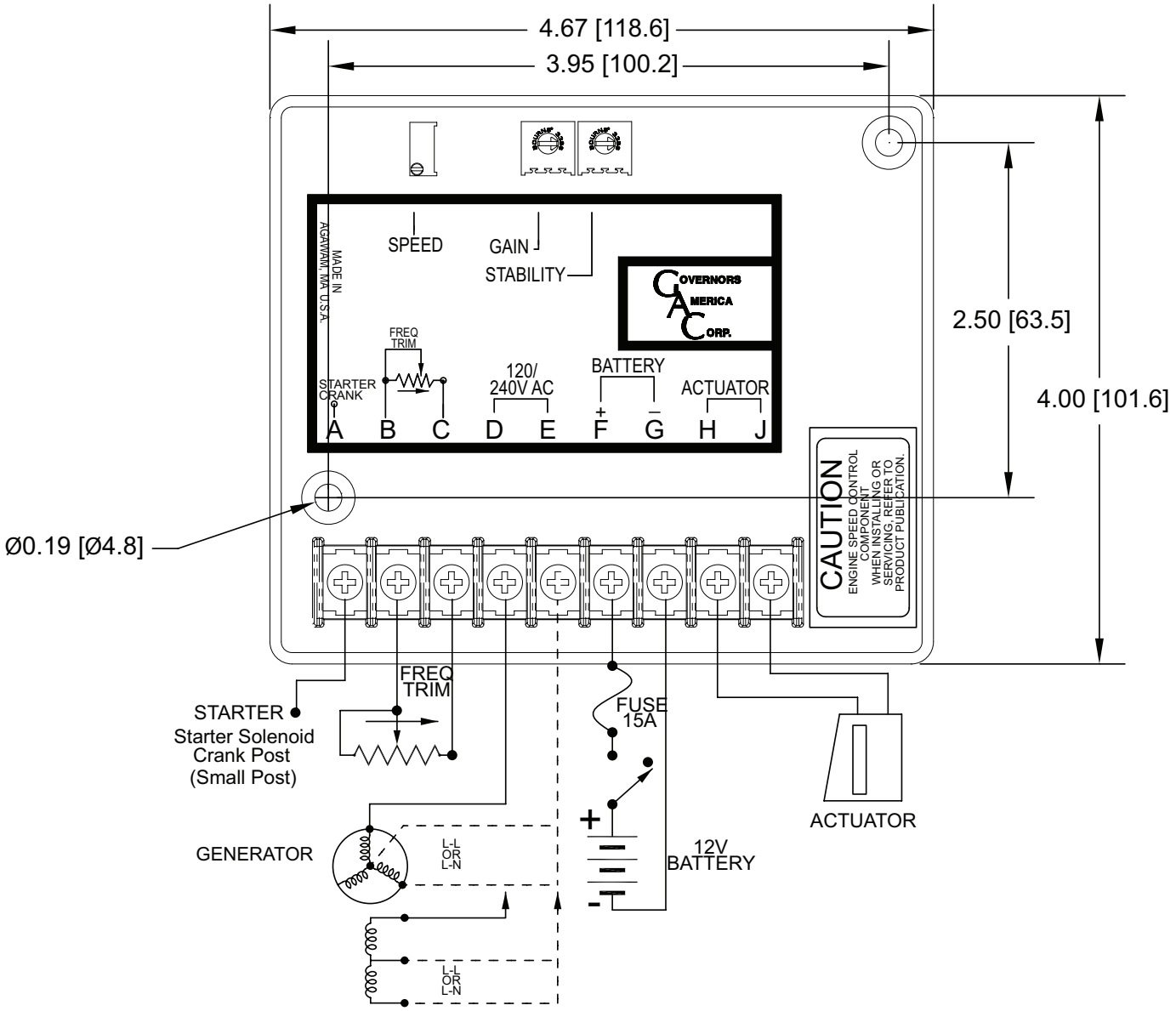
DIAGRAM 1 SYSTEM WIRING/OUTLINE



SPECIFICATIONS

PERFORMANCE

Isochronous Operation..... ±0.250%
Speed Range (unless stated in units specifications).....40 - 80 HZ
Speed Drift with Temperature..... ±1%
Speed Trim (see units specifications)..... +/- 2 Hz

ENVIRONMENTAL

Ambient Temperature..... -40° to 185°F (-40 to +85C)
Relative Humidity.....up to 100%

INPUT POWER

DC Supply.....12 VDC (8 - 15 VDC) Nominal
.....(24 VDC available as special order)
Polarity.....Negative Ground (case isolated)
Power Consumption.....<50 mA + Actuator Current
Maximum Actuator Current.....5 Amps
Generator Frequency Sensing.....Load on generator, 40K OHMS
.....Minimum sensing 1 VAC RMS
.....Maximum voltage 260 VAC

RELIABILITY

Vibration.....5G, 20-500 Hz
Shock.....20G's
Testing.....100% Functional Testing before and after potting

PHYSICAL

Dimensions..... See Wiring Diagram (Fig. 1)
Weight.....0.75 lb (0.34 kg)
Mounting.....Any Position

SYSTEM TROUBLESHOOTING

System Inoperative

If the governing system does not function, the fault may be determined by performing the voltage tests described in Steps 1 & 2; (+) and (-) refer to meter polarity. Should normal values be indicated, the fault may be with the actuator or the wiring to the actuator. See specific actuator publication for testing details.

STEP	TERMINALS	NORMAL READING	PROBABLE CAUSE OF ABNORMAL READING
1	F(+) & G(-)	Battery Supply Voltage (12 VDC) (while cranking, 8.0 VDC)	1. DC battery power not connected. 2. Low battery voltage. 3. Check for blown fuse. 4. Wiring error.
2	J(+) & H(-)	Battery Voltage less 1.5 volts (When cranking)	Terminal (A) not connected to starter solenoid properly
3	J(+) & H(-)	Voltage present, but actuator does not move	Actuator circuit open; measure actuator resistance
4	J(+) & H(-)	Engine stalls after starting, 0 voltage	Generator residual voltage too low or absent, check wiring terminals D and E

Unsatisfactory Performance

If the governing system functions poorly, perform the following tests.

Symptom	Test	Probable Fault
Engine Overspeed	1. Do Not Crank. Apply DC power to the governor system. **Generated residual voltage must be 10 volts or higher for this test**	1. If actuator goes to full fuel, then disconnect speed sensing wires at Terminals D & E. If actuator is still at full fuel the speed control unit is defective. If actuator is at minimum fuel position - erroneous speed signal. Check wiring to generator to assure generator voltage is properly connected to the unit.
	2. Manually hold the engine at the desired running speed. Measure the DC voltage between Terminals H (-) & J (+).	1. If the voltage reading is 2.0 to 3.0 VDC, a) SPEED adjustment set above desired speed. Turn CCW. b) Defective speed control unit. 2. If the voltage reading is above 3.0 VDC, on the speed control unit Actuator or linkage binding. 3. If the voltage reading is below 1.0 VDC, Defective speed control unit.
Overspeed during start up	1. Low GAIN setting.	1. Try to increase the Gain setting CW and also turn the Stability CW as much as possible without causing instability. 2. Check the actuator for binding or friction
Actuator does not fully energize	1. Measure the DC voltage at the actuator. It should be 0.8 to 1.5 VDC less than the actual battery voltage but not less than 8 VDC.	1. Replace the battery if it is weak or undersized. 2. Actuator wiring incorrect or too small a wire gauge.
	2. Momentarily connect Terminals J and F. The actuator should move to the full fuel position.	1. Actuator or battery wiring error. 2. Actuator or linkage binding. 3. Defective actuator.
Engine remains below desired governing speed.	1. Measure the actuator output, Terminals J (+) & H (-) while running under governor control. 1. Turn speed pot CW to increase speed set point.	1. If voltage is within approximately 2 VDC of the battery supply voltage, then fuel control restricted from reaching full fuel position possibly due to mechanical governor, carburetor spring, linkage alignment, or interference. 2. If not, increase SPEED setting.
Engine does not start or stall	1. Turn speed pot CCW to increase speed set point	1. Check wiring to Terminial A, make sure Terminial A is connected to the Terminal of the starter.
	2. Measure VAC at Terminals D and E while cranking.	2. Low speed reference set point below engine idle speed.

Instability

Instability in a closed loop speed control system can be categorized into two general types:
1. PERIODIC
2. NON PERIODIC

1. The PERIODIC type can be further classified as a fast or slow instability. Fast instability is a 3 Hz. or faster irregularity of the speed and is usually a jitter. Slow periodic instability is below 3 Hz., can be very slow, and is sometimes violent.

If a fast instability occurs, this is typically the governor responding to engine firings. Raising the engine speed increases the frequency of instability and vice versa.

Interference from powerful electrical signals can also be the cause. Turn off the battery chargers or other electrical equipment to see if the symptom disappears.

Slow instability can have several causes. Adjustment of the GAIN and STABILITY usually cures most situations by matching the speed control unit dynamics. The control system can also be optimized for best performance by following procedure.

If slow instability is unaffected by this procedure, evaluate the fuel system and engine performance. Check the fuel system linkage for binding, high friction, or poor linkage. Be sure to check linkage during engine operation. Also look at the engine fuel system. Irregularities with carburated or fuel injection systems can change engine power even with a constant throttle setting. This can result in speed deviations beyond the control of the governor system. Poor mixture adjustment or bad ignition timing can cause speed instability in Gas engine applications.

2. NON PERIODIC instability should respond to the GAIN control. If increasing the gain reduces the instability, then the problem is probably with the engine. Higher gain allows the governor to respond faster and correct for the disturbance. Look for engine misfiring, an erratic fuel system, or load changes on the engine generator set voltage regulator.

If unsuccessful in solving instability, contact the factory for technical assistance.

Electromagnetic Compatibility (EMC)

EMI SUSCEPTIBILITY: Any governor system can be adversely affected by large interfering signals that are conducted through the cabling or through direct radiation into the control circuits.

All GAC speed control units contain filters and shielding designed to protect the unit's sensitive circuits from moderate external interfering sources. The ECC328 can tolerate levels of at least 10 V/Meter from 10 MHz to 1 GHz (CE requirements)

Although it is difficult to predict levels of interference, applications that include magnetos, solid state ignition systems, radio transmitters, voltage regulators or battery chargers; should be considered suspect as possible interfering sources.

If it is suspected that external fields, either those that are radiated or conducted, are or will affect the governor systems operation; it is recommended to use shielded cable for all external connections. Be sure that only one end of the shield is connected to a single point on the grounded metal plate or place the unit in a sealed metal box.

Conduction is when the interfering signal is conducted through the interconnecting wiring to the governor system electronics. Shielded cables and installing filters are common remedies.