ECC328
Generator Frequency Sensing Speed Control Unit

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1 INTRODUCTION

The ECC328 speed control unit is an electronic device designed to control engine speed with precise response to transient engine load changes. The closed-loop speed control, when connected to a proportional actuator and supplied with a speed signal/frequency from the main AC generator, will control a wide variety of engines in an isochronous mode.

The speed signal input must be in the frequency range of 40 to 80 Hz.

Other features include:

- 12/24 V DC • Light-Force (Low-Current Optimized PID)
- Isochronous operation
- No magnetic speed pick-up required
- For Genset only – 260 V AC MAX
- Rugged hard potted design
- Gain and stability adjustments
- Lower system cost

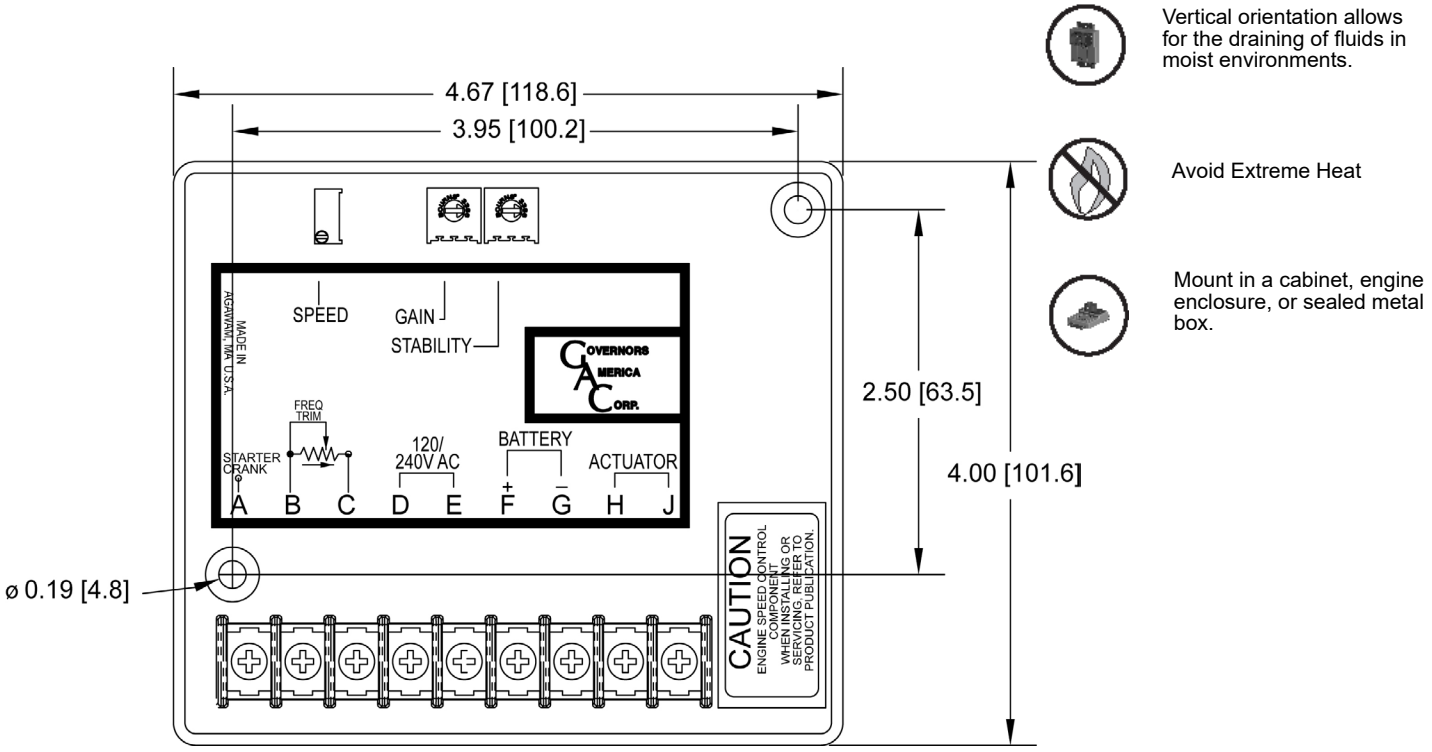
The ECC328 is compatible with GAC ALN, ALR, 100, and 103 Series actuators.

2 SPECIFICATIONS

PERFORMANCE	
Isochronous Operation	± 0.25 %
Frequency	40 - 80 Hz Factory setting 60Hz +/- 0.05Hz
Speed Drift with Temperature	±1 %
Speed Trim	±2 Hz
INPUT / OUTPUT	
Supply	12 V DC (8 - 15 V DC) Nominal 24 V DC (16 - 32 V DC) Nominal
Polarity	Negative Ground (Case Isolated)
Power Consumption	<50 mA + actuator current
Maximum Actuator Current	4 A
Generator Frequency Sensing	Load on generator, 40 K Ω Minimum sensing 1 V AC RMS MAX 260 V AC

PHYSICAL	
Dimensions	See Section 3
Weight	0.75 lbf [0.34 kgf]
Mounting	Any Position, Vertical Preferred
RELIABILITY	
Vibration	5 g, 20 - 500 Hz
Shock	20 g peak
Testing	100 % Functional Testing
ENVIRONMENTAL	
Ambient Temperature	-40 to 185 °F [-40 to 85 °C]
Relative Humidity	up to 100 %

3 INSTALLATION DIAGRAM



4 WIRING

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.

The wiring diagram on page 3 details the placement and location of the terminals. Please note wire gauge requirements and notes for additional information.

TERMINAL	DEFINITION	NOTES
A	Starter	16 AWG wire recommended Connect to the starter solenoid crank post (solenoid terminal) usually the small post on the solenoid) Starter solenoid crank post.
B and C	Freq Trim	Potentiometer input for frequency trim (small)
D and E	Generator	Connect directly to generator's AC windings (before voltage regulator). Connections can be line-to-line or line-to-neutral. Terminal E should be connected to neutral if used.
F and G	Battery	16 AWG wire recommended Terminal F is positive (+) and should be fused for 15 A
H and J	Actuator	16 AWG wire recommended

4 WIRING (CONTINUED)

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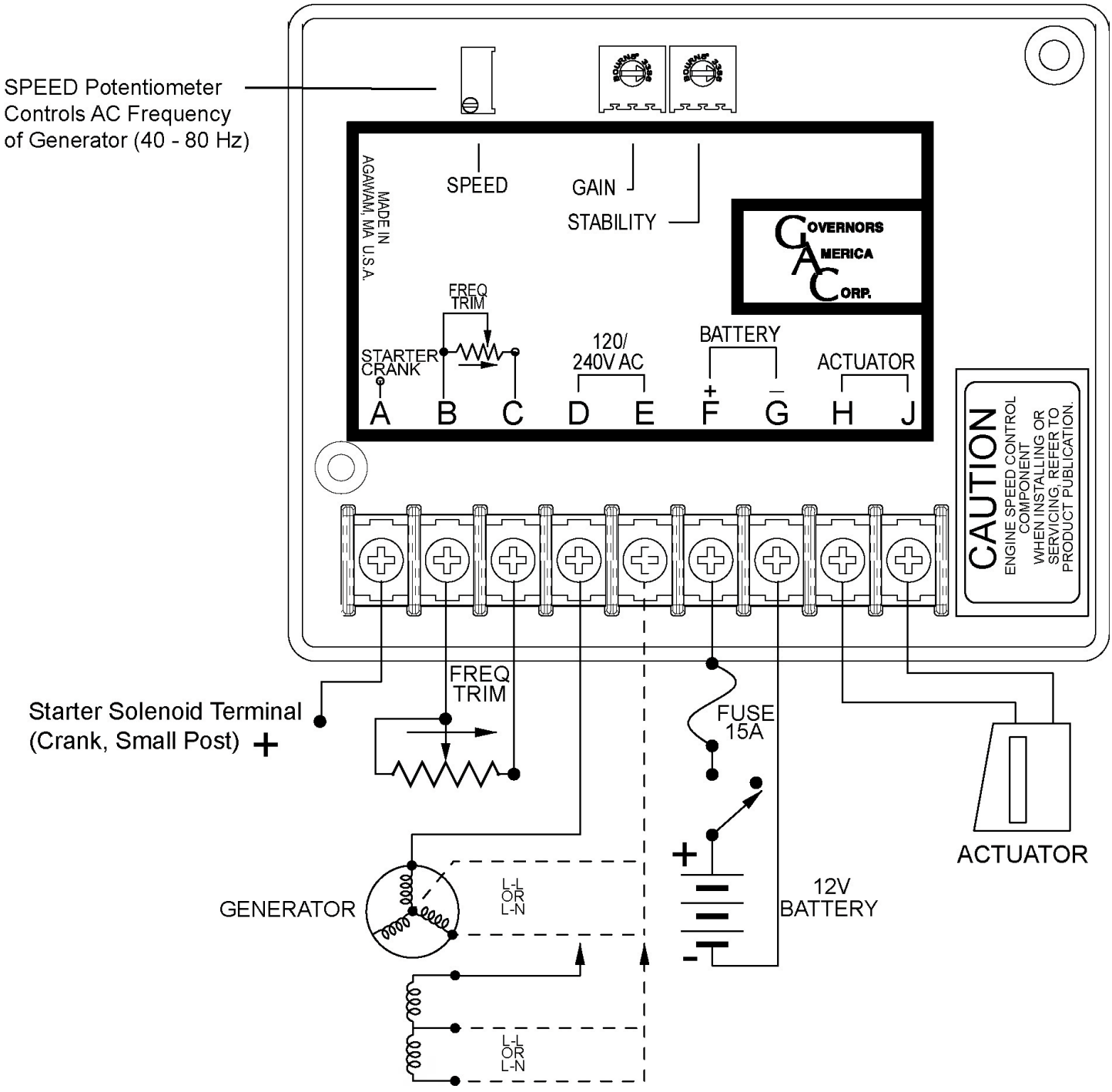

5 STARTING THE ENGINE

IMPORTANT Before starting the engine, check to ensure that the GAIN, STABILITY, and external SPEED TRIM controls are set to their mid positions.

1. STARTING THE ENGINE: The ECC328 controller is factory set to operate at approximately 60 Hz generator frequency.
2. Crank the engine with DC power applied to the governor system. The actuator will energize (within 1.5 V DC 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.
3. If the engine is unstable after starting, turn the GAIN and STABILITY pots counter-clockwise (CCW) until the engine speed is stable. See Adjusting for Stability.

6 SETTING GOVERNOR SPEED

Increase the governed speed set point by rotating the SPEED adjustment clockwise (CW). Use the optional remote speed adjustment as a FREQ TRIM control. The frequency range is 40 - 80 Hz.

7 ADJUSTING FOR STABILITY

Once the engine is running at operating speed and at no load, perform the following adjustments to increase engine stability.

PARAMETER	ADJUSTMENT PROCEDURE
GAIN	1. Rotate the GAIN adjustment CW until instability develops. 2. Gradually move the adjustment CCW until stability returns. 3. Move the adjustment 1/8 of a turn further CCW further to ensure stable performance. If instability persists, adjust the stability parameter.
STABILITY	1. Rotate the STABILITY adjustment CW until instability develops. 2. Gradually move the adjustment CCW until stability returns. 3. Move the adjustment 1/8 of a turn further CCW further to ensure stable performance.

NOTE 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. Use a strip chart recorder or storage oscilloscope with appropriate electronics to measure generator frequency for further optimization.

If instability repeats or additional performance improvements are required, see TROUBLESHOOTING.

8 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, 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 manual for testing procedures for the specific actuator.

STEP	TERM.	NORMAL READING	PROBABLE CAUSE
1	F(+) & G(-)	Battery Supply Voltage (8-15 V DC for 12 V) or (16-32 V DC for 24 V)	1. DC battery power not connected. Check for blown fuse 2. Low battery voltage 3. Wiring error
2	J(+) & H(-)	Battery Voltage less than 1.5 v (When cranking)	1. Terminal (A) not connected to starter solenoid properly
3	J(+) & H(-)	Voltage present, but actuator does not move	1. Actuator circuit open; measure actuator resistance
4	J(+) & H(-)	Engine stalls after starting, 0 voltage	1. Generator residual voltage too low or absent, check wiring to Terminals D and E

8 TROUBLESHOOTING (CONTINUED)

INSTABILITY

INSTABILITY	SYMPTOM	PROBABLE CAUSE	
Fast Periodic	An irregularity of speed above 3 Hz. (Usually jitter)	1.	Interference from powerful electrical signals can be a cause. Turn off battery chargers or other electrical equipment to see if the symptom disappears.
Slow Periodic	Speed irregularity below 3 Hz. (Sometimes severe)	1.	Adjustment of GAIN and STABILITY usually cures most instability. If instability persists, check for: a. The fuel system linkage for binding high friction, or poor linkage. b. Poor fuel mixture or bad ignition timing
Non-Periodic	Erratic Engine Behavior	1.	Increasing the GAIN adjustment 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: a. engine mis-firings b. an erratic fuel system c. load changes on the generator set voltage regulator.

UNSATISFACTORY PERFORMANCE

SYMPTOM	NORMAL READING		PROBABLE CAUSE
Engine Overspeed	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 the speed control unit is defective.
	Manually hold the engine at the desired running speed. Measure the DC voltage between Terminals H(-) & J(+) on the speed control unit.	1. 2. 3.	If the voltage reading is 2.0 to 3.0 V DC: a. SPEED adjustment set above desired speed b. Defective speed control unit If voltage reading is > 3.0 V DC then check for: a. Actuator binding b. Linkage binding If the voltage reading is below 1.0 V DC you may have a defective speed control unit
Overspeed during start up	Low GAIN setting	1. 2.	Try to increase the GAIN setting CW and also turn the STABILITY CW as much as possible without causing instability. Check the actuator for binding or friction.
Actuator does not energize fully	Measure the DC voltage at the actuator. It should be 0.8 to 1.5 V DC less than the actual battery voltage but not less than 8 V DC.	1.	If the voltage is less than: a. 7 V for a 12 V DC system, or b. 14 V for a 24 V DC system, then check or replace battery.
	Momentarily connect terminals J and F. The actuator should move to the full fuel position.	1. 2. 3.	Actuator or battery wiring in error Actuator or linkage binding Defective actuator
Engine remains below desired governed speed	Measure the actuator output, Terminals J (+) & H (-) while running under governor control.	1. 2.	If voltage measurement is within 2 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. SPEED adjustment set too low
Engine does not start or stalls	Turn speed pot CCW to increase speed set point	1.	Check wiring to Terminal A, make sure Terminal A is connected to the terminal of the starter.
	Measure V AC at terminals D and E while cranking.	1.	Low speed reference set point below engine idle speed.

NOTE If unsuccessful in solving instability, contact GAC for assistance.
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