

ESD-5400 Series - Speed Control Unit



INTRODUCTION

The **ESD-5400** Series speed control unit is an all-electronic 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 built ruggedly to withstand the engine environment.

Simplicity of installation and adjustment was foremost in the design. Non-interacting performance controls allow near optimum response to be easily obtained.

Other features include adjustable droop and idle operation, inputs for accessories used in multi-engine or special applications, protection against reverse battery voltage, transient voltages, accidental short circuit of the actuator and fail safe design in the event of loss of speed sensor signal or battery supply.

*Solutions for combustion engines,
that work right from the beginning.*

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DESCRIPTION

Engine speed information for the speed control unit is usually received from a magnetic speed sensor. Any other signal-generating device may be used provided that the generated frequency is proportional to engine speed and meets the voltage input and frequency range specification. The speed sensor is typically mounted in close proximity to an engine driven ferrous gear, usually the engine ring gear. As the teeth of the gear pass the magnetic sensor, a signal is generated which is proportional to engine speed.

Signal strength must be within the range of the input amplifier. An amplitude of 0.5 to 50 volts RMS is required to allow the unit to function within its design specifications. The speed signal is applied to Terminals C and D of the speed control unit. Between these terminals there is an input impedance of over 33,000 ohms. Terminal D is internally connected to Terminal E, battery negative. Only one end of the cable shield should be connected.

When a speed sensor signal is received by the controller, the signal is amplified and shaped by an internal circuit to provide an analogue speed signal. If the speed sensor monitor does not detect a speed sensor signal, the output circuit of the speed control unit will turn off all current to the actuator.

A summing circuit receives the speed sensor signal along with the speed adjust set point input. The speed range has a ratio of 9:1 and is adjusted with a 25-turn potentiometer. The output from the summing circuit is the input to the dynamic control section of the speed control unit. The dynamic control circuit, of which the gain and stability adjustments are part, has a control function that will provide isochronous and stable performance for most engine types and fuel systems.

The speed control unit circuit is influenced by the gain and stability performance adjustments. The governor system sensitivity is increased with clockwise relation of the gain adjustment. The gain adjustment has a range of 33:1. The stability adjustment, when advanced clockwise, increases the time rate of response of the governor system to match the various time constants of a wide variety of engines. The speed control unit is a PID device, the "D", derivative portion can be varied when required. (See 2113-ESD-5400 Series Technical Information.)

During the engine cranking cycle, the actuator becomes fully energized and moves to the maximum fuel position. The actuator will remain in this state during engine cranking and acceleration. While the engine is at steady load, the actuator will be energized with sufficient current to maintain the governor speed set point.

The electric actuator circuit is a closed loop position control circuit. The summation point for position control includes the requested fuel position and the actual position as measured in the actuator by the internal position sensor. The control compares the two signals. Any error between the two requests results in the actuator current being changed appropriately to eliminate any error. This actuator control loop is fast and tends to eliminate the effects of friction in the control systems linkage.

The power output stage of the ESD-5401 that drives the actuator is a high frequency PWM with output capability up to 10 Amps.

The output circuit provides switching current at a frequency of about 500 Hz. to drive the actuator. Since the switching frequency is well beyond the natural frequency of the actuator, there is no visible motion of the actuator output shaft. Switching the output transistors reduces its internal power dissipation for efficient power control. The output circuit can provide current up to 10 amps continuous at 25°C for 12 and 24 VDC battery systems. The actuator responds to the average current to position the engine fuel control lever.

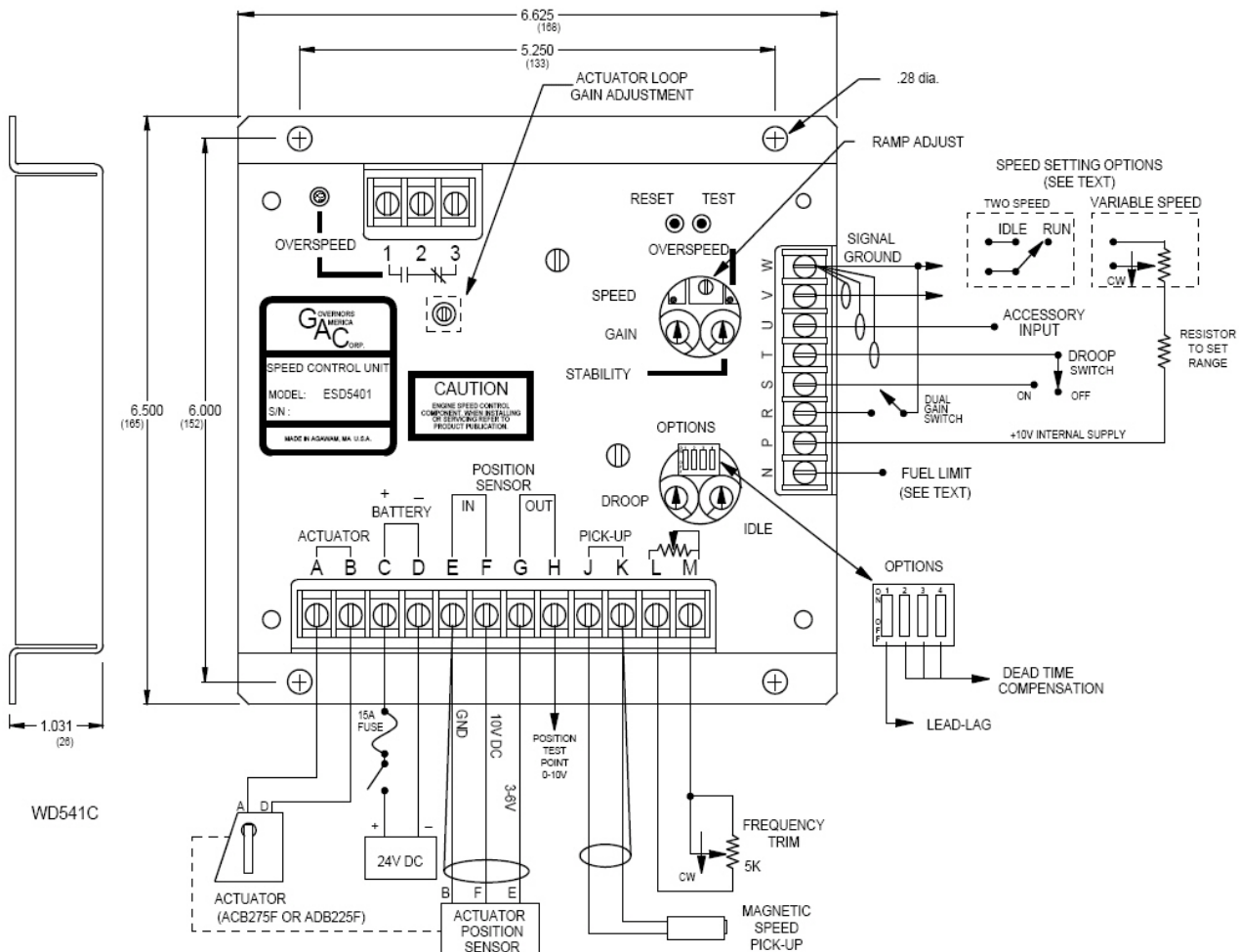
In standard operation, the speed control unit performance is isochronous. Droop governing can be selected by connecting Terminals S and T and the percent of droop governing can be varied with the droop adjustment control.

The speed control unit has several performance and protection features, which enhance the governor system. A speed anticipation circuit minimizes speed overshoot on engine startup or when large increments of load are applied to the engine. Engine idle speed can be remotely selected and is adjustable. Accessory inputs to achieve variable speed operation and multi-engine control can be accepted by the ESD-5400 Series speed control unit from GAC load sharing module, automatic synchronizer's, ramp generators and other accessory engine control modules. Protection against reverse battery voltage and transient voltages is provided. The design is fail-safe in the event of loss of speed sensor signal or battery supply.

The ESD-5400 Series speed control unit includes a single element speed switch. It provides a convenient means of sensing an overspeed condition and activating an internal relay. This relay may be used to shut off fuel or ignition to provide safe engine shut down. The speed switch feature includes a wide adjustment range, test and reset functions, and an LED indicator.

The ESD-5400 Series speed control unit is compatible with GOVERNORS AMERICA CORP. electric feedback actuator models 120F, 225F, and 275F.

DIAGRAM 1. SYSTEM WIRING/OUTLINE



ESD-5400 SERIES SPEED CONTROL UNITS

ESD-5401	Standard unit
ESD-5402-24	24 VDC/Operates w/Feedback Actuators
ESD-5402-12	12 VDC/Operates w/Feedback Actuators
ESD-5403	Use with AB sensors w/Position Feedback

SPECIFICATIONS

PERFORMANCE

Isochronous Operation/Steady State Stability	0.25% or better
Speed Range/Governor	1K-7.0K Hz continuous
Speed Drift with Temperature	±1% Maximum
Idle Adjust CW	Min. 300 Hz. Below set speed
Idle Adjust CCW	Min. 4100 Hz. Below set speed
Gain Range	1 - 5% non-linear
Droop Range	1 - 5% regulation*
Droop Adj. Max. (S-T Jumpered)	1500 Hz., ± 75 Hz. per 50% change
Droop Adj. Min	6 Hz., ± 6 Hz. per 50% change
Speed Trim Range	± 200 Hz.
Remote Variable Speed Range	500 - 7.0 Hz. or any part thereof
Terminal Sensitivity	
M	100 Hz., ± 15 Hz / Volt @ 5.0 K Impedance
T	735 Hz., ± 60 Hz / Volt @ 65 K Impedance
U	148 Hz., ± 10 Hz / Volt @ 1 Meg. Impedance
P	10 VDC Supply @ 20 ma Max.
Speed Switch Adjustment Range	1000 - 10000 Hz.

ENVIRONMENTAL

Ambient Operating Temperature Range	-40 to +180°F (-40° to +85°C)
Relative Humidity	up to 95%
All Surface Finishes	Fungus Proof and Corrosion Resistant

INPUT POWER

Supply	12 (ESD5401-12) or 24 VDC Battery Systems (Transient and Reverse Voltage Protected) **
Polarity	Negative Ground (Case Isolated)
Power Consumption	50 mA continuous plus actuator current
Actuator Current Range @ 77°F (25°C)	10 Amps continuous***
Speed Sensor Signal	0.5-50 Volts RMS
Speed Switch Relay Contacts (N.O. and N. C.)	10 Amps

RELIABILITY

Vibration	±0.7G up to 100 Hz.
Testing	100% Functionally Tested

PHYSICAL

Dimensions	See Outline (DIAGRAM 1)
Weight	1.8 lbs. (820 grams)
Mounting	Any Position, Vertical Preferred

- * Droop is based on a speed sensor frequency of 4000 Hz. and an actuator current change of 1 amp from no load to full load. Applications with higher speed sensor signals will experience less percentage of droop. Applications with more actuator current change will experience higher percentages of droop. See droop description for specific details on operation of droop ranges.
- ** When used with the ADC-100 actuator the droop percentage will be less due to the actuators low current consumption.
- *** Protected against reverse voltage by a series diode. A 15 amp fuse must be installed in the positive battery lead. For 32V systems, contact Huegli Tech.
- **** Protected against short circuit to actuator (shuts off current to actuator), unit automatically turns back on when short is removed.