ENGINE GOVERNING SYSTEMS

PED 5111 Series

Speed Control Unit

PRECISION ELECTRO DYNAMICS

- Selectable droop operation.
- Adjustable idle speed.
- Interfaces with accessories.
- Multi-voltage unit.
- Soft coupling option.
- Precise speed control.

INTRODUCTION

The **PED 5111** 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.

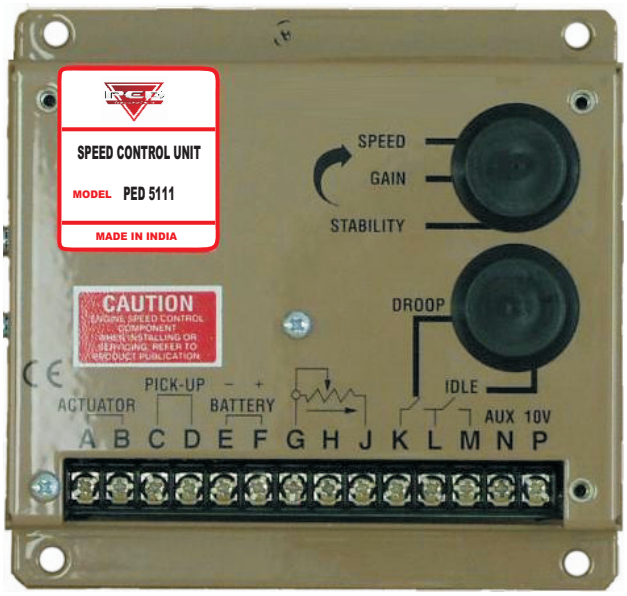
Simplicity of installation and adjustment was foremost in the design. Non-interacting performance controls allow near optimum response to be easily obtained.

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.

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 analog 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.

PRECISION ELECTRO DYNAMICS
No 5 Union Chambers, Opp. Apollo Tyres,
Ferry Road, North Kalamassery - 683 104
Tel : +91 484 2551758, Fax : + 91 484 2551758
http://www.precisionelectrodynamics.com
E-mail: info@precisionelectrodynamics.com

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.

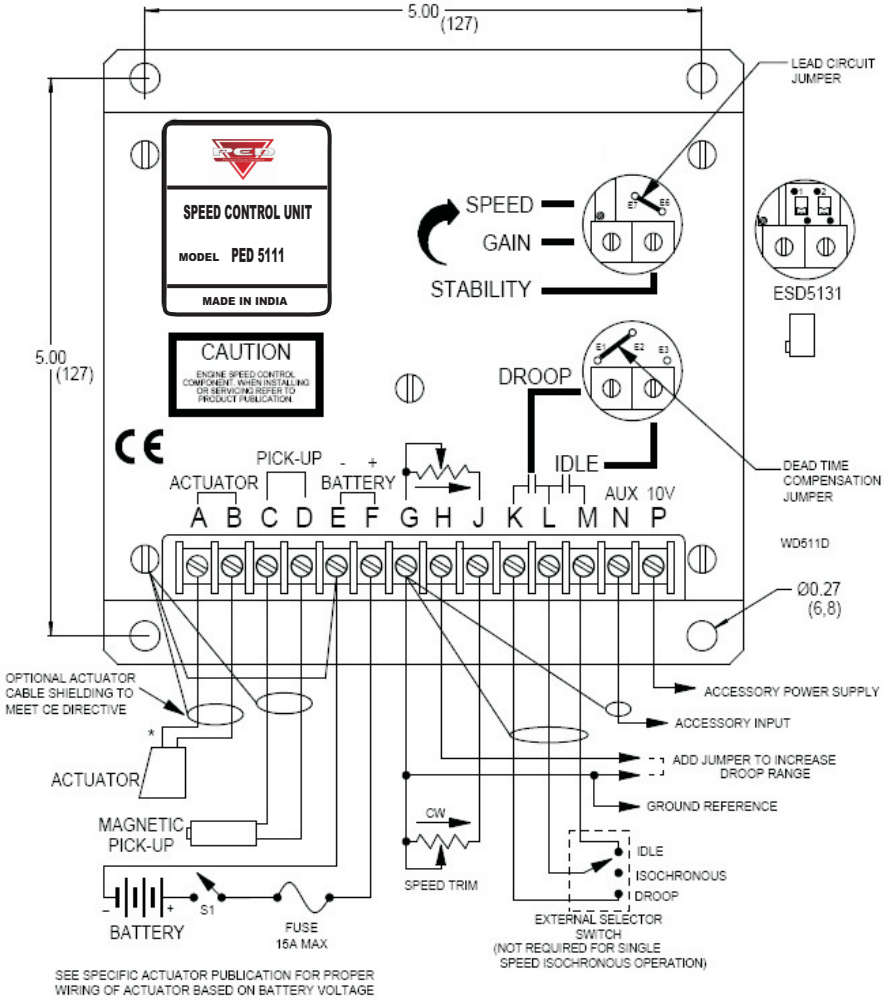
The output circuit provides switching current at a frequency of about 500 Hz. to drive the actuator. Since the switching frequency is well beyond the natural frequency of the actuator, there is no visible motion of the actuator output shaft. Switching the output transistors reduces its internal power 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 K and L and the percent of droop governing can be varied with the droop adjustment control. Connecting Terminals G and H can increase the droop range.

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 PED 5111 Series speed control unit for any 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-sale in the event of loss of speed sensor signal or battery supply.

The PED 5111 Series speed control unit is compatible with PRECISION ELECTRO DYNAMICS proportional electric actuators as well as those from other manufacturers.

DIAGRAM 1 SYSTEM WIRING/OUTLINE



SPECIFICATIONS

PERFORMANCE

Isochronous Operation/Steady State Stability ..... 0.25% or better
Speed Range/Governor..... 1K-7.5K Hz continuous
Speed Drift with Temperature ..... ± .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 - 3.7 kHz. or any part thereof
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 Meg. Impedance
- P .....10 VDC Supply @ 20 ma Max.

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 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 Senior Signal ..... 0.5-50 Volts RMS

RELIABILITY

Vibration..... 7G @ 20-100 Hz.
Testing .....100% Functionally Tested

PHYSICAL

Dimensions ..... See Outline (DIAGRAM 1)
Weight ..... 1.2 lbs. (545 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 PED 5000 actuator the droop percentage will he less due to the actuators low current consumption.

**Protected against reverse voltage by a series diode. A I5 amp fuse must be installed in the positive battery lead.

***Protected against short circuit to actuator (shuts off current to actuator), unit automatically turns back on when short is removed.

* ABOVE INFORMATION IS SUBJECT TO CHANGE WITHOUT NOTICE *

PRECISION ELECTRO DYNAMICS
No 5 Union Chambers, Opp. Apollo Tyres,
Ferry Road, North Kalamassery - 683 104
Tel : +91 484 2551758, Fax : + 91 484 2551758
http://www.precisionelectrodynamics.com
E-mail: info@precisionelectrodynamics.com

INSTALLATION

The **PED 5111** Series speed control unit is 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 illustrated in Diagram 2. Actuator and battery connections to Terminals A, B, E, and F should be #16 AWG (1.3 mm sq.) or larger. Long cables require an increased wire size to minimize voltage drops.

The battery positive (+) input, Terminal F, should be fused for 15 amps as illustrated. The PED 5111 series is suitable for 12 VDC and 24 VDC operation.

Magnetic speed sensor wires connected to Terminals C and D **MUST BE TWISTED AND/OR SHIELDED** for their entire length. The speed sensor cable shield should ideally be connected as shown in Diagram 2. The shield should be insulated to insure no other part of the shield comes in contact with engine ground, otherwise stray speed signals may be introduced into the speed control unit. With the engine stopped, adjust the gap between the magnetic speed sensor and the ring gear teeth. The gap should not be any smaller than 0.020 in. (0.45 mm). Usually, backing out the speed sensor 3/4 turn after touching the ring gear teeth will achieve a satisfactory air gap. The magnetic speed sensor voltage should be at least 1 VAC RMS during cranking.

ADJUSTMENTS

Before Starting Engine

Check to insure the **GAIN** and **STABILITY** adjustments, and if applied, the external **SPEED TRIM CONTROL** are set to mid position.

Start Engine

The speed control unit governed speed setting is factory set at approximately engine idle speed. (1000 Hz., speed sensor signal)

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, turn the **GAIN** and **STABILITY** adjustments counterclockwise until the engine is stable.

Governor Speed Setting

The governed speed set point is increased by clockwise rotation of the **SPEED** adjustment pot. Remote speed adjustment can be obtained with an optional 5K Speed Trim Control. (See Diagram 2)

Governor Performance

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

A. Rotate the **GAIN** adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment one division further counterclockwise to insure stable performance (270° pot).

B. Rotate the **STABILITY** adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment one division further to insure stable performance (270° pot).

C. Gain and stability adjustments may require minor changes after engine load is applied. Normally, adjustments made at no load achieve satisfactory performance. A strip chart recorder can be used to further optimize the adjustments.

PRECISION ELECTRO DYNAMICS
No 5 Union Chambers, Opp. Apollo Tyres,
Ferry Road, North Kalamassery - 683 104
Tel : +91 484 2551758, Fax : + 91 484 2551758
http://www.precisionelectrodynamics.com
E-mail: info@precisionelectrodynamics.com

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 clockwise 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.

Place the optional external selector switch in the DROOP position. DROOP is increased by clockwise rotation of the DROOP adjustment control. 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 engine no load to full load. A wide range droop is available with the internal control. Droop level requirements above 10% are unusual.

If droop levels experienced are higher or lower then these required, contact the PED for assistance.

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.

Accessory Input

The **AUX**iliary Terminal N accepts input signals from load sharing units, auto synchronizers, and other governor system accessories, PED accessories are directly connected to this terminal. It is recommended that this connection from accessories be shielded, as it is a sensitive input terminal.

If the auto synchronizer is used alone, not in conjunction with a load-sharing module, a 3 M 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.

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.

Accessory Supply

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

Wide Range Remote Variable Speed Operation

Simple and effective remote variable speed can be obtained with the PED 5111 Series speed control unit.

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.) If the exact range cannot be found, select the next higher range potentiometer. 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

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.

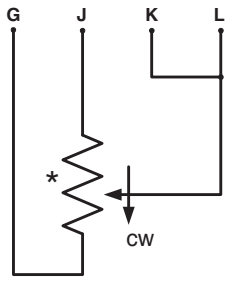
Contact PED for assistance if difficulty is experienced in obtaining the desired variable speed governing performance.

TABLE 1

VARIABLE SPEED RANGE POTENTIOMETER VALUE

Speed Range	Potentiometer Value
900 Hz.	1K
2,400 Hz.	5K
3,000 Hz.	10K
3,500 Hz.	25K
3,700 Hz.	50K

DIAGRAM 1



*Select proper potentiometer value from Table

PRECISION ELECTRO DYNAMICS
No 5 Union Chambers, Opp. Apollo Tyres,
Ferry Road, North Kalamassery - 683 104
Tel : +91 484 2551758, Fax : + 91 484 2551758
http://www.precisionelectrodynamics.com
E-mail: info@precisionelectrodynamics.com