SPEED CONTROL UNIT

MODEL PED 6000

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PRODUCT TECHNICAL INFORMATION

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The PED 6000 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 is foremost in the design. Two 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, a single element speed switch, protection against reverse battery voltages, and fail-safe design in the event of loss of speed sensor signal or battery supply.

DESCRIPTION

Engine speed information for the speed control until is usually received from a magnetic speed sensor. Any other signal generating device may be used provided 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 0.25 to 120 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 20,000 ohms. Terminals D is internally connected to Terminal E, battery negative.

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 in a period of not longer than 0.1 second the output circuit of the speed control unit 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 8:1 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 output circuit is influenced by the integral gain and stability performance adjustments.
The governor system sensitivity is increased with clockwise rotation of the gain adjustment. The gain adjustment has a non-liner range of 33:1. The stability adjustment, when advanced clockwise, increase the time rate of response of the governor system to match the various time constants of a wide variety of engines. Since the speed control unit is a P I D device, the "D", derivative portion can be varied when required (Seen instability section).

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

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 transistor reduces its internal power dissipation for efficient power control. The output circuit can provide actuator current of 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 adjustment control. The droop range can be increased by connecting Terminals G and H.

The speed control unit has several performance and protection features which enhance the governor system. A speed anticipation circuit minimizes speed overshoot on 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 6000 speed control from load sharing modules, automatic synchronizers, 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 PED 6000 includes a single element speed switch .It provides convenient means of sensing an overspeed condition and activating an internal relay. This relay may be used to shut off the fuel or ignition to provide safe engine shut down. The speed switch feature includes a wide adjustment range, test and reset buttons, and an LED indicator.

The PED 6000 is compatible with proportional electric actuators from other manufacturers also

SPECIFICATIIONS

PERFORMANCE

Isochronous Operation / Steady State Stability ....+/- 0.25% or better
Speed Range/Governor... 1K – 8K Hz continuous
Speed Drift With Temperature (Governor and Speed Switch)...+/- 1% maximum
Idle Adjust CW..Min. 1200Hz.Below set speed
Idle Adjust CCW.. Min. 4100Hz.Below set speed
Droop Range……...1-5% regulation*
Droop Adjust Max.H-G Jumper …..875 Hz., +/- 75Hz.per 1.0A change.
Droop Adjust Min. No jumper…... 31 Hz, +/- 6 Hz. Per 1.0 A change
Speed Trim Range…...+/- 200Hz.
Remote Variable Speed Range ....+/- 500 – 7.5K Hz. or any part thereof.
Terminal Sensitivity

J…..100 Hz.,+/- 15 Hz / Volt@ 4.75 K impedance
L…...735 Hz., +/- 60 Hz / Volt@ 255 K impedance
N...…148 Hz., +/- 10 Hz / Volt@ 1 Meg. Impedance
P...…10 VDC Supply@20ma Max.

Speed Switch Adjustment Range …...…1000 – 10000Hz.

ENVIRONMENTAL

Ambient Operating Temperature Range …..- 40^0 to + 180^0 F (-40^0 to + 85^0 C)
Relative Humidity…..up to 95%
All Surface Finishes…...Fungus proof & corrosion resistant

INPUT POWER

Supply..12 or 24 VDC Battery Systems (transient & reverse voltage protected**)
Polarity…..Negative ground (case isolated)
Power Consumption…...90 ma continuous plus actuator current
Maximum Actuator Current at 250c (770F)…... 10 Amps continuous
Speed Sensor Signal.. 0.25 – 120 Volts RMS
Speed Switch Relay Contacts (N.O. and N.C)…...5 Amps

RELIABILITY

Vibration…... 5G 20-500 Hz
Testing …...Functionally tested.

PHYSICAL

Dimensions…...See outline (Diagram 1)
Weight …...1.8 lbs. (820 grams)
Mounting..… any position, vetical preferred

*Droop is based on a speed sensor frequency of 4000 Hz. And a actuator current change of 1 amp from no load to full load. Applications with higher speed sensor signal will experience lower percentages 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.

**Protected against reverse voltage by a series diode. A 15 amp fuse must be installed in the positive battery lead. For 32V systems, order PED 6000.

APPLICATION AND INSTALLATION INFORMATION

The 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 sytem, should be provided to prevent loss of engine control which may cause personal injury or equipment damage. Do not rely on the internal electronic shut down to prevent overspeed. A secondary shut off device, such as a fuel solenoid, should be used.

WIRING

Basic electrical connections are illustrated in Diagram1, Actuator and battery connection to Terminals A,B,E and F should be # 16 AWG (1.5 mm sq.) or larger. Long cables require an increased wire size to minimize volt age drops. The battery positive (+) input, Terminal F, should be fused for 15 amps as illustrated.

Magnetic speed sensor connections to Terminals C and D MUST BE TWISTED AND/OR SHIELDED for their entire length. The speed sensor cable shield should only be connected to Terminal D. The shield should be insulated to insure no other part of the shield comes in contact wsith engine ground, otherwise stray signals may be introduced into the speed control unit. With the engine stopped, adjust the gap between the matnetic 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 ¾ turn after touching the ring gear tooth will achieve a satisfactory air gap. The magnetic speed sensor voltage should be at least 1 VAC RMS during cranking.

ADJUSTMENTS.

Before Starting Engine.

A. Check to insure the GAIN and STABILITY adjustments, and if applied, the external SPEED TRIM CONTROL are set to mid position.
B. Check the fail-safe features of the controller and part of the actuator wiring by applying D.C. battery current to the governing system by closing S1, shown in Diagram 1. The actuator should momentarily move but must return to minimum fuel position.

Start Engine

The controller is factory set to operate at approximately engine idle speed. (1000 Hz. Speed sensor signal)
Crank the engine with D.C. 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 STABILITY adjustments counterclockwise until engine is stable.

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 Speed Trim Contorl . (See Diagram1)

Governor Performance

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

A. Rotate the GAIN adjustment clockwise until unstability develops. Gradually move the adjustment counter clockwise until stability returns. Move the adjustment one division further counter clockwise to insure stable performance.
B. Rotate the STABILITY adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment one division further counterclockwise to stable performance.
C. Gain and stability adjustments may require some changes after engine load is applied. Normally, adjustments made at no load achieve satisfactory performance.

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

Idle Speed Setting.

After the governor speed setting has been adjusted place the optional external selector switch in the IDLE position. The idle speed set point is increased by clockwise rotation of the IDLE adjustment control . When engine is at idle speed, the speed control unit adds 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 droop operation, the engine speed will decrease as engine load increases. The actual percentage of “DROOP” is based on the actuator current change from Engine No load to full load. A wide range of droop is available with the internal control. If more droop is required, a jumper between Terminals G and H can be added to double the droop available . Droop level requirements above this are unusual.

If droop levels experienced are higher or lower than those required, contact the factory for assistance
After the DROOP level has been adjusted, the engine speed setting may need to be reset. Check engine speed and adjust the speed setting accordingly

PED 6000 WIRING DIAGRAM

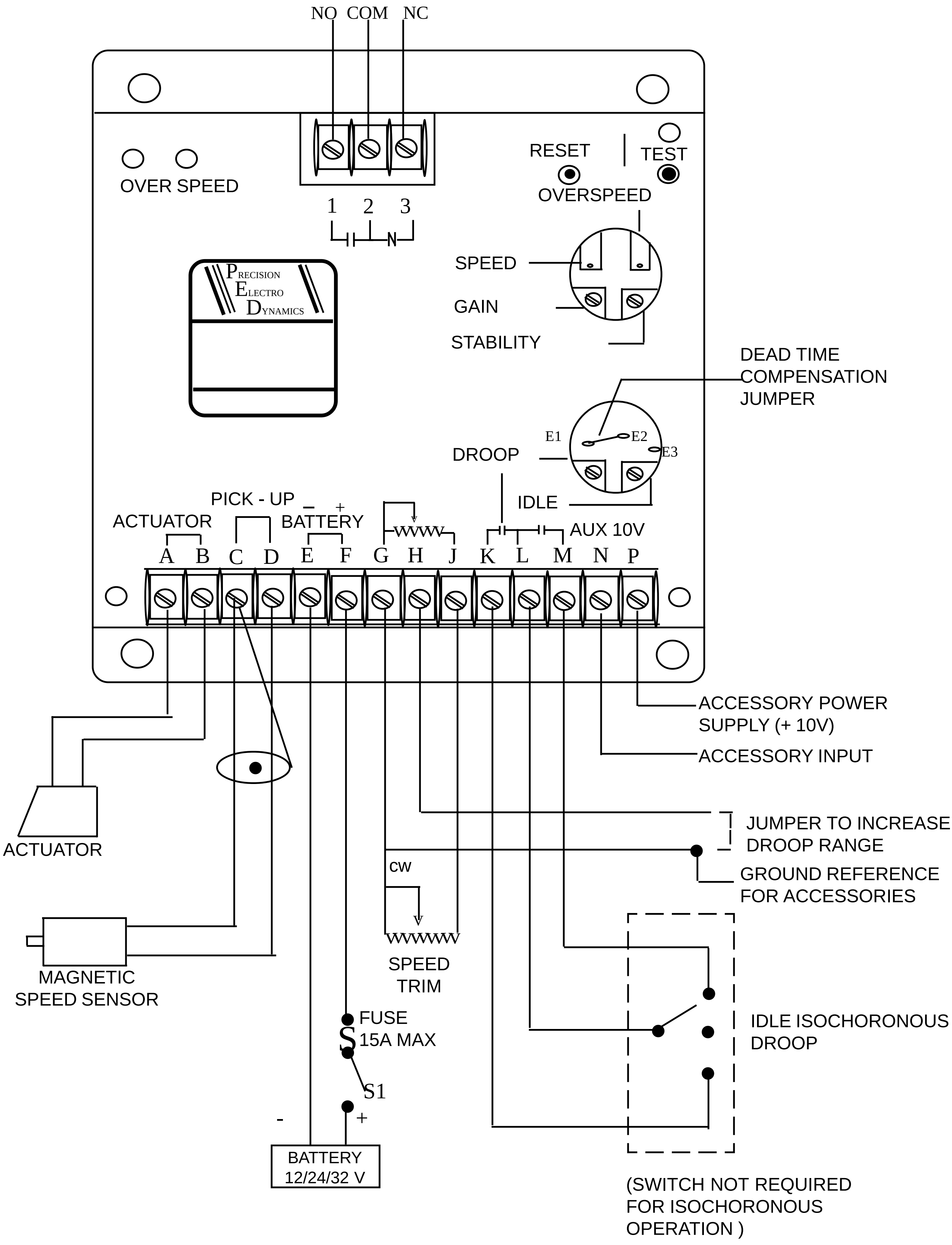


DIAGRAM 1.

Accessory Input

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

If the auto synchronizer is used alone not in conjuctin with a load sharing module, a 1.2 Mohm 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 governor system accessories. Up to 20 ma of current can be drawn from this supply. Ground reference is Terminal G.

Internal Speed Switch Setting.

When the engine is running at the desired speed, push and hold the TEST button. Rotate the OVERSPEED adjustment counterclockwise until the LED lights and the relay energizes. Current to the actuator will be removed and the engine will shut off.

Release TEST button. After the engine stops, press the RESET button or remove battery power. Restart the engine and it will return to the original speed setting.

Overspeed function is now set to approximately 10% above the requested speed. If a different value for over speed is required, standard procedures for adjustment should be used.

Always use the relay contacts provided to shut down the system by a means other than the governor or actuator.

It is recommended that the overspeed protection system be tested and verified during scheduled service of the equipment.

Wide Range Variable Speed.

Simple and effective remote variable speed can be obtained with the PED 6000 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 the 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 2.

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 isochronoous, regardless of the droop adjustment setting.

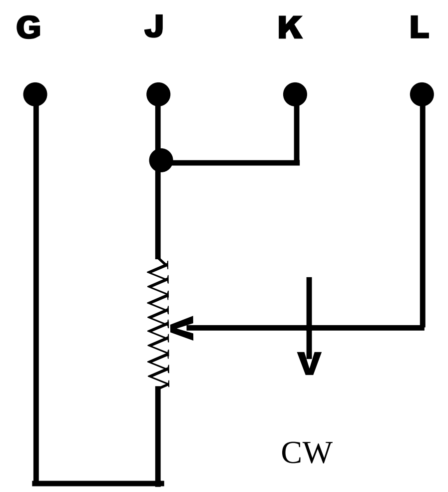
Contact the factory for assistance if difficulty is experienced in obtaining the desired variable speed governing performance.

TABLE 1

VARIABLE SPEED RANGE POTENTIOMETER VALUE

Speed Range	Potentiometer Value
1,100 Hz	1K
3,200 Hz	5K
4,200 Hz	10K
5,000 Hz	25K
5,300 Hz	50K

DIAGRAM 2.



Select proper potentiometer Value From Table 1