

Precision governors, LLC  
E-411P Configuration:

The E-411P is a governor which maintains a desired engine speed regardless of load ( unless overloaded).

The governor will attempt to maintain a fixed engine speed. This engine speed is determined by:

- 1) an external switch. When active, this commands a fixed speed. This fixed speed is not adjustable and must be set using a computer.
- 2) When the switch is not set, the external pot ( or sensor) commands a speed. As presently configured, the active range is approximately 0.3v to 3.0 volts.

To increase a setting, turn the adjustment clockwise. Turning the adjustment counter clockwise will decrease the adjustment. The adjustments have  $\frac{3}{4}$ " of rotation. Forcing the adjustments past the stops will damage the adjustment.

The adjustments:

- 1) Minimum Speed ( speed at 0 volts) ( located approximately 1" from #6 adjustment
- 2) Maximum Speed ( speed at 5 volts) ( located next to #1)
- 3) Derivative Gain ( located next to #2)
- 4) Integral Gain ( located between #3 and edge of PCB)
- 5) ( not used)
- 6) Master gain ( located in center of PCB, above DIP switch)

The minimum speed adjustment controls the set speed when the external pot's input voltage is low.  
The maximum speed adjustment controls the set speed when the external pot's input voltage is high.

Due to the selected external pot and the design of the controller, (The design of the governor was for a 0-5 volt input and the pot gives 0.3-3.0) the 2 adjustments will affect one another. It is recommended to attempt maximum engine speed then adjust the max. Then set the engine to minimum speed and adjust the minimum. A few iterations of this should get the actual speeds quite close to the desired limits.

Gain adjustments:

Below is a general description and tips for adjusting the system gains. All gain factors can affect one another and often when one is adjusted, others may need to be increased or decreased. Before making adjustments, note the location of each in case they need to be reset.

The Master gain is the primary gain adjustment. Increasing this adjustment makes the controller more aggressive in reacting to load and engine speed changes. If the engine seems "lazy" or responds too slowly, this adjustment should be increased. If the engine is unstable – this is oscillates or hunts – the master gain may be too high.

The derivative gain adjusts how much the controller reacts to quick changes in set speed. Rapid oscillations in engine speed may point indicate the derivative gain is too high. Sluggish response may indicate the derivative is too low.

The integral gain adjusts how fast the controller fully recovers from a load change. If the controller takes several seconds to fully recover the integral gain may be too low. If, when loaded, the engine drops initially, then overshoots and stays above set speed for a little while, the integral gain may be too high.

Another sign of the integral being too high is an engine that slowly oscillates in speed – having several seconds between low and high speeds.

**Troubleshooting:**

If the engine speed does not come up at all:

Verify the speed pot is commanding engine speed

Verify the controller has power

Verify there is a signal coming out of the mag pickup ( 4 volts AC or more and frequency should be > 1khz).

Verify the throttle actuator is wired to the controller.

**If the engine speed is not stable:**

This may be a sign of gains being set improperly. Please attempt to set the adjustments as per above.

Verify the mag pickup does not have a buildup on it's tip. Any steel shavings can cause erratic speed signals and governing. The recommend way to set the gap is to center a tooth in the mag pickup hole. Then screw the pickup (by hand and gently) until it just touches the tooth. Back it out  $\frac{1}{2}$  to  $\frac{3}{4}$  of a turn and lock it in place. This gives sufficient gap to avoid mechanical interference and ensures a robust signal.

Other factors that can cause an unstable engine is a poorly running engine, inconsistent load, sticking throttle body, intermittent wires, noisy speed command pot, etc.

**If the engine speed goes too fast ( faster than controller wants):**

The actuator should remain closed when the engine is not running. It may briefly open immediately after power up but this should not last long. If the actuator remains open, the wires may be damaged or the controller may be defective.

Verify the mag pickup as described above.