EG3000

Electronic Engine Governor Controller
Operation Manual

Smoke Limit Control. Idle Speed Control. Suitable for External, Built-in, and PT Pump type Actuators

KUTAI

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SECTION 1 : SPECIFICATION

Operating Voltage

Voltage 12 or 24 Vdc +/-20%

Output Current

Current 0.5 to 15 A

Run Speed Adjustment range

Speed adjustment Potentiometer (30 turn)
DIP Switch selection of MPU frequency range :
600 to 9500 Hz

IDLE Speed Adjustment Range

Run Speed 30 to 85%

Ramp Time

3 to 20 Secs.

Remote Speed Potentiometer

Ext. Remote speed pot terminal 6, 7, 8 (ILS)
and 6, 7, 9 connect a 5K ohms
potentiometer +/- 5% adjustment range.

Run Speed Stability

Less than +/- 0.25% at steady state

MPU Input signal

1 to 120 Vac RMS

Droop

4%

Settings

Run Speed, IDLE Speed, Ramp Time, Droop,
PID settings : Gain, Integration (INT.),
Differentiation (DIF.)

Temperature Stability

Less than 0.01%

Environment

Operating Temperature	-40 to +85 ˚C
Storage Temperature	-40 to +85 ˚C
Relative Humidity	Max. 95%
Vibration	1.0 G @ 18 – 30 Hz
	2.5 Gs @ 48 – 70 Hz

Dimensions

147.0 (L) x 114.0 (W) x 50.0 (H) mm

Weight

690 g +/- 2%

SECTION 2 : Function Descriptions

The EG3000 is an electronic speed controller designed for precise speed control of diesel, gas, and gasoline (petrol) engines. The EG3000 installed together with a magnetic pickup (MPU) and an actuator form the engine governor assembly.

The EG3000 has adjustable Idle Speed and also adjustable fuel limiting function for controlling engine smoke and vibration during start.

2.1 Controller operation

The EG3000 controller receives the engine speed signal from a magnetic pickup (MPU). This rotational speed is compared with the setting in the EG3000 and any difference results in an output to the actuator to change the speed. DIP Switch settings on the EG3000 are used to select the frequency range for the MPU.

The EG3000 receives its power from the engine batteries or from an AC to DC power supply rated at 12 Vdc or 24 Vdc (+/- 20%) to match the Actuator voltage.

The average operating current is 2.5 to 3.5 Amps but may reach 15 Amps during engine start or during sudden load changes.

2.2 Installation Instructions

2.2.1 Protect the EG3000 by installing it inside the engine instrument control panel.

2.2.2 Mount the Actuator close to the engine fuel system. Consult the instructions from the actuator manufacturer for installation.

2.2.3 Choose a point on the actuator control arm at which it can rotate freely and provide both minimum and maximum fuel supply (Do not “bottom out” the actuator - leave at least 2-3 degrees before the On and Off positions).

2.2.4 Use a linear linkage for diesel pumps. Use a Non-Linear linkage on gas engines to obtain low Gain at light loads and high Gain at heavy loads.

2.2.5 Mount the MPU on the flywheel housing to measure the rotational speed of teeth on the ring gear. (The timing gear housing can also be used if flywheel housing cannot be accessed.)

SECTION 3 : CONNECTION

Terminal	
1, 2	DC Power Input
2, 3	IDLE Terminal
4, 5	Output to Actuator, Max @ 15A
6, 7, 8 6, 7, 9	Remote speed control. Connect 5K ohms potentiometer approx. +/-5% adjustment range.
10、11	MPU input, Ground Terminal No. 10

3.1 Terminals 1 & 2 are the DC power inputs. Terminal 1 positive (+). Terminal 2 negative (–). Input Voltage is 12/24 Vdc +/- 20%.

3.2 Terminals 2 & 3 are the IDLE Switch connection. When the connections between 2 & 3 are open the controller commands the engine to Run Speed. When Terminals 2 & 3 are shorted the controller commands the engine to Idle Speed.

3.3 Terminals 4 & 5 are the output terminals for the actuator providing a maximum output of 15A.

3.4 Terminals 6 and 7-8 or terminals 6 and 7-9 are for connecting a remote speed control potentiometer. Refer to figure 4. Connect a 5K ohm potentiometer and turn the knob to central position. Let engine run on Run Speed to adjust to the rated engine speed. The adjustment range is +/- 5%. Users can also add a resistor in series with the potentiometer variable point to either terminal 8 or 9 to narrow the adjustment range. The potentiometer connection to terminals 6 with 7-8, or 6 with 7-9, must use the 3-wire shielded cable. The drain wire of the shielded cable should be connected to terminal 10 on the controller and the opposite end of the drain shield wire must cut off and taped.

3.5 Terminal 8 can be used for Isochronous Load Sharing (ILS) input from an external controller.

3.6 Terminals 10 and 11 are the MPU signal inputs. The wiring used to connect to the terminals must use a 2-wire shield cable. The drain shield wire must be connected to Terminal 10 and the other end of the drain shield wire must cut off (terminated) and taped.

3.7 The wiring used to connect to Terminals 1, 2, 4 and 5 must be > 2.0mm twisted pair cables.

SECTION 4 : OPERATION

4.1 IDLE Speed and Smoke Limiting Settings

4.1.1 IDLE Speed : Set lowest engine operating speed.

(1) Before starting the engine adjust the Idle Speed to the maximum and Ramp Time to the minimum.

(2) Adjust Run Speed to minimum and leave the connection between Terminals 2 & 3 open.

(3) Start the engine. The engine speed will increase directly to Run Speed. When operating speed is reached slowly adjust Run Speed to the rated generator speed (RPM).

(4) Short Terminals 2 & 3 and the engine speed should drop. Slowly set Idle Speed to an appropriate engine idle speed.

(5) Stop the engine and adjust Ramp Time to a center point, then restart engine. This time the engine speed will stay in Idle and slowly Ramp up to normal engine speed when Terminals 2 & 3 are opened. Adjust ramp time to preferred Ramp speed. Refer to Figure 1.

(6) With the engine operating at normal RPM close the IDLE SW, decreasing engine RPM back to idle RPM according to preset Ramp Time.

(7) To ensure positive engine starts every time follow step (4) and turn the Idle Speed potentiometer an additional 3 to 5%.

4.1.2 Ramp Time.

(1) Engines with specific fuel limit setting will control smoke during startup but not completely. A hot engine does not require the same fuel limit to start as a cold starting engine.

(2) Ramp Time can be set from 3 up to 20 seconds. The Ramp Time is the length of time for engine to accelerate from Idle to Run Speed.

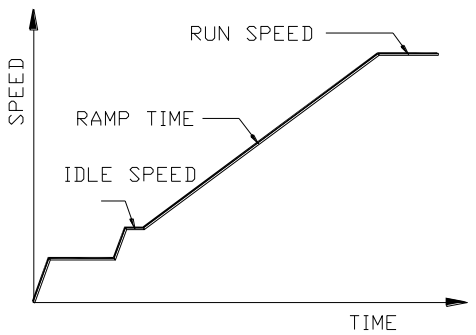


Figure 1

4.2 Isochronous Operation

The EG3000 is normally operated in isochronous mode, maintaining constant engine RPM (+/- 0.25%). Speed does not change regardless of load up to the engine's maximum capability. Refer to Figure 2. Isochronous operation is obtained by setting the Droop potentiometer fully counterclockwise.

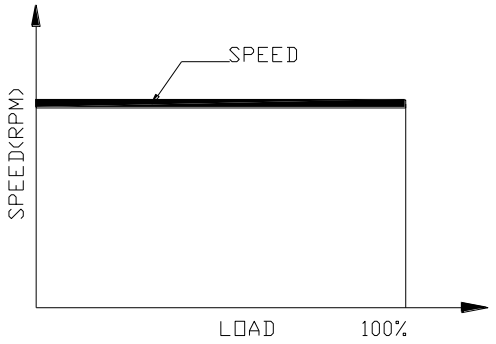


Figure 2

4.3 Non-Isochronous Operation (Droop)

In Non-isochronous operation (Droop) engine speed decreases with increase in load to distribute the real power load between generators operating in parallel. Refer to Figure 3.

Adjusting the Droop potentiometer clockwise increases the Droop to a maximum of 4%. The amount of Droop for a given setting depends on the magnetic pickup frequency and the amount of shaft rotation from no load to full load.

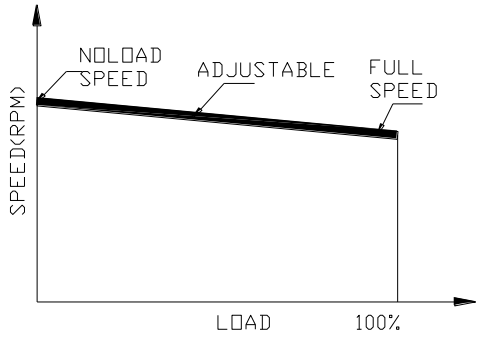


Figure 3

A Droop potentiometer setting of 10 o'clock will give about 4% Droop, when the pickup frequency is 4600Hz and actuator shaft rotation is approximately 30 degrees from no load to full load. A lower pickup frequency or lower shaft rotation results in less Droop for the system.

4.4 External Speed Potentiometer setting

EG3000 is equipped with two sets of terminals for adding a 5K ohm External Speed potentiometer. Refer to Fig. 4 for connection information. The user can also add a resistor in series with either Terminal 8 or 9 to reduce the adjustment range. Without a resistor the adjustment range is approximately 5%.

4.5 GAIN, Integration (INT.), Differentiation (DIF.) Adjustment

(1) Engine shutdown. DC input to controller OFF.
(2) Potentiometer at original setting.
(3) Adjust INT., Gain, DIF, and Ramp Time Potentiometer to minimum settings (Fully Counterclockwise)
(4) For Isochronous operation set Droop potentiometer fully counterclockwise.
(5) Setting the MPU frequency range :

Select the appropriate frequency setting according to the highest engine RPM.

Input Signal Frequency :

$$\frac{\text{RPM} \times \text{Flywheel teeth}}{60 \text{ sec}}$$

Frequency Selection	
SW-1 ON	600 to 1200 Hz
SW-2 ON	1200 to 2500 Hz
SW-3 ON	2500 to 5000 Hz
SW-4 ON	5000 to 9500 Hz

If uncertain about range set SW3 to ON and other switches to OFF. Only one DIP switch can be ON.

(6) Set Idle Speed to maximum and Run Speed to minimum.
(7) Adjust Remote Speed POT to a central (If used)
(8) Start the engine

The engine should go directly to Run Speed. Slowly adjust Run Speed pot clockwise to the rated engine speed. (If engine speed exceeds its rated speed, stop engine immediately and choose a lower frequency setting.)

For Idle Speed, Ramp Time And Idle Sw Settings see section 4.1 above :

(9) Slowly adjust Gain clockwise until the actuator linkage begins to oscillate.
(10) Slowly adjust Gain counterclockwise until the actuator linkage becomes stable again.

(11) Manually push (tap) the linkage to the actuator to test controller response. If linkage stabilizes after 3 to 5 oscillations then the setting is correct.

(12) f engine speed increases too much or decreases too much when a load is added or removed then adjust the Gain potentiometer clockwise slightly.

(13) I If engine speed recovers too slowly then adjust the INT. (Integration) setting clockwise and at the same time decrease the GAIN setting. Observe the actuator linkage. If the linkage is stable then manually tap the linkage. If the linkage oscillates slowly then the response time is inadequate. Adjust INT clockwise until response speed improves.

(14) After completing the above steps, slowly adjust DIF clockwise until engine speed begins to oscillate then slowly adjust counterclockwise to stable critical point / knee point.

*** Knee point is the position where the adjustment is at the point of stable and edge of unstable.**

(15) Slowly adjust GAIN clockwise until engine speed reach the stable critical point / knee point.

(16) Manually push (tap) the linkage to test controller response. If the linkage stabilizes after oscillating 3 to 5 times then the setting is complete.

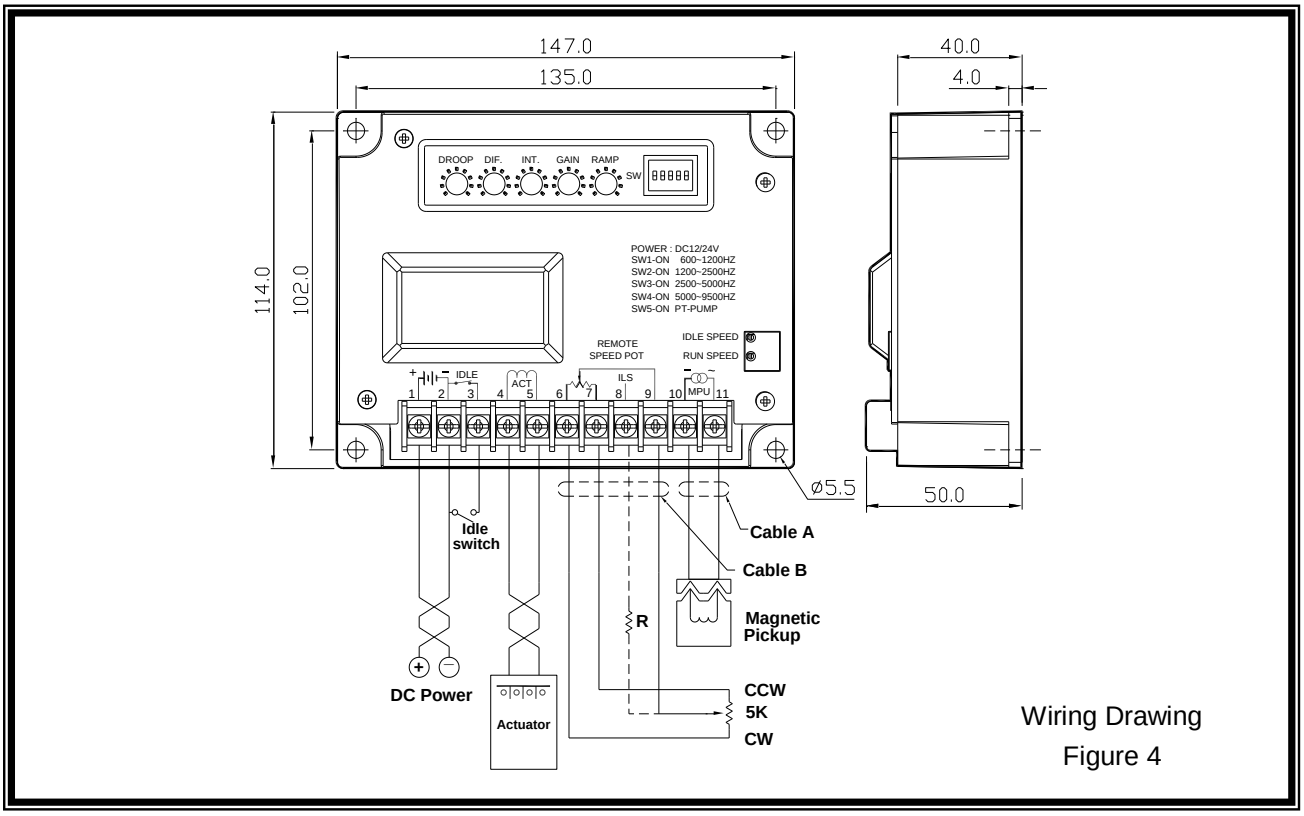
(17) Setting SW-5 to "ON" will decrease the GAIN and make the unit suitable for PT-PUMP type actuators.

- Refer to sections 4.2 and 4.3 for Droop setting.

Note 1 : If GAIN or DIF is over adjusted it will cause the engine speed to oscillate. Repeated adjustment of the GAIN and INT. arrangement can help to obtain the best performance.

Note 2 : Due to different types of external and internal built-in type actuators the GAIN is very important together with INT adjustment. The movement of PT pump type actuators is very limited, so Gain is set to the minimum using INT and DIF to adjust engine speed compensation.

SECTION 5 : DIMENSION AND TYPICAL WIRING DIAGRAM



Wiring Drawing
Figure 4

* Cable A, B - use a cable with a wrapped Mylar aluminum foil shield with a drain wire.

* To connect the 5K ohm external potentiometer refer to section 3. Connections.

1. To connect the DC power supply and actuator use a 12 AWG / 2mm twisted pair wire.

2. Use a shielded, twisted pair to connect the MPU to the EG3000. Attach the drain shield wire to Terminal 10 and terminate the opposite end.

SECTION 6 : TROUBLESHOOTING

PROBLEM	CORRECTIVE ACTION
Actuator goes to full stroke when DC power is turned on (Engine is not operating)	1. Check magnetic pickup leads for proper shielded wire or open shield. Verify and correct wiring as necessary. Be sure there is no jumper between terminals 2 and 3. 2. Failsafe circuit in the controller may be damaged or defective. Replace with new controller. 3. With DC power OFF remove leads at actuator. Check continuity of conduction on each terminal to case. There should be no continuity of conduction between any terminal and case of EG3000. If conduction is measured, then replace the controller. 4. If remote speed potentiometer has been connected to terminals 6, 7 and 9 of the controller, disconnect these leads. Turn DC power ON to the governor if the actuator is now normal. Proceed to corrective actions for the next problem.
Governor is completely dead and actuator lever stays at minimum position when power is applied to governor.	1. Check battery voltage at terminals 1 and 2 on controller. Terminal 1 is positive. Check battery connections and contacts for turning power ON to the controller. 2. Check for proper linkage setup. Correct and free linkage. 3. Magnetic pickup signal absent or too low. Measure AC voltage across terminals 10 and 11 while cranking the engine. Voltage should be min. 1.0 Vac. NOTE : The voltmeter should have an impedance of 5000 ohms / volts or higher. Check pole tip gap over gear tooth. Should be 0.037 mm – / - 0.127 mm. 4. Measure the resistance of the magnetic pickup coil. This should be above 50 ohm. If there is an open or shorted coil, replace the magnetic pickup. 5. Measure the resistance of each pin to the metal case of the magnetic pickup. No continuity should be evident. 6. If there is continuity of conduction to the case, replace with new magnetic pickup. 7. Measure actuator coil resistance: If actuator coil is open or shorted to case, replace the actuator. If governor still does not operate, continue with steps below. 8. Measuring the resistance of each coil lead to the actuator case should indicate an open circuit on a low scale of the ohm meter. If continuity is defected, replace the actuator. 9. With DC to the governor ON and the engine OFF, measure the DC voltage from terminal 6(+) to terminal 2(-). This should be approx. 4 Vdc. If 4 Vdc is not present, replace the controller. 10. Between terminal 7(+) and terminal 2(-), the voltage should be approx. 4.6 Vdc. If 4.6 Vdc is not present, replace the controller.
Erratic governor operation	1. Measure DC voltage at 1 and 2 on controller terminal strip. Normal battery voltage should be indicated. If nominal voltage is present, wiring is correct. 2. Low battery voltage 20% below rated can cause erratic operation. Check battery and charging system. 3. RFI noise due to incorrect shielding. Correct wiring. 4. RFI noise fed through power supply leads. Connect power leads directly to the battery.

PROBLEM	CORRECTIVE ACTION
Improper operation from remote speed potentiometer	1. Investigate wiring to remote speed potentiometer for open or shorted circuits. Checking wiring. 2. If the leads at terminals 6 and 7 to the remote speed potentiometer are reversed, speed control by the remote speed potentiometer will be reversed. Correct wiring. 3. Lead wire to remote speed setting potentiometer should be 3-wire shielded cable. Verity that the drain shield wire is isolated from ground at the potentiometer. If terminal 6 lead to the remote speed potentiometer is open, engine speed will go high. Correct the wiring. 4. If lead 8 and 9 (wiper lead to remote potentiometer) is open, there will be no control by the remote speed potentiometer. Verify and correct wiring. 5. If lead 7 to the clockwise terminal of the remote speed potentiometer is open, speed will remain at the value set in EG3000.
Slow, small amplitude hunting of speed or frequency	Jammed or very loose linkage. Correct linkage.
Fast oscillation of governor linkage	Verity calibration setting of the controller. Re-adjust setting as necessary.
Engine will not start – Actuator goes to full fuel during cranking	1. Make sure fuel is available. Check fuel to engine. Check for correct wiring to the automatic shutdown circuits. 2. Air may be trapped in fuel line. Check fuel lines for leaks. 3. Try to operate engine manually.

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