EG4015

Digital Generator Governor Controller
User Manual

Digital Governor for use in Gas and Diesel Generators with smoke and idle controls working off the generator frequency, (no MPU required) compatible with all types of actuators and PT Pumps,

KUTAI

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SECTION 1 : SUMMARY

The EG4015 Governor uses generator frequency to control engine speed. It works without a magnetic pickup (MPU), a digital circuit detects the reference frequency from the generators output.

Digital governors are not influenced by frequency drift caused by temperature changes. For example over a full temperature range from -40 to +80 ˚C the frequency drift is only +/- 0.1 Hz.

This control uses advanced PID Software, which together with GAIN and DIF settings simplifies adjustments and governor response.
The EG4015 can be used in all types of engine actuators that work with less then 15Amps it also works with Cummins PT PUMP actuators. LED's allows the user to determine operational and fault status making it easy to install.

SECTION 2 : SPECIFICATION

Sensing Input (S1, S2)

Voltage	1 – 600 Vac
Frequency	5 – 100 Hz

Operating Voltage (DC+, DC-)

Voltage	10 – 32 Vdc

Reverse Voltage Protection

Max. -50 Vdc

Actuator Output (ACT+, ACT-)

Current	Continuous 15A

Steady State Speed Band

+/- 0.25 % (with stable load)

Idle Speed Frequency

25 Hz @ 50 Hz mode
30 Hz @ 60 Hz mode

Temperature Drift Frequency Range

0.1 Hz @ -40 to +80 ˚C

External Frequency Control (VR1, VR2, VR3)

Frequency adjustment range
+/- 2 Hz 5K ohms 1watt potentiometer

EMI Suppression

Internal electromagnetic interference filtering and common mode ferrite beads

Static Power Dissipation

Min. 120 mA @ 12 Vdc
Min. 60 mA @ 24 Vdc

Protection Functions

Loss Sensing Protection
Actuator Short Circuit Protection activate to stop the output
Overspeed Protection activate to stop the output
Max. 57 Hz @ 50 Hz system
Max. 67 Hz @ 60 Hz system

VR Adjustment

SPEED	50 Hz : 45 to 55 Hz
	60 Hz : 55 to 65 Hz
DIP	PID Differential adjustment
GAIN	PID Actuator output gain adjustment

DIP Switch

SW1 Actuator type	OFF : Built-in & Non-Built-in
	ON : PT PUMP
SW2 Ramp time	OFF : 10 seconds ramp time
	ON : no ramp
SW3 frequency selection	OFF : 60 Hz
	ON : 50 Hz

Environment

Operating Temperature	-40 to +80 ˚C
Storage Temperature	-40 to +85 ˚C
Relative Humidity	Max. 95%
Vibration	5 Gs @ 60 Hz

Dimensions

162.0 (L) x 112.0 (W) x 43.0 (H) mm

Weight

330 g +/- 2%

SECTION 3 : APPEARANCE / DIMENSIONS / INSTALLATION DRAWING

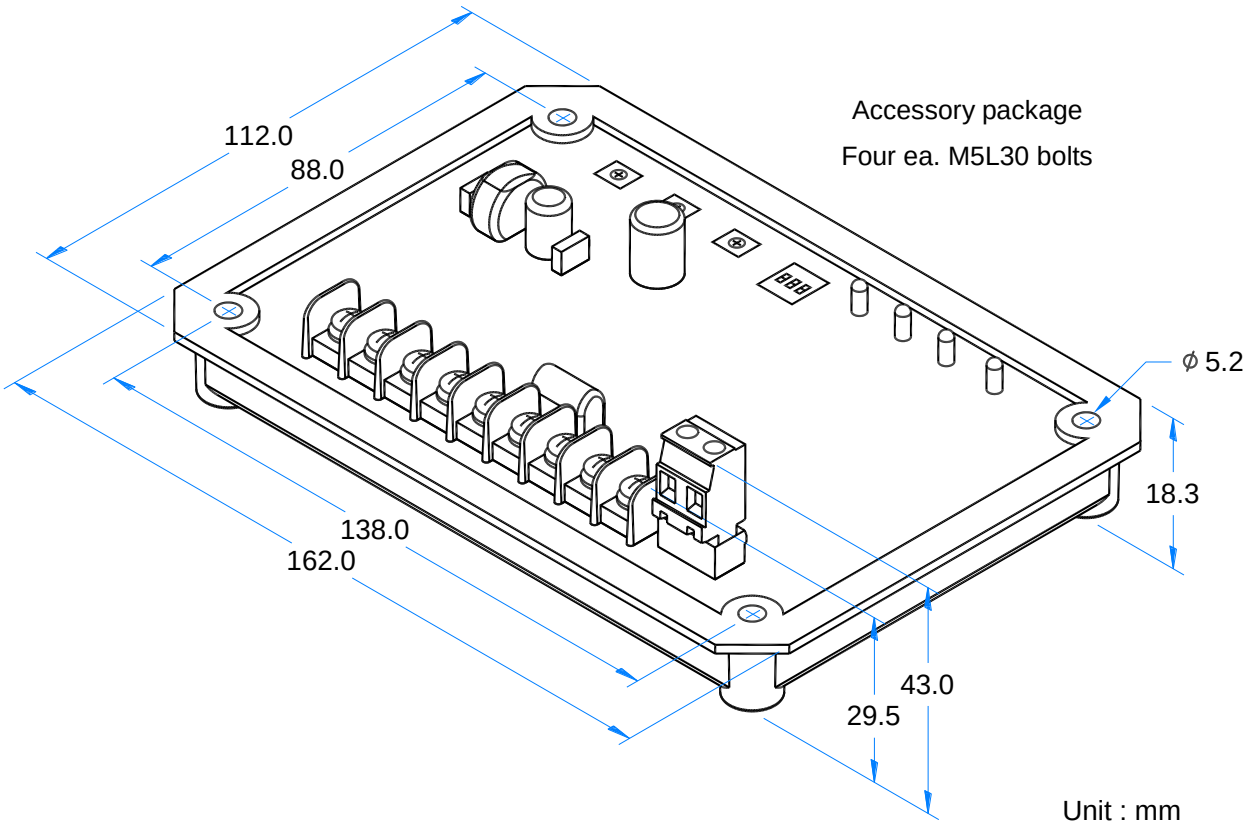


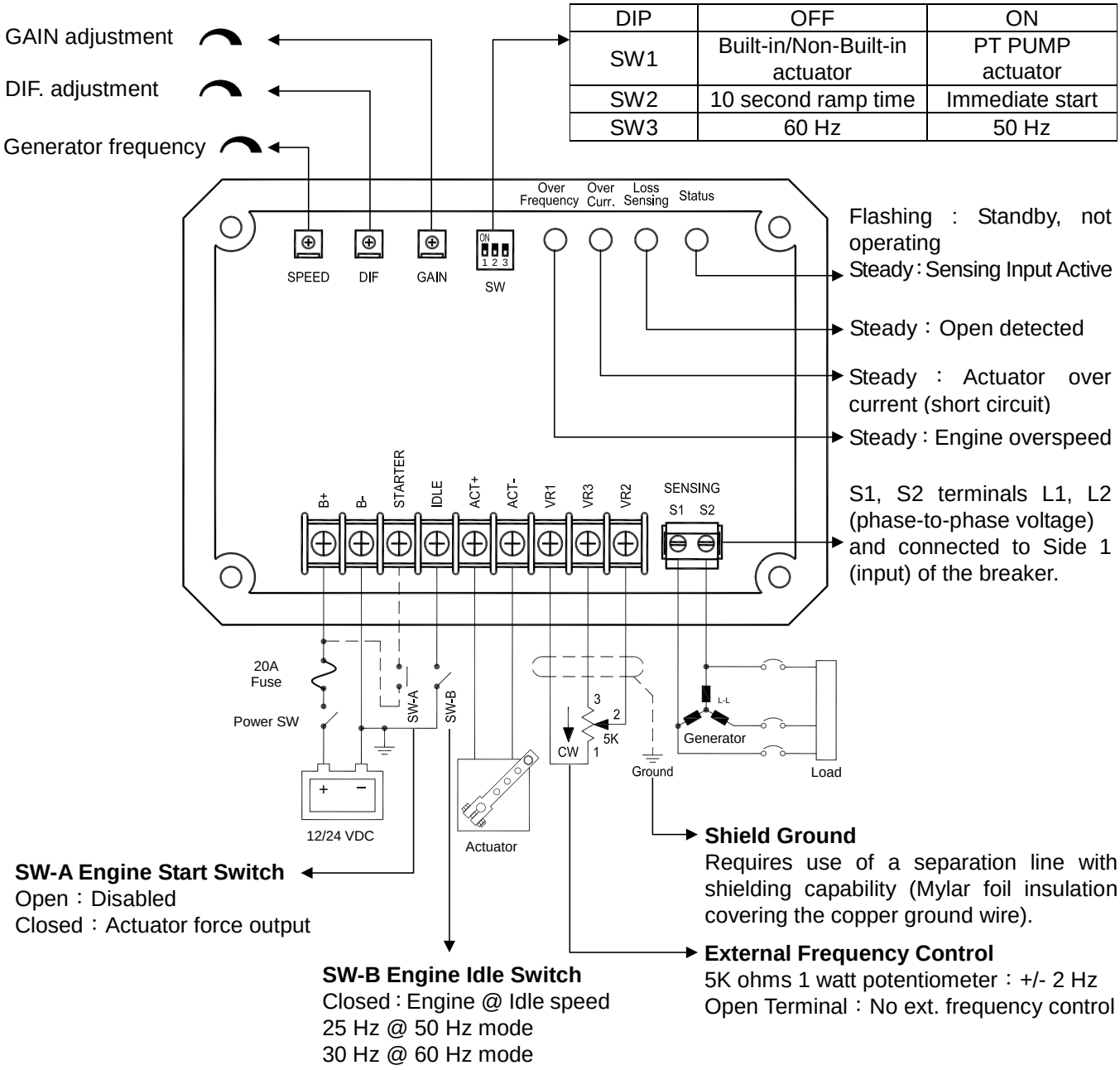
Figure 1 Outline Drawing

SECTION 4 : ALARMS AND WIRING DIAGRAM

ATTENTION

1. **Installation personnel must be individual who have received training in order to avoid incorrect installation. Defective installations may cause damage and injury to personnel.**
2. **An independent external shutdown device is installed. If the controller power source is lost it can shutdown the system to avoid damage to equipment or injury to personnel during the fault.**
3. **We recommend also installing a second engine shutdown device, such as a fuel switch, in order to facilitate immediate shutdown of the engine if there is a system failure.**
4. **There should be a fuse installed between the battery and the unit. The specification is a 20A slow-blow fuse.**
5. **The wiring between the battery and the actuator must be #AWG10 (2.58 mm^2) or a higher specification.**
6. **SENSING (S1, S2) wiring must be # AWG18 (1.02 mm2) with an insulation voltage rating of 600V or higher.**

DIP	OFF	ON
SW1	Built-in/Non-Built-in actuator	PT PUMP actuator
SW2	10 second ramp time	Immediate start
SW3	60 Hz	50 Hz



Flashing : Standby, not operating

Steady : Sensing Input Active

Steady : Open detected

Steady : Actuator over current (short circuit)

Steady : Engine overspeed

S1, S2 terminals L1, L2 (phase-to-phase voltage) and connected to Side 1 (input) of the breaker.

SW-A Engine Start Switch
Open : Disabled
Closed : Actuator force output

SW-B Engine Idle Switch
Closed : Engine @ Idle speed
25 Hz @ 50 Hz mode
30 Hz @ 60 Hz mode

Shield Ground
Requires use of a separation line with shielding capability (Mylar foil insulation covering the copper ground wire).

External Frequency Control
5K ohms 1 watt potentiometer : +/- 2 Hz
Open Terminal : No ext. frequency control

SECTION 5 : Installation

5.1 Inspections before starting engine

5.1.1 Check that all wiring is correct. Before starting the engine, turn on the power source to the unit (Power SW) and close engine start switch (SW-A). The actuator will be forced to its maximum engine start output (pulled to all the way to the stop) and will confirm that the wiring between the battery and the actuator are functioning normally. This also confirms the actuator is working smoothly without getting stuck. Repeat several times to confirm normal operation of the unit.

5.1.2 Adjust GAIN, DIF potentiometers to a central position.

5.1.3 When installing the external frequency control potentiometers they should be adjusted to a central position. These terminals should be open when not in use.

5.1.4 DIP SW 1, 2, 3 should be set to the desired modes of the system.

5.1.5 Idle setting. With SW-B closed the engine will enter idle speed (25 Hz or 30 Hz). When SW-B is opened the engine will go directly to the rated operating speed (50 Hz or 60 Hz). Select according to generator requirement.

5.1.6 Attach an analog frequency meter while making adjustments to make it easier to measure changes in generator frequency.

5.1.7 We recommend installing a fuel switch that can immediately shutdown the engine when the system is not operating normally.

5.2 Starting the engine

5.2.1 After turning on the unit power (Power SW) start the engine.

5.2.2 When the starter motor begins to turn terminals S1, S2 will detect the starting frequency and the actuator will be forced to its maximum engine start output (pulled to all the way to the stop). After the engine is started (frequency > 18 Hz), the controller will automatically adjust the actuator according to frequency.

5.2.3 If the residual voltage of the generator is too low (<1 Vac @ 5 Hz) terminals S1, S2 have no way to detect the starting frequency and the actuator will have no output, thus preventing the engine from starting smoothly. In this situation connect the engine start switch (SW-A) directly to the starter motor. Alternatively, when the engine is starting close the engine start switch (SW-A). The actuator will open to full output when the engine is starting causing the engine to start smoothly.

5.3 Idle (IDLE) operation

After the engine is started and SW-B closed, the engine will enter Idle speed (25 Hz or 30 Hz). When the engine Idle Speed countdown is completed SW-B will open and the engine will enter the rated frequency (50 Hz or 60 Hz). If SW-B is opened after the engine is started the engine will skip the Idle operation and go directly to the rated operating frequency.

5.4 Engine Speed Ramp Time

5.4.1 DIP SW2 OFF - the ramp up time from Idle frequency to rated frequency is 10 secs.

5.4.2 DIP SW2 ON - the generator will immediately go to rated operating frequency.

5.5 Unstable engine speed

If engine speed is unstable after starting slowly adjust the GAIN potentiometer counter-clockwise (CCW) until the engine reaches stability.

5.6 Generator frequency adjustment

When the engine speed has entered into a stable state adjust the SPEED potentiometer and external frequency control to the rated frequency of the generator (50 or 60 Hz).

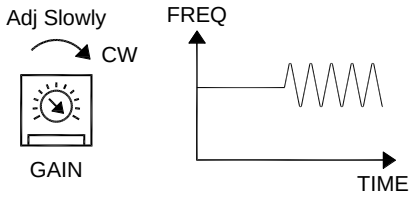
5.7 Restart the generator

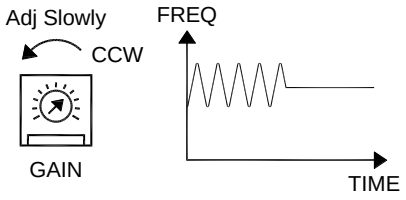
Shutdown the generator engine and then restart it. Confirm that the controller can smoothly control engine speed as the engine starts. If it is stable during this start period then go to < SECTION 6. Optimal Engine Response Adjustment Procedure > below. If it is not stable during the starting period then repeat Step 5.1 above.

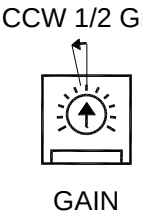
SECTION 6 : Optimal Engine Response Adjustment Procedure

6.1 After Step 5. Installation is completed and engine start operation is smooth, then carry out the following adjustments with generator in a no-load condition.

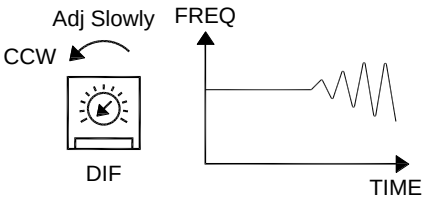
6.2 Slowly adjust the GAIN potentiometer clockwise (CW) until voltage frequency swings rapidly, then slowly adjust in a counter-clockwise direction (CCW) until the voltage frequency is stable. Wait for the voltage frequency to stabilize, then adjust a further turn counter-clockwise (CCW).

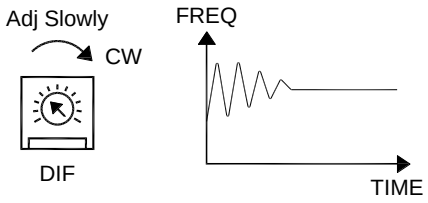


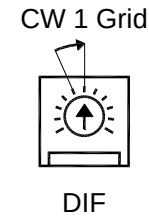




6.3 Slowly adjust the DIF potentiometer counter-clockwise (CCW) until the voltage frequency goes from a stable to an oscillating state, then slowly adjust clockwise (CW). The oscillations in voltage frequency will gradually stabilize. Wait for the frequency to stabilize then turn clockwise (CW) approximately one more time.



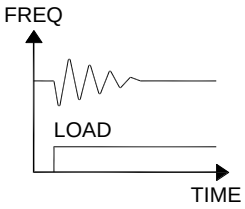




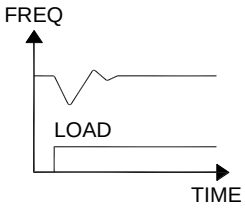
6.4 Push (or tap) the arm of the actuator with your hand or add a load to the generator and observe how the voltage frequency recovers. If normal it should return quickly to stability. If it requires further adjustment then repeat Steps 6.2 and 6.3 to readjust.

6.5 Optimal response curve and the DIF potentiometer adjustment.

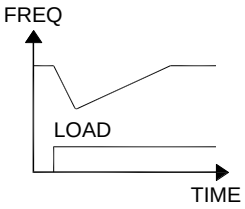
DIF setting insufficient - oscillations in frequency continue long after a load has added



DIF setting for optimal response curve

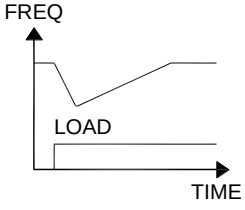


DIF setting too high. Frequency recovery after a load has been added is too slow

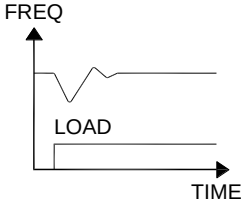


6.6 Optimal response curve and the GAIN adjustment

GAIN setting too low. Frequency recovers slowly after a load is added

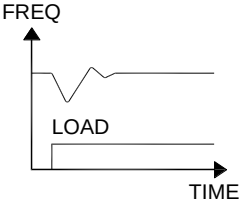


GAIN setting for optimal response curve



GAIN setting too high.

Oscillations in frequency continue for too long after a load is added



SECTION 7 : TROUBLESHOOTING

PROBLEM	CORRECTIVE ACTION
7.1 Engine Overspeed	1. Engine overspeed caused by inappropriate setting of GAIN & DIF potentiometers. Adjust settings according to procedure in Step. 5. 2. Check whether or the wiring for the voltage detection inputs (S1, S2) is normal, and whether or not the residual voltage produced is >1 Vac. 3. Check whether actuator is stuck in lowest position, causing overspeed. 4. If all of the checks above are normal then change the EG4015 controller.
7.2 Actuator cannot open completely to maximum output	1. Check if the battery voltage is below 10 Vdc. 2. Check if the actuator has overheated. 3. Check whether the actuator specs. match the driving power supply voltage. 4. Check that the linkage between the actuator and the fuel valve is not impeded. 5. For actuator installation refer to "**Electronic Governor Controller Concept**" http://www.kutai.com.tw/en/electronic-governor.html
7.3 Actuator does not operate	1. Check the power switch and the fuse. 2. Using an ohm meter measure ACT+, ACT- terminals will measure the internal resistance of the actuator (pay attention to measurement polarity). If the actuator is damaged it is possible that the measured resistance level will not meet the specifications of the actuator. Change the actuator to meet system requirements. 3. Confirm that the actuator has been installed in accordance with Step 5.1.1
7.4 Over Current (short circuit) protection lamp illuminated	1. Check whether or not the actuator is short-circuited. 2. Check whether the actuator has a parallel diode. Ensure that the ACT+ is connected to the N (Cathode) pole of the diode, and ACT- is connected to the P (Anode) pole.
7.5 Engine will not start	1. Check whether or not the actuator is a maximum during starting. If it cannot be opened to the maximum then reference Step 7.2 above. 2. Check whether there is sufficient fuel and the fuel switch is open. 3. It is possible that air could be trapped in the fuel line. 4. Check the fuel time for leaks. Try manually operating the engine.
7.6 Engine speed oscillates irregularly	1. Measure voltage between B+、B- on the EG4015. If voltage is insufficient (<10 Vdc) it could possibly cause irregular operation. Change the battery. 2. RFI caused by improper shielding. Fix shield grounding wire.
7.7 Engine speed continually swings after a load is added	1. Gain adjustment is not good. Re-adjust Gain setting according to Step SECTION 6. Optimal Engine Response Adjustment Procedure.
7.8 Frequency oscillates in a small range	1. Check the linkage between the actuator and the fuel valve, either too tight or if there is a gap (too loose). Correct any problems with the linkage.
7.9 Radio Frequency Interference (RFI) causing irregular engine speed oscillations	1. Install EG4015 in a grounded metal case in order to shield from RFI.

※ Appearance and specifications of products are subject to change for improvement without prior notice.