



## Installation & Operation Manual

**DYNA 8000**



**DYNA 8200**



**DYNA 8400**



## DYNA 8000, 8200 & 8400 Series Electronic Governor Systems

**Manual 36569**

## IMPORTANT

### DEFINITIONS

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

## WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.



Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.



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Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

## NOTICE

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

## NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

■ Revisions—Text changes are indicated by a black line alongside the text.

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## Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).
2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the work area as much as possible.
4. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
  - Do not touch any part of the PCB except the edges.
  - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
  - When replacing a PCB, keep the new PCB in the plastic anti-static protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the anti-static protective bag.

### **NOTICE**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

# Chapter 1.

## General Information

### Introduction

DYNA 8000, DYNA 8200, and DYNA 8400 governor systems provide engine governing for speed and power control of piston and gas turbine engines or steam and water turbines. The system components are a rotary actuator and an electronic controller, both of which are described further in this manual.

The DYNA 8000 and DYNA 8400 hazardous duty actuators are UL listed for Class I, Division 2, Group D, hazardous duty applications that are often encountered in the petroleum or chemical industries.

#### ACTUATOR

The actuator consists of an electromagnet with an iron armature rolling on the center shaft bearings. The actuator is provided with a return spring which balances the magnetic force of the armature. When DC current flows in the coil, the magnetic force moves the armature in the stator and this linear motion is transformed into rotary motion through a crank arm that forms part of the output shaft.

#### CONTROLLER

The electronic controller is the information processing unit of the governor assembly. It contains electronic components which process the input signal from the magnetic pickup to command the engine to the desired speed/RPM set into the controller. Electronic adjustments are available on the controller for field adjusting the unit as necessary.

#### DC POWER SOURCE

The governor system receives its power from a battery or an AC to DC power supply supplying 12 or 24 Vdc  $\pm$  20% to match the governor voltage. The average operating current consumption is 2.5A to 3.5A and the highest consumption is 14.75A during engine start-up or during a large load change. The power source must be rated above maximum stall current.

#### ISOCRONOUS OPERATION

Isochronous operation is obtained by setting DROOP potentiometer fully counterclockwise. The DYNA governor is all electric, and it is normally operated in the isochronous mode; i.e., engine RPM is constant ( $\pm$  0.25%) under steady state load conditions, up to the engine's maximum capability, regardless of load on the engine.

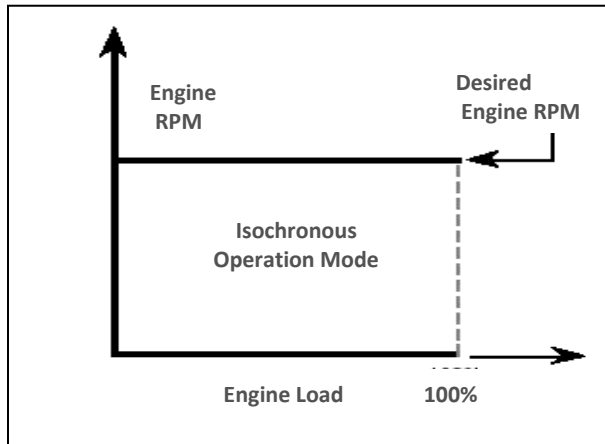


Figure 1. Isochronous Operation Mode

**DROOP OPERATION**

Droop operation is obtained by setting the DROOP potentiometer. *Clockwise* increases the droop. The amount of droop for a given setting depends on the magnetic pickup frequency and no-load to full-load actuator shaft rotation. A DROOP potentiometer setting of 10 o'clock will give about 4% droop, no load to full load when the pickup frequency is 4260 Hz and actuator shaft rotation is approximately 30° from no load to full load. Lower pickup frequency or smaller shaft rotation results in less droop for the system.

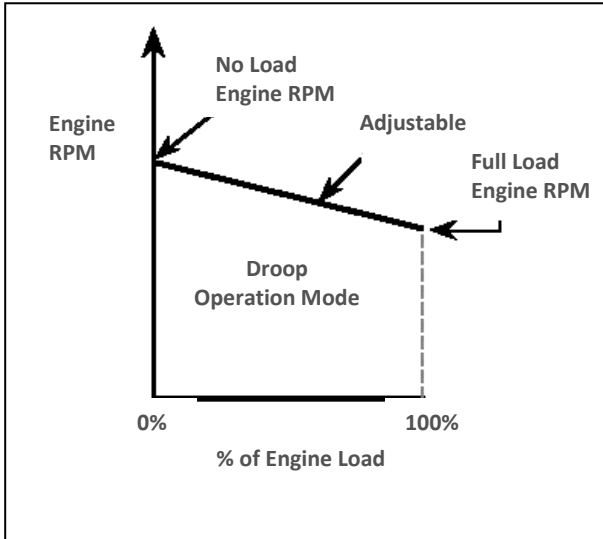


Figure 2. Droop Operation Mode

**REMOTE SPEED ADJUSTMENT**

An optional remote speed selector (DYNS-10000) is available for adjusting engine RPM from up to 90 meters (300 feet.) from the engine. Refer to the electrical wiring schematic shown in **Figure 6**. The potentiometer can be connected for a narrow (fine) or wide speed range control.

## Chapter 2.

# Specifications

### Actuator Specifications

<b>Operating Voltage</b>	12 Vdc or 24 Vdc $\pm$ 20%
<b>Ambient Operating Temperature</b>	-55 to + 125 °C (-65 to + 255 °F)
<b>Mechanical Vibration</b>	5 to 500 Hz, Curve F, per MIL-STD. 810D, Method 514-2
<b>Connection</b>	Terminal strip or "MS" connector
<b>Sealed Unit</b>	Oil, water, and dust tight

### Actuator Selection Guide

DYNA Series	Work	Torque	Output	Current @ 12 Vdc		Current @ 24 Vdc		Nominal Response Time for 63% of Stroke	Weight
				Max. Amps at Stall	Nominal Steady State Amps	Max. Amps at Stall	Nominal Steady State Amps		
<b>8000</b>	1.2 J (0.9 ft-lb)	1.4 N·m 1.0 lb-ft	Rotary 35°	12.5 mA	3.5 A	9.5 mA	1.5 A	0.030 sec	5 kg (11.0 lb)
<b>8200</b>	2.85 J (2.10 ft-lb)	4.07 N·m 3.0 lb-ft	Rotary 45°	14.75 mA	4.5 A	14.0 mA	3.5 A	0.138 sec	8.4 kg (18.5 lb)
<b>8400</b>	5.8 J (4.3 ft-lb)	7.3 N·m 5.4 lb-ft	Rotary 45°	N/A	N/A	13.0 mA	2.0 A	0.104 sec	12.2 kg (27.0 lb)

## DYNA 8000 Series Actuators

ACTUATOR MODEL	FORMER DYNC PART NUMBER	VOLTAGE	OUTPUT SHAFT ROTATION		ACTUATOR HEAD POSITION	MOUNTING		HAZARD- OUS DUTY
			CW	CCW		Stan- dard	Side	
DC11020-000-012	DYNC 11020-000-0-12	12 Vdc	■		—	■		
DC11020-000-024	DYNC 11020-000-0-24	24 Vdc	■		—	■		
DC11020-300-012	DYNC 11020-300-0-12	12 Vdc	■		—		■	■
DC11020-300-024	DYNC 11020-300-0-24	24 Vdc	■		—		■	■
DC11021-000-012	DYNC 11021-000-0-12	12 Vdc	■		180° from DC11020	■		
DC11021-000-024	DYNC 11021-000-0-24	24 Vdc	■		180° from DC11020	■		
DC11021-300-012	DYNC 11021-300-0-12	12 Vdc	■		180° from DC11020		■	■
DC11021-300-024	DYNC 11021-300-0-24	24 Vdc	■		180° from DC11020		■	■
DC11022-000-012	DYNC 11022-000-0-12	12 Vdc	■		90° CCW from DC11020	■		
DC11022-000-024	DYNC 11022-000-0-24	24 Vdc	■		90° CCW from DC11020	■		
DC11022-300-024	DYNC 11022-300-0-24	24 Vdc	■		90° CCW from DC11020		■	■
DC11023-000-024	DYNC 11023-000-0-24	24 Vdc	■		90° CW from DC11020		■	
DC11023-300-024	DYNC 11023-300-0-24	24 Vdc	■		90° CW from DC11020		■	■
DC11023-350-024	DYNC 11023-350-0-24	24 Vdc						

## DYNA 8000 Series Actuators (cont'd.)

ACTUATOR MODEL	FORMER DYNC PART NUMBER	VOLTAGE	OUTPUT SHAFT ROTATION		ACTUATOR HEAD POSITION	MOUNTING		HAZARD- OUS DUTY
			CW	CCW		Stan- dard	Side	
DC11024-000-012	DYNC 11024-000-0-12	12 Vdc		■	—	■		
DC11024-000-024	DYNC 11024-000-0-24	24 Vdc		■	—	■		
DC11024-300-012	DYNC 11024-300-0-12	12 Vdc		■	—		■	■
DC11024-300-024	DYNC 11024-300-0-24	24 Vdc		■	—		■	■
DC11025-000-024	DYNC 11025-000-0-24	24 Vdc		■	90° CW from DC11024	■		
DC11025-300-012	DYNC 11025-300-0-12	12 Vdc		■	90° CW from DC11024		■	■
DC11026-000-012	DYNC 11026-000-0-12	12 Vdc		■	180° CCW from DC11024	■		
DC11026-000-024	DYNC 11026-000-0-24	24 Vdc		■	180° CCW from DC11024	■		
DC11026-300-012	DYNC 11026-300-0-24	12 Vdc		■	180° CCW from DC11024	■	■	■
DC11026-300-024	DYNC 11026-300-0-24	24 Vdc		■	180° CCW from DC11024	■	■	■
DC11028-000-012	DYNC 11028-000-0-12	12 Vdc		■	90° CCW from DC11024	■		
DC11028-300-012	DYNC 11028-300-0-12	12 Vdc		■	90° CCW from DC11024		■	
DC11028-300-024	DYNC 11028-300-0-24	24 Vdc		■	90° CCW from DC11024		■	

## DYNA 8200 Series Actuators

ACTUATOR MODEL	FORMER DYNC PART NUMBER	VOLTAGE	OUTPUT SHAFT ROTATION		ACTUATOR HEAD POSITION	MOUNTING		HAZARD- OUS DUTY
			CW	CCW		Stan- dard	Side	
<b>DC12000-000-012</b>	DYNC 12000-000-0-12	12 Vdc	■		—			
<b>DC12000-000-024</b>	DYNC 12000-000-0-24	24 Vdc	■		—			
<b>DC12001-000-012</b>	DYNC 12001-000-0-12	12 Vdc	■		180° from DC12000			
<b>DC12001-000-024</b>	DYNC 12001-000-0-24	24 Vdc	■		180° from DC12000			
<b>DC12002-000-012</b>	DYNC 12001-000-0-12	12 Vdc	■		90° CCW from DC12000			
<b>DC12003-000-024</b>	DYNC 12003-000-0-24	24 Vdc	■		90° CW from DC12000			

## DYNA 8400 Series Actuators

ACTUATOR MODEL	FORMER DYNC PART NUMBER	VOLTAGE	OUTPUT SHAFT ROTATION		ACTUATOR HEAD POSITION	MOUNTING		HAZARD- OUS DUTY
			CW	CCW		Stan- dard	Side	
<b>DC14800-000-024</b>	DYNC 14800-000-0-24	24 Vdc	■ †	■ †	—			

(†) Through output shaft makes available both CW and CCW output.

## Controller Selection Guide

Any of the controllers listed below can be used on a DYNA 8000, DYNA 8200, or DYNA 8400 actuator. The controllers are categorized as either Derivative Pot or Non-derivative Pot models, depending on their adjustability features.

### Controller Input Signal Frequency

Select your controller for the correct input signal frequency range generated by the magnetic pickup at the maximum engine operated (RPM) speed. Use the following formula to convert from RPM to Hertz.

$$\frac{[(EngineRPM) \times (NumberOfTeeth)]}{[60s]} = [MpuHertz]$$

### Controller Models

CONTROLLER MODEL	FORMER DYNI PART NUMBER	VOLTAGE	FREQUENCY	CE MARKED
NON-DERIVATIVE POT MODELS				
<b>8270-1021</b>	DYN1-10654-000-0-12	12 Vdc	2500–5000 Hz	
<b>8270-1004</b>	DYN1-10654-000-0-24	24 Vdc	2500–5000 Hz	
<b>8270-1072</b>	DYN1-10654-001-0-24	24 Vdc	2500–5000 Hz	■
DERIVATIVE POT MODELS				
<b>8270-1024</b>	DYN1-10684-000-0-12	12 Vdc	2500–5000 Hz	
<b>8270-1073</b>	DYN1-10684-000-0-24	24 Vdc	2500–5000 Hz	

## Specification Chart

<b>Operating Voltage</b>	12 Vdc or 24 Vdc $\pm$ 20%
<b>Ambient Operating Temperature</b>	-40 to +85 °C (-40 to + 180 °F)
<b>Temperature Stability</b>	Better than $\pm$ 0.5% over a temperature range of -40 to + 75 °C (-40 to + 167 °F)
<b>Output Current</b> <b>Current Draw w/o Actuator:</b> <b>Maximum Amps at Stall:</b>	At 12 and 24 Vdc: 80 mA 13 A
<b>Steady State Speed Band</b>	$\pm$ 0.25%
<b>Adjustments</b> <b>Non-Derivative Pot Models:</b> <b>Derivative Pot Models</b>	Speed, Gain, Integral, and Droop Speed, Gain, Integral, Droop, and Derivative
<b>Mechanical Vibration</b>	Withstands the following vibration without failure or degraded performance: 0.06 inch double amplitude at 5 to 18 Hz; 1 G at 18 to 30 Hz; 0.02 inch double amplitude at 30 to 48 Hz; 2.5 G's at 48 to 70 Hz
<b>Connection</b>	Terminal strip
<b>Circuit Boards</b>	Boards are covered with a heavy conformal coating for moisture and vibration protection
<b>Sealed Unit</b>	Oil, water, and dust tight
<b>Weight</b>	0.863 kg (1.9 lb)

## Chapter 3. Installation

The actuator of the governor assembly is mounted on the engine next to the fuel system. The magnetic pickup is normally mounted in the flywheel housing in such a way that it can count the teeth on the starter ring gear. The controller is off-mounted or installed in the engine control panel or cabinet.

1. Mount the actuator on a suitable rigid steel bracket or plate.

### NOTICE

Mounting kits are available for particular engines. Please contact your Woodward customer service representative if you require mounting information or a kit.

2. Set up the linkage and rod end bearings as shown in **Figures 4 and 5**.
3. Install the speed sensor (magnetic pickup) with SAE threads. (Magnetic pickups with M16x1.5 threads and 14.5 Ø mm tap drills are available.)
4. Remove the inspection cover over the ring gear teeth. (The magnetic pickup should not be installed in inspection covers.) Gear teeth should be free of burrs, excessive grease, or dirt.
5. Inspect the ring gear housing and pick a location where a 37/64" hole can be drilled such that the ring gear teeth will pass in front of the pickup pole face. After the 37/64" hole is drilled, use a 5/8-18 starting tap to cut threads for the magnetic pickup, and then run a bottom tap through the hole.

### NOTICE

The tapped hole should be drilled as perpendicular as possible over the center of the ring gear teeth.

6. Manually rotate the ring gear until a tooth face is directly in the center of the tapped hole. Gently turn the magnetic pickup clockwise into the hole until it bottoms on the tooth, and back off 1/4 turn. Tighten the jam nut firmly, maintaining the 1/4 turn position.
7. Mount the controller in the control panel.
8. Connect the wiring as shown in **Figure 6** or according to your particular wiring diagram.

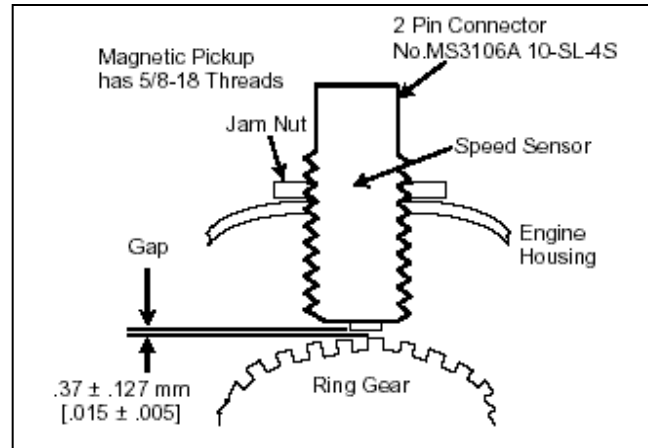


Figure 3. Installation of Magnetic Pickup

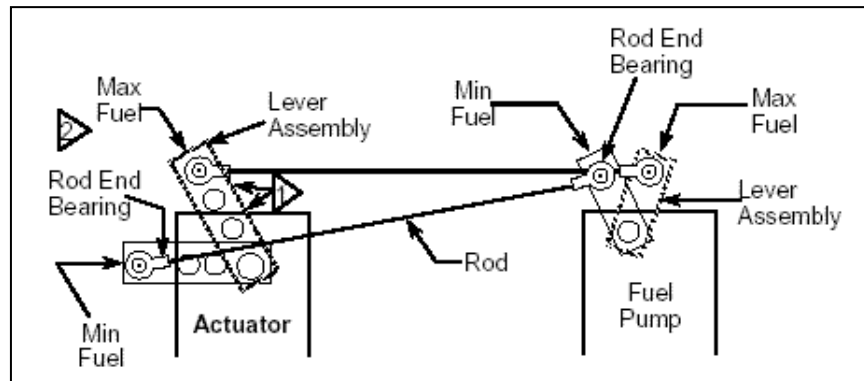


Figure 4. Rotary Actuator to Rotary Fuel Pump Linkage

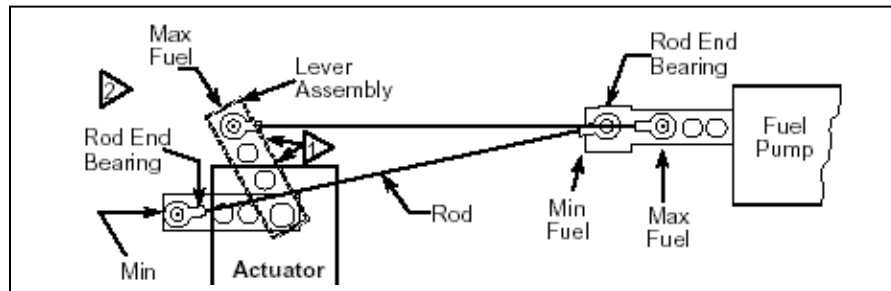


Figure 5. Rotary Actuator to Linear Fuel Pump Linkage

#### DIAGRAM NOTES

- 1 Choose hole in actuator lever which causes actuator to rotate through its maximum rotation to provide minimum to maximum fuel.
- 2 Non-linear linkage to actuator is proper for best operation. Provides low GAIN at light loads and high GAIN at heavy loads.

## Controller Dimensions & Wiring Diagram

Dimensions are in mm. Dimensions in brackets [ ] are in inches.

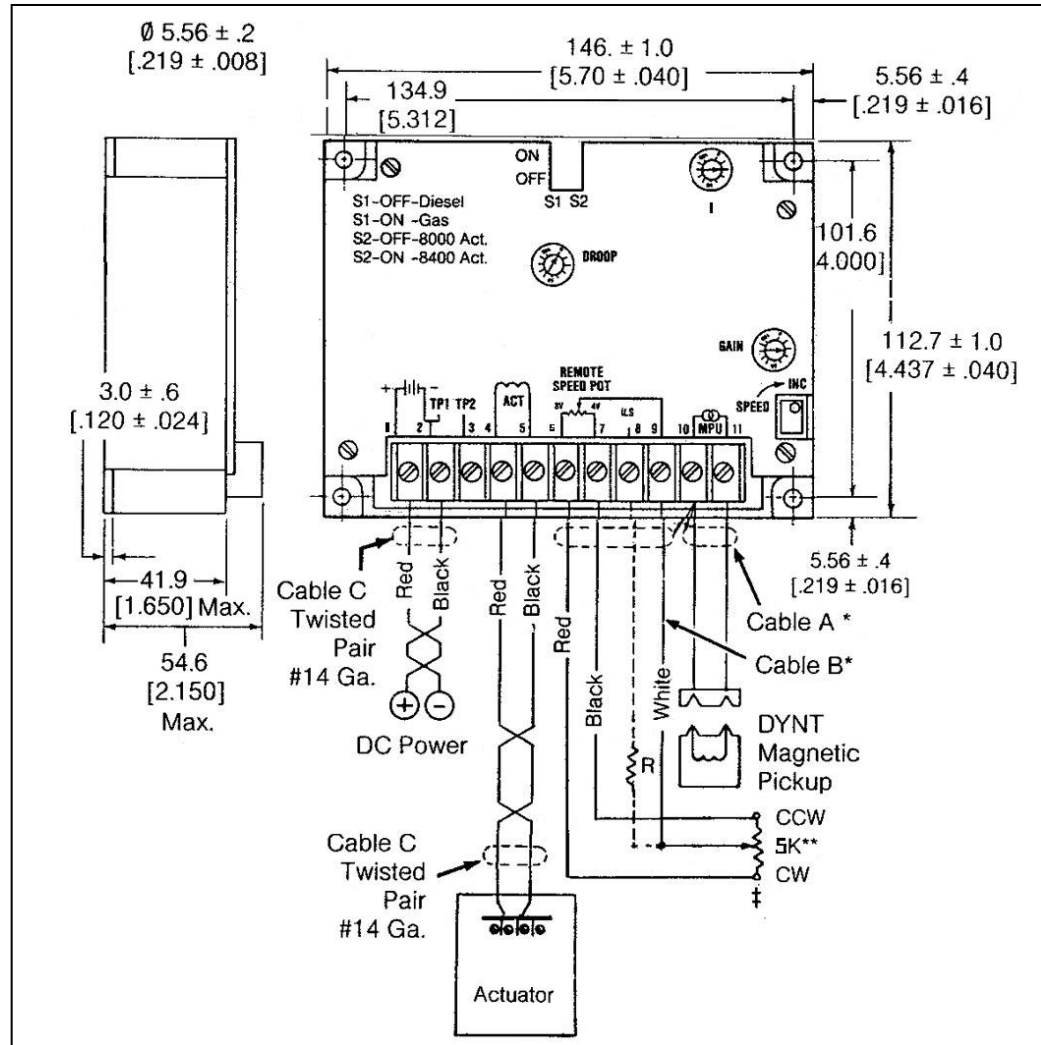


Figure 6. Dimensions & Wiring Diagram for 8270-1072 Controller

### DIAGRAM NOTES

Cable A: DK44-XX 90° connector (specify length) Cable B: E26-22N (specify length)  
Cable C— DZ70-004-XX terminal strip (specify length) OR MS connector

\* Shielded cable – A customer should purchase a cable with a wrapped Mylar supported aluminum foil shield with a drain wire.

\*\* Remote speed potentiometer and 499K ohm resistor is P/N (DYNS-10000).

† The 5K remote speed potentiometer can be wired two different ways:

1. As shown by the solid line from the wiper of the 5K potentiometer and then connected to terminal #9 (no resistor required). Adjustable range is approximately  $\pm 5\%$  at 1800 RPM.
2. As shown by the dashed line from the wiper of the 5K potentiometer through resistor R and then connected to terminal #8. Reducing the value of R increases the remote adjustable speed range.

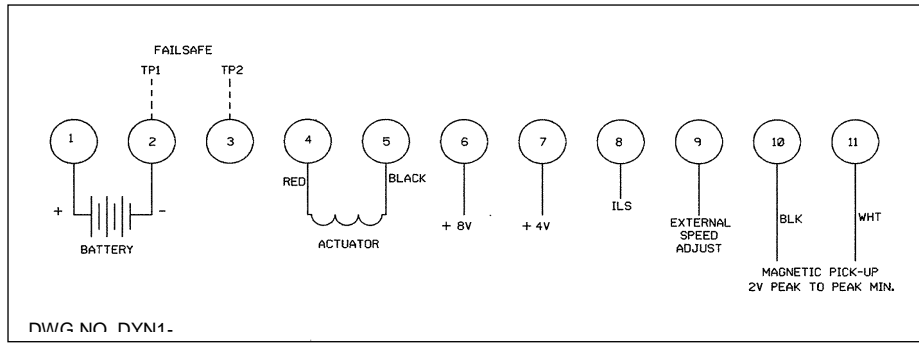


Figure 7. Wiring Diagram for CE Controllers



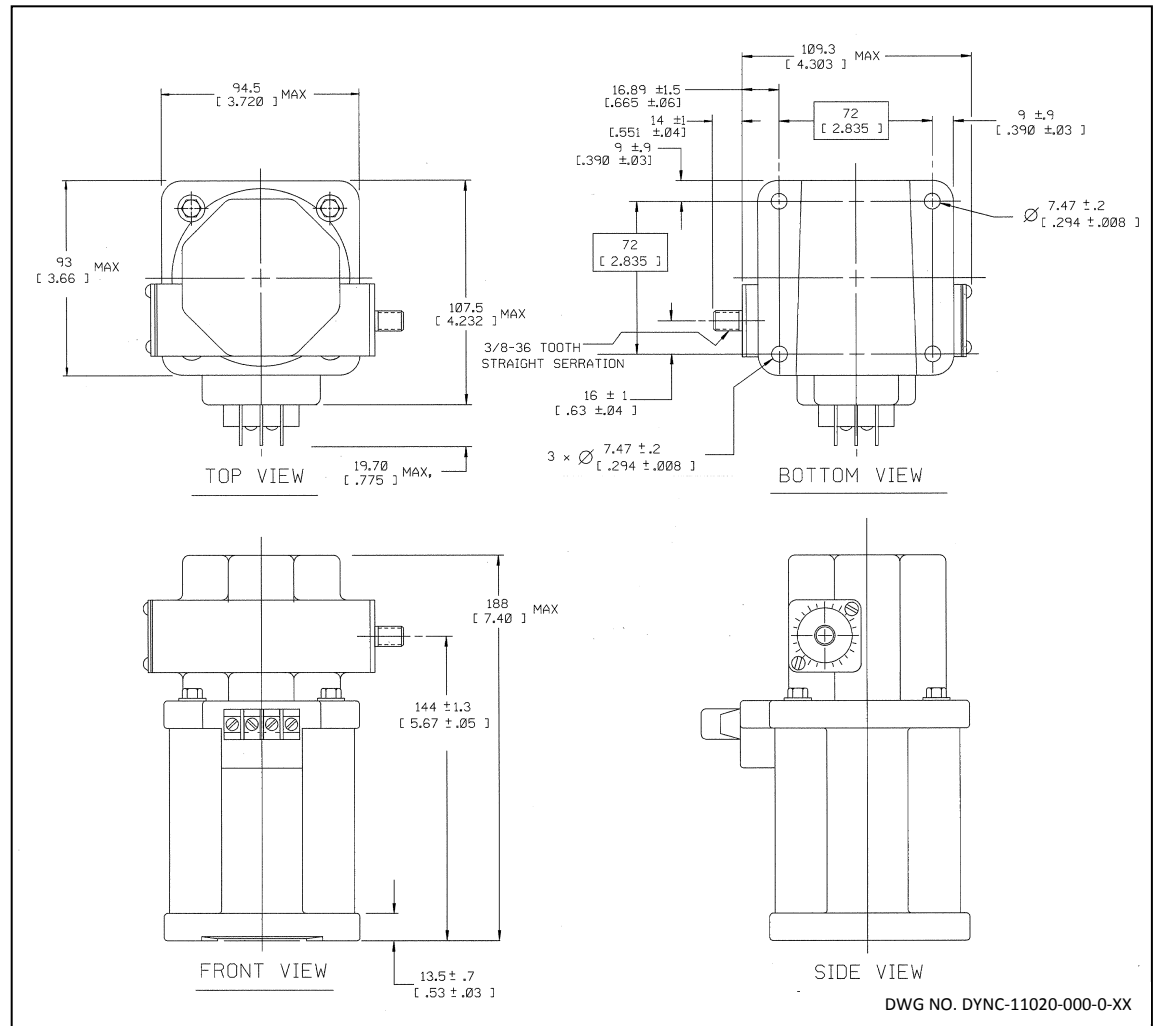
The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

## Actuator Dimensions

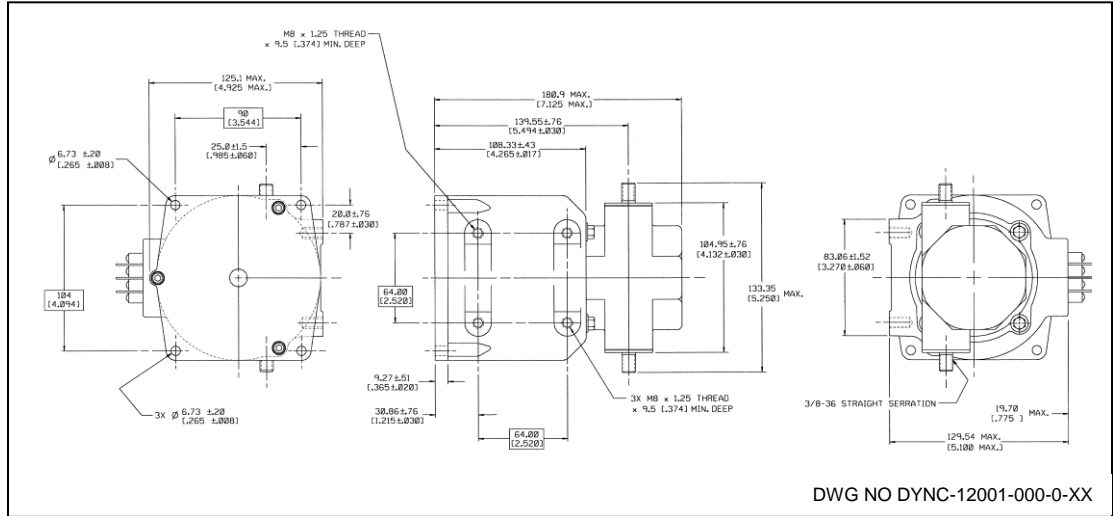
### DYNA 8000 Series

Dimensions are in millimeters. Dimensions in brackets [ ] are inches.



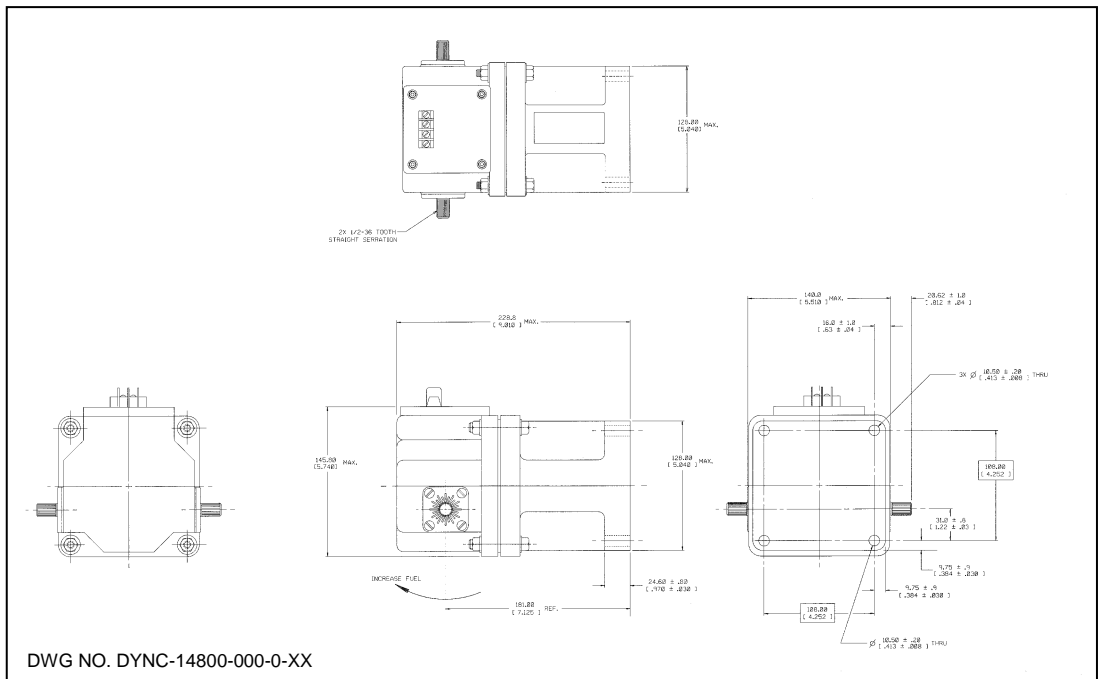
## DYNA 8200 Series

Dimensions are in millimeters. Dimensions in brackets [ ] are inches.



## DYNA 8400 Series

Dimensions are in millimeters. Dimensions in brackets [ ] are inches.



## Chapter 4. Calibration

As mentioned previously, any of the controllers described in Chapter 2 can be used with DYNA 8000, DYNA 8200, or DYNA 8400 actuators. The controllers are categorized as either Derivative Pot or Non-derivative Pot models, depending on their adjustability features, and each category has its own calibration procedure. Follow the calibration instructions relevant to the controller type you have. Model numbers are provided to help you determine the correct calibration procedures to follow.

### Switch SW1 and SW2 Adjustments

Switch adjustments are the same for both controller types. These switches allow for fuel response ranges (SW1 for matching either diesel or gas engine dynamics) and actuator selections (SW2 for either DYNA 8000, 8200, or 8400 actuators)

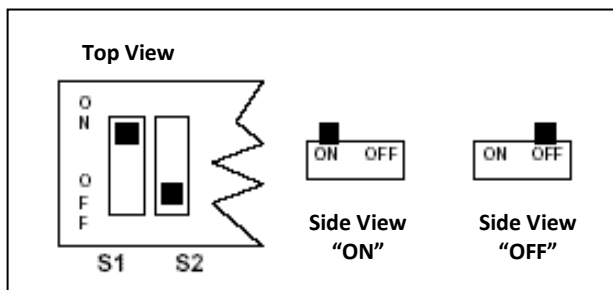
SW1 selects one of two integrating rate ranges. The diesel version integrates at twice the rate of the gas version

- Set S1 to the OFF position for diesel engine applications.
- Set S1 to the ON position for gas/gasoline engine applications.

**NOTE:** For some diesel engines, better operation may be obtained by placing SW1 in the ON position. If difficulty is experienced in the OFF position, try SW1 ON and recalibrate.

SW2 selects the point at which actuator coil current level causes the integrator limit to be actuated. This level is nominally 6.3A for the DYNA 8000 and 7.3A for the DYNA 8200 and 8400 actuators.

The easiest way to set the switches is to apply pressure with a small pointed object until the switch clicks into position.



## Calibration Procedure for Non-derivative Pot Controllers

### Model Numbers:

**8270-1021** (DYN1-10654-000-0-24)

**8270-1004** (DYN1-10654-000-0-24)

**8270-1072** (DYN1-10654-001-0-24) [CE Marked]

**8270-1053** (DYN1-10654-704-0-12)

### Connection Information

When using an ILS unit, the remote speed potentiometer may be left connected to the controller as shown.

When an ILS unit is used, connect 3-wire shielded cable to terminals 6, 7 and 8. Connect drain shield wire to terminal 10 at the controller only. The other end of drain shield wire is to be cut off and taped.

### Calibration Procedures

1. Refer to **Figure 6** or **Figure 7** before making any adjustments of the potentiometers, DROOP, I, GAIN and SPEED.
2. Turn power OFF to be sure that the engine is not operating.
3. Initial potentiometer settings:
  - a Set the I adjustment three divisions from zero and the GAIN at the second division from zero.
  - b For isochronous operation, set DROOP counterclockwise to minimum position as shown in **Figure 1**.
  - c For DROOP operation, set DROOP potentiometer clockwise to obtain desired amount of DROOP from no-load to full load. Turning potentiometer clockwise *increases* DROOP.

### NOTICE

If the full 35° rotation of the actuator shaft is used and the linkage adjusted to use only the active fuel range, the maximum obtainable DROOP would be approximately 12% at full load.

4. Start the engine.
5. Adjust the controller speed potentiometer until the engine is operating at the desired engine RPM. Clockwise increases engine RPM.
6. If the governor system is unstable, slightly reduce the GAIN setting.  
**NOTE:** Except for the speed adjustment, the potentiometers have internal stops at the 0 and 100% positions.
7. With the engine unloaded, finalize the settings, I and GAIN adjustments as follows:
  - a Turn the GAIN adjustment *clockwise* slowly until the actuator lever oscillates. (You may need to disturb actuator lever to cause oscillation.) Reduce the GAIN adjustment slowly *counterclockwise* until the lever is stable. Upset the lever by hand. If the lever oscillates 3 to 5 diminishing oscillations and stops, the setting is correct.
  - b If system performance to load changes is satisfactory, omit step (c).

- c Reduce the GAIN setting *counterclockwise* one division. Next, turn the I adjustment fully *clockwise* while observing the actuator lever. If the lever does not become unstable, upset it by hand. When the lever slowly oscillates, turn the adjustment *counterclockwise* slowly until the lever is stable. Upset the lever again; it should oscillate 3 to 5 times and then become stable for optimum response.

**NOTE:** Use whichever settings from steps (b) or (c) provide the best performance.

8. The unit is now calibrated.

## Calibration Procedure for Derivative Pot Controllers

### Model Numbers:

**8270-1024** (DYN1-10684-000-0-12)

**8270-1073** (DYN1-10684-000-0-24)

### Calibration Procedures

1. Observe that potentiometer settings are adjustable from zero to 100%. Each small division is 10%. The speed potentiometer is 10K, 20 turn.
2. Set SW1 and SW2.  
Set switch, S1, for the correct engine:
  - Set S1 to the OFF position for diesel engine applications.
  - Set S1 to the ON position for gas/gasoline engine applications.  
Set switch S2 for the correct actuator:
  - Set S2 to the "OFF" position for DYNA 8000 actuator
  - Set S2 to the "ON" position for DYNA 8200 or 8400 actuator.
3. If a remote speed potentiometer is used for narrow range, set to mid range.
4. Initial potentiometer settings:
  - GAIN        20%
  - I            20%
  - D            30%
  - DROOP     Zero
5. For isochronous operation, set DROOP *counterclockwise* to minimum position as shown in **Figures 2 and 3**.
6. For droop operation, set DROOP potentiometer *clockwise* to obtain desired amount of droop from no-load to full load. Turning potentiometer clockwise increases droop.
7. Start engine (No Load)
8. Adjust the controller speed potentiometer for desired engine speed.
9. Adjust the GAIN potentiometer *clockwise* until the engine begins to hunt. (If the engine remains stable at 100% GAIN, physically disrupt the actuator linkage by

hand.) With the engine hunting, turn the GAIN potentiometer *counterclockwise* until stable.

10. Repeat step 9 for the "D" setting.

11. Repeat step 9 for the "I" setting.

12. The unit is now calibrated.

NOTE: After calibration, it may be necessary to readjust the speed.

13. Conduct the following test:

With the engine operating at rated speed, turn the electric governor off. When engine speed slows to approximately half of rated speed, turn the electric governor back on. Observe the overshoot. If there is a small hunt at steady state, slightly turn the "I" potentiometer *counterclockwise* until stable. In some cases, 2 to 3 Hz overshoot may be acceptable.



For gas engines, make certain that method used does not put gas in exhaust which might result in an explosion.

If possible, operate the unit through various load ranges up to 100% to ensure stability.

## Chapter 5.

# Diagnostics & Troubleshooting

**SYMPTOM:** GOVERNOR IS COMPLETELY DEAD AND ACTUATOR LEVER STAYS AT MINIMUM POSITION WHEN POWER IS APPLIED TO GOVERNOR

Means of Detection	Corrective Action
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.
Check for proper linkage setup.	Correct and free linkage.
Magnetic pickup signal absent or too low. Measure AC voltage across terminals 10 and 11 while cranking the engine. Voltage should be min. 2.5 VAC. <b>Note:</b> The voltmeter should have an impedance of 5000 ohms/volts or higher.	Check pole tip gap over gear tooth. Gap should be .037 mm $\pm$ 0.127 mm (0.015" $\pm$ 0.005").
Measure the resistance of the magnetic pickup coil. This should be above 150 ohms (250 ohms max).	If there is an open or shorted coil, replace the magnetic pickup.
Measure the resistance of each pin to the metal case of the magnetic pickup. No continuity should be evident.	If there is continuity to case, replace the magnetic pickup.
DC SUPPLY OFF. Place an insulated jumper between terminals 2 and 3 (TP1 & TP2). With DC ON, the actuator should go to full stroke. DC voltage at terminals 4 and 5 should be within 3 volts of the supply.	If the actuator still does not move to full stroke, continue with steps below.
Measure actuator coil resistance: <i>DYNA 8000</i> Coil resistance $0.75 \pm 0.2$ ohms @ 12 Vdc Coil resistance $2.3 \pm 0.4$ ohms @ 24 Vdc <i>DYNA 8200</i> Coil resistance $.710 \pm 0.2$ ohms @ 12 Vdc Coil resistance $1.600 \pm 0.4$ ohms @ 24 Vdc <i>DYNA 8400</i> Coil resistance $1.630 \pm 0.4$ ohms @ 24 Vdc	If actuator coil is open or shorted to case, replace actuator. If governor still does not operate, continue with steps below.
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 detected, replace the actuator.
With the DC to the governor ON and the engine OFF, measure the DC voltage from terminal 6 (+) to terminal 2 (-). This should be approx. 8 Vdc.	If 8 Vdc is not present, replace the controller.
Between terminal 7 (+) to terminal 2 (-), the voltage should be approx. 4 Vdc.	If 4 Vdc is not present, replace the controller.

**SYMPTON:** ACTUATOR GOES TO FULL STROKE WHEN DC POWER IS TURNED ON  
(ENGINE IS NOT OPERATING)

Means of Detection	Corrective Action
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.	Verify and correct wiring as necessary.
Failsafe circuit in the controller may be damaged or defective.	Replace controller.
With DC power OFF remove leads at actuator. Check continuity of each terminal to case. There should be no continuity between any terminal and case of the controller.	If continuity is detected, replace the controller.
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 Improper operation from Remote Speed Potentiometer Table, Step 1 on the next page.

**SYMPTON:** IMPROPER OPERATION FROM REMOTE SPEED POTENTIOMETER

Means of Detection	Corrective Action
Investigate wiring to remote speed potentiometer for open or shorted circuits.	Check wiring.
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.
Lead wire to remote speed setting potentiometer should be 3-wire shielded cable.	Verify that the drain shield wire is isolated from ground at the potentiometer.
If terminal 7 lead to the remote speed potentiometer is open, engine speed will go high.	Correct the wiring.
If lead 9 (wiper lead to remote potentiometer) is open, there will be no control by the remote speed potentiometer.	Verify and correct wiring.
If lead 6 to the clockwise terminal of the remote speed potentiometer is open, speed will remain at the value set in the controller.	

**SYMPTON: ERRATIC GOVERNOR OPERATION**

Means of Detection	Corrective Action
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.
Low battery voltage 20% below rated can cause erratic operation.	Check battery and charging system.
RFI noise due to incorrect shielding.	Correct wiring.
RFI noise fed through power supply leads.	Connect power leads directly to the battery.

**SYMPTON: SLOW, SMALL AMPLITUDE HUNTING OF SPEED OR FREQUENCY**

Means of Detection	Corrective Action
Sticking or very loose linkage.	Correct linkage.

**SYMPTON: FAST OSCILLATION OF GOVERNOR LINKAGE**

Means of Detection	Corrective Action
Verify calibration settings of the controller.	Readjust settings as necessary.

**SYMPTON: ENGINE WILL NOT START; ACTUATOR GOES TO FULL FUEL DURING CRANKING**

Means of Detection	Corrective Action
Make sure fuel is available.	Check fuel to engine. Check for correct wiring to the automatic shutdown circuits.
Air may be trapped in fuel line.	Air may be trapped in fuel line.
Try to operate engine manually.	

## Chapter 6.

# Service Options

### Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

**OEM and Packager Support:** Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

**Woodward Business Partner Support:** Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at [www.woodward.com/support](http://www.woodward.com/support).

## Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

**Replacement/Exchange:** Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

**Flat Rate Repair:** Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

**Flat Rate Remanufacture:** Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in "like-new" condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

## Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

### Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

### **NOTICE**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

## Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

## Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

**Technical Support** is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

**Product Training** is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

**Field Service** engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website and reference **[www.woodward.com/support](http://www.woodward.com/support)**, and then **Customer Support**.

## How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems		Engine Systems		Turbine Systems	
FACILITY	PHONE NUMBER	FACILITY	PHONE NUMBER	FACILITY	PHONE NUMBER
Brazil -----	+55 (19) 3708 4800	Brazil -----	+55 (19) 3708 4800	Brazil -----	+55 (19) 3708 4800
China -----	+86 (512) 6762 6727	China -----	+86 (512) 6762 6727	China -----	+86 (512) 6762 6727
Germany:		Germany:		India -----	+91 (129) 4097100
Kempen ---	+49 (0) 21 52 14 51	Stuttgart ----	+49 (711) 78954-0	Japan -----	+81 (43) 213-2191
Stuttgart ----	+49 (711) 78954-0	India -----	+91 (129) 4097100	Korea -----	+82 (51) 636-7080
India -----	+91 (129) 4097100	Japan -----	+81 (43) 213-2191	Poland -----	+48 12 295 13 00
Japan -----	+81 (43) 213-2191	Korea -----	+82 (51) 636-7080	The Netherlands -	+31 (23) 5661111
Korea -----	+82 (51) 636-7080	The Netherlands -	+31 (23) 5661111	United States-----	+1 (970) 482-5811
Poland -----	+48 12 295 13 00	United States-----	+1 (970) 482-5811		
United States-----	+1 (970) 482-5811				

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**[www.woodward.com/support](http://www.woodward.com/support)**) for the name of your nearest Woodward distributor or service facility.

For the most current product support and contact information, please refer to the latest version of publication **51337** at **[www.woodward.com/publications](http://www.woodward.com/publications)**.

## Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

### General

Your Name \_\_\_\_\_

Site Location \_\_\_\_\_

Phone Number \_\_\_\_\_

Fax Number \_\_\_\_\_

### Prime Mover Information

Engine/Turbine Model Number \_\_\_\_\_

Manufacturer \_\_\_\_\_

Number of Cylinders (if applicable) \_\_\_\_\_

Type of Fuel (gas, gaseous, steam, etc) \_\_\_\_\_

Rating \_\_\_\_\_

Application \_\_\_\_\_

### Control/Governor Information

Please list all Woodward governors, actuators, and electronic controls in your system:

Woodward Part Number and Revision Letter

\_\_\_\_\_

Control Description or Governor Type

\_\_\_\_\_

Serial Number \_\_\_\_\_

Woodward Part Number and Revision Letter

\_\_\_\_\_

Control Description or Governor Type

\_\_\_\_\_

Serial Number \_\_\_\_\_

Woodward Part Number and Revision Letter

\_\_\_\_\_

Control Description or Governor Type

\_\_\_\_\_

Serial Number \_\_\_\_\_

*If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.*



**We appreciate your comments about the content of our publications.**

**Send comments to: [icinfo@woodward.com](mailto:icinfo@woodward.com)**

**Please reference publication **36569**.**



PO Box 1519, Fort Collins CO 80522-1519, USA  
1000 East Drake Road, Fort Collins CO 80525, USA  
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

**Email and Website—[www.woodward.com](http://www.woodward.com)**

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service and sales facilities throughout the world.**

**Complete address / phone / fax / email information for all locations is available on our website.**