WOODWARD

Product Manual 03113
(Revision NEW)
Original Instructions

3161–EGB Governor/Actuator

Supplement to Manual 03101

Installation and Operation Manual

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.

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the *publications page* on the Woodward website:
www.woodward.com/publications
The current revision and distribution restriction of all publications are shown in manual *26311*.

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

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*.

Contents

Illustrations and Tables

Chapter 1.
General Information

Application

The 3161–EGB governor/actuator is a version of the 3161 hydro-mechanical governor that incorporates a hydraulically amplified electric torque motor. The torque motor, driver, and 3161 limit pilot valve work together to provide a terminal shaft output position proportional to the input signal (0–200 mA) from an electronic speed control, such as the 2301A, 701, 721, etc. EGB stands for **E**lectronic **G**overnor **B**allhead backup, based on the proven 3161 mechanical governor platform. The 3161–EGB is recommended for diesel and gas reciprocating engines and steam turbines requiring a backup mechanical governor in the event of failure of the electronic governor signal.

Description of Operation

The 3161 governor has two pilot valves in series, either of which controls high pressure oil supplied to the servo piston connected to the output terminal shaft. One of the valves is controlled by the rotating flyweights to regulate prime mover fuel and speed when under control of the mechanical governor. The other pilot valve, also referred to as the limit pilot valve, regulates the prime mover fuel and speed when the mechanical governor is calling for more fuel, but one of the limiting accessories is active and calling for less fuel. In standard 3161 governors, the governor shutdowns, torque limiter, or smoke limiter typically are connected to this limit pilot valve to limit or regulate fuel. In the 3161–EGB, the smoke limiter has been removed and replaced with an electric torque motor to control the limit pilot valve.

Normally the prime mover is under control of the electronic governor (2301A, 701, etc.), and the electric torque motor modulates the limit pilot valve to control the high pressure oil to the servo, thereby controlling the fuel to the engine. Since the flyweight-controlled pilot valve is in series with the torque-motor-controlled pilot valve, the flyweight pilot valve must be biased fully open to allow the electronic governor to control. To accomplish this, the mechanical governor speed setting must always be greater than the electronic governor's speed setting (by approximately 5%), so that the mechanical governor is always calling for more fuel.

The 3161–EGB system is reverse acting. If there is a loss of signal from the control to the driver, or from the driver to the actuator, the actuator will rotate to the maximum fuel position and the ballhead will assume control of engine speed.

Due to this feature, Woodward recommends that all marine applications use a pneumatic speed control in conjunction with an I-P (current-to-pressure) converter to set the ballhead speed setting. The I-P converter receives a secondary signal from the control room which is identical to the signal being supplied to the Woodward electronic speed control. This procedure is referred to as a "tracking ballhead" and is used to minimize the increase in engine speed if the electronics should fall. If the I-P converter signal is lost, the ballhead speed setting may be set manually with a lever on the governor lever speed setting shaft.

Hardware Description

The 3161 governor is a standard governor without the smoke limiter diaphragm assembly. The actuator is a 60° limited angle torque motor, mounted on top of the 3161 governor in a water-resistant housing. The torque motor's rotary output is transmitted down to the limit pilot valve assembly via a rod, lever, and feedback link from the terminal shaft (see Figure 1-3). All contacting parts are hardened steel to prevent calibration shift. The 3161 output shaft position is proportional to torque motor position, and torque motor position is proportional to driver input signal. The driver module receives a fuel demand signal from the electronic governor. If the fuel demand signal changes, the driver changes the pulse width modulated (PWM) current signal, positive or negative, to the torque motor to drive it to the new position. Torque motor position is sensed by a contactless position sensor, and fed back to the driver module's position control loop to make the torque motor position proportional to demand signal from the governor.

Installation

Install the 3161–EGB on the prime mover's UG 8 style governor drive pad, following the per instructions in manual 03101. Connect the fuel rack linkage according to the manufacturer's instructions. Since the 3161–EGB has a self-contained oil supply, be sure to seal any 3161 engine oil supply ports in the drive pad (keep standard Caterpillar O-rings [2] in place on pad). Fill the 3161–EGB to the sight glass fill line with clean engine oil (see Figure 1-2).

Mount the driver module near the 3161–EGB (within 4.6 m/15 ft) on the engine skid or on a bracket on the engine. Bracket and ambient temperature should not be above 70 °C (158 °F). Wire the driver terminals 3, 4, 6, 7, and 8 to the 3161–EGB actuator connector as shown in the plant wiring diagram (Figure 1-1). Connect terminals 1 and 2 on the driver to a reliable 18–32 Vdc power source with short leads and a 10 A fuse. Connect the speed control's actuator output to the driver's input terminals 10 (positive) and 11 (negative). This completes the installation.

Troubleshooting

If stability or low power problems are experienced while running on the electronic governor, verify proper operation of the mechanical portion of the control system by running the engine on the mechanical governor. This is accomplished with the following steps.

Make sure the engine is not running. Override the electronic governor by removing the electronic governor's actuator leads from the driver. Lower the mechanical governor's speed setting to idle, and then start the engine. Operate the engine over its full operating range. Verify that at full load and speed, the mechanical governor's controlling speed is greater (by approximately 5%) than the normal high speed of the electronic governor. Interference between the backup mechanical governor and the electronic governor is the most common source of problems. If the engine operates correctly, the problem probably lies in the electrical side of the system.

The driver and 3161–EGB torque motor can be tested with the engine shut down. Remove the cover from the torque motor on the top of the 3161–EGB. Apply power to the electronic speed control (2301A, 701, etc.) and to the driver module. Temporarily override the electronic governor's failsafe and adjust the start fuel limit setting from min to max (or replace the governor's actuator signal with a 0–200 mA source), to stroke the actuator output signal.

IMPORTANT **The torque motor connecting rod will not stroke completely upwards due to lack of governor oil pressure.**

At the 3161, verity that the torque motor is rotating smoothly from min to max stop, proportional to the driver input signal above. If not, verify the proper connections to the torque motor from the driver. If this is performing correctly, the problem probably lies in the speed control (refer to the appropriate speed control manual). If not, replace the faulty component.

Additional References

03101	3161 Governor
25071	Oils for Hydraulic Controls
	Appropriate Electronic Speed Control Manual

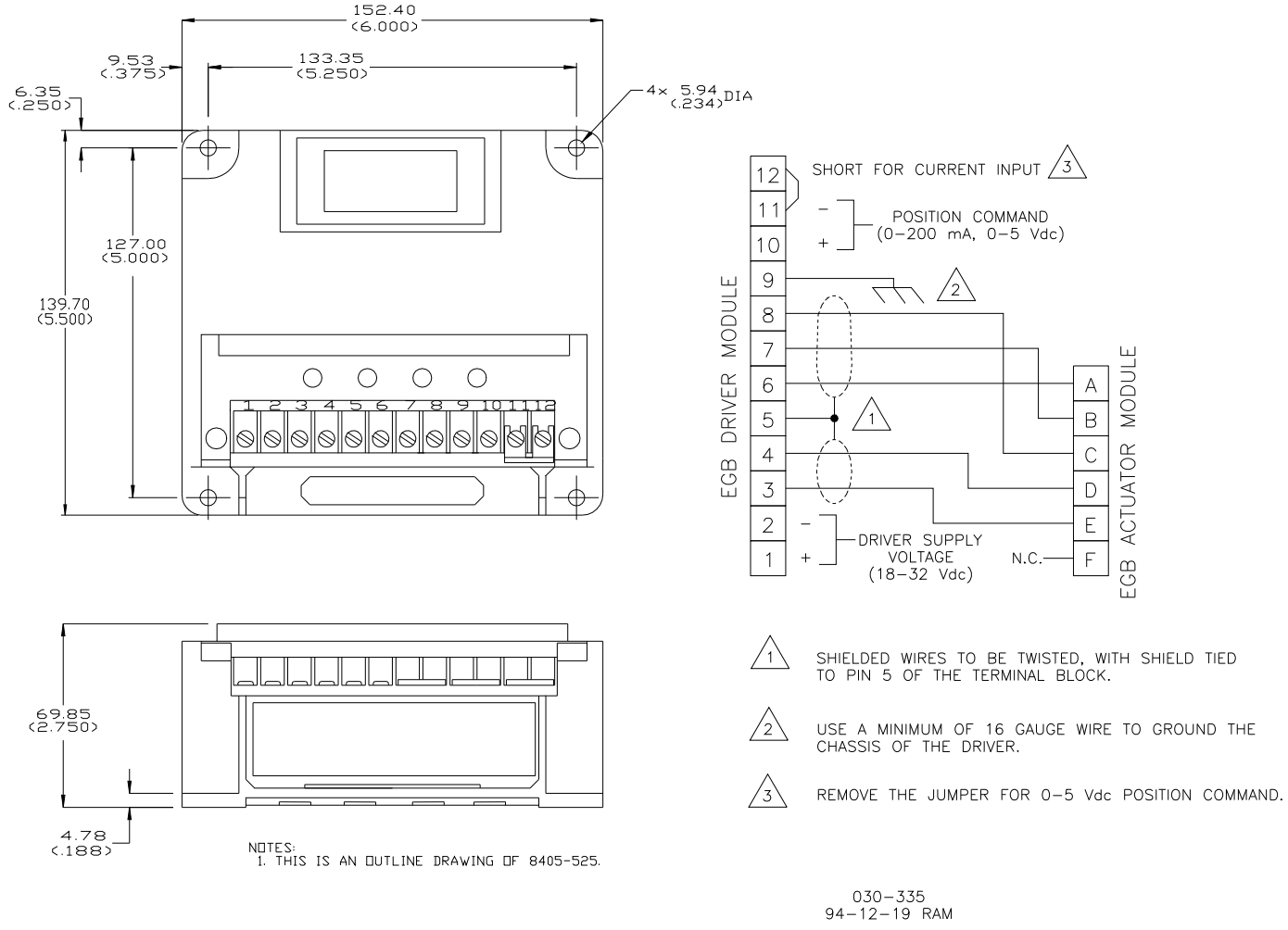

Figure 1-1. Outline Drawing of 3161–EGB Driver and Plant Wiring

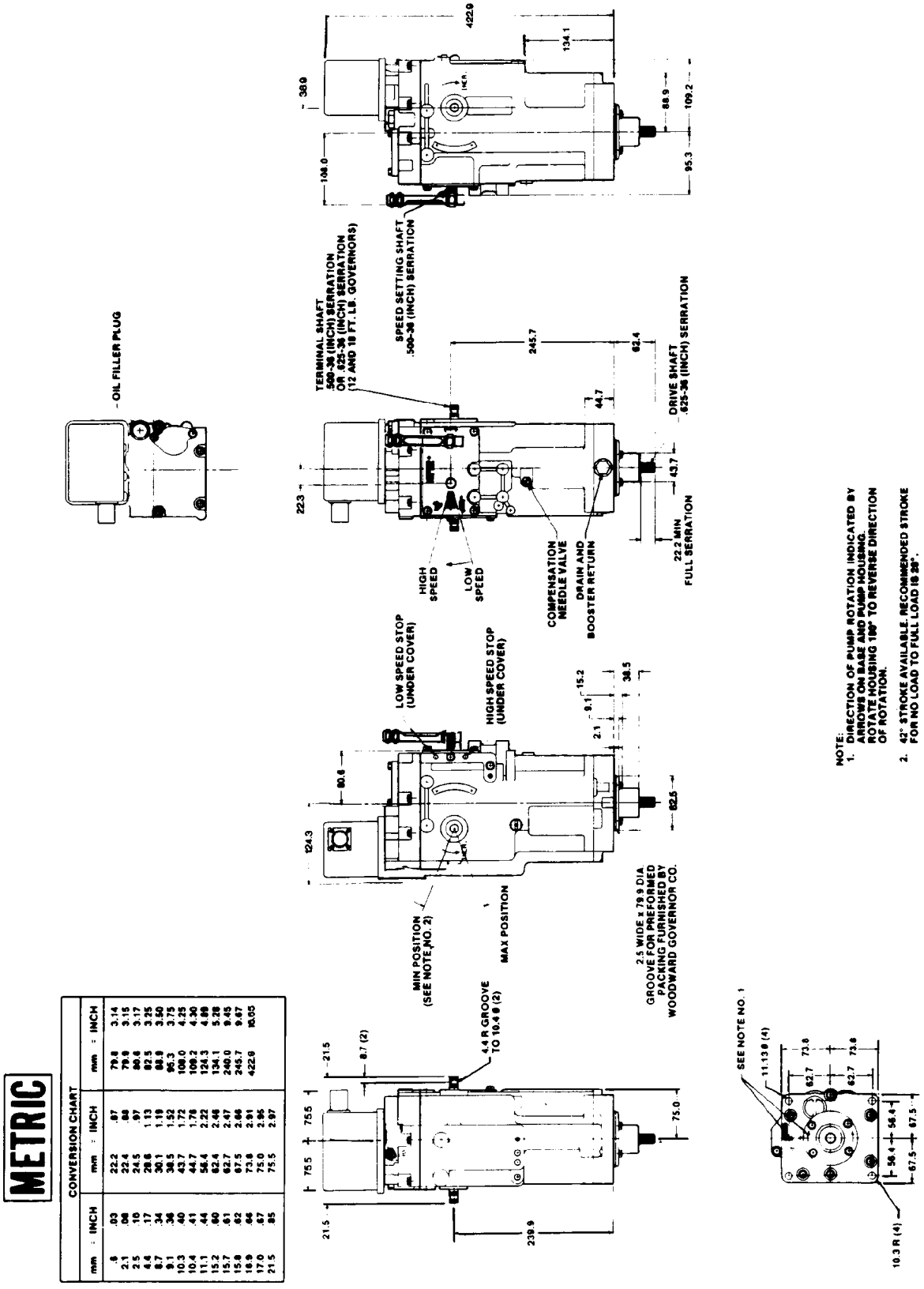

Figure 1-2. Outline Drawing of 3161–EGB

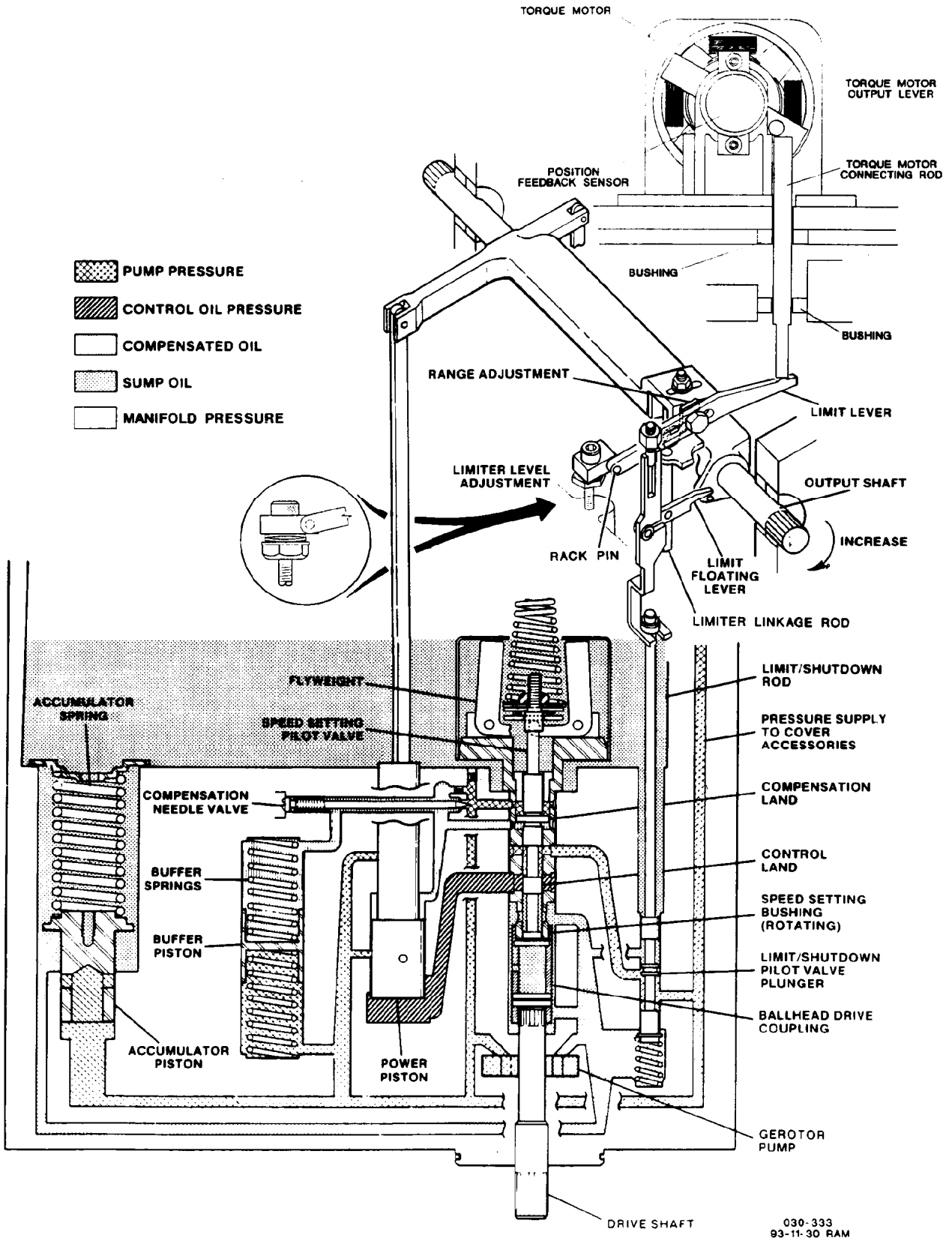

Figure 1-3. Schematic of 3161–EGB

Chapter 2.
Product Support and Service Options

Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or 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 current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- 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 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.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic 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.

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. 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's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- 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.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor 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 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 one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at **www.woodward.com/directory**.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name

Site Location

Phone Number

Fax Number

Prime Mover Information

Manufacturer

Engine Model Number

Number of Cylinders

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.)

Power Output Rating

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter

Control Description or Governor Type

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter

Control Description or Governor Type

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter

Control Description or Governor Type

Serial Number

Symptoms

Description

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.

3161–EGB Control Specifications

Power Supply Rating	18–32 Vdc (24 Vdc nominal)
Power Consumption	8 W nominal
Remote Speed Setting Input	0–200 mA
Ambient Operating Temperature	–40 to +70 °C (–40 to +158 °F)
Storage Temperature	–55 to +105 °C (–67 to +221 °F)
EMI/RFI Specification	US MIL-STD 461C (Parts 5 & 9)
Shock Specification	US MIL-STD 810C (40 g sawtooth)
8405-525 EGB Driver	2.5 g @ 24–2000 Hz
EGB Actuator	10.0 g @ 24–2000 Hz

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 03113.

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

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

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

2012/9/Colorado