WOODWARD

Application Note

8270-0644 Controller

(Used with DC10502 Actuator)

Calibration Instructions

Manual 36584

WARNING—DANGER OF DEATH OR PERSONAL INJURY

WARNING—FOLLOW INSTRUCTIONS

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.

WARNING—OUT-OF-DATE PUBLICATION

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 Woodward website:

www.woodward.com/pubs/current.pdf

The revision level is shown at the bottom of the front cover after the publication number. The latest version of most publications is available at:

www.woodward.com/publications

If your publication is not there, please contact your customer service representative to get the latest copy.

WARNING—OVERSPEED PROTECTION

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.

WARNING—PROPER USE

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.

CAUTION—POSSIBLE DAMAGE TO EQUIPMENT OR PROPERTY

CAUTION—BATTERY CHARGING

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.

CAUTION—ELECTROSTATIC DISCHARGE

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

IMPORTANT DEFINITIONS

- **A WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**
- **A CAUTION indicates a potentially hazardous situation which, if not avoided, could result in damage to equipment or property.**
- **A NOTE provides other helpful information that does not fall under the warning or caution categories.**

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

Contents

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.

CAUTION—ELECTROSTATIC DISCHARGE

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. Calibration

CALIBRATION PROCEDURE

Observe that potentiometer settings are adjustable from zero to 100%. Each small division is 10%. The speed potentiometer is 10K, 20 turns.

If a remote speed potentiometer is used for narrow range, set to mid range.

INITIAL POTENTIOMETER SETTINGS

GAIN	20%
INT	20%
SPEED	CCW

The controller is shipped with the onboard speed set potentiometer in the fully counterclockwise position. When starting the engine, this potentiometer may require to be turned clockwise one or two turns (10-turn potentiometer) in order to get the engine to start.

START ENGINE (NO LOAD)

1. Adjust the controller speed potentiometer for desired engine speed.
2. 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.

NOTE
A warm engine is normally more stable than a cold one. If the governor is adjusted on a warm engine, turn the adjustment potentiometers counterclockwise 5% (1/2 div.) to ensure a stable engine when started cold.

3. Repeat **Step 2** for the "I" setting.
4. After calibration, it may be necessary to readjust the speed.
5. If the engine is a diesel, following the above calibration, 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 the overshoot is too great, turn the "I" potentiometer counterclockwise to lessen the overshoot. If there is a small hunt at steady state, slightly turn the "I" potentiometer counterclockwise until stable. In some cases, 2 to 5 Hz overshoot may be acceptable.
6. If the engine is an ignition type using compressed fuel such as natural gas or LP, stop the engine and restart in the normal manner to check overshoot.

   If possible, operate the unit through various load ranges up to 100% to ensure stability and check for overshoot. Readjust “GAIN” and “INT” as necessary.

CAUTION
As a safety measure, the engine should be equipped with an independent overspeed shutdown device in the event of failure, which may render the governor inoperative.

BATTERY

Battery is nominal 12 or 24 Vdc with positive lead to terminal 1 and negative lead to terminal 2.

REMOTE SETSPEED POTENTIOMETER

A narrow speed adjust input is provided by connection of a 5K-Ohm potentiometer to terminals 6, 7, and 9 as shown in **Figure 1**.

ISOCHRONOUS LOAD SHARING INPUT (ILS)

The isochronous load sharing is a high gain speed setting input. The speed set signal typically comes from a synchronizer, or load sharing control. The input also typically requires connection of the 4-volt reference terminal 7 to the same device. The input signal connected to terminal 8 is typically in the 0 to 300 mV range with respect to the 4-volt reference when being used for synchronizing or load sharing.

This same input can be used to provide a wide speed range of operation. We use the ILS input instead of using the narrow range speed set input terminal 7 (remote setspeed potentiometer.

In this case the input voltage from the potentiometer varies from 4 to 8 Vdc. This large voltage is attenuated using an external resistor wired between the potentiometer wiper and the ILS input on terminal 8. Refer to **Table 1**. Select proper resistor value (R) from Table 1 for the series wiper resistor for your desired remote speed potentiometer adjustable range.

Table 1

RESISTOR VALUE (R)	2500-5000 HZ ADJUSTABLE RANGE
0	4250 Hz
499	3750 Hz
1.0K	3000 Hz
2.0K	2500 Hz
3.01K	2000 Hz
4.99K	1500 Hz
10.0K	1000 Hz

Input Signal Frequency:

$$\text{Input Signal Frequency in Hertz} = \frac{\text{Engine RPM} \times \text{Number of Gear Teeth on Flywheel}}{60}$$

Speed Sensor (MPU)

A variable reluctance speed sensor (magnetic pickup) signal is used to provide speed information from a gear or flywheel that is rotating at a speed that is proportional to the engine speed. The frequency is based on the RPM of the engine and the number of teeth on the gear.

This controller is specified to operate within the range of 2500 to 5000 Hz (MPU) frequency.

At crank the minimum Vac RMS voltage should be 2.5 Vac.

The sensor is not polarized until the shield wire is connected to one of the active signal wires. This pair must be landed on terminal 10 and the other signal wire connected to terminal 11.

Actuator

DC1502-000-012: 12Vdc linear actuator with internal spring return to the OFF position, 0.5 lbf (2.22 N)

Chapter 2.
Wiring Diagram

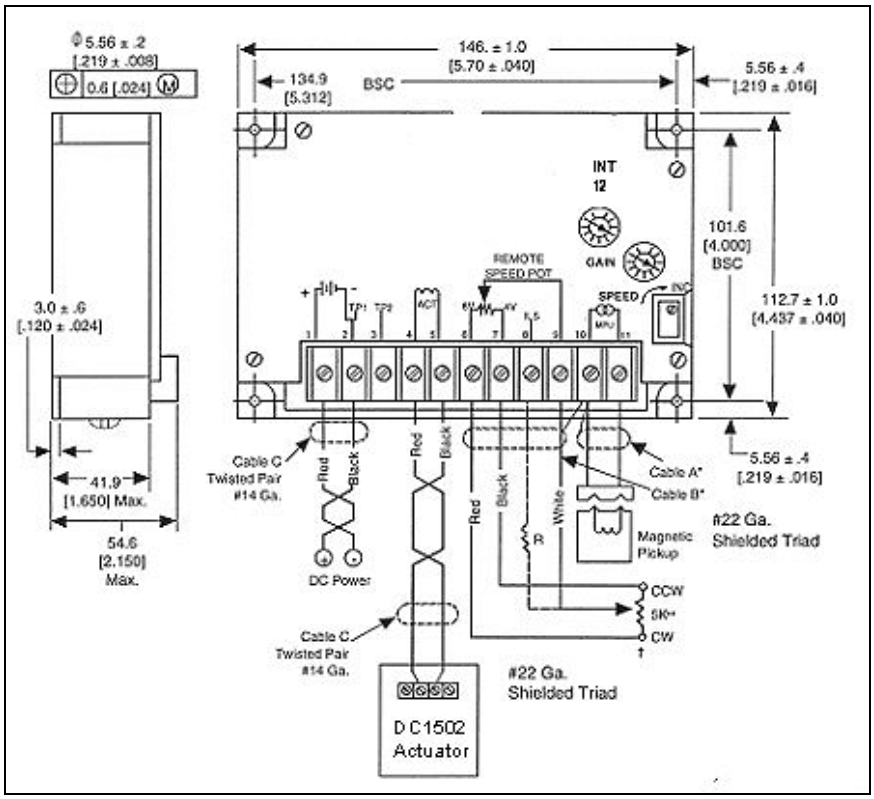

Figure 1. Typical Wiring Diagram

DIAGRAM NOTES

(*) Shielded cable—a cable with a wrapped mylar supported aluminum foil shield with a drain wire

(**) Remote speed potentiometer (DYNS 10000)

(†) The remote speed potentiometer can be wired two different ways:

1. As shown by the solid line from the wiper of the speed pot and then connected to terminal 9 (no resistor required). Adjustable range is approx. ± 5% at 1800 rpm.
2. As shown by the dashed line from the wiper of the speed pot through resistor “R” and then connected to terminal 8. Reducing the value of “R” increases the remote adjustable speed range.

Cable A: DK44-XX 90° connector (specify length)

Cable B: E26-22N (specify length)

Cable C: DZ70-004 (specify length)

Chapter 3. Troubleshooting

SYSTEM IS COMPLETELY DEAD. ACTUATOR LEVER STAYS AT MINIMUM

MEANS OF DETECTION	CORRECTIVE ACTION
Check for battery voltage at controller on terminals 1 and 2. Terminal 1 is positive.	Check battery connections and contacts for turning power "ON" to the controllers.
Check for proper linkage set up.	Correct and free linkage.
Magnetic pickup signal absent or too low. Measure AC volt across terminals 10 & 11 while cranking the engine. Voltage should be at least 2.5 VAC. **NOTE:** The voltmeter should have an impedance of 5000 ohms/volts or higher.	Check pole tip gap over gear tooth. It should be 0.37 ± 0.127mm (0.015" ± 0.005") or adjusted to obtain 2.5 VAC or greater. Verify magnetic pickup wiring.
Measure the resistance of the magnetic pickup coil. This should be from 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 & 3 (TP1 & TP2). With DC "ON" the actuator should go to full stroke. DC voltage at terminals 4 & 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: • 12 VDC Linear coil resistance 1.8 ± 0.2 ohms. • 12 VDC Dyna Master coil resistance 1.2 ± .15 ohms.	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 ohmmeter.	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	2 (-). This should be approximately 8 VDC. If 8 VDC is not present, replace the controller.
Between terminals 7 (+) to 2 (-), the voltage should be approximately 4 VDC.	If 4 VDC is not present, replace the controller.
The following should be found when measuring current in series with one of the actuator leads from terminal 4 or 5: 12 V Act. - 2.5A to 5.9A 24 V Act. - 1.0A to 3.0A (Values may indicate negative if polarity of meter reversed.)	If no output current, replace the controller.

SLOW, SMALL AMPLITUDE, HUNTING OF SPEED OR FREQUENCY

MEANS OF DETECTION	CORRECTIVE ACTION
Linkage or rod end bearings sticking or binding.	Correct linkage, lubricate or replace.
Verify calibration settings of the controller.	Readjust Gain and Integral potentiometers.
Use a voltmeter to determine if the power supply voltage is low (< 9.6 VDC)	Charge or replace battery.

ACTUATOR LEVER 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 shield wire or open shield wire connection.	Verify and correct wiring as necessary.
Be sure there is no jumper between terminals 2 & 3.	Verify and correct wiring as necessary.
Fail-safe 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.
Check for shorted actuator lead.	Correct or replace actuator leads as necessary.
If remote speed potentiometer has been connected to terminals 6, 7 and 8, or 9 of the controller, DISCONNECT THESE LEADS.	Turn DC power "ON" to the governor if the actuator is now normal.

IMPROPER OPERATION WITH REMOTE SPEED POTENTIOMETER CONNECTED

MEANS OF DETECTION	CORRECTIVE ACTION
Investigate wiring to remote speed potentiometer for open or shorted circuits.	Check wiring.
If the leads at terminals 6 & 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 wiring.
If wiper lead to remote potentiometer is open, there will be no control by the remote speed potentiometer.	Verify and correct wiring.
If terminal 6 lead to the clockwise terminal of the remote speed potentiometer is open, speed will remain at the value set in the controller.	Verify and correct wiring.

ERRATIC GOVERNOR OPERATION

MEANS OF DETECTION	CORRECTIVE ACTION
Measure DC voltage at 1 & 2 on controller terminal strip. Nominal battery voltage should be indicated.	Verify that all screw terminal connections are tight.
Measure AC RMS voltage on the MPU terminals and verify that the cranking signal s at least 2.5 VRMS and that the signal is consistent during regular running of the engine.	Remove, inspect and clean the MPU. If okay, re-install using normal MPU installation instructions.
Battery voltage must be 80% or greater for governor to operate.	Check battery and charging system.
RFI noise due to incorrect shielding.	Correct wiring per applicable wiring diagram.
RFI noise fed through power supply leads.	Connect twisted pair power leads direct to the battery.

FAST OSCILLATION OF GOVERNOR LINKAGE

MEANS OF DETECTION	CORRECTIVE ACTION
Verify calibration settings of the controller.	Readjust Gain and Integral potentiometers.
Use a voltmeter to verify that the power supply voltage is correctly matched to the controller and actuator.	Replace parts (controller or actuator) that do not show operation at the existing battery voltage.

ENGINE WILL NOT START — ACTUATOR AT FULL STROKE DURING CRANKING

MEANS OF DETECTION	CORRECTIVE ACTION
Make sure fuel is available. Air may be trapped in fuel line. Try to operate engine manually.	Check fuel to engine and check for correct wiring to shut downs.
Improper linkage arrangement. (Stroke is too short.)	See installation information.

ENGINE NOT ABLE TO CARRY LOAD

MEANS OF DETECTION	CORRECTIVE ACTION
Check fuel tank level. Crank engine and verify Fuel is being delivered.	Add fuel as necessary.
Improper linkage arrangement. (Stroke is too short.)	See installation information.

CAUTION

As a safety measure, the engine should be equipped with an independent overspeed shutdown device in the event of failure which may render the governor inoperative.

Chapter 4.
Service Options

Product Service Options

The following factory options are available for servicing Woodward equipment, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is purchased from Woodward or the service is performed:

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

If you are experiencing problems with installation or unsatisfactory performance of an installed system, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In most cases, your problem can be resolved over the phone. If not, you can select which course of action you wish to pursue based on the available services listed in this section.

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 also a flat rate structured program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call 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 Woodward facility as explained below (see “Returning Equipment for Repair” later in this chapter).

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 to Woodward within 60 days, Woodward will issue a credit for the core charge. [The core charge is the average difference between the flat rate replacement/exchange charge and the current list price of a new unit.]

Return Shipment Authorization Label. To ensure prompt receipt of the core, and avoid additional charges, the package must be properly marked. A return authorization label is included with every Replacement/Exchange unit that leaves Woodward. The core should be repackaged and the return authorization label affixed to the outside of the package. Without the authorization label, receipt of the returned core could be delayed and cause additional charges to be applied.

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 to Woodward for repair, please contact Woodward in advance to obtain a Return Authorization Number. When shipping the item(s), attach a tag with the following information:

- 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.

CAUTION—ELECTROSTATIC DISCHARGE

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*.

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.

Return Authorization Number

When returning equipment to Woodward, please telephone and ask for the Customer Service Department [1 (800) 523-2831 in North America or +1 (970) 482-5811]. They will help expedite the processing of your order through our distributors or local service facility. To expedite the repair process, contact Woodward in advance to obtain a Return Authorization Number, and arrange for issue of a purchase order for the item(s) to be repaired. No work can be started until a purchase order is received.

NOTE

We highly recommend that you make arrangement in advance for return shipments. Contact a Woodward customer service representative at 1 (800) 523-2831 in North America or +1 (970) 482-5811 for instructions and for a Return Authorization Number.

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.

How to Contact Woodward

In North America use the following address when shipping or corresponding:

Woodward Governor Company
PO Box 1519
1000 East Drake Rd
Fort Collins CO 80522-1519, USA

Telephone—+1 (970) 482-5811 (24 hours a day)
Toll-free Phone (in North America)—1 (800) 523-2831
Fax—+1 (970) 498-3058

For assistance outside North America, call one of the following international 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.

Facility	Phone Number
Brazil	+55 (19) 3708 4800
India	+91 (129) 230 7111
Japan	+81 (476) 93-4661
The Netherlands	+31 (23) 5661111

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

Engineering Services

Woodward Industrial Controls Engineering Services offers the following after-sales support for Woodward products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Contact information:

Telephone—+1 (970) 482-5811
Toll-free Phone (in North America)—1 (800) 523-2831
Email—icinfo@woodward.com
Website—**www.woodward.com**

Technical Support is available through our many worldwide locations or our authorized distributors, depending upon the product. This service can assist you with technical questions or problem solving during normal business hours. Emergency assistance is also available during non-business hours by phoning our toll-free number and stating the urgency of your problem. For technical support, please contact us via telephone, email us, or use our website and reference ***Customer Services*** and then ***Technical Support***.

Product Training is available at many of our worldwide locations (standard classes). 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. For information concerning training, please contact us via telephone, email us, or use our website and reference ***Customer Services*** and then ***Product Training***.

Field Service engineering on-site support is available, depending on the product and location, from one of our many worldwide locations or from one of our authorized 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 field service engineering assistance, please contact us via telephone, email us, or use our website and reference ***Customer Services*** and then ***Technical Support***.

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

Please include the manual number from the front cover of this publication.

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.

2007/06 Niles