

Digital Reference Unit
with high, low, and intermediate setpoints

Installation and Operation Manual



General Precautions

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.



Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual **26311**, *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications* page of the Woodward website:

www.woodward.com/publications

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.



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.



Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual **26311**, *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with . Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Woodward reserves the right to update any portion of this publication at any time. Information provided by Woodward is believed to be correct and reliable. However, no responsibility is assumed by Woodward unless otherwise expressly undertaken.

Copyright © Woodward 1989
All Rights Reserved

Contents

WARNINGS AND NOTICES	II
ELECTROSTATIC DISCHARGE AWARENESS	III
CHAPTER 1. GENERAL INFORMATION.....	1
Introduction	1
Digital Reference Units	1
Applications	1
CHAPTER 2. INSTALLATION AND ADJUSTMENT	3
Introduction	3
Unpacking and Inspection	3
Location Considerations	3
Setting the Output Limits	3
Setting Ramp Rates	5
Plant Wiring	5
Relays	6
External Reference	6
CHAPTER 3. APPLICATIONS	7
CHAPTER 4. PRODUCT SUPPORT AND SERVICE OPTIONS	9
Product Support Options	9
Product Service Options	9
Returning Equipment for Repair	10
Replacement Parts	10
Engineering Services	11
Contacting Woodward's Support Organization	11
Technical Assistance	12

Illustrations and Tables

Figure 1-1. Digital Reference Unit Block Diagram	2
Figure 3-1. Plant Wiring Diagram and Outline Drawing	6
Figure 4-1. Wiring Applications	7
Figure 4-2. Wiring Diagrams	8

Warnings and Notices

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

Overspeed / Overtemperature / Overpressure

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

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- Eye Protection
- Hearing Protection
- Hard Hat
- Gloves
- Safety Boots
- Respirator

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE**Battery Charging
Device**

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.

Electrostatic Discharge Awareness

NOTICE**Electrostatic
Precautions**

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.

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*.

Follow these precautions when working with or near the control.

1. 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.
2. 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 antistatic 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 antistatic protective bag.

Chapter 1.

General Information

Introduction

This manual provides description, installation, and maintenance information for the Woodward Digital Reference Unit with three set points.

Digital Reference Units

Digital Reference Units use a precise linear ramp to provide a 0 to 8 volt reference signal to the attached control. The reference unit can be used with a speed or load control or a Process and Import/Export control. The reference unit has two separate ramps which are switch selectable to control the 0–8 volt reference signal.

The high, low, and intermediate points on the ramp are selectable on the reference unit. The same set points are used by both ramps. One of the ramps is always engaged so any movement of the output is at the speed of the engaged ramp.

Options

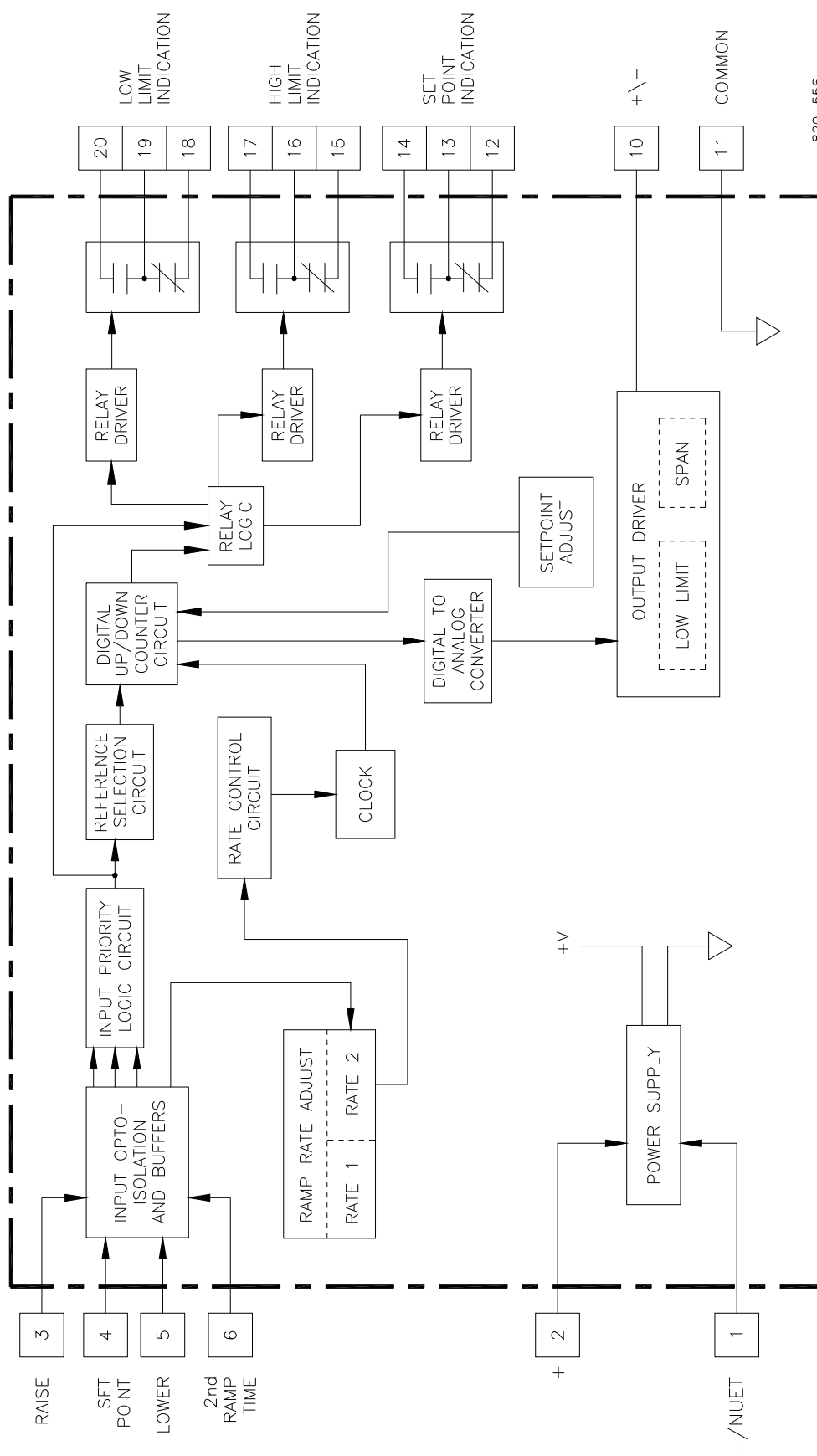
Digital Reference units are available for use with a low voltage power source (10 to 45 Vdc) or a high-voltage power source (90 to 150 Vdc or 88 to 132 Vac at 45 to 440 Hz.)

The three-relay option may be used to provide indication of when the output is at low limit, set point, or high limit, or to cause automatic switching functions within the same system.

Part Number	Power Supply	Relay Indication
8272-682	10–45 Vdc	No
8272-683	10–45 Vdc	Yes
8272-684	90–150 Vdc or 88–132 Vac 45–440 Hz	No
8272-685	90–150 Vdc or 88–132 Vac 45–440 Hz	Yes

Applications

Digital Reference Units are used in place of MOPs (Motor Operated Potentiometers), but provide more precise and more dependable control functions. The Digital Reference Unit set points are easier to adjust than those on a MOP, and the adjustable ramp time is generally not available with a MOP. Installation of the maintenance-free Digital Reference Unit is less restrictive than is installation of a MOP.



820-556

Figure 1-1. Digital Reference Unit Block Diagram

Chapter 2. Installation and Adjustment

Introduction

This chapter includes information on unpacking, installation, setup, and checkout of the Digital Reference Unit. Information on power requirements, location considerations, and wiring information is also included.

Unpacking and Inspection

Before handling the unit, read page ii, *Electrostatic Discharge Awareness*. Visually inspect the unit for damage such as bent or dented panels, and loose or broken components. Immediately notify the shipper of any damage.

Compare the part number on the front panel with the chart on page 1 of this manual to be sure the reference unit is compatible with the supply voltage to be used.

NOTICE

To prevent damage to a direct-current powered control, make sure that the alternator or other battery-charging device is turned off or disconnected before disconnecting the battery from the control.

Location Considerations

The unit can be installed in any position that provides adequate ventilation and space for servicing. Maximum power use is 3.0 W. The unit will generate a minimal amount of heat during operation. The Digital Reference Unit will operate between -40 and $+185$ °F (-40 to $+85$ °C). It is designed to withstand 4 Gs of vibration between 5 and 500 Hz, and 60 Gs of shock.

The unit is not designed for mounting on the engine. Do not expose the box to rain, or pressure wash.

The location should provide ready access to the terminals on the control which is to be influenced by the unit.

See Figure 3-1 for installation dimensions.

Setting the Output Limits

The Low Limit potentiometer sets the minimum output from the Digital Reference Unit. The Range potentiometer sets the maximum output at a position above the Low Limit setting. Since the Low Limit setting changes the setting of the High Limit (Range), it is necessary to always set the Low Limit first and to reset the Range (High Limit) after any change in the Low Limit.

The following step-by-step procedure should be followed any time the limits are set or reset.

To determine and preset the Digital Reference Unit output values, set up the speed, load, or process control as it would be used without the Digital Reference Unit. Replace the reference unit connections to the control with wiring, switches, or potentiometers, as indicated on the plant wiring diagram for the control. Adjust the control for the speeds, loads, or process values which the reference unit will set. For each operating condition (low limit, high limit, and intermediate set point) measure and record the voltage on the terminals to which the output of the reference unit will be connected. (See Chapter 4 for wiring suggestions between the reference unit and various controls.)

It is sometimes difficult to use this method to determine the voltages of the reference unit output on load-sharing lines. Since the load-sharing lines voltage is one-half of the load gain voltage, it is easy to calculate the reference unit output voltage proportional to the load-gain voltage. Zero load is zero volts. One-half load is $1/2$ by $(1/2 \times \text{load gain})$. With the typical 6 volts load gain, this would be 1.5 volts. Full load for the same system is then $1 \times (1/2 \times \text{load gain})$ or 3 volts.

1. Attach a voltmeter capable of reading 0 to 8 Vdc to terminals 10(+) and 11(-).

IMPORTANT

The reference unit can produce a negative voltage. If a negative voltage output is desired, the voltmeter at terminals 10 and 11 should be able to read both + and – outputs.

2. Connect the power supply and appropriate switches to terminals 1 through 5. Close the switch between terminals 2 and 5. (Set the FIRST ramp time counterclockwise to minimize the time required to reach the limits or set point.) When the output stops ramping down, adjust the Low Limit potentiometer through the cover of the reference unit for the desired output as indicated by the voltmeter. (Clockwise on the potentiometer will increase the low-limit position.)
3. Open the switch between terminals 2 and 5, and close the switch between terminals 2 and 3. Adjust the Range pot to provide the maximum desired output from the reference unit. Clockwise will increase the High Limit setting.
4. Open the switch between terminals 2 and 3, and close the switch between terminals 2 and 5. The output should decrease to the desired low limit. If readjustment is necessary, ramp back to High Limit and readjust the Range potentiometer (clockwise is increase.)
5. Open all the switches. Close the switch between terminals 2 and 4. The output will ramp to the set-point position. Adjust the set-point potentiometer up or down as necessary.

IMPORTANT

When selecting two inputs at the same time, Set Point has priority over the Raise, and Lower has priority over the Set Point. If Raise is permanently closed, the unit will automatically go to the High Limit when neither Lower nor Set Point switches are closed.

Setting Ramp Rates

The reference unit is shipped with ramp rates 1 and 2 independently adjustable from a minimum of 20 seconds to a maximum of 120 seconds. If the 20 second to 120 second ramp rate is not applicable to the particular installation, the ramp rates may be changed by setting a miniature rocker switch. The switch is located inside the cover on the printed circuit board, just to the right of the "ramp time second" adjustment potentiometer.

The four switches on the mini-switch are numbered. Switches 1 and 2 control the ramp times for the second ramp. Switches 3 and 4 set the ramp time for the first ramp. The unit defaults to the first ramp, if the second ramp is not selected. Approximate ramp times available are shown in the following table:

Switch Location		Ramp Time with Adjustment Full CCW	Ramp Time with Adjustment Full CW
1st (default) Ramp			
3 open	4 open	5 seconds to	25 seconds
3 open	4 closed	20 seconds to	120 seconds
3 closed	4 open	100 seconds to	10 minutes
2nd Ramp Selected			
1 open	2 open	5 seconds to	25 seconds
1 open	2 closed	20 seconds to	120 seconds
1 closed	2 open	100 seconds to	10 minutes

Ramp time is the time it takes the output to ramp from the low limit to the high limit and is independent of the values of the limits. The ramps are linear.

The time to ramp from the Low Limit to the Set Point is dependent on where the Set Point is adjusted. If the Set Point is halfway between the low and high limits, the ramp time will be one-half of the overall ramp time.

Plant Wiring

After the ramp rates have been selected, and the low limit, high limit, and intermediate output positions are set, the reference unit should be permanently wired into the electronic control loop.

Wire according to the plant-wiring diagram (Figure 3-1) and according to the applications chart in Chapter 4. Observe the shielded wiring requirements between the reference unit and the control system. All shields should terminate at the control system only, not the reference unit. Do not terminate any shield at both the reference unit and the control, as this will reduce the effectiveness of the shield.

IMPORTANT

The electronics of the Digital Reference Unit always respond to the lowest signal selected, should two or more of the selection switches be closed at the same time. The ramp will stop should a selection be opened before the limit or set point has been reached.

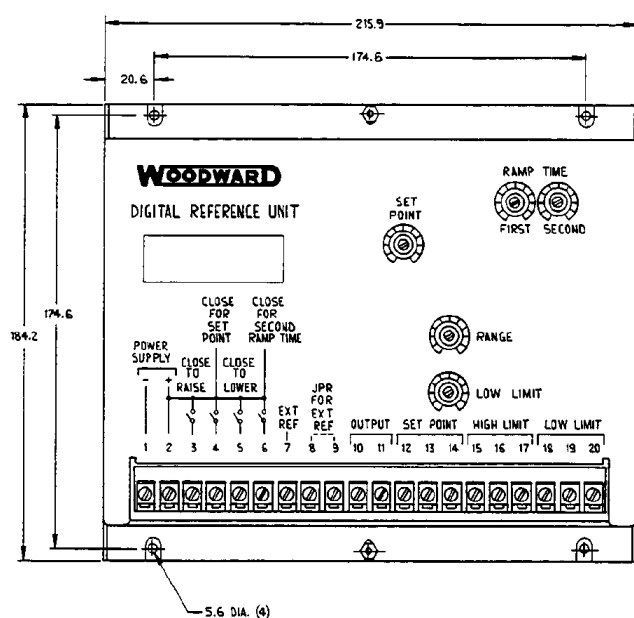
When Set Point is selected, the output will ramp up or down as necessary to reach the predetermined set point.

Relays

Some Digital Reference Units are equipped with three relays for use by the system operator. The relay contacts are 5 A resistive at 30 Vdc, or 2 A resistive at 115 Vac.

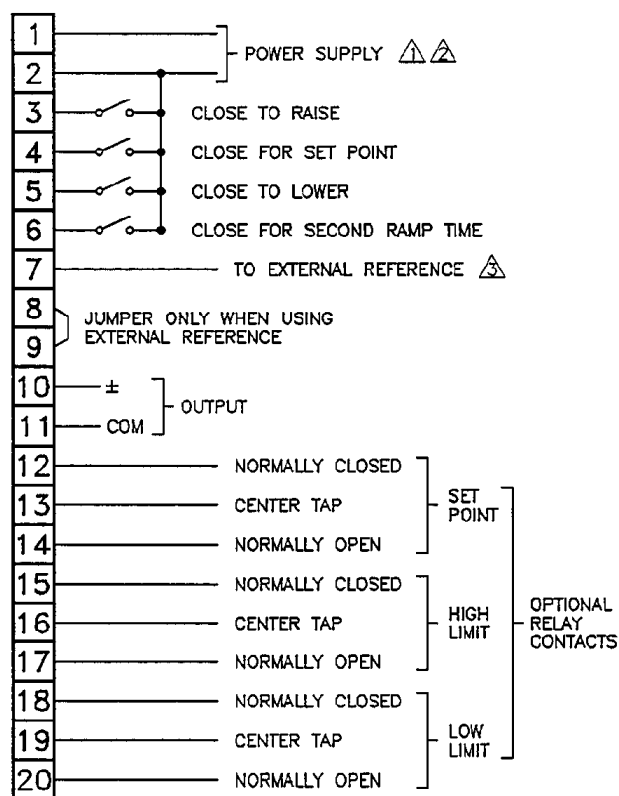
External Reference

The Digital Reference Unit will provide ramp-speed setting for EPG and 2500 controls by connecting the external reference from these controls to terminal 7 on the reference unit, and then connecting the output from the reference unit to the speed-setting connections on the speed control. Terminals 8 and 9 on the reference unit must be jumpered to allow the external reference feature to function.

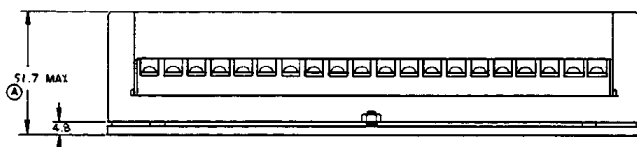


NOTE:
Terminals 10 through 20 used only
on models with optional relays

METRIC



82000-A-503
90-10-03 CA



Digital Reference Unit Outline Drawing

CONVERSION CHART	
MM	INCH
4.8	.188
20.6	.812
51.7	2.032
5.6	.219
174.6	6.875
184.2	7.250
215.9	8.500

NOTES:

- ⚠ POWER REQUIREMENT LESS THAN 3 WATTS.
- ⚠ TERMINAL 1 TO BE NEGATIVE POLARITY FOR DC POWER SUPPLY, NEUTRAL FOR AC POWER SUPPLY; TERMINAL 2 TO BE POSITIVE POLARITY FOR DC POWER SOURCE, LINE FOR AC POWER SUPPLY.
- ⚠ EXTERNAL REFERENCE USED ONLY ON SPEED REFERENCE APPLICATIONS.

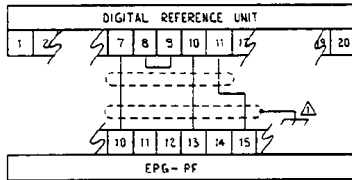
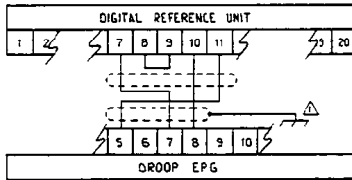
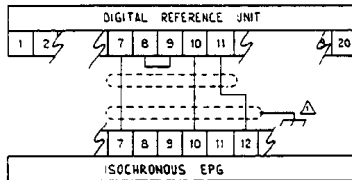
Typical Plant Wiring

Figure 3-1. Plant Wiring Diagram and Outline Drawing

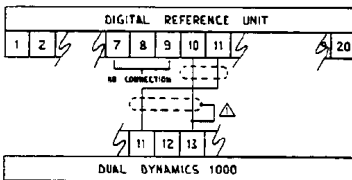
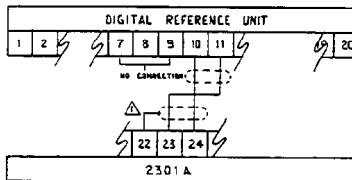
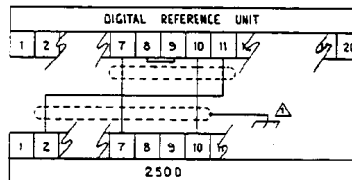
Chapter 3. Applications

The wiring diagrams in Figure 4-1 show some of the methods used to connect the reference unit to various electronic speed/load controls. Use of the unit is not limited to the installations shown.

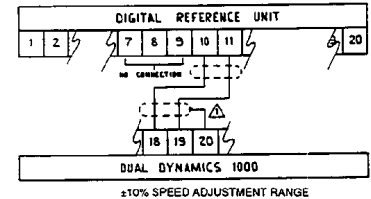
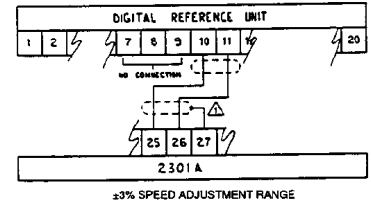
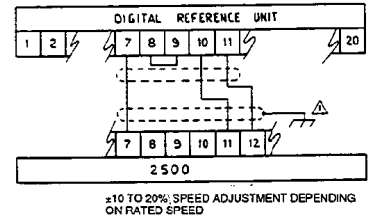
FULL AUTHORITY SPEED SETTING



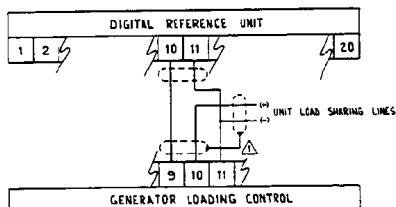
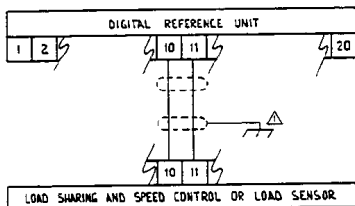
FULL AUTHORITY SPEED SETTING



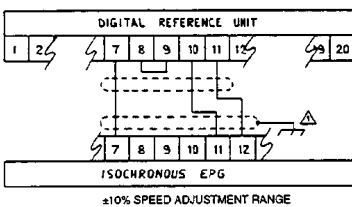
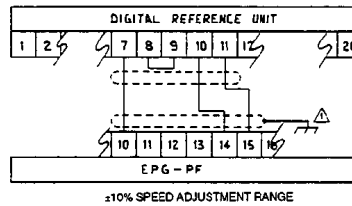
SPEED TRIM APPLICATIONS



LOAD SETTING APPLICATIONS



SPEED TRIM APPLICATIONS



IMPORT/EXPORT APPLICATION

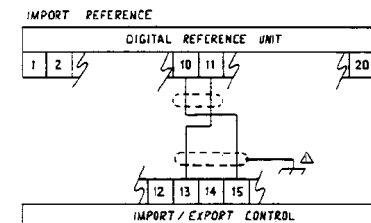
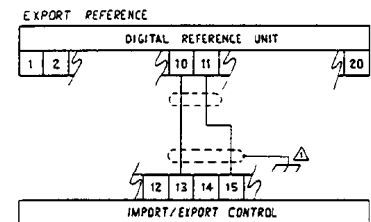


Figure 4-1. Wiring Applications

PROCESS CONTROL APPLICATION

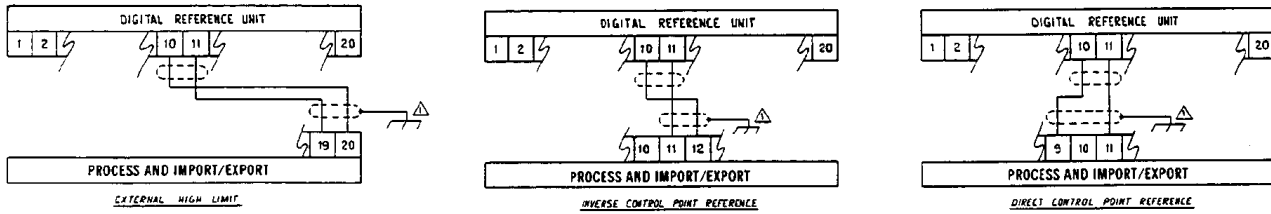


Figure 4-2. Wiring Diagrams

Chapter 4.

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

<u>Facility</u> -----	<u>Phone Number</u>
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

<u>Facility</u> -----	<u>Phone Number</u>
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

<u>Facility</u> -----	<u>Phone Number</u>
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.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 82006A.



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.