



Product Manual 82454
(Revision NEW)
Original Instructions

Stepping Motor Driver Control

8271-501

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

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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 Out-of-date translations are marked with .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.

Contents

WARNINGS AND NOTICES	II
ELECTROSTATIC DISCHARGE AWARENESS	III
CHAPTER 1. GENERAL INFORMATION.....	1
Introduction.....	1
Additional Information.....	1
CHAPTER 2. INSTALLATION.....	2
Receiving.....	2
Handling Precautions and Procedures.....	2
Mounting the Control	2
Electrical Connections.....	3
CHAPTER 3. OPERATION AND ADJUSTMENTS.....	6
Motor Driver Operation Check.....	6
Stepping Speed Adjustment.....	6
CHAPTER 4. PRINCIPLES OF OPERATION	8
Introduction.....	8
Motor Driver Circuits.....	8
CHAPTER 5. TROUBLESHOOTING	9
Introduction.....	9
Bench Performance Check.....	9
Troubleshooting Procedure	9
CHAPTER 6. PRODUCT SUPPORT AND SERVICE OPTIONS.....	11
Product Support Options	11
Product Service Options.....	11
Returning Equipment for Repair.....	12
Replacement Parts	12
Engineering Services.....	13
Contacting Woodward's Support Organization	13
Technical Assistance.....	14

Illustrations and Tables

Figure 2-1. Typical Outline Drawing	4
Figure 2-2. Plant Wiring Diagram	5
Figure 3-1. Block Diagram.....	7
Table 5-1. Troubleshooting Table	10

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

The 8271-501 Stepping Motor Driver Control (Figure 2-1) contains the logic elements and power circuits to provide bi-directional control of the stepping motors used for remote speed setting of UG-8 Dial or UG-40 Dial governors. Stepping rate is adjustable within a wide range so synchronization and/or load sharing functions may be performed. The device can either be locally or remotely controlled from multiple locations. The Stepping Motor Driver is mounted in a 19 inch (483 mm) rack and has a hinged door on the front that gives access to three printed circuit boards (PCBs). All adjustments can be made from the front of the unit.

Additional Information

The Woodward literature listed here contains information on related equipment to the 8271-501 Stepping Motor Driver and can be ordered from any Woodward location listed on the back page.

Manual 03040	<i>UG Dial Governor</i>
Manual 03039	<i>UG-40 Dial and Lever Governors</i>
Manual 03027	<i>Synchronous/Stepping Speed Adjusting Motors for UG Governors</i>

Chapter 2. Installation

Receiving

After factory testing and adjusting, the control is packed in foam for shipment. Storage or installation and operation may be performed as received. If it is desirable to electrically test the Motor Driver before it is installed and operated, use the bench performance check described in Chapter 5.

Handling Precautions and Procedures

1. Do not install the electronic control until all wiring is correct and the prime mover is ready to be started.
2. Do not completely remove the modules from the electronic control unless absolutely necessary.
3. Do not touch the circuits and terminals of the modules with the hands or other conductive devices.
4. Store printed circuit board modules in conductive plastic bags (Woodward part number 4951-019) with a conductive plastic strip (Woodward part number 4962-005) installed over the terminals.
5. Use battery powered instruments when working on the electronic control.
6. Double check all test connections.
7. The wiring must be correct before applying input power to the electronic control, or damage may result.
8. Do not remove or install modules with the input power on.

Complete handling and protection is covered in Woodward manual 82715, *Guide for Handling and Protection: Electronic Controls, PCBs, Modules*.

Mounting the Control

The 8271-501 Stepping Motor Driver is designed for mounting into a standard 19 inch (483 mm) equipment rack. The cabinet is mounted with the rack mounting extensions located on each side (Figure 2-1). The unit is intended for mounting and operation within an ambient temperature range of -40 to $+71$ °C (-40 to $+160$ °F). Provide for access to wiring connections.

NOTICE

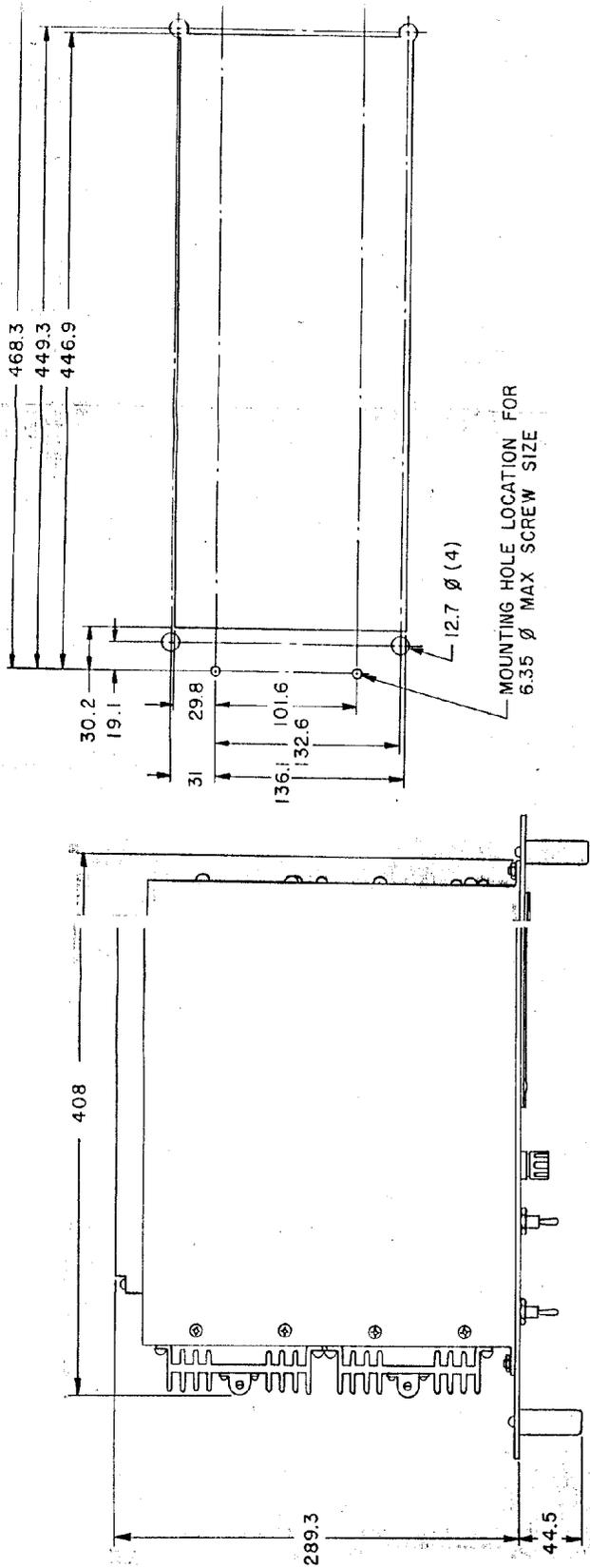
The unit contains dropping resistors producing up to 125 W of heat, so it is absolutely necessary to provide for adequate ventilation to keep temperature within limits. Do not install heat sensitive equipment in the close vicinity.

Electrical Connections

The plant wiring diagram (Figure 2-2) shows typical wiring connections which can be varied depending on the application. To assure the proper direction of rotation of the Stepping Motors, the wiring diagram of the governor showing the connection of the motor leads to the receptacle must be observed, and the color codes must be matched. If the remote control option is not used, a jumper is required between terminals 2 and 8 to power the local control switches on the front panel. To expand the number of remote control locations, a multiple position selector switch must be used that can select the remote location in control, and power the corresponding control switches. This switch is necessary to avoid conflicting commands coming from different locations. The power supply may vary from 20 to 30 Vdc, nominal voltage is 24 Vdc. Input current is approximately 3.5 A maximum per motor, thus 7 A total if two motors are connected. Connect the negative power supply lead to terminal 1, and the positive lead to terminal 2. If a battery is used, be sure the system includes a battery charger of sufficient capacity. No shielded wires are required for external connections, however, do not run lines in a conduit carrying high-voltage cables, because they may pick up stray signals. Do not subject the wiring to temperatures above 100 °C (212 °F).



This is a controlling device. Failure to competently install, operate, and maintain can cause personal injury and/or property damage.



CONVERSION CHART	
mm	inch
6.35	.250
9.53	.375
12.70	.500
19.05	.750
29.77	1.172
30.18	1.188
30.96	1.219
44.45	1.750
101.60	4.000
132.56	5.219
136.12	5.359
162.74	6.407
177.01	6.969
289.33	11.391
407.97	16.062
446.88	17.594
449.27	17.688
468.33	18.438
482.60	19.000

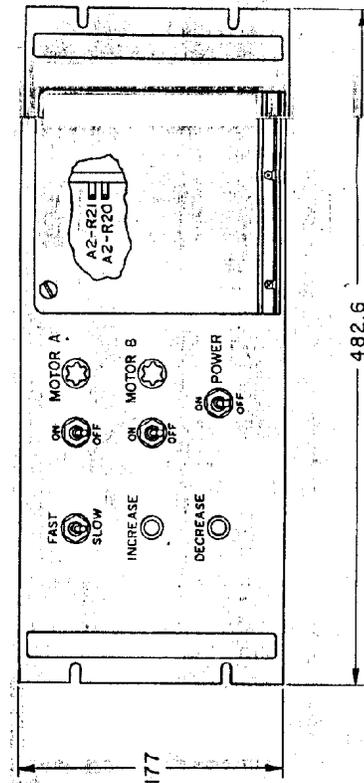
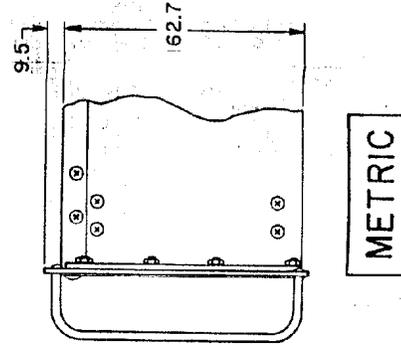
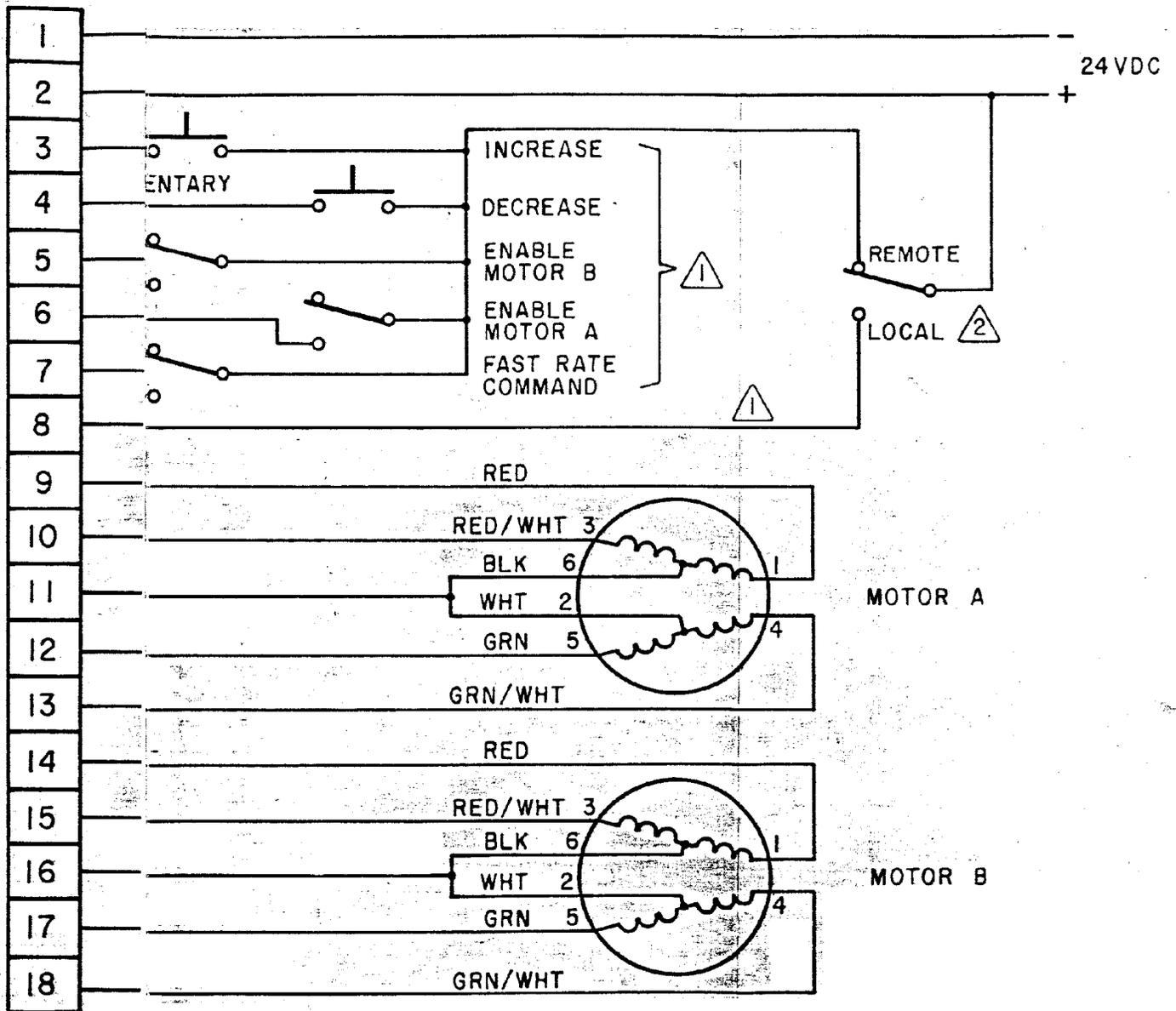


Figure 2-1. Typical Outline Drawing



NOTES

- 1 Terminals 3 through 8 are optional remote station command inputs.
- 2 When remote commands are used, a switch must be included to avoid conflicting commands. When the switch is not used, jumper terminal 2 to terminal 8.

Figure 2-2. Plant Wiring Diagram

Chapter 3.

Operation and Adjustments

Motor Driver Operation Check

Refer to block schematic diagram, Figure 3-1.

Follow initial engine operation and adjustments described in the appropriate speed governor manual. The speed setting can be adjusted manually by the synchronizer knob on the front panel. Adjust the compensation and needle valve settings until speed control is satisfactory. When powering up the Stepping Motor Driver and enabling the motor A or motor B knob, the logic will arbitrarily select two windings of the motor to energize, thus producing a holding torque of approximately 1 N·m (8.8 lb-in) depending on the motor type. This will hold the motor in its proper angular position despite vibrations or other external forces.

NOTICE

The current required for the “holding torque” mode of operation is approximately 3.5 A per motor. Be sure the battery and battery charger have adequate capacity.

Stepping Speed Adjustment

Two potentiometers R20 and R21 provide adjustment of the stepping rate in the fast and the slow mode of operation. The potentiometers are located behind the hinged door on the middle printed circuit board (see Figure 2-1). R20 corresponds with the fast mode and R21 with the slow mode. Since the two potentiometers are functionally interrelating, repeated adjustments may be necessary to get the required stepping rates.

IMPORTANT

Older types of the 8271-501 driver have the R20 and R21 potentiometers located on the top side of the PCB, so the PCB must be removed from its connector to make the pots accessible. Always switch off the input power before removing boards, and be careful in handling (see Electrostatic Discharge Awareness).

In the “slow” mode of operation, the stepping rate can be adjusted from 0 to approximately 750 steps per minute. In the “fast” mode, the minimum stepping rate is as low as the slow speed adjustment, the maximum rate is approximately 750 steps per minute. The Stepping Motor requires 200 steps per revolution, however, the resulting rate of change of the speed setting is also dependent on other governor parameters like speed setting motor gear, box ratio, type of governor flyweights, speeder spring, etc. The speed range of the governor is defined by mechanical end stops that are provided in the panel assembly of the governor. These end stops will also block the Stepping Motor when reaching the high and low limit. This blocking of the motor is in no way harmful for the motor itself or for its electronics. However, a prolonged continuation of this situation may cause damage to the end stops due to the “hammering” action of the Stepping Motor, and this must be avoided.

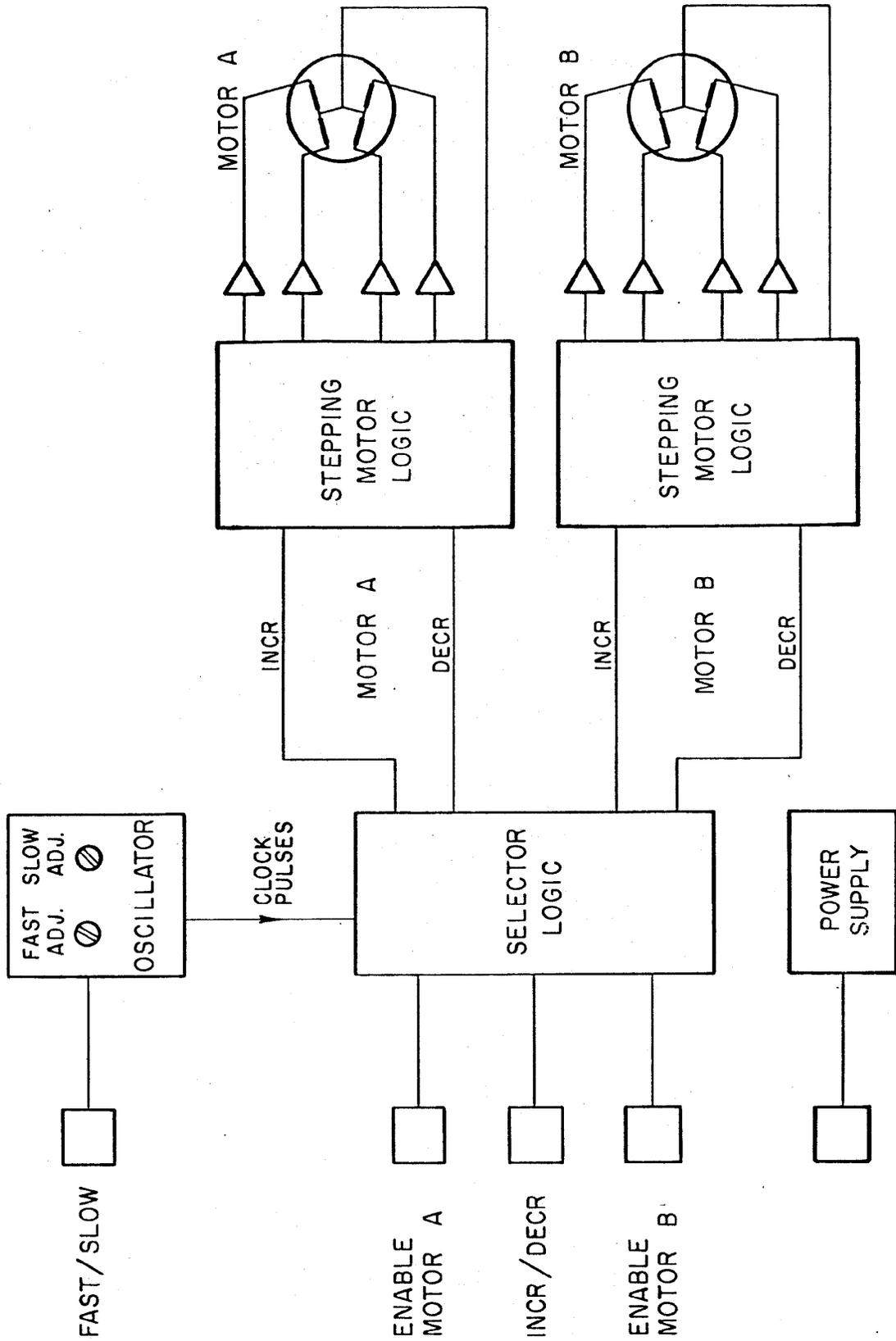


Figure 3-1. Block Diagram

Chapter 4.

Principles of Operation

Introduction

This chapter describes the individual circuit functions of the Stepping Motor Driver and its operation in the governing system. With an understanding of circuit functions, the unit's operation, adjustment, and troubleshooting techniques can be more fully utilized.

Motor Driver Circuits

The basic circuits of the 8271-501 Stepping Motor Driver are shown in Figure 3-1: a power supply, oscillator, selector logic, and the Stepping Motors sequencing logic.

The power supply uses its 24 Vdc input to provide a regulated 5 and 12 Vdc for the selector's logic circuits.

The oscillator circuitry generates the clock pulses to the selector logic and thus defines the stepping rate of the motors. Two clock frequencies can be selected by a fast/slow switch, and the resulting frequencies are adjustable by potentiometer settings (R20 and R21).

The selector logic receives the clock pulses from the oscillator and sends them to the Stepping Motor logic. Dependent on the mode of operation inputs to the selector, either motor A or motor B can be directed, or both at the same time. The selected direction of rotation will apply for both motors, the same is true for the stepping rate, being defined by the clock frequency.

The Stepping Motor logic converts the clock pulses into the switching sequence needed to drive the motor in steps. This is done by energizing 2 out of 14 motor windings in a certain sequence, whereby every clock pulse advances the sequence one step. In series with the common of the motor, a dropping resistor is included that serves two purposes. First, it adapts the motor voltage to the supply voltage of 24 Vdc, and second, it adds to the inductive load created by the motor windings a resistive load that greatly increases the maximum the stepping rate of the motor.

Chapter 5.

Troubleshooting

Introduction

Use inspection and troubleshooting information in the appropriate governor and additional equipment manuals. Check the terminal screws of the Stepping Motor Driver for tightness, and keep the terminal blocks clean. Check the condition of the wiring and the receptacle-plug assembly on the governor. The fastest way to verify correct Stepping Motor Driver operation is to replace it, if possible, with a spare.

Bench Performance Check

The bench check is made with the Stepping Motor Driver disconnected from all the wiring connections.

1. Connect a 20–30 Vdc power supply rated at 3.5 A to terminals T1 (–) and T2 (+).
2. Jumper terminal T8 to T2. This activates the control switches on the front panel.
3. Connect the Stepping Motor to terminals T9 through T13 in accordance with the color code of the plant wiring diagram (Figure 2-2).
4. Set the motor A switch to the “on” position, the motor B switch to the “off” position, and the fast/slow switch to the “slow” position.
5. Turn on the power supply and power switch on the front panel. Push the “increase” button. The motor shaft must rotate counterclockwise as seen from the nameplate side of the motor. Push the “decrease” button for clockwise rotation.
6. Open the hinged door and adjust R21 (upper potentiometer) to check if the motor responds to a change in clock pulse frequency. Repeat with the fast/slow switch in the fast position, adjusting R20 (lower potentiometer).
7. Turn off the power supply. Connect the Stepping Motor to terminals T14 through T18 as shown on the plant wiring diagram (Figure 2-2). Set the motor A switch to the “off” position, and the motor B switch to the “on” position. Repeat steps 5 and 6.

Troubleshooting Procedure

Table 5-1 is a general guide for isolating system problems. This guide assumes that the system wiring, solder connections, switch and relay contacts, and input and output connections are correct and in good order. Use the table by first locating the appropriate symptom. Accompanying tests aid in providing and isolating the cause and recommend a remedy.

Table 5-1. Troubleshooting Table

Symptoms	Cause/Test	Test Results/Remedy
Both motors not running.	No input supply voltage.	Check T1 (-) and T2 (+) for 20 to 150 Vdc. Check fuses on front panel.
	Control switches not powered.	Check for jumper from T2 (+) to T8 for internal switches. Check external switches for 24 Vdc over the contacts when open.
	Check temperature of the dropping resistors on the heat sink at the left side of the box and/or the temperature of the motor(s).	If heating up the motor is at its holding torque and so far working properly. Check A2 PCB performance by replacing it with a spare.
One motor not running, other motor working properly.	Put A1 PCB in place of A3 and A3 PCB in place of A1. (The Stepping Motor logic boards A1 and A3 are identical.)	If improper operation transfers from one motor to another, the Stepping Motor logic board is faulty. (PCB A1 drives motor A, and PCB A3 drives motor B.)
	Measure motor windings of suspect motor with an ohmmeter for open connections.	If open winding(s) are found, replace motor.
	Check temperature of dropping resistors mounted on the heat sink at the left side of the box.	If working properly, motor will draw current when powered up to produce holding torque. Dropping resistors will heat up to approx. 80–100 °C (175–210 °F). If resistors keep cold, check wiring from Stepping Motor logic board to motor. If resistors heat up but motor will not run, control logic board (A2) or control switches may be faulty.
One motor running irregularly at high stepping rates only.	Check motor performance in both fast and slow mode.	If motor is running properly at low speed but irregularly at high speed, then motor is overloaded. Reduce stepping frequency in fast mode with R20 and/or check smooth rotation of the governor speed setting parts.
One motor running irregularly through the whole stepping rate range.	Swap A1 PCB and A3 PCB as described under symptom: one motor not running.	If faulty operation transfers from one motor to another, the Stepping Motor board is at fault. (A1 drives motor A, and A3 drives motor B).
	Check the supply voltage with an oscilloscope for spikes.	Correct as necessary.

Chapter 6.

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	Products Used In Engine Systems	Products Used In Industrial Turbomachinery Systems
<u>Facility</u> ----- <u>Phone Number</u>	<u>Facility</u> ----- <u>Phone Number</u>	<u>Facility</u> ----- <u>Phone Number</u>
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-----+49 (711) 78954-510	India -----+91 (129) 4097100
Kempen----+49 (0) 21 52 14 51	India -----+91 (129) 4097100	Japan-----+81 (43) 213-2191
Stuttgart--+49 (711) 78954-510	Japan-----+81 (43) 213-2191	Korea-----+82 (51) 636-7080
India -----+91 (129) 4097100	Korea-----+82 (51) 636-7080	The Netherlands- +31 (23) 5661111
Japan-----+81 (43) 213-2191	The Netherlands- +31 (23) 5661111	Poland-----+48 12 295 13 00
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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 **82454**.



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