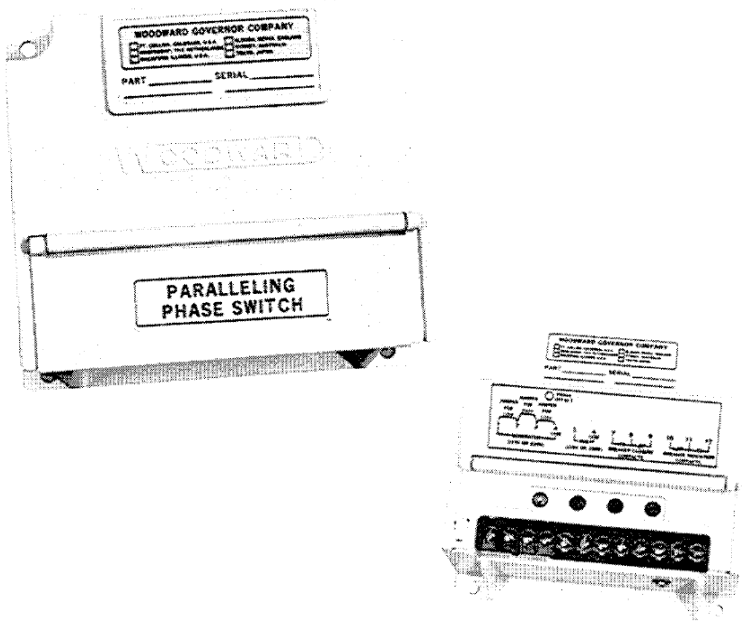
WOODWARD

**Product Manual 82461**
**(Revision A)**
**Original Instructions**




# Paralleling Phase Switch

**8271-851**

**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 Out-of-date translations are marked with ⚠.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.**

# Contents



# Illustrations and Tables

# 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

## Application

The Paralleling Phase Switch is used in paralleled generator applications which are manually synchronized. The Paralleling Phase Switch compares the frequency and phase of the generator and of the bus. (It does not adjust speed to achieve synchronization as the Woodward SPM Synchronizer does.) It allows the circuit breaker connecting the generator to the bus to be closed when the frequency and phase are watched within selected limits and within limits for a specified time.

The Paralleling Phase Switch is designed for use with Woodward 2301, 2500, EPG, EGA, and EGM electric load sharing control systems. Compatibility with other load sharing accessories such as the Generator Loading Control, Import/Export Control, and the Time Control is maintained.

## Reference Publications

This publication is available on the Woodward website (**www.woodward.com**): 25070, *Electronic Control Installation Guide*.

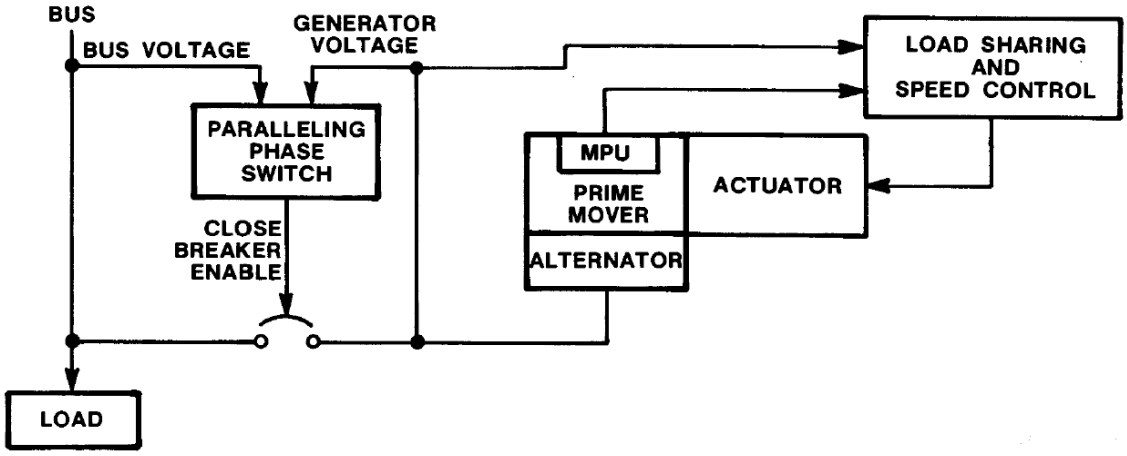



Figure 1-1. Basic Paralleling System

# Chapter 2.
# Theory of Operation

## Introduction

This chapter describes the circuit functions in the Paralleling Phase Switch and its operation in the control system of the prime mover. The important circuits are shown in the block diagram, Figure 2-1.

## Operation

The Paralleling Phase Switch checks the phase angle and frequency of the bus and an off-line generator which is to be paralleled. Terminal connections on the Paralleling Phase Switch are made to the bus and generator. These voltage inputs are first applied to separate Signal Conditioner circuits. Each signal conditioner is a filter and changes the shape of the voltage input signals so they can be measured with accuracy. In the Bus Signal Conditioner circuit is a phase offset potentiometer. It is factory adjusted to compensate for phase errors caused by small differences in the input transformers. The signal conditioners also amplify the bus and generator signals and apply them to the Frequency and Phase Detector.

The Frequency and Phase Detector compares the two signals and determines any difference between the frequency of the generator and that of the bus. The Breaker Close circuit takes its input from the Frequency and Phase Detector. Using the conditioned generator and bus inputs, the Breaker Close circuit measures the phase angle, also called window. When the phase angle is less than the selected angle the circuit begins to measure the amount of time (dwell) the input signals are in phase and checks that the signals remain in phase during breaker closure. When phase angle and dwell time requirements are correct, the Breaker Close circuit sends a signal to the Breaker Close Relay to operate the circuit breaker relay.

The close breaker signal consists of a relay changing state for as long as the generator remains synchronized. If the circuit breaker is not closed and the generator shifts out of synchronization, the close breaker signal ceases. Terminal connections from the breaker close relay to enable operation of the bus tie breaker and connections for indication of the breaker closure signal are provided.

The Paralleling Phase Switch will not enable closure of the circuit breaker connecting the generator to a dead bus. If the Frequency and Phase Detector measures the frequency and phase of the generator and there is no voltage on the bus, then the output of the Frequency and Phase Detector is not within limits. A breaker closure signal cannot be given.

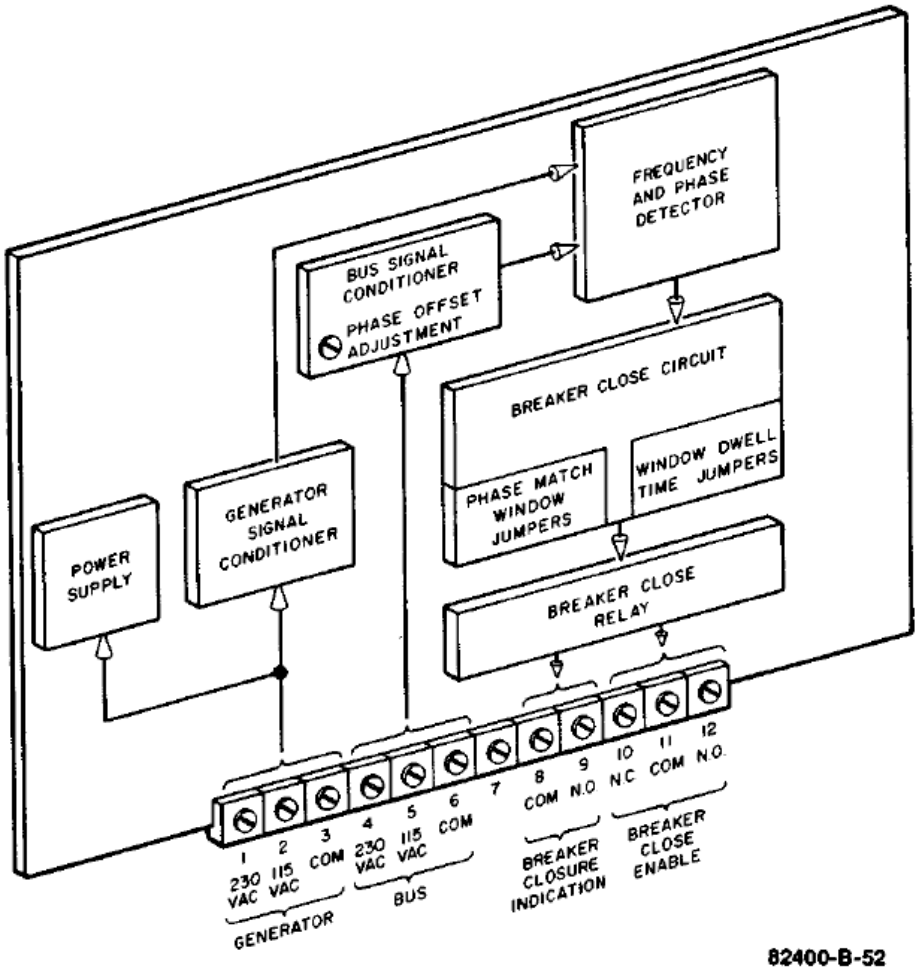



Figure 2-1. Block Schematic Diagram

# Chapter 3.
# Installation

## Receiving

**IMPORTANT** **Do not change the setting of the Phase Offset potentiometer.**

Use care while handling and installing the unit.

After factory testing and adjustment, the Paralleling Phase Switch is packed in foam for shipment. This packing is suitable for storage.

**⚠WARNING**

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

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

**METRIC**

| CONVERSION CHART | | |
|---|---|---|
| MM | = | INCH |
| 5 | | 0.20 |
| 6 | | 0.25 |
| 10 | | 0.40 |
| 70 | | 2.80 |
| 114 | | 4.50 |
| 127 | | 5.00 |
| 133 | | 5.25 |
| 140 | | 5.50 |
| 152 | | 6.00 |

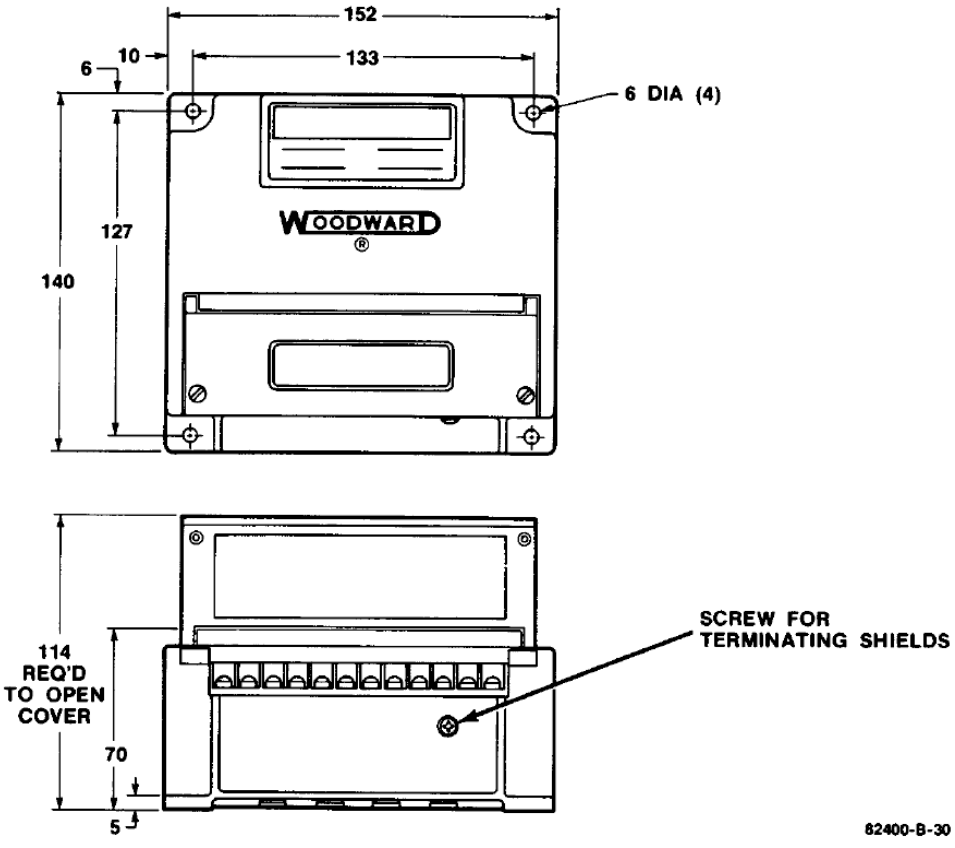



Figure 3-1. Outline Drawing of the Paralleling Phase Switch

# Specifications

Voltage inputs from the generator and the bus are 115 or 230 Vac rms. The actual operating voltage is selected by wiring at the terminal block on the Paralleling Phase Switch. Voltage tolerance is ±10%. Maximum power consumption is 5 watts from the generator input. The letters A, B, or no letter before the 8271-851 part number indicate the Paralleling Phase Switch usage in 50, 60, or 400 Hz power systems. Input frequency and the standard phase windows and match-up times are listed. Before installation, make sure the Paralleling Phase Switch matches the frequency of the power system . The standard phase window (10°) and match-up time (1/2 or 1 second) are satisfactory in most applications. These are listed in Table 3-1. Other phase windows and match-up times are available for special requirements. See Table 3-2. Make sure match-up time is three to four times longer than breaker closure time. The specifications that any unit is adjusted for can be identified by the jumpers installed on the circuit board. See Figure 3-2.

Table 3-1. Standard Specifications

| Part Number | Input Frequency | Phase Window | Match-Up Time |
|---|---|---|---|
| 8271-851 | 60 Hz, jpr 8 in | 10°, jpr 7 in | 1/2 s, jpr 4 in |
| A8271-851 | 5OHz, jpr 8 & 9 in | 10°, jpr 7 in | 1/2 s, jpr 4 in |
| B8271-851 | 400 Hz, jpr 10 in | 10°, jpr 7 in | 1 s, jpr 5 in |

Table 3-2. Optional Specifications

| Phase Window | Match-Up Time |
|---|---|
| 15°, jpr 6 in | 1/16 s, jpr 1 in |
| 20°, jpr 6 & 7 out | 1/3 s, jpr 2 in |
| | 1/4 s, jpr 3 in |

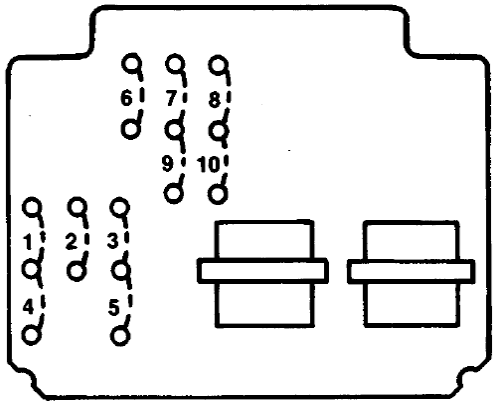



Figure 3-2. Jumper Location

## Changing Jumpers

The best way to change a jumper, if it is necessary, is to return it to the factory. Changing a jumper in the field is not recommended. Components of the Paralleling Phase Switch are electrostatically sensitive and can be damaged or destroyed by static charges while handling and soldering to change a jumper.

**NOTICE**

**Electrostatic charges can damage components unless correct handling and soldering procedures are used.**

## Mounting

Mount the Paralleling Phase Switch in a location which gives:

- Adequate ventilation. The unit is designed for operation within an ambient temperature range of –54 to +65 ° C (–65 to +149 °F)
- Protection from moisture and vibration

## Electrical Connections

### General Instructions

The following instructions and schematic wiring diagrams illustrate typical wiring connections for the 8271-851 Paralleling Phase Switch. A plant wiring diagram for your specific control part numbers must be used for actual installation.

Make all electrical connections using insulated terminals.

Do not subject any wiring to temperatures above 100 °C (212 °F) or allow sharp kinks or bends in the wiring.

Read Woodward manual 25070, *Electronic Control Governor Installation Guide*, for additional wiring information. Install and wire the other units and actuators in the system using instructions in applicable manuals.

### Connections to the Generator and Bus

Voltage connections to the Paralleling Phase Switch must be within 90 to 132 Vac or 180 to 264 Vac. If voltages are not within these ranges, a potential transformer must be selected to give the proper voltage. The Paralleling Phase Switch can use the same generator voltage connections as the 2301 Load Sharing and Speed Control, 2500 Load Sensor, EGA, or the EGM. Power consumption is five watts maximum.

### Wye Connected Generator

Connect the generator common to the Paralleling Phase Switch terminals 3 and 6. Connect one phase of the generator (usually ΦA) to terminal 1 if 230 Vac or terminal 2 if 115 Vac. Connect the same phase from the bus to terminal 4 if 230 Vac or terminal 5 if 115 Vac.

## Delta Connected Generator

Connect the generator common (usually ΦB) to Paralleling Phase Switch terminal 3. Connect the same phase from the bus to terminal 6.

Connect one of the remaining generator phases (ΦA is shown) to terminal 1 if 230 Vac or 2 if 115 Vac. Connect the same phase from the bus to terminal 4 if 230 Vac or 5 if 115 Vac.

## Breaker Closure Enable Indication

For indication of the breaker closure enable signal, normally open contacts are provided at terminals 8 and 9.

The ratings for the contacts are:

Resistive Loads:
10 A at 28 Vdc
3 A at 115 Vac, 50 to 400 Hz
1.5 A at 230 Vac, 50 to 400 Hz

## Breaker Closure Enable Contacts

Make connections from the breaker close switch to Paralleling Phase Switch terminals 10 through 12, as required for operation. Terminals are shown in Figure 3-3 which give normally open or normally closed contacts.

The ratings for the breaker close contacts are:

Resistive Loads:
10 A at 28 Vdc
3 A at 115 Vac, 50 to 400 Hz
1.5 A at 230 Vac, 50 to 60 Hz

Inductive Loads:
6 A at 28 Vdc
2 A at 115 Vac, 50 to 400 Hz
1 A at 230 Vac, 50 to 400 Hz

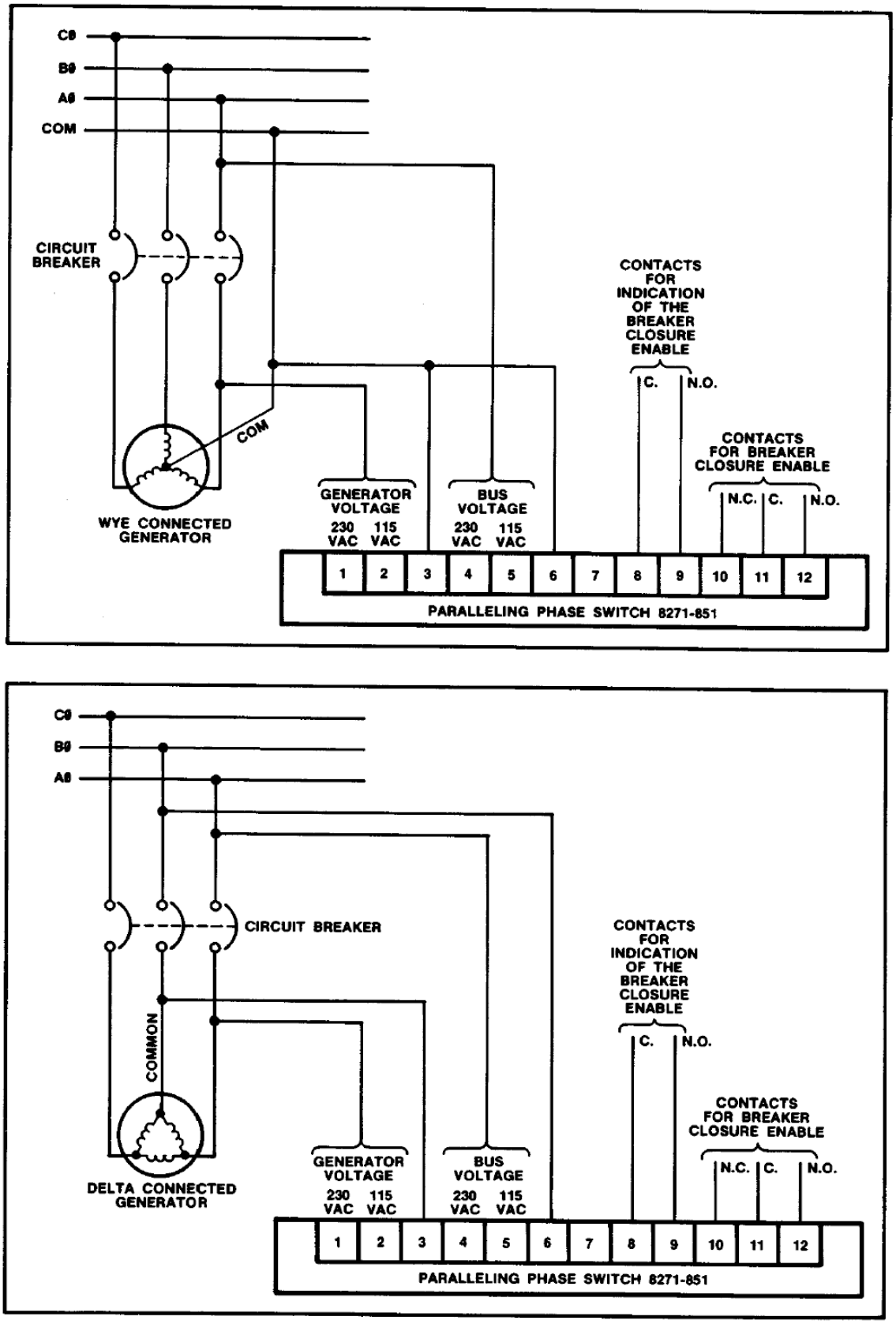



Figure 3-3. Typical Wiring Diagram

# Chapter 4.
# Operation and Adjustments

## Introduction

Make sure all electrical connections are correct and made with insulated terminals.

All other units in the prime mover control system must be adjusted and working correctly before attempting to parallel with the bus. The best way to test the Paralleling Phase Switch is to operate it without closing the circuit breaker.

## Operation

1. Operate the generator at rated speed for the specified generator frequency.

**⚠WARNING** **When starting and operating the prime mover, be prepared to initiate an immediate stop in the event of a prime mover, actuator, or control failure.**

2. Watch the panel meters to check that the Paralleling Phase Switch issues a breaker closure enable signal when the frequency and phase of the generator matches those of the bus. The closure indicator will remain on as long as the generator's frequency and phase remains within matched limits.

## Adjustments

Adjustment of the phase offset potentiometer is made at the factory. Make no adjustments to it.

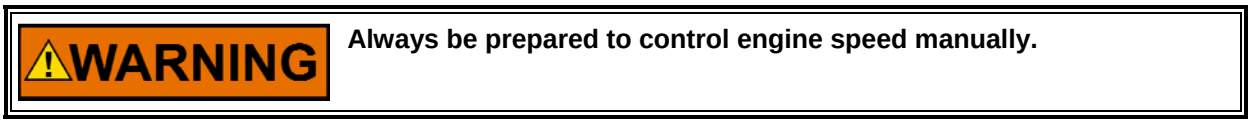
# Chapter 5. Troubleshooting

If incorrect operation of the governing system or Paralleling Phase Switch is evident, first check that the prime mover and prime mover control operate correctly. Use applicable manuals for the units in the systems to isolate the problem.

If the Paralleling Phase Switch is not operating correctly, use the following troubleshooting chart to isolate the problem. Make the checks in the order indicated. Where disassembly, repair, or changing of jumpers become necessary, all work must be done only by personnel thoroughly trained in the proper procedure.

Check that the terminal connectors are tight. All shielding must be properly grounded at one end only. Fuses, switches, or other devices must operate correctly. Some problems are caused by an incorrect phase match angle or too fast a match-up time for the circuit breaker. If these problems are proven by the troubleshooting chart, consult Woodward.

When requesting additional information or service help from Woodward or an authorized service shop, it is important to include in your correspondence the part numbers of all Woodward components and a complete description of problems or symptoms.




**Always be prepared to control engine speed manually.**

Table 5-1. Troubleshooting Chart

| Symptom | Cause/Test | Remedy |
|---|---|---|
| The PPS will not issue a breaker closure enable. | No Bus Voltage.<br>The PPS will not issue a close breaker enable to a dead bus. | The customer must establish a bus frequency by switch-gear or manual means. |
| | Voltage Supply. Check that the generator voltage is within the specified range. Check voltage supply wiring. Wiring for each phase of bus and generator must be correctly matched and wired to the terminal block. | Change, correct as necessary. |
| | Match-Up Time<br>The match-up time is too fast or the circuit breaker is too slow. | In most applications, the standard 1/2 or 1 second match-up time is satisfactory. Consult Woodward if other times are required. |

# 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

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

### Products Used In Engine Systems

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

### Products Used In Industrial Turbomachinery Systems

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

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

# Technical Assistance

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

## General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

## Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

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

Power Output Rating _____

Application (power generation, marine, etc.)

## Control/Governor Information

**Control/Governor #1**

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

**Control/Governor #2**

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

**Control/Governor #3**

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

## Symptoms

Description _____

_____

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

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

**Send comments to: icinfo@woodward.com**

**Please reference publication 82461A.**

WOODWARD

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**Email and Website—www.woodward.com**

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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.**

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