WOODWARD

Product Manual 37839
(Revision B)
Original Instructions

CPC Current-to-Pressure Converter

Redundant Duplex CPC Skid Assembly

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 Out-of-date translations are marked with ⚠.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

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

System Description

The Woodward CPC is a current-to-pressure converter. It is intended to be used to position steam valves by interfacing to the steam valve servo system. The CPC supplies a hydraulic fluid control pressure that is proportional to a 4–20 mA drive current signal. For a full description of the CPC, see Woodward manual 89543.

The system described in this manual consists of a skid-mounted arrangement of two CPCs operating through a transfer valve assembly.

The system offers redundant operation of a steam valve servo assembly on steam turbines, where it is not desirable to allow failure of a single component to interrupt the operation of the turbine.

Operating under the control of a redundant control system (such as the Woodward 5009 digital control), the system allows for an automatic transfer of control to a standby CPC should the duty CPC fail.

Additionally the system allows for the field replacement of either CPC or the transfer valve assembly in the event of a failure, without the need to stop the turbine.

Construction

The two CPCs are mounted to a modular anodized aluminum manifold containing the transfer valve, isolation valves, a flow rate limiter (damping valve), and pressure test points. The manifold and CPCs are themselves mounted to a steel support frame.

The complete assembly is designed for use in a hazardous environment, and all parts used are explosion proof including the electrical terminal box for customer interface wiring connections.

Individual components used have the hazardous area classification:

E Ex d iiC T6

All skid wiring is potted within explosion proof conduit connectors and runs within high temperature conduit.

Design Principles

The skid assembly has been designed to offer maximum reliability for critical steam turbine applications, and features include:

- easy assembly leading to cost benefits for the end user
- a minimum of hydraulic connections, reducing the potential for oil leakage
- a compact design
- the ability to calibrate the CPCs and to check system pressures through self-sealing pressure test points (test gauge is supplied)
- the use of a high flow oil pilot-operated cartridge type transfer valve
- the use of a poppet type solenoid valve which is not prone to oil silting
- easy online change-out of transfer valve assembly or faulty CPC
- replacement of the pilot solenoid valve coil without the need to remove the valve body
- a single design that can be used in both non-hazardous and hazardous locations
- switch to provide transfer valve position indication

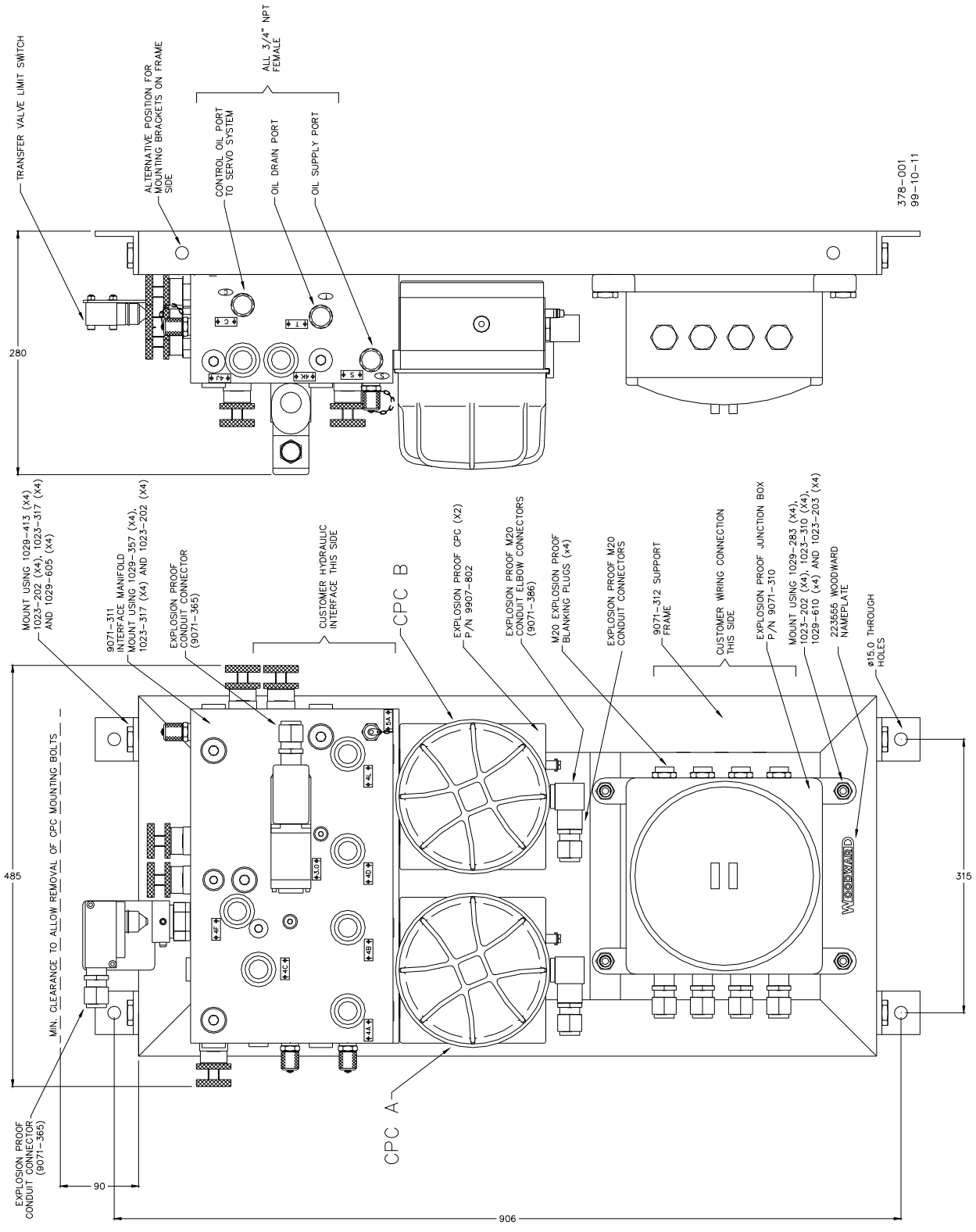

Figure 1-1. General Assembly Diagram

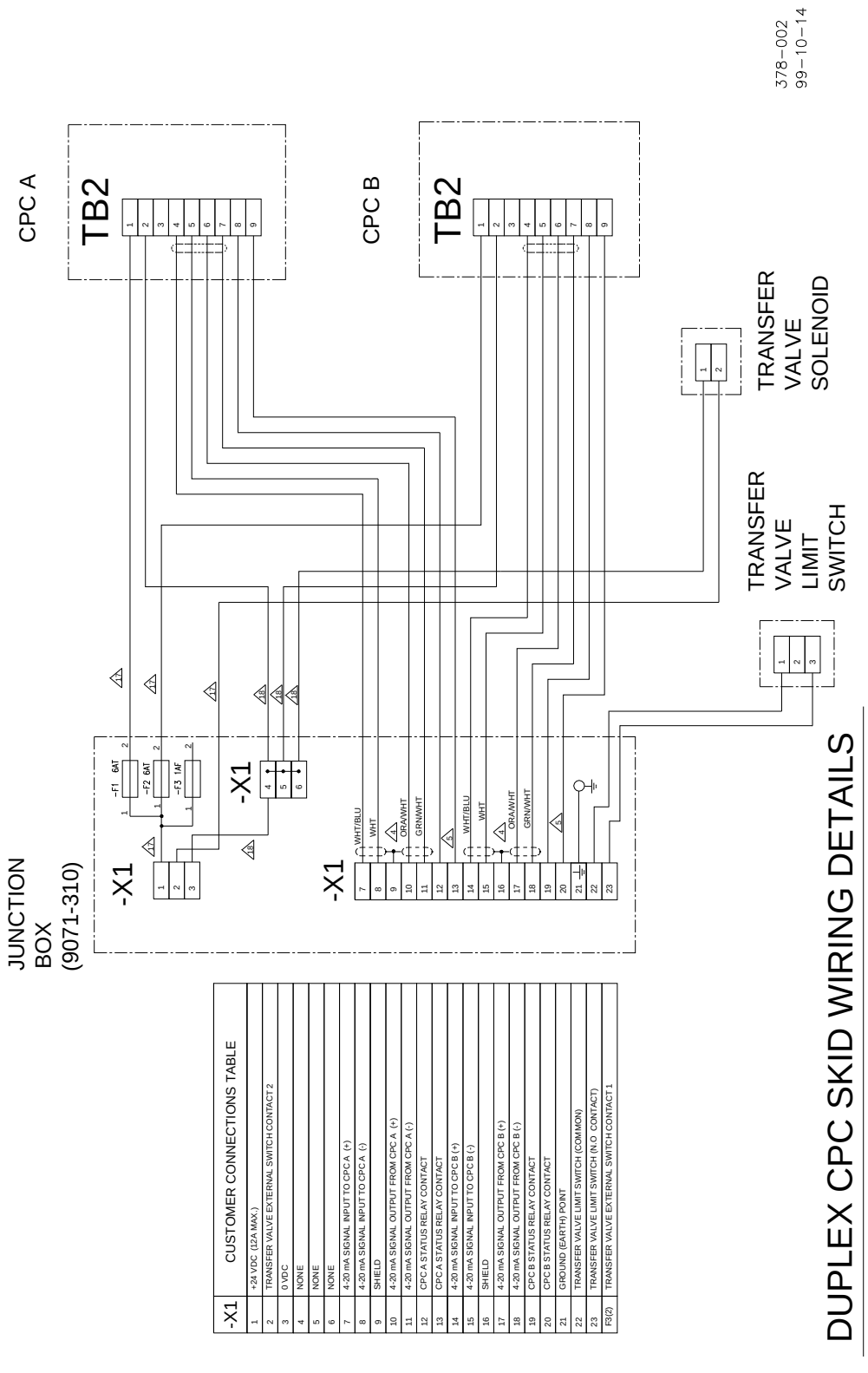

Figure 1-2. Wiring Diagram

Chapter 2.
System Specifications

The design specifications for the CPC apply with the following additions:

Transfer Valve Solenoid Operating Voltage	24 Vdc
Transfer Valve Solenoid Power Consumption	30 W
Hydraulic Interface Ports (ALL)	3/4 NPT female
Main Components Explosion Proof To:	CENELEC Eex ‘d’ iiC T6
Minimum Required Supply Pressure*	4.1 bar (414 kPa/60 psi)
Complete Assembly Weight (approx.)	100 kg (220 lbs)
Skid Dimensions	see Figure 1-1
Customer Electrical Interface	4x M20 conduit ports on Ex-proof junction box

Transfer Valve Limit Switch Contact Ratings (amps):

Voltage	Resistive Load	Inductive load
125 Vac	15	15
250 Vac	15	15
24 Vdc	5	5
125 Vdc	0.5	0.05

*–A minimum supply pressure of 4.1 bar is required to pilot the transfer valve (to oppose the transfer valve return spring).

Chapter 3. Installation

Receiving Instructions

The skid assembly is carefully packed at the factory to protect it from damage during shipping. However careless handling may result in damage to the unit. If any damage to the skid is discovered, notify both the shipping agent and Woodward. When unpacking the skid, do not remove the hydraulic blanking plugs until you are ready to mount the unit.

Mounting Instructions

The skid assembly is designed to be attached to a vertical structure via the four mounting brackets, but can be mounted in any suitable attitude. The skid should be mounted as close to the servo system to be controlled as possible to minimize the hydraulic control line length. Avoid mounting the skid near heat sources and provide adequate ventilation. When installing the assembly, pay attention to clearances required to remove/replace component parts.

Hydraulic Connections

There are three hydraulic ports on the side of the manifold assembly. These are clearly marked S for the supply oil port, T for the drain (tank) line, and C for the control oil connection to the servo system. All ports are 3/4 inch NPT female. We recommend that for all three lines a minimum pipe inner diameter of 12 mm be used.

Prior to connecting the hydraulic lines to the skid, ALL hydraulic lines should be thoroughly flushed to prevent contamination from entering the CPCs.

Electrical Connections

Apply local procedures, codes, and directives for installing electrical/electronic equipment and, when applicable, for installing explosion proof devices in hazardous environments.

The junction box has 4x M20 entry points for the customer wiring interface. The two CPCs and transfer solenoid valves are protected with fuses mounted within the junction box.

Use screened cable for all analogue signals, and avoid routing power supply wires and signal wires within the same conduit.

Refer to the wiring diagram shown in Figure 1-2.

CPC Calibration

Refer to Woodward manual 89543 for detailed instructions on calibrating the CPCs.

To minimize the system disturbance during transfer of control between the two CPCs, it is important that both the output pressure range and dynamic adjustments of both CPCs be as identical as possible.

The system should be calibrated and commissioned with isolation valves 4A to 4J in the position indicated under “Normal Operation” in Chapter 4. It is important that valve 4H is only opened 1/4 of a turn. Having valve 4H slightly open in this way has been demonstrated to smooth the system disturbance during transfers between CPCs and also to have beneficial effects on system stability.

Once calibration is complete, we suggest that several transfers be completed (de-energizing and re-energizing of the transfer valve) with a CPC demand signal of 12 mA to ensure that the outputs of both CPCs remain stable during transfers.

We recommend that a third CPC be kept identically calibrated to the two installed on the skid to allow easy change-out of a faulty unit.

To aid with calibration, a self sealing pressure test point on the hydraulic control output is provided on the manifold for use with the pressure gauge assembly provided (see Figure 4-1).

Additional self sealing pressure test points are provided to enable checking of the supply pressure, drain pressure, and pilot pressure to the transfer valve.

Chapter 4.
Operation

Normal Operation

A schematic of the system manifold is shown in Figure 4-1. The actual CPCs are not shown. The duty CPC ports are represented as TA, CA, and SA (Tank, Control output, and Supply ports). Similarly the standby CPC ports are shown as TB, CB, and SB. The system interface connections are shown on the right hand side (C, T, and S), item 2 is the transfer valve, item 3 is the transfer valve's piloting solenoid valve. Items 4A to 4N are the isolation valves (4J operates as a flow rate limiter). Items 5A to 5D are the self sealing test points.

The system is designed to be operated with the solenoid valve energized under normal conditions. This removes the pilot pressure from the transfer valve allowing the control pressure output from CPC A to be output to the steam valve servo system and the control pressure output from CPC B to be blocked. The normal position of the isolation valves is:

4A, 4B, 4C, 4D, 4E, 4F, 4K, 4L, 4M—all fully open
4G—fully closed, 4H—closed fully then opened ¼ turn (see "CPC Calibration" in Chapter 3)
4J—partially closed or fully open depending on the need to limit the control flow

Following a failure of CPC A, the solenoid valve (item 3) should be de-energized by the control system. This causes the transfer valve to be piloted, allowing the control pressure output from CPC B to be output to the steam valve servo system and the control pressure output from CPC A to be blocked.

Online Change-out of a CPC

A faulty duty CPC (CPC A) can be isolated by closing valves 4A, 4B, and 4C. The CPC can then be electrically isolated and disconnected from the skid and replaced by removing the four M10 mounting bolts. With a correctly calibrated replacement CPC installed, valves 4A, 4B, and 4C can be opened and control can be returned to the duty CPC by energizing the solenoid operated pilot valve.

Similarly valves 4K, 4L, and 4M can be closed to enable online replacement of CPC B.

Online Change-out of Transfer Valve

The hydraulic control output of either the duty CPC or the standby CPC reaches the control output of the manifold via the transfer valve. Following a failure of the transfer valve, the control output of the CPC can be made to bypass the transfer valve. The transfer valve or piloting solenoid valve can then be isolated, allowing one or both to be changed online.

To change the transfer valve online the piloting solenoid valve would need to be de-energized, ensuring that CPC B is in control. If CPC B is in control, isolation valve 4H can be opened to allow the control output from CPC B to bypass the transfer valve. The transfer and pilot valves can then be isolated by closing 4C, 4M, 4D, and 4E to enable online change-out. In this manner the transfer valve is taken out of the circuit and isolated without interrupting the control flow. Having replaced the faulty transfer valve, valves 4C, 4M, 4D, 4E, and 4F would be opened. Valve 4H would then be slowly closed to bring the transfer valve back into the circuit. Finally the piloting solenoid valve would be energized to return control to the duty CPC (CPC A). Once the system has been returned to the normal operating mode, we recommend that valve 4H be once again opened approximately ¼ turn.

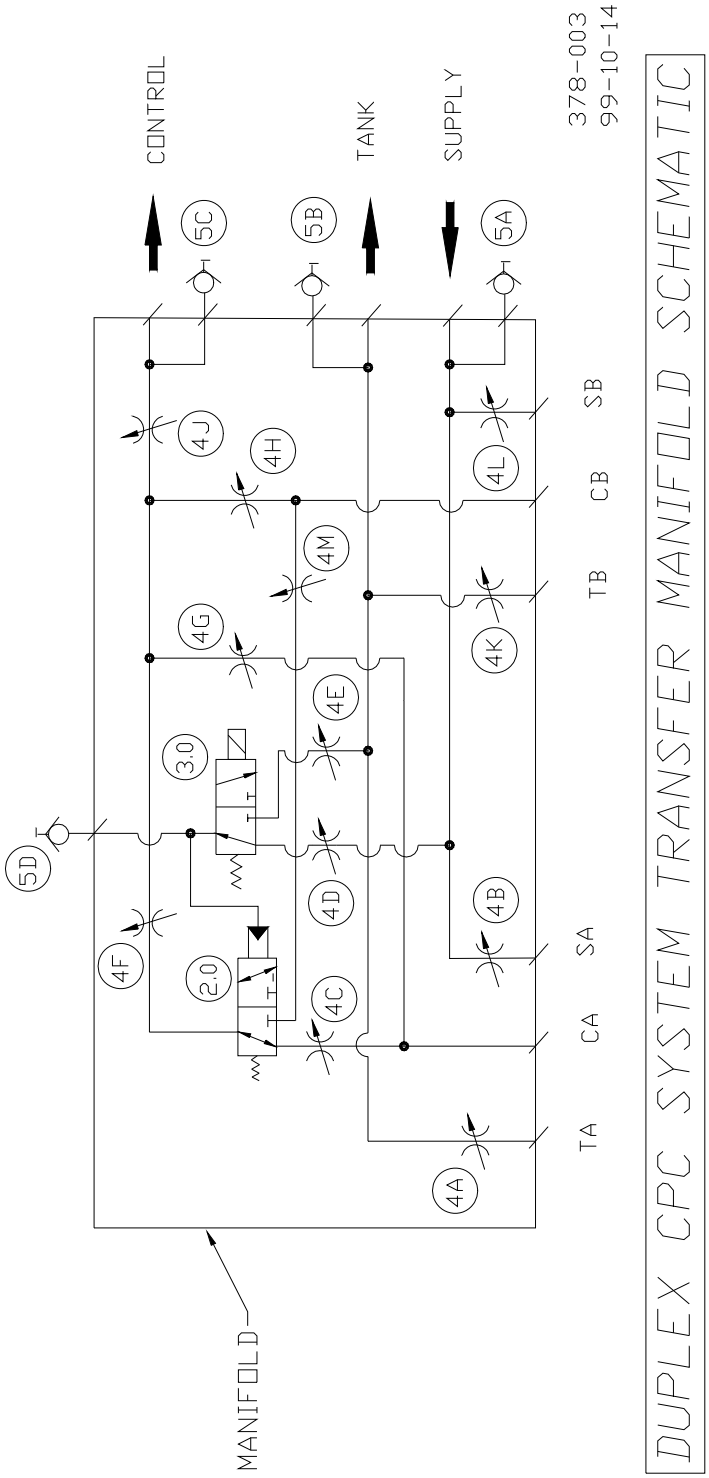

Figure 4-1. System Manifold Schematic

Chapter 5.
Service Options

Product Service Options

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

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM and 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 **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

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

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.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned 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 authorization 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 offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- 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. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or 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 us via telephone, email us, or use our website: **www.woodward.com**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
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

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

Turbine 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

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
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	

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 37839B.

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

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as well as authorized distributors and other authorized service and sales facilities throughout the world.**

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