WOODWARD

Product Manual 26232
(Revision C)
Original Instructions

2300 Digital Electronic Load Sharing and Speed Control

2300-059 (Ordinary Locations)
2300-061 (Hazardous Locations)

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 Out-of-date translations are marked with ⚠.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

Regulatory Compliance

European Compliance for CE Mark
These listings are limited only to those units bearing the CE Marking.

EMC Directive: 2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments.

Low Voltage Directive: 2006/95/EC Council Directive of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

North American Compliance
These listings are limited only to those units bearing the appropriate CSA identification and marking.

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, D, T4 Hazardous Locations and ordinary locations at 70 °C ambient. For use in Canada and the United States.
Certificate 1150575

NOTE—Wiring must be in accordance with applicable electric codes with the authority having jurisdiction.

Marine Compliance

Bureau Veritas:	BV Rules Part C, June 2000
Det Norske Veritas:	Standard for Certification, No. 2.4.2001
Germanischer Lloyd:	Additional Rules and Guidelines, Part 1, 2001
Lloyd's Register of Shipping:	Type Approval System, Test Specification Number 1, 2002
Registro Italiano Navale:	RINA Rules 2001 – Part C

NOTE—Marine certifications apply to specific models only.

Connector J1 must not be used in hazardous locations.

The control must be installed in a suitable enclosure. The final combination must be approved by the local authority having jurisdiction.

Connect the ground terminal to earth ground.

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous vous situez bien dans une zone non explosive.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2.

Chapter 1.
General Information

Description

The 2300 is a digital control that can be programmed with applicable application software. This control is housed in a sheet metal chassis and consists of a single printed circuit board. This control is designed to perform the speed and load control functions for a small engine, steam turbine, or gas turbine. The 2300 has no application software in it when shipped from Woodward, which allows it to be configured and modified to meet site-specific requirements.

The 2300 has serial communications, allowing it to easily interface with a Human Machine Interface (HMI), PLC, or plant DCS. The 2300 is configured and serviced via a laptop computer connected to the control's RS-232 communications port. These configuration and dynamic settings are set, changed, tuned, and saved via a laptop computer and Woodward's user-friendly Watch Window software program. This program allows users to set and adjust all application-based parameters, plus upload and download configurations to and from the control.

The 2300 Hardware includes:

- 1 Load Sensor
- 3 PT Inputs, 3 CT Inputs
- 1 Actuator Driver
- 1 MPU Speed Sensor
- 1 Configurable Analog Output
- 2 Configurable Analog Inputs
- 8 Discrete (Switch) Inputs
- 4 Discrete (Relay Driver) Outputs

References

The following publications contain additional product or installation information on Load Sharing and Speed Controls and related components. They can be obtained from the Woodward website (**www.woodward.com/searchpublications.aspx**) or ordered from any Woodward office.

Manual	Title
25070	*Electronic Control Installation Guide*
25195	*Governing Fundamentals*
82384	*SPM-A Synchronizer*
82510	*Magnetic Pickups and Proximity Switches for Electronic Governors*
82715	*Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*

Product Spec	Title
82383	*SPM-A Synchronizer*
82516	*EG3P/6P/10P Actuator*
82575	*EGB1P/2P Governor/Actuator*
03202	*Woodward Watch Window Standard*

Chapter 2. Installation

Introduction

This chapter contains general installation instructions for the 2300 control. Power requirements, environmental precautions, and location considerations are included to determine the best location for the control. Additional information includes unpacking instructions, electrical connections, and an installation check-out procedure.

Unpacking

Before handling the control, read the “Electrostatic Discharge Awareness” information on page iv. Be careful when unpacking the electronic control. Check the control for signs of damage such as bent or dented panels, scratches, and loose or broken parts. If any damage is found, immediately notify the shipper.

Mounting Considerations

This product is intended for installation in a “closed electrical operating area” or in an enclosed industrial control cabinet. Consider these requirements when selecting the mounting location:

- Adequate ventilation for cooling
- Space for servicing and repair
- Protection from direct exposure to water or to a condensation-prone environment
- Protection from high-voltage or high-current devices, or devices which produce electromagnetic interference
- Avoidance of vibration
- Selection of a location that will provide an operating temperature range of –40 to +70 °C (–40 to +158 °F)
- The control must NOT be mounted on the engine or turbine.

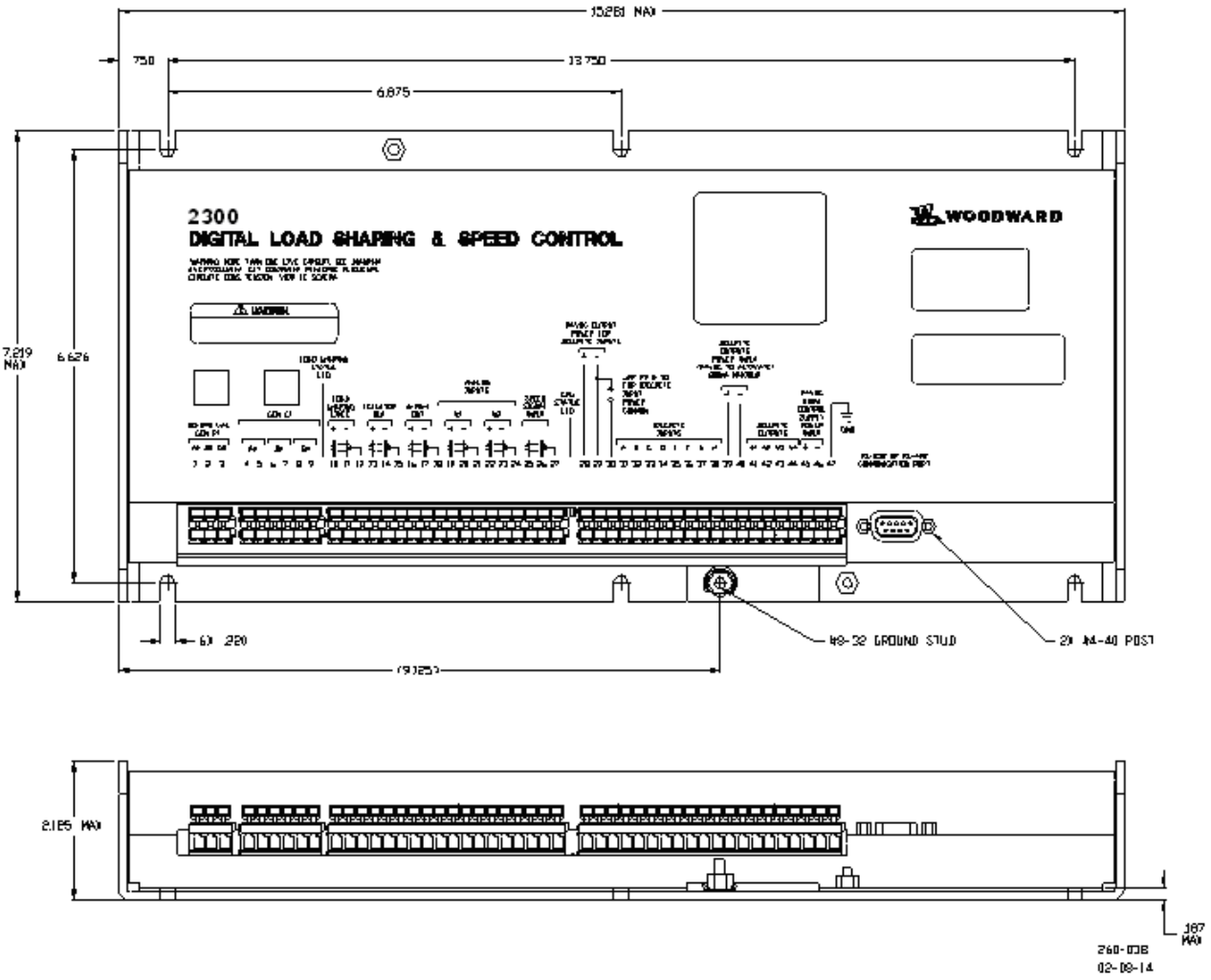


Figure 2-1. 2300 Outline Drawing (2300-059)

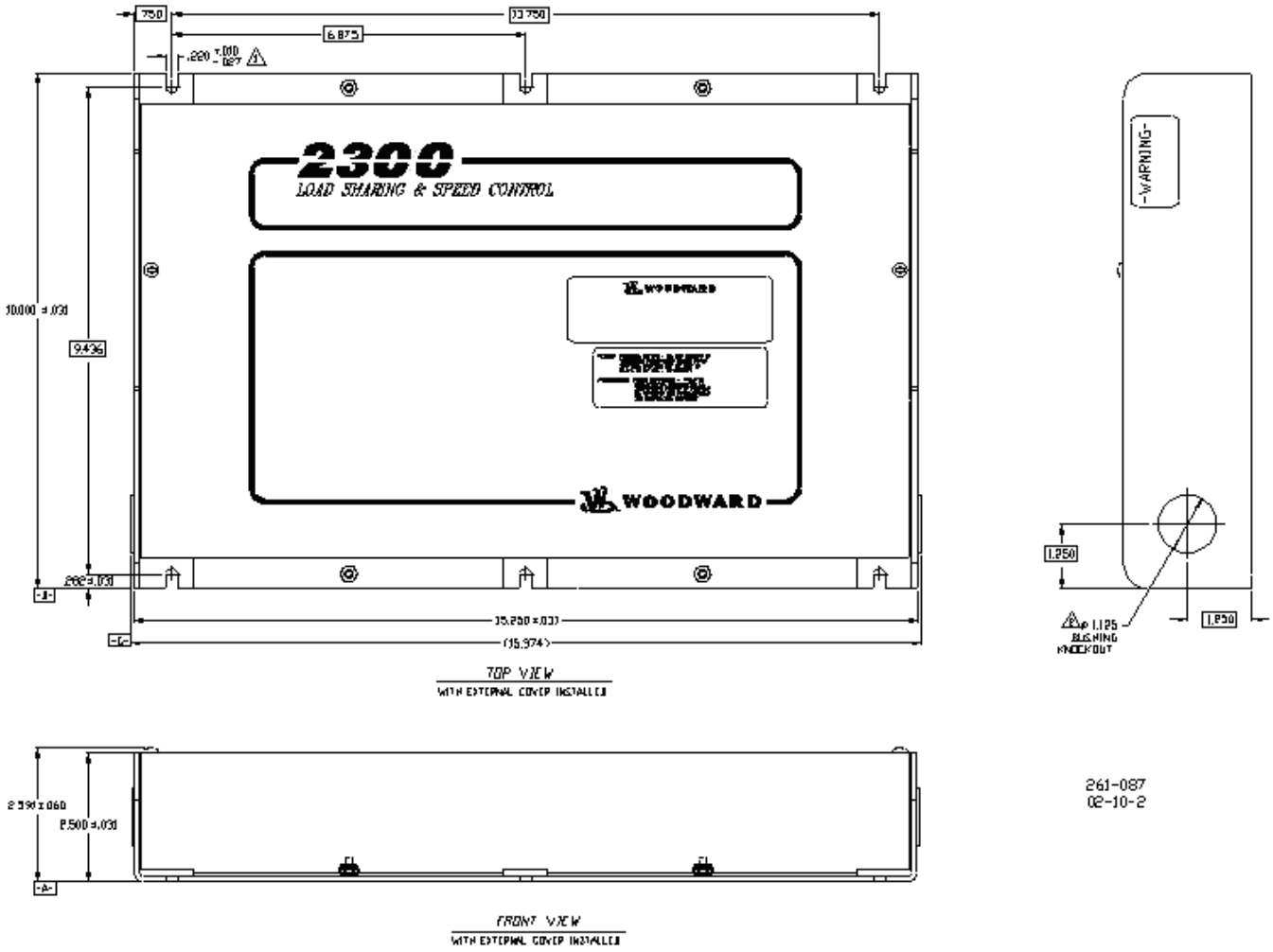


Figure 2-2. 2300 Outline Drawing (2300-061)
(Hazardous Locations, external cover installed)

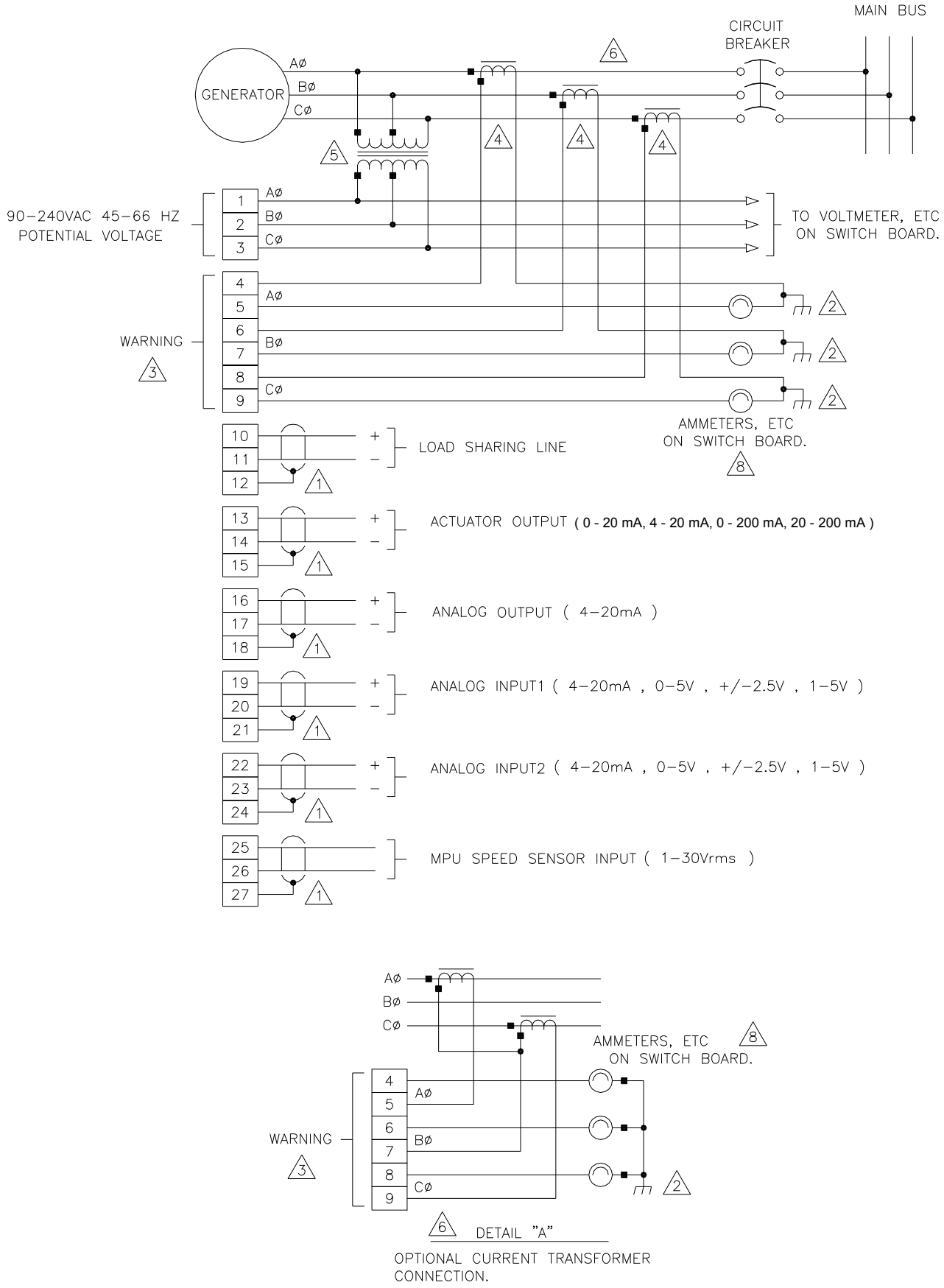
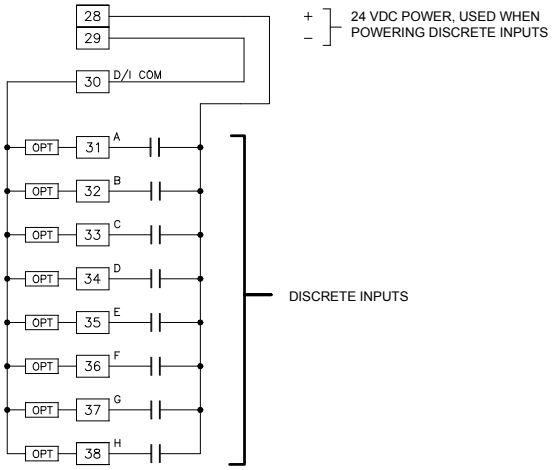
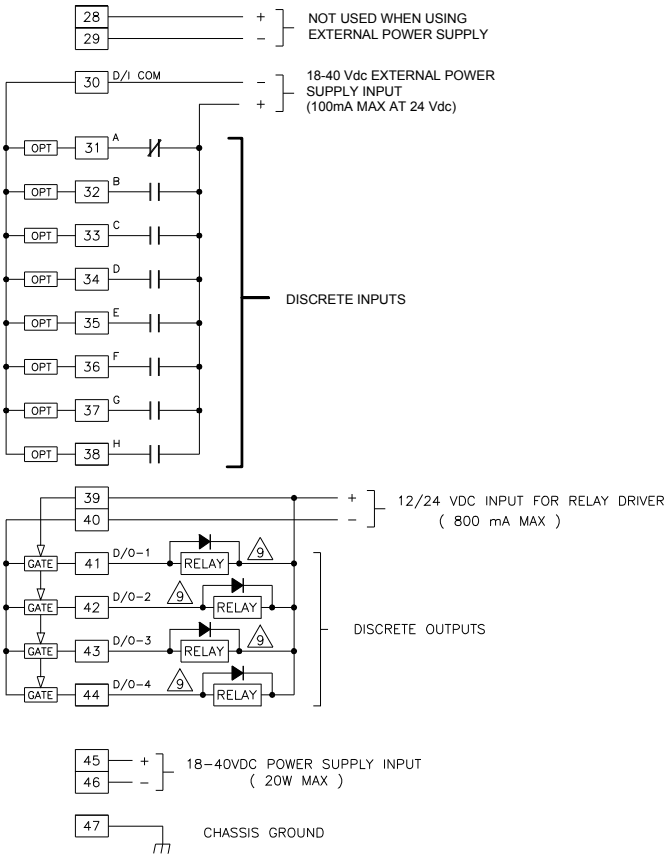


Figure 2-3a. 2300 Plant Wiring Diagram (sheet 1)

DISCRETE INPUTS WITH INTERNAL POWER SUPPLY



DISCRETE INPUTS WITH EXTERNAL POWER SUPPLY



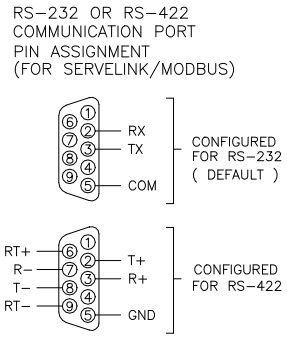


Figure 2-3b. 2300 Plant Wiring Diagram (sheet 2)

NOTES:

1. SHIELDED WIRES TO BE TWISTED PAIRS, WITH SHIELD GROUNDED AT CONTROL END ONLY.
2. POINT OF GROUNDING IF REQUIRED BY WIRING CODE.
3. INTERNAL CURRENT TRANSFORMER BURDEN MUST BE CONNECTED ACROSS POWER SOURCE CURRENT TRANSFORMER AT ALL TIMES, TO PREVENT LETHAL HIGH VOLTAGES.
4. POWER SOURCE CURRENT TRANSFORMERS SHOULD BE SIZED TO PRODUCE 5A SECONDARY CURRENT WITH MAXIMUM GENERATOR CURRENT. CURRENT TRANSFORMER BURDEN IS LESS THAN 0.1 VA PER PHASE.
5. WITH A BALANCED THREE PHASE LOAD AND UNITY POWER FACTOR, THE CURRENT TRANSFORMERS SHOULD BE WIRED IN THE CORRECT POTENTIAL LEG AND MUST BE PHASED AT THE CONTROL AS FOLLOWS:
   PHASE A: POTENTIAL TERMINAL 1, WITH RESPECT TO NEUTRAL, IN PHASE WITH CT TERMINALS 4 TO 5.
   PHASE B: POTENTIAL TERMINAL 2, WITH RESPECT TO NEUTRAL, IN PHASE WITH CT TERMINALS 6 TO 7.
   PHASE C: POTENTIAL TERMINAL 3, WITH RESPECT TO NEUTRAL, IN PHASE WITH CT TERMINALS 8 TO 9.
6. FOR OPTIONAL CURRENT TRANSFORMER CONNECTION, SEE DETAIL "A".
7. DISCRETE INPUTS WITH CABLE LENGTHS GREATER THEN 30 METERS THAT ARE USED FOR CRITICAL FUNCTIONS, SUCH AS SHUTDOWN, SHOULD NOT BE FLOATED IN EITHER AN ON OR OFF STATE. THESE INPUTS SHOULD BE SWITCHED TO EITHER 24 VDC OR GROUND.
8. IF METERS ARE NOT USED, JUMPERS MUST BE INSTALLED IN PLACE OF METERS SHOWN.
9. INDICATES RELAY COIL OR LAMP, 200 mA MAXIMUM PER CHANNEL.
10. JUMPER TERMINAL 29 TO 30 IF USING INTERNAL POWER FOR DISCRETE INPUTS. TERMINAL 28 AND 29 SHOULD NOT BE USED , IF EXTERNAL POWER IS USED.

Figure 2-3c. 2300 Plant Wiring Diagram (notes)

Electrical Connections

WARNING

Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.

NOTICE

Do not connect any cable grounds to “instrument ground”, “control ground”, or any non-earth ground system. Make all required electrical connections based on the wiring diagrams.

All inputs and outputs are made through screwless spring-actuated terminal blocks. For EMI reasons, it is recommend that all low-current wires be separated from all high-current wire.

The spring clamp can be actuated using a standard 2.5 mm or 3/32 inch flat bladed screwdriver. The terminal blocks accept wires from 0.08–4 mm² (27–12 AWG). Two 0.8 mm² (18 AWG) or three 0.5 mm² (20 AWG) wires can be easily installed in each terminal. Wires for the fixed mounted power terminals should be stripped 5–6 mm (0.22 inch) long.

IMPORTANT

It is recommended that stranded wire be used for connections to the terminal block. Do not tin (solder) the wires that terminate at the terminal blocks. The spring-loaded terminal blocks are designed to flatten stranded wire and if those strands are tinned together, the connection loses surface area and is degraded.

Shields and Grounding

An individual shield termination is provided at the terminal block for each of the signals requiring shielding. All of these inputs should be wired using shielded, twisted-pair wiring. The exposed wire length beyond the shield should be limited to one 25 mm (1 inch). Relay outputs, contact inputs and power supply wiring do not normally require shielding, but can be shielded if desired.

The 2300 is designed for shield termination to earth ground at the control. If intervening terminal blocks are used in routing a signal, the shield should be continued through the terminal block. If shield grounding is desired at the terminal block, it should be ac coupled to earth. All other shield terminations except at the control should be ac coupled to earth through a capacitor. A 1000 pF, 500 V capacitor is sufficient. The intent is to provide a low impedance path to earth for the shield at frequencies of 150 kHz and up. Multiple direct connections of a shield to earth risk high levels of current to flow within the shield (exception, see note below on cabinet installations).

Shields can be grounded at both ends (2300 and load) if the cable length is sufficiently short (within a cabinet) to prevent ground loop current in the shield.

IMPORTANT

Cabinet Installations: If the 2300 is installed in a cabinet, shielded I/O can be terminated directly to the cabinet (earth ground) at the entry to the cabinet, as well as at the control.

For EMC reasons, it is recommend that all low-current wires be separated from all high-current wires. Input Power ground terminal should also be wired to earth ground.

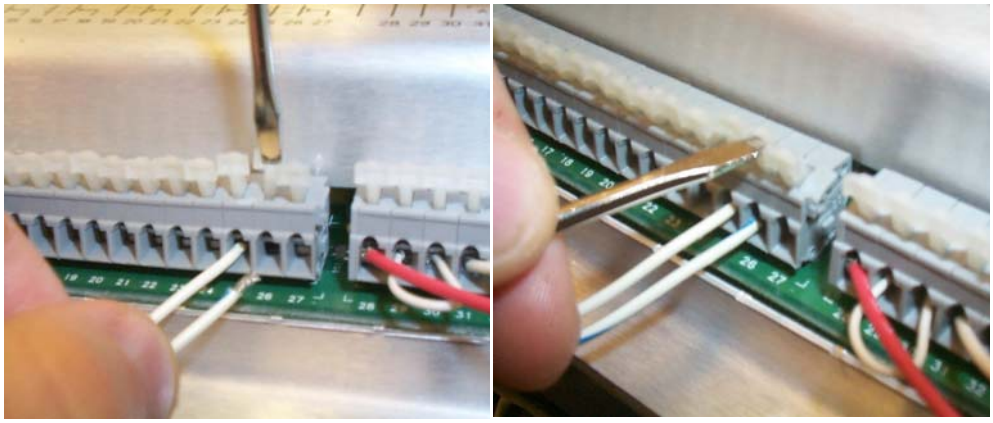


Figure 2-4. Installation of Wiring into Terminal

Power Supply Connections

The 2300 requires a voltage source of 18 to 40 Vdc, with a current capacity of at least 900 mA for operating power. If a battery is used for operating power, an alternator or other battery charging device is necessary to maintain a stable supply voltage.

Connect 18–40 Vdc input power to terminals 45(+) and 46(–).

IMPORTANT

The 18–40 Vdc input power must be supplied from a power supply/battery charger certified to IEC standard with SELV (Safety Extra Low Voltage) classified output. The installer should properly size wiring and fusing for the input power and PT/CT circuits.

Potential Transformer Connections

The control's potential transformer inputs accept line-to-line voltages of 90 to 240 Vac (refer to the plant wiring diagram, Figure 2-3). Connect the potential transformer secondary leads to the following terminals:

Phase A to Terminal 1
Phase B to Terminal 2
Phase C to Terminal 3

Current Transformer Connections

The control's current transformer inputs accept a current range of 0 to 7.2 A (refer to the plant wiring diagram, Figure 2-3). Connect the current transformer leads to the following terminals:

Phase A to Terminals 4 & 5
Phase B to Terminals 6 & 7
Phase C to Terminals 8 & 9

Load Sharing Lines Connections

The Load Sharing Lines provide an analog communication path between compatible controls. The 2300 provides an internal relay for connecting the Load Sharing Signal to the internal circuitry at the appropriate times. When the internal relay is closed, a green LED will illuminate between terminals 9 and 10. Because the load-sharing-line relay is contained in the control, no relay is required between the control and the load-sharing-line bus. Use shielded cable and connect the load-sharing lines directly to terminals 10(+) and 11(–). Connect the shield to terminal 12. When all controls in the system are 2300s, the shields may be connected continuously between controls. When load sharing with different controls, do not connect the shields at the point where connections are made to the load-sharing-line bus.

Discrete Input Connections

In general, discrete inputs must change state for a minimum of 15 milliseconds for the control to sense and register a change in state. All contact inputs accept dry contacts. Contact wetting voltage is available through terminals 28 and 29. If desired, an external 18-40 Vdc power source can be used for the circuit wetting voltage. In this case terminal 30 (contact input common) must be connected to the external power source's negative common to establish a common reference point. Each contact input pulls 3 mA when closed and requires at least 14 Vdc to recognize a closure command. See Figure 2-3 for wiring information and see the 2300 Control Specifications on the inside back cover for input specifications.

A positive voltage on any discrete input terminal is sensed by the control as a closed contact or "TRUE" state. With no voltage applied to a discrete input terminal the control senses an open contact or "False" state.

For power loading reasons, it is recommended that the control's internal 24 Vdc not be used to power other external equipment.

IMPORTANT

Discrete inputs with cable lengths greater than 30 meters that are used for critical functions, such as emergency stop, should not be floated in either an on or off state. These inputs should be switched to +24 Vdc or ground.

Actuator Output

Connect the unit's actuator wires to the control's actuator driver output on terminals 13(+), 14(–), and 15(shield). This output's current range is software configurable and can be programmed to output a drive current of 0–200 mA, 20–200 mA, 4–20 mA, or 0–20 mA. Do not connect the shield wire to the actuator or any other point. Verify that the output's shield wire has continuity its entire distance to the actuator and is insulated from all other conducting surfaces.

Analog Inputs (#1, #2)

Connect input wiring to terminals 19(+), 20(–), and 21(shield) to use Analog Input #1 and connect input wiring to terminals 22(+), 23(–), and 24(shield) to use Analog Input #2. These Analog Inputs are software configurable.

The type of the analog inputs can also be chosen from one of the following options:

- 4–20 (mA)
- 0–5 (V)
- ±2.5 (V)
- 1–5 (V)

MPU Speed Sensor Input

To sense speed, the control accepts a signal from a passive magnetic pickup unit (MPU) mounted off a gear connected or coupled to the turbine's rotor. Connect the MPU speed sensor to terminals 25, 26, and 27(shield). This input is limited to a frequency range of 100–24 950 Hz and a voltage range of 1.7–35 Vac (it needs the voltage above 2.7 Vac in case of a signal above 13 000 Hz). Verify that the input's shield wire has continuity its entire distance to the input sensor and is insulated from all other conducting surfaces.

With proper MPU, gear size and MPU-to-gear clearance, speed measurement should be capable down to 100 Hz. Check the speed sensor for visible damage. Standard MPU clearance is recommended to be between 0.25 and 1.0 mm (0.010 and 0.040 inch) at the closest point. Make sure that the gear has less than 0.5 mm (0.020 inch) diametric run out. See manual 82510, *Magnetic Pickups and Proximity Switches for Electronic Governors*.

Relay Driver Outputs (Terminals 41–44)

The 2300 has four discrete output driver channels, Terminals 41, 42, 43, and 44.

These discrete outputs are low-side drivers with a maximum output current of 160 mA. The discrete output drivers are isolated from the control's internal power supply (but not from each other) and are powered by an external +12 Vdc or +24 Vdc source connected at terminals 39(+) and 40(–) (refer to Figure 2-3 for plant wiring information).

Analog Output

Connect readout wiring to terminals 16(+), 17(–), and 18(shield) to use the control's 4–20 mA Analog Output.

Verify that the output's shielded wire has continuity its entire distance to the output device and is insulated from all other conducting surfaces. This current driver based output is designed to drive into impedances of up to 250 Ω. This output is not isolated from the other control inputs and outputs, thus an isolation device may be required with this output if the device being interfaced to is not isolated.

Communication Port

The control's serial communications port is used to configure and service the unit, as well as communicate to a Human Machine Interface (HMI) or plant distributed control system (DCS).

IMPORTANT **The communication port must be connected with an approved jacketed serial communication cable. The connector must be secured to the 2300 to prevent contact with other circuits.**

RS-232

See Figure 2-5 for cable connection.

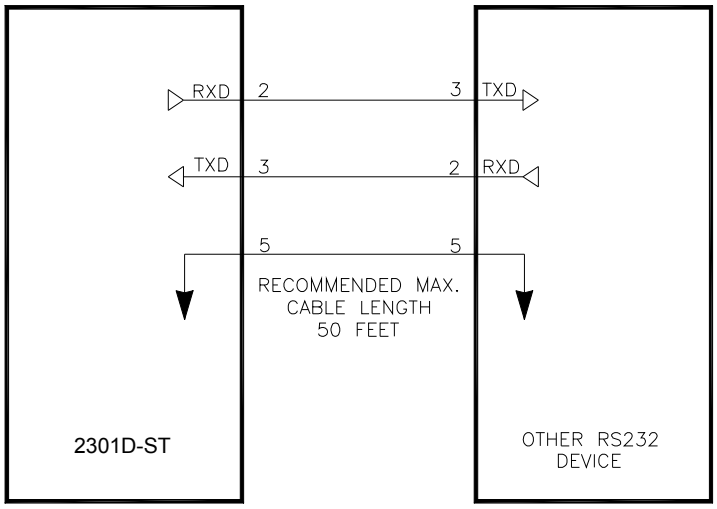


Figure 2-5. RS232 Pin assignments for Serial Communication Cable

RS-422

See Figure 2-6 for termination and cable connection example.

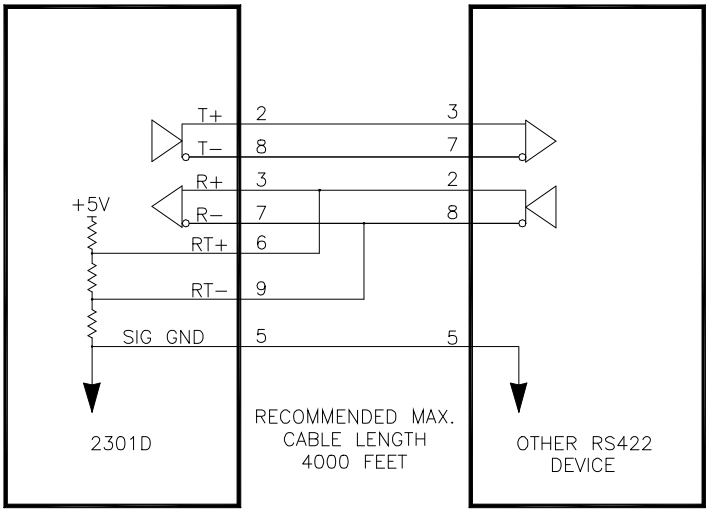


Figure 2-6. Typical RS422 Communications Connections

Termination

For RS-422, termination should be located at the receiver when one or more transmitters are connected to a single receiver. When a single transmitter is connected to one or more receiver, termination should be at the receiver farthest from the transmitter. Figure 2-7 is an example.

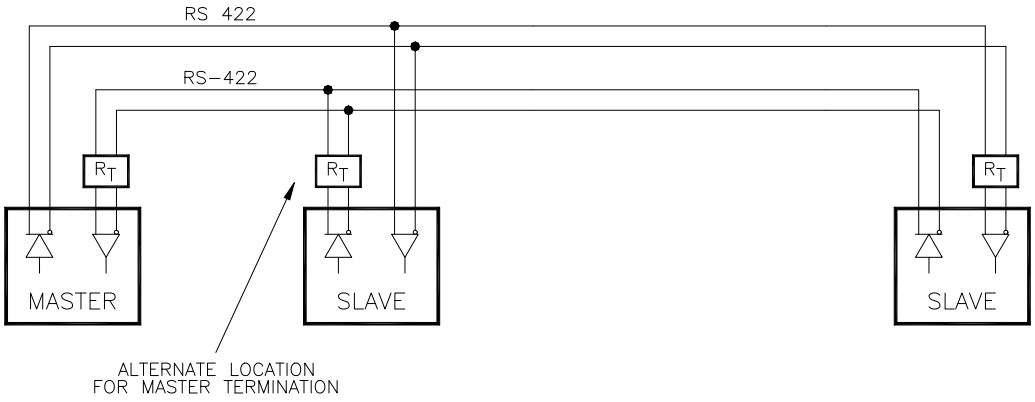


Figure 2-7. RS-422 Terminator Locations

Grounding and Shielding

The RS-422 specifications state that a ground wire is needed if there is no other ground path between units. The preferred method to do this is to include a separate wire in the cable that connects the circuit grounds together. Connect the shield to earth ground at one point only. The alternate way is to connect all circuit grounds to the shield, and then connect the shield to earth ground at one point only. If the latter method is used, and there are non-isolated nodes on the party line, connect the shield to ground at a non-isolated node, not at an isolated node. Figures 2-8 and 2-9 illustrate these cabling approaches.

IMPORTANT

Non-isolated nodes may not have a signal ground available. If signal ground is not available, use the alternate wiring scheme in Figure 2-9 with the signal ground connection removed on those nodes only.

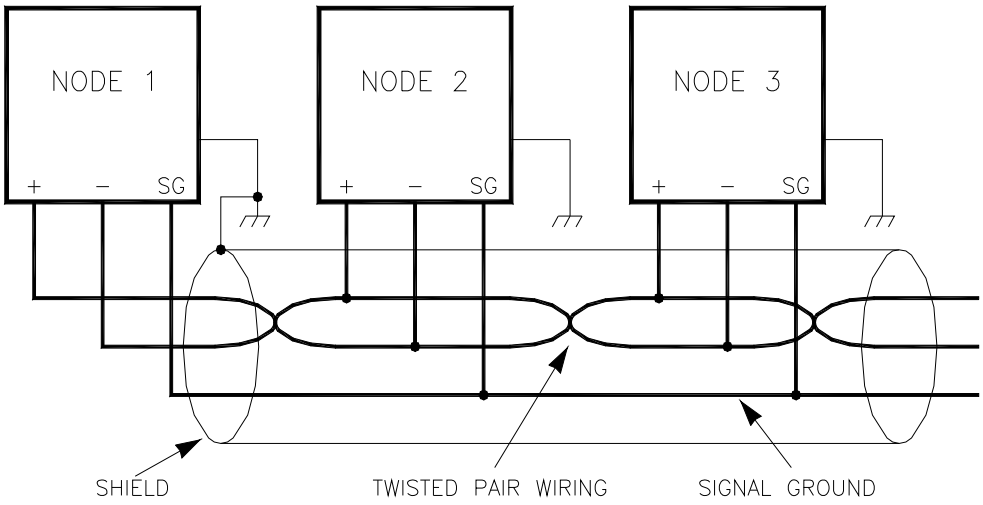


Figure 2-8. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

IMPORTANT

The SG (signal ground) connection is not required if signal ground is unavailable.

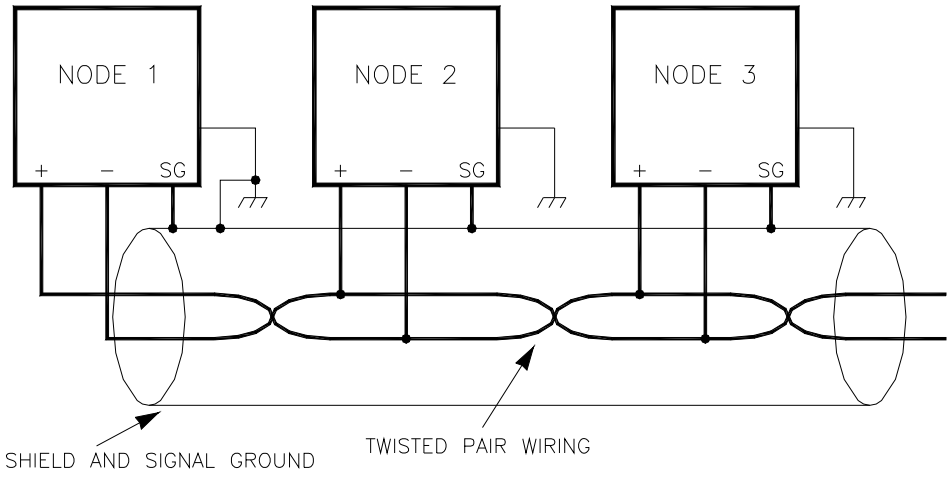


Figure 2-9. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

Chapter 3.
GAP Software and Communication Procedures

Introduction

This chapter contains information on the GAP Graphical Application Programmer software and the use of Woodward's Watch Window software tool.

GAP Software

Woodward's GAP is a Windows based software program that allows controls engineers to create block format application programs for the 2300. Once the control logic is entered using the program's graphical programming environment, the GAP software compiler function generates code that runs in the control.

GAP software blocks are written in C code, which is a transportable language, allowing it to be used on many different hardware platforms. Because of this feature, the same control logic software that has been used and proven in thousands of controls is available for use in the creation of future controllers, without introducing system bugs. For ease of learning and use, the GAP software diagram entry screen has the look and feel of several software simulator tools familiar to many control engineers.

The GAP software package is a mature programming package, providing revision control, security, and code import/export tools to facilitate program management and code re-use.

The block format allows a controls engineer to re-use a library of known control blocks, string them together with other known control blocks, and develop a software program to match customer needs. Through years of use, GAP has proven to be an extremely successful software package that can be field modified, even after installation or based on changing customer needs.

An additional advantage incorporated into GAP is the unique rate group structure on which it operates. Variable execution time blocks have been avoided. This means that under an unanticipated set of conditions (system upset), the processor will not become overburdened, and will have time to complete its assigned tasks. Only with predictable execution times can a multitasking operating system have a guaranteed update rate. Software tasks may be programmed to run every 5 milliseconds, 10 ms, 20 ms, etc., and all tasks seem to run simultaneously.

This versatile software program is structured to allow OEMs or other engineering companies the capability of creating or controlling their own fuel control algorithms.

IMPORTANT **The 2300 control is not shipped with any application software in it.**

Watch Window Program

Watch Window is the primary communications tool for Woodward controls that support the Servlink protocol. Watch Window runs on a PC connected to the control system through a serial communications port. The PC may be permanently connected to the control or only as needed. The communications server, Servlink I/O Server, is included in the same CD-ROM with the Watch Window software.

An “inspector” provides a window for real-time monitoring and editing of all control Configuration and Service Menu parameters and values. Custom “inspectors” can easily be created and saved. Each window can display up to 28 lines of monitoring and tuning parameters without scrolling. The number with scrolling is unlimited. Two windows can be open simultaneously to display up to 56 parameters without scrolling. Tunable values can be adjusted at the inspector window. Watch Window communicates with the control through an RS-232 cable connection to the comm. port configured as a point-to-point only Servlink Server.

Watch Window is a typical Windows application that provides a powerful and intuitive interface. The menu structures are familiar to Windows users. Variable navigation is provided through the Explorer window similar to the Explorer in Windows.

Watch Window performs these primary functions:

- Monitoring and Tuning of Control Variables—Watch Window presents variables in a tabular format. The user chooses the variables to view. Multiple pages of variables can be created, each with useful parameters for various troubleshooting or tuning procedures. The user can toggle between pages depending on the task being performed.
- Control Configuration and Set Point Management—Watch Window can upload or download all tunable variables from the control system. This feature allows a user (e.g., fleet owner, distributor, packager) to upload (and save) all tunable parameters from one control and download the same settings to other controls for similar turbine configurations.


Watch Window version 1.05 and higher, allows for automatic generation of inspector sheets. Click on the Q icon (Quick Inspector) on the tool bar. A sheet will automatically be created from each Service and Configure Header programmed into the control. Multiple inspectors can be created to allow for viewing more than one sheet at a time.


To enter the I/O Lock mode and enable a configure value to be entered, click on the I/O Lock icon on the Tool Bar. Because the values set in Configure are critical to turbine operation, it is not safe to operate the prime mover while these parameters are being configured. In the Configure mode the control outputs will be set to their off state and the microprocessor will stop executing the application code. The control will have to be reset to continue operation.


The Reset icon allows the microprocessor to store the configure parameters, to return the outputs to their active state and to resume executing the application software.


When the tuning or setting of parameters is complete, the values must be saved in the control's non-volatile memory. Go to the Tool Bar and click the PROM icon for Save Values. The values will be saved in non-volatile memory and will be unaffected by loss of power to the control.


If an application configuration has been previously saved to a *.CFG file, the saved set of parameters can be loaded into the 2300 as a group by selecting the Load Application Settings icon.


To save the configuration to a file in the external computer for backup or download later into another 2300, select the Save Application Settings icon. All the tunable values presently set in the control will be saved to a file and can be loaded into this 2300 to reprogram it to the saved values or into another 2300 at a later time.

Install Watch Window Software

Woodward's Watch Window Standard configuration and service tool may be downloaded at no cost from the Woodward website (www.woodward.com). As an alternative a Watch Window CD Install Kit may be purchased from the nearest Woodward distributor. Once downloaded, select the kit's Setup.exe program on the computer on which you wish to install the Watch Window software program. Please refer the product specification 03202 for detailed installation procedures.

Connect PC to 2300

The connection of a computer is only required for calibration and setup of the 2300 on a prime mover (Figure 3-1). The computer and Watch Window software program are not required or necessary for normal operation of the control. The cable is a 9-pin female to 9-pin male, null modem cable.

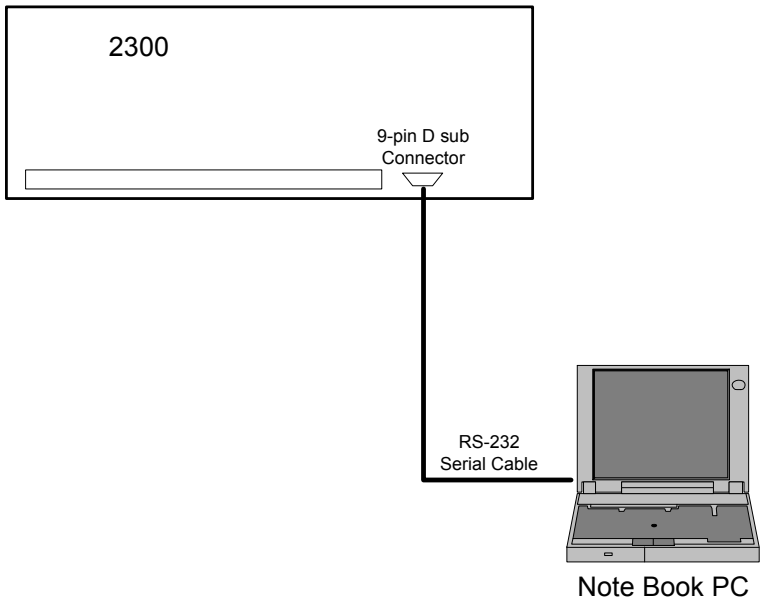


Figure 3-1. Connection between PC and 2300

Apply Power to the 2300

At power-up, the 2300 runs through its boot-up routine and performs a set of initial diagnostics to verify CPU, memory and bus health. This boot-up routine takes approximately 30 seconds to execute. During this time, the control's red status LED (located between terminals 27 and 28) should be on. When boot-up is complete, the application program code begins running, the control outputs will be enabled and system control will begin - the control's red status LED will be turned off and should remain off as long as the control is running.

Initial 2300 Communications

Before communications can begin between the Watch Window program and a control, a network definition file must be created. Once this network definition file is created and saved, it never has to be recreated.

To create a network definition file:
1. Open the Watch Window program's associated Servlink server by Clicking on Start > Programs > Woodward > Servlink Server.exe
2. Select the communications port the control is connected to
3. Select "Point-to-Point" communications
4. Select the a Baud Rate of 38400
5. Select the OK button

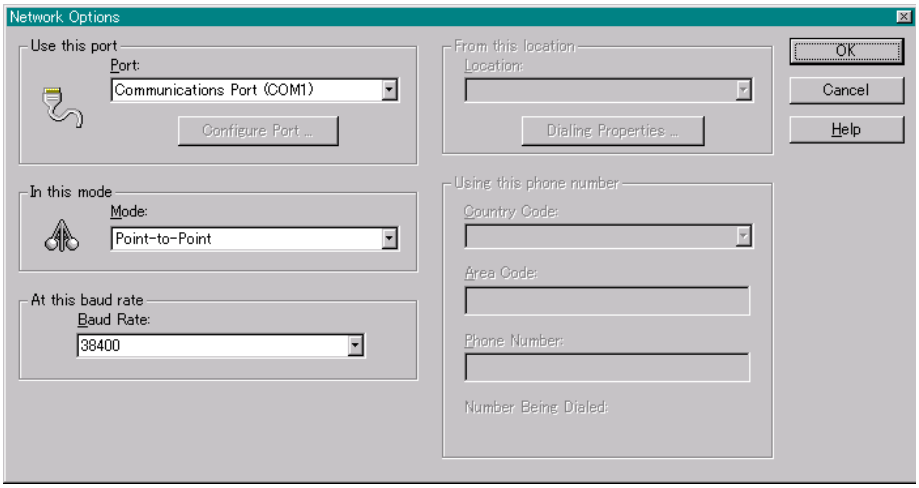


Figure 3-2. Setup Servlink Communication

At this point the Servlink Server program will establish control communications, begin reading all control setting registers and create a lookup table for these registers to expedite future control communications. Upon reading register location information from the control the following Windows pop-up box will appear. (This step can take several minutes to complete.)

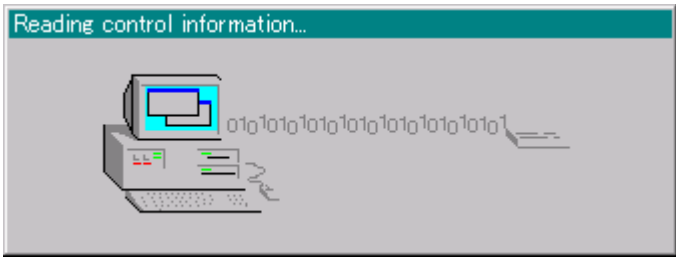


Figure 3-3. Reading Control Information

Once all control program registers have been read, the text “Dflt Control ID” will appear within the Servlink program window and the network definition file can be saved for future retrieval by the Watch Window program. If the network definition file is not saved it will have to be re-created before computer-to-control communications can be established again.

Start Watch Window Software

At this point, start the Watch Window software program by clicking on Start > Programs > Woodward > Watch Window Standard.exe.

The Watch Window Menu bar, Explorer and Inspector will appear as shown in Figure 3-4. Click on the icon (Quick Inspector) on the tool bar. Multiple sheets will automatically be created from each Service and Configure Header programmed into the control. Optionally, other inspectors can be created to allow viewing of more than one sheet at a time.

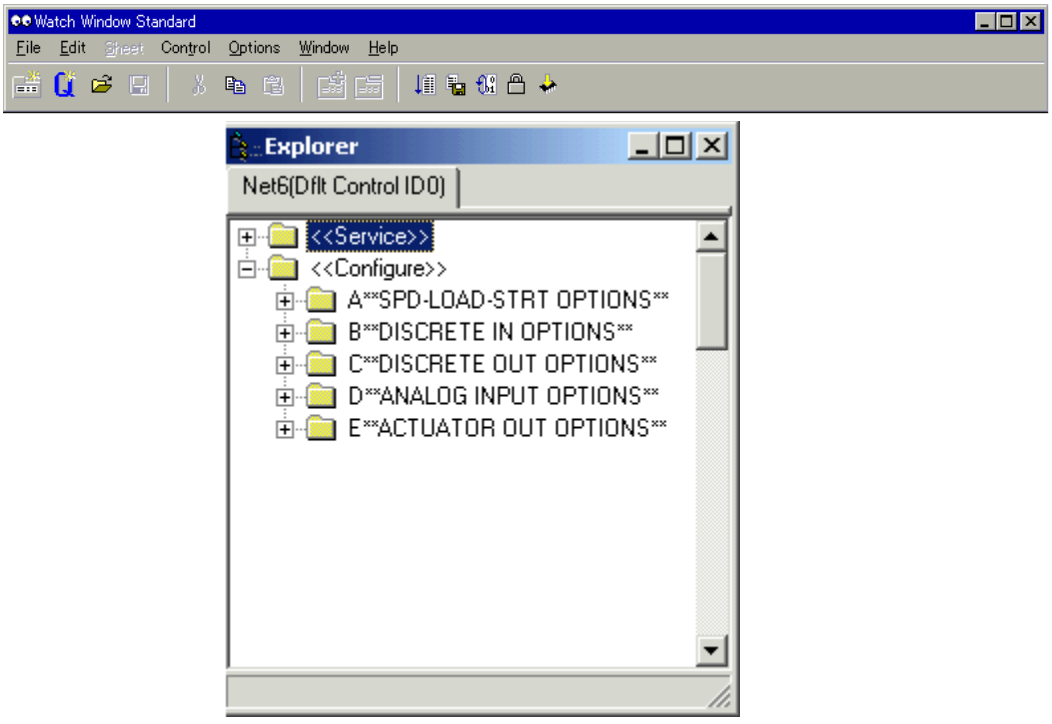


Figure 3-4. Watch Window Menu and Explore (Configure)

Downloading an application program to the 2300

1. Make sure that all other programs that may access your computer's communication port are shut down.

2. Use a null modem cable to talk from your PC to the control.

3. Cycle power to the 2300 control. During the boot-up of the control, start the Servlink server and open a new file. From the dialog window, select the proper COM port for your PC, select POINT TO POINT communications mode, and set the baud rate to 38400.

4. Select OK. Keep selecting retry until you communicate with the control. During this time, the control's red status LED (located between terminals 27 and 28) should be on. This takes approximately 20 seconds. You now have a network definition file whose default name is <Unidentified>.

5. Start the Watch Window Professional program. Under the Main Header bar you will find an icon labeled "Load Application". Left click this icon to load a new application program. You will have to close the Inspector window and a window will pop-up where you will enter the name of the file you want to download. The new file name should have a .scp file extension.

6. Once the filename is correct, click on the OPEN button. A Warning screen will ask you to make sure that you want to continue before downloading. Downloading will proceed automatically once your accept the message to shut down the engine.

⚠WARNING **Be sure the engine is shut down before downloading. An engine overspeed is possible if the engine is running during the download process.**

Chapter 4. Communications

Modbus Communication

The 2300 control can communicate with plant distributed control systems or CRT based operator control panels through one Modbus communication port. The communication port support RS-232 and RS-422 communications using RTU Modbus transmission protocols. Modbus utilizes a master/slave protocol.

This protocol determines how a communication network's master and slave devices establish and break contact, how a sender is identified, how messages are exchanged, and how errors are detected.

Modbus Communication Mode

The 2300 control supports two Modbus transmission modes. A mode defines the individual units of information within a message and the numbering system used to transmit the data. Only one mode per Modbus network is allowed. The supported RTU (Remote Terminal Unit). These modes are defined in the following table.

Characteristic	RTU
Coding System	8-bit binary
Start Bits	1
Data Bits per Character	8
Parity	none
Stop Bits	1
Baud Rate	110,300, 600, 1200, 1800, 2400, 4800, 9600, 19200, or 38400
Error Checking	CRC (Cyclical Redundancy Check)

Table 4-1. Modbus Modes

In the RTU mode, data is sent in 8-bit binary characters and transmitted in a continuous stream.

The Modbus protocol allows one master and up to 247 slaves on a common network. Each slave is assigned a fixed, unique device address in the range of 1 to 247. With the Modbus protocol, only the network master can initiate a transaction. A transaction consists of a request from the master to a slave unit and the slave's response. The protocol and Modbus device number are set in the Program Mode and can be adjusted in the Service Mode, if required.

The 2300 control is programmed to function as a slave unit only. As a slave unit, the 2300 will only respond to a transaction request by a master device. The 2300 can directly communicate with a DCS or other Modbus supporting device on a single communications link, or through a multi-dropped network. If multi-dropping is used, up to 246 devices (2300s or other customer devices) can be connected to one Master device on a single network. The control address is programmed under the 2300's communications block

Each message to or from a master has a defined structure called the message "frame". A frame consists of the slave device address, a code defining the requested data and error checking information (see Table 4-2).

	Beginning of Frame	SLAVE Address	Function Code	DATA	Error Check Code	End of Frame
RTU	3-Char Dead Time	1 Char 8 bits	1 Char 8 bits	8 bits Data per Char	1 Char 8 bits	3-Char Dead Time

Table 4-2. Modbus Frame Definition

The Modbus function code tells the addressed slaves what function to perform. Table 4-3 lists the function codes supported by this control.

Modbus Function Codes

Code	Definition	Reference Address
01	Read Digital Outputs *(Raise/Lower and Enable/Disable Commands)*	0XXXX
02	Read Digital Inputs *(Status Indications / Alarms and Trips)*	1XXXX
03	Read Analog Outputs	4XXXX
04	Read Analog Inputs *(Speed, Setpt, etc.)*	3XXXX
05	Write Single Discrete Output *(Raise/Lower and Enable/Disable Commands)*	0XXXX
08	Loopback Diagnostic Test *(Subfunction 0 only)*	N/A
15	Write Digital Outputs	0XXXX
16	Write Analog Outputs	4XXXX

Table 4-3. Modbus Function Codes

Port Adjustments

Before the 2300 will communicate with the master device, the communication parameters must be verified. These values are set from the Service Mode.

Parameter	Port Adjustment Range
Baud Rate	110 TO 38400
Data Bits	7 or 8
Stop Bits	1, 2 or 1.5
Parity	NONE, ODD or EVEN
Receive Mode	Line or Character
Flow	OFF, XON/XOFF or CTR-RTS
Auto Echo	OFF or ON
End Line	LF, CR or CRLF
Ignore	OFF or ON
Driver	RS232 or RS422

Table 4-4. Port Adjustments

For More Modbus Information

Detailed information on the Modbus protocol is presented in “Reference Guide PI-MBUS-300” published by AEC Corp./Modicon Inc. (formerly Gould Inc). To implement your own source code, you must register with Modicon. Registration includes purchasing document PI-MBUS-303 and signing a non-disclosure agreement. You can register to use Modbus at your nearest Modicon field office. To find the office nearest you, contact Modicon Technical Support at 1-800-468-5342.

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.

2300 Control Specifications

Woodward Part Numbers:	
2300-059	2300 certified for ordinary locations
2300-061	2300 certified for hazardous locations
8923-932	Watch Window Installation
Power Supply Rating	18–40 Vdc (SELV)
Power Consumption	less than or equal 20 W nominal
Input Supply Voltage	Input Supply Current
18 V	589 mA
24 V (nominal)	431 mA
32 V	319.6 mA
Inrush Current	7 A for 0.1 ms (low-voltage model)
Inrush Current	22 A for 15 ms (high-voltage model)
Steady State Speed Band	±0.25% of rated speed
Magnetic Pickup	100–24 950 Hz (900–20000 rpm)
Discrete Inputs (8)	3 mA at 24 Vdc, impedance approximately 5.2 kΩ
Analog Input #1, #2	4–20 mA
SPM-A Input	±2.5 Vdc, externally powered
Analog Output #1	4–20 or 20–200 mA to actuator, software configurable
Analog Output #2	4–20 mA to monitor, internally powered
Discrete Outputs (4)	configured to provide various level switches or conditions, power by external +12 Vdc or +24 Vdc source, max output current 200 mA
Discrete Output Ratings	Low-side drivers with overvoltage protection, 200 mA maximum
Communication Port (J2)	RS-232, RS-422, 9-pin connector, 1200 to 38 400 baud, full duplex
Ambient Operating Temperature	–40 to +70 °C (–40 to +158 °F)
Storage Temperature	–40 to +105 °C (–40 to +221 °F)
Humidity	95% at +20 to +55 °C (+68 to +131 °F)
	Lloyd's Register of Shipping Test Specification No. 1, 1996, Humidity Test 1
Mechanical Vibration	Lloyd's Register of Shipping Test Specification No. 1, 1996, Vibration Test 2 (5-25 Hz, ± 1.6 mm; 25-100 Hz, 4.0g)
Mechanical Shock	US MIL-STD 810C, Method 516.2, Procedure I (basic design test), Procedure II (transit drop test, packaged), Procedure V (bench handling)
Equipment Classification	1 (grounded equipment)

Revision History

Changes in Revision C—

- Updated Compliance information (EMC & Low Voltage Directives)
- Added new DOC

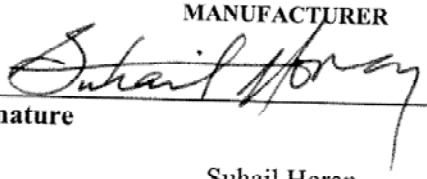
Declarations

DECLARATION OF CONFORMITY

DoC No.:	00138-04-CE-02-02.DOCX
Manufacturer's Name:	WOODWARD INC
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	2300
Conformance to Directive(s):	2004/108/EC COUNCIL DIRECTIVE of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and all applicable amendments.
The object of the declaration described above is in conformity with the following Directives of the European Parliament and of the Council:	2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.
Applicable Standards:	EN61000-6-4, 2007: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN50178, 1997: Electronic Equipment for Use in Power Installations

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER



Signature

Suhail Horan

Full Name

Quality Manager

Position

Woodward, Fort Collins, CO, USA

Place

5/29/2012

Date

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26232C.

B26232:C

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1000 East Drake Road, Fort Collins CO 80525, USA
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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.

2013/2/Colorado