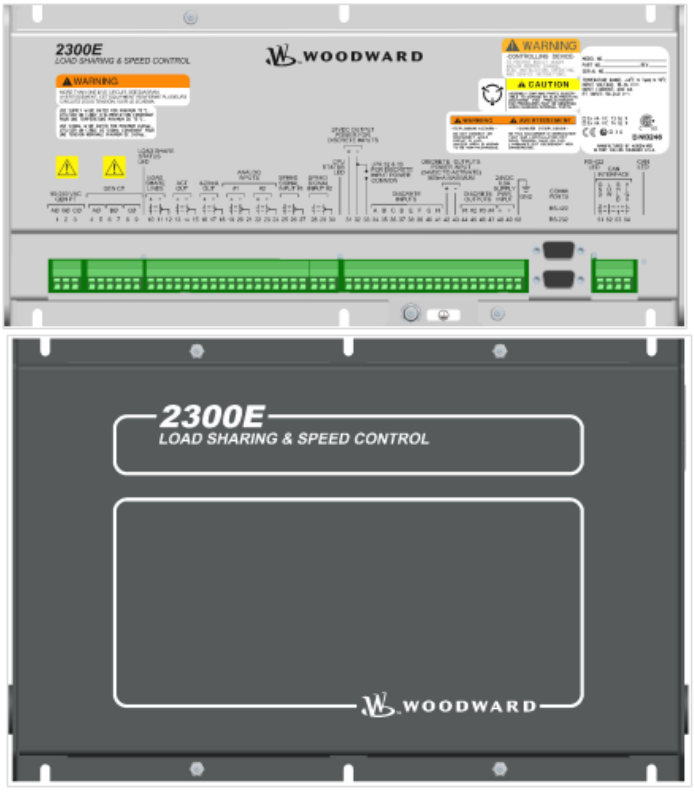
WOODWARD

Product Manual 26691
(Revision E, 7/2016)
Original Instructions



2300E Digital Load Sharing and Speed Control for Engines

8273-1017 / Ordinary Locations
8273-1018 / Hazardous Locations

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 *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 Out-of-date translations are marked with ⚠.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.

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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.

Low Voltage Directive:	Directive 2014/35/EU on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
ATEX – Potentially Explosive Atmospheres Directive:	Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Zone 2, Category 3, Group II G, Ex nA IIC T3 Gc X Zone 2, Category 3, Group II G, Ex nA IIC T4 Gc X
EMC Directive:	Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC)

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, T3 or 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.

T3 when the Potential Transformer input is 240 Vac
T4 when the Potential Transformer input is 120 Vac or less

Marine Compliance

American Bureau of Shipping:	ABS Rules 2012 SVR 1-1-4/7.7, 1-1-A3, 4-2-1/7.3, 7.5.1; 4-9-3/17, 4-9-4/23 & 4-9-7/Table 9 (as appropriate)
Bureau Veritas:	BV Rules for the Classification of Steel Ships, Approval valid for ships intended to be granted with the following additional class notations: AUT-UMS, AUT-CCS, AUT-PORT and AUT-IMS.
China Classification Society:	CCS Chapter 2, Part Seven of CCS ~ “Rules for Classification of Sea-going Steel Ships~” 2012
Det Norske Veritas:	Standard for Certification No. 2.4, 2006: Temperature Class B, Humidity Class B, Vibration Class A, EMC Class A, Enclosure B.

Lloyd's Register of Shipping: LR Type Approval Test Specification No. 1, 2002 for Shipping: Environmental Categories ENV1, ENV2 and ENV3

Nippon Kaiji Kyokai: Requirements specified in Chapter 1, Part 7 of Guidance for the approval and Type Approval of materials and equipment for Marine use and relevant Society's Rules.

Other International Compliance

Australia & New Zealand: Compliance is limited to application for those units bearing the Regulatory Compliance Mark (RCM) or used in applications where only EMC is applicable, such as "Fixed Installations" where the RCM & a DoC are not required.

EMC: The Electromagnetic Compatibility (EMC) portion of RCM Declaration for the Australian Radio Communications Act (with applicable amendments) is a separate document only created for marked products. The products with RCM on the label have a DoC available, but all products comply with CISPR11 Group 1 Class A emissions per EN/IEC 61000-6-4 via Electromagnetic Interference (EMI) testing. This product is part of "Fixed Installations".

Special Conditions for Safe Use:

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.

Use supply wire rated for minimum 75 °C

Use signal wire rated for a minimum of 240 Vac.

Per EN 60079-15:2010: Device meets ATEX Zone 2 requirements when installed in an ATEX compliant IP54 or better enclosure.

T3 when the Potential Transformer input is 240 Vac.
T4 when the Potential Transformer input is 120 Vac or less.

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.

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 2300E 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 2300E has no application software in it when shipped from Woodward, which allows it to be configured and modified to meet site-specific requirements. It utilizes the Woodward GAP 3.X software to create an application specific application software that can be downloaded to the 2300E.

The 2300E has the following Woodward part numbers:

8273-1017	2300E Load Sharing and Speed Control, 24 Vdc input, Ordinary Locations
8273-1018	2300E Load Sharing and Speed Control, 24 Vdc input, Hazardous Locations

The control is housed in a sheet-metal chassis and consists of a single printed circuit board. The 2300E is set up and configured through an external computer connected at the 9-pin connector (RS-232 Port) at the front of the control. The configuration software, Control Assistant, can be downloaded from our website at www.woodward.com.

The 2300E has two serial communication ports, allowing it to easily interface with a Human Machine Interface (HMI), PLC, or plant DCS. These configuration and dynamic settings are set, changed, tuned, and saved via a laptop computer and Woodward's user-friendly Control Assistant software program. This program allows users to set and adjust all application-based parameters, plus upload and download configurations to and from the control. Woodward's Toolkit software is also capable of communicating to the 2300E

The 2300E Control Hardware includes:

- 1 Load Sensor
- 1 Actuator Driver
- 2 MPU Speed Sensors
- 1 Analog Output
- 2 Analog Inputs
- 8 Discrete (Switch) Inputs
- 4 Discrete (Relay Driver) Outputs
- 2 Serial Ports
- 1 CAN Port

The following is an example of the typical hardware needed for a 2300E system controlling a single prime mover and generator:

- A 2300E electronic control
- An external 18 to 36 Vdc power source
- Two speed-sensing devices, typically magnetic pickups (MPUs)
- A proportional actuator to position the fuel-metering device
- Current and potential transformers for measuring the load carried by the generator

The frequency from the magnetic pickup must be within the range of 100 to 25 000 Hz at rated speed. The 2300E speed range needs to be configured using an external computer during installation.

References

The following publications contain additional product or installation information on Load Sharing and Speed Controls, and related components. They can be ordered from any Woodward office.

Manual	**Title**
25070	Electric Governor Installation Guide
25195	Governing Fundamentals
82510	Magnetic Pickups and Proximity Switches for Electric Governors
82715	Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules

Product Spec	**Title**
03405	2300E Digital Load Sharing and Speed Control Hardware
82516	EG-3P/3PC Actuator
82575	EGB-1P/2P Governor/Actuator

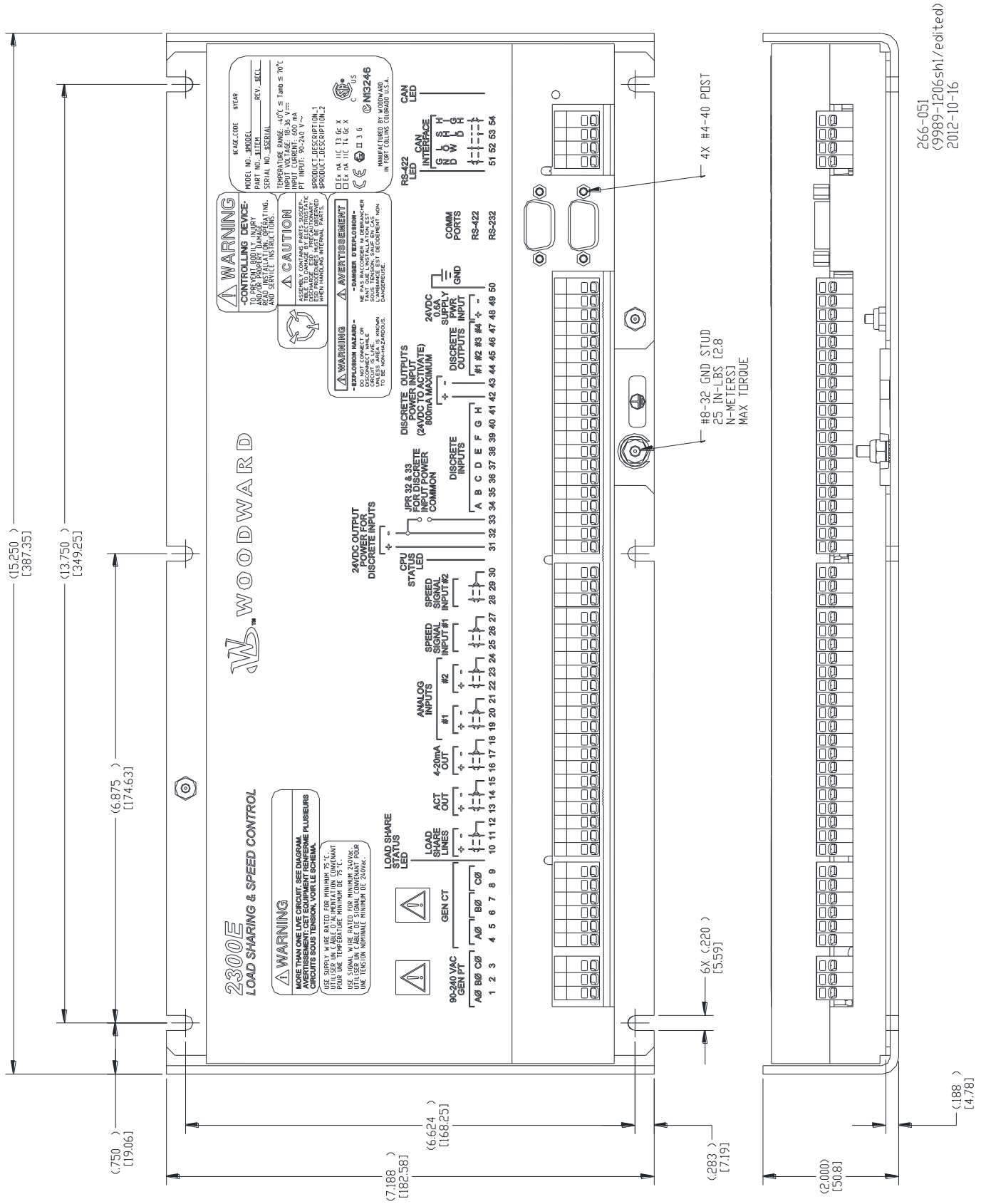

Figure 1-1a. 2300E Outline Drawing (Ordinary Locations)

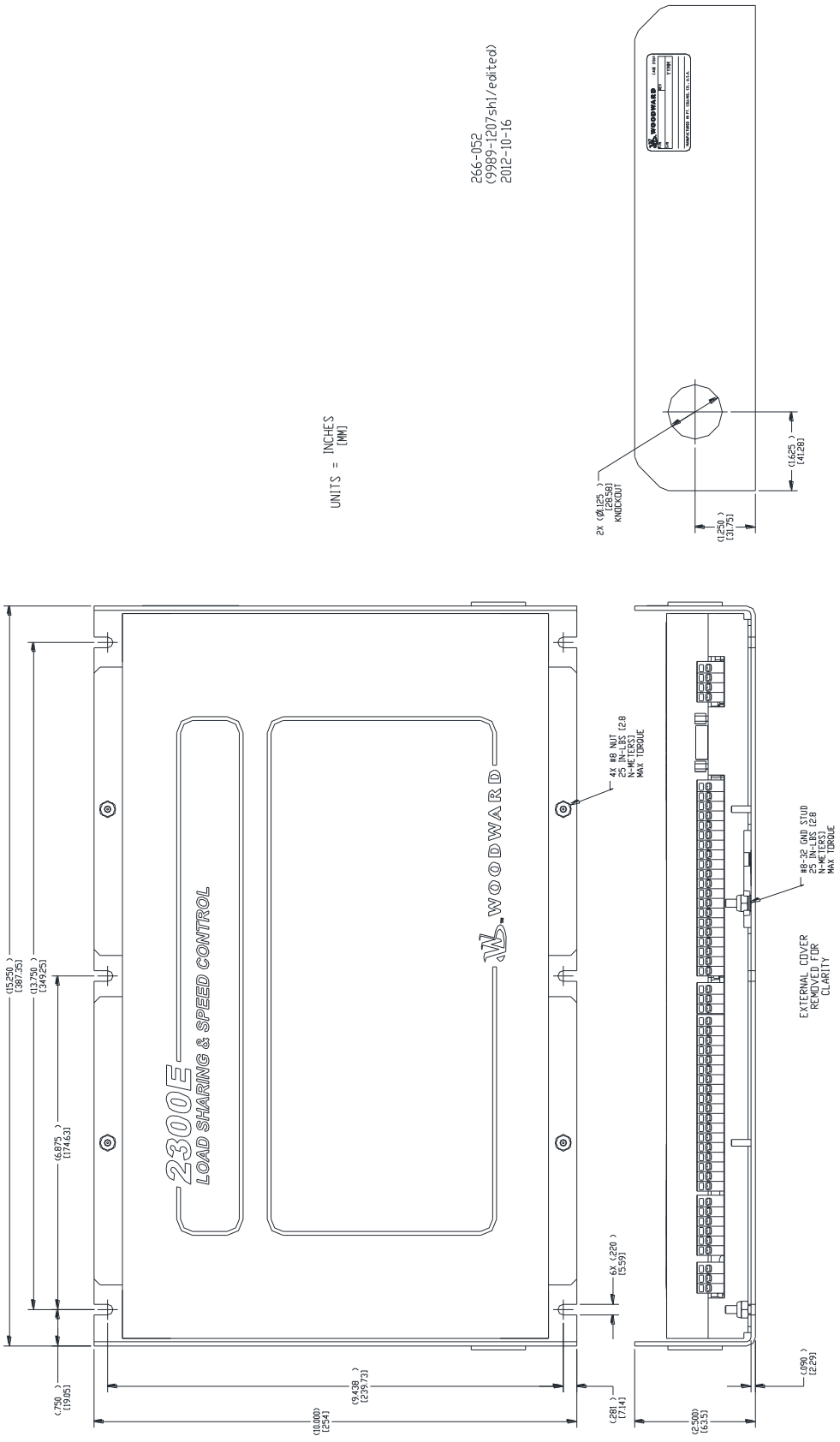

Figure 1-1b. 2300E Outline Drawing (Hazardous Locations)

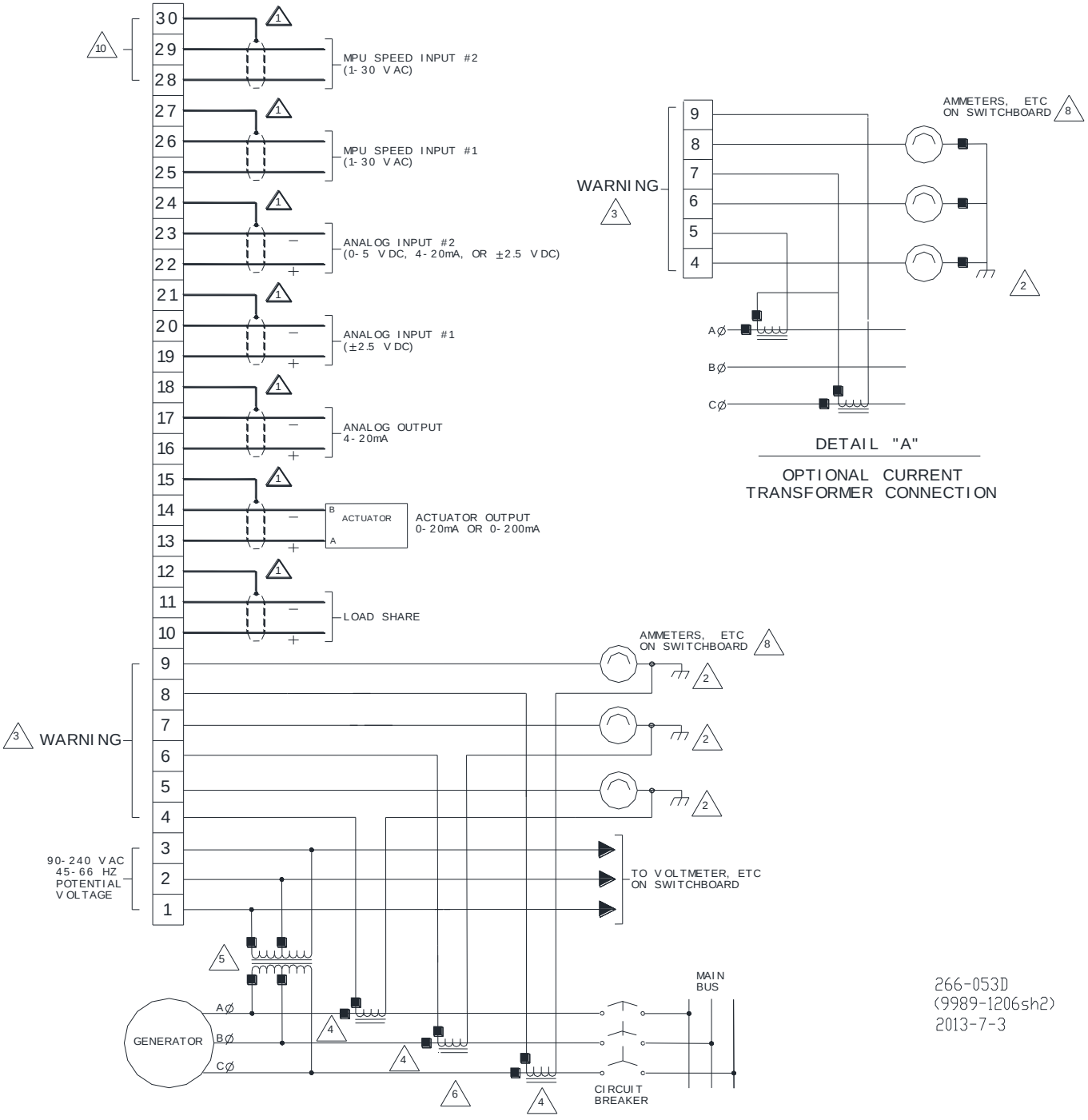

Figure 1-2a. 2300E Control Wiring Diagram (sheet 1)

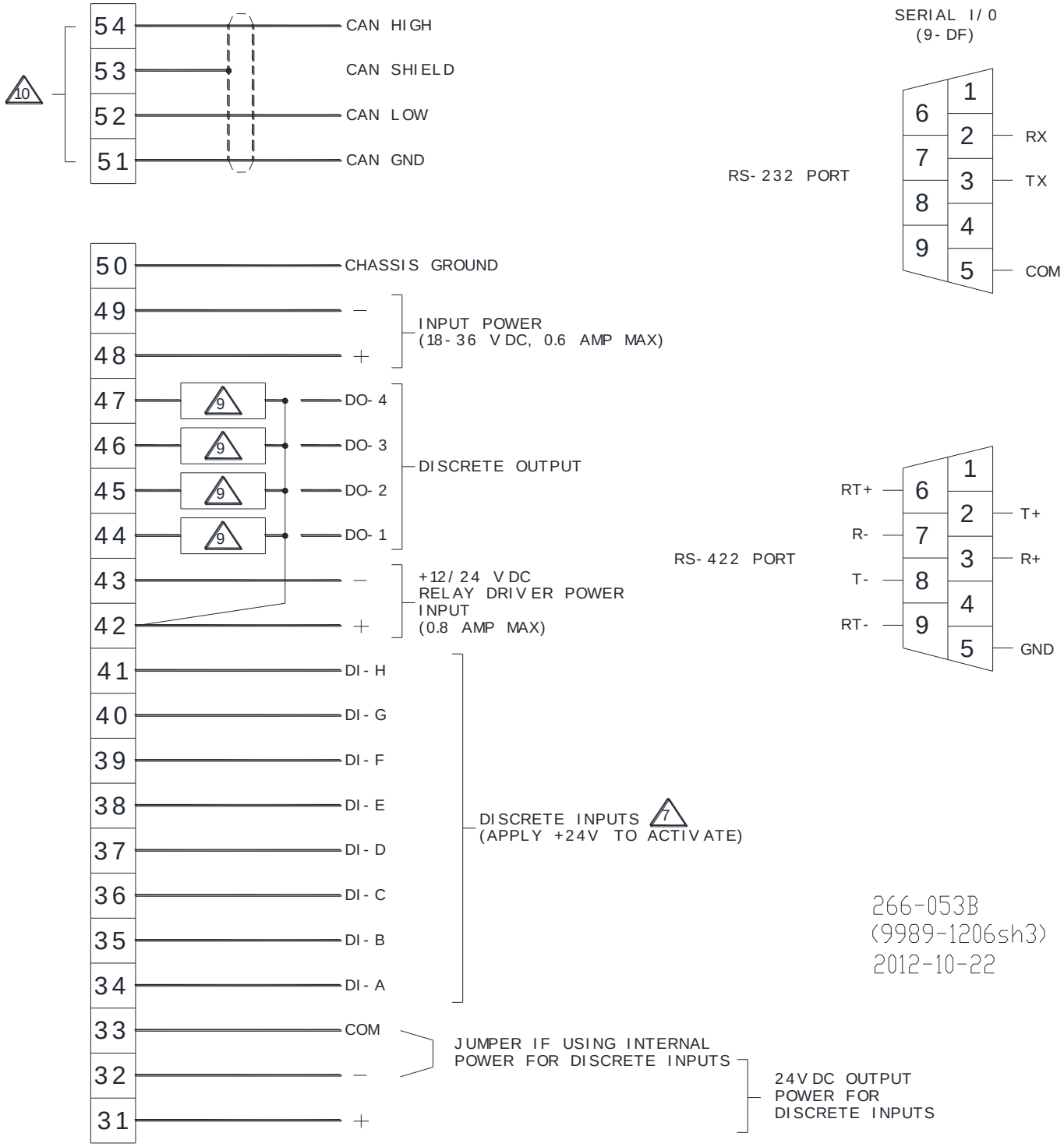

Figure 1-2b. 2300E Control Wiring Diagram (sheet 2)

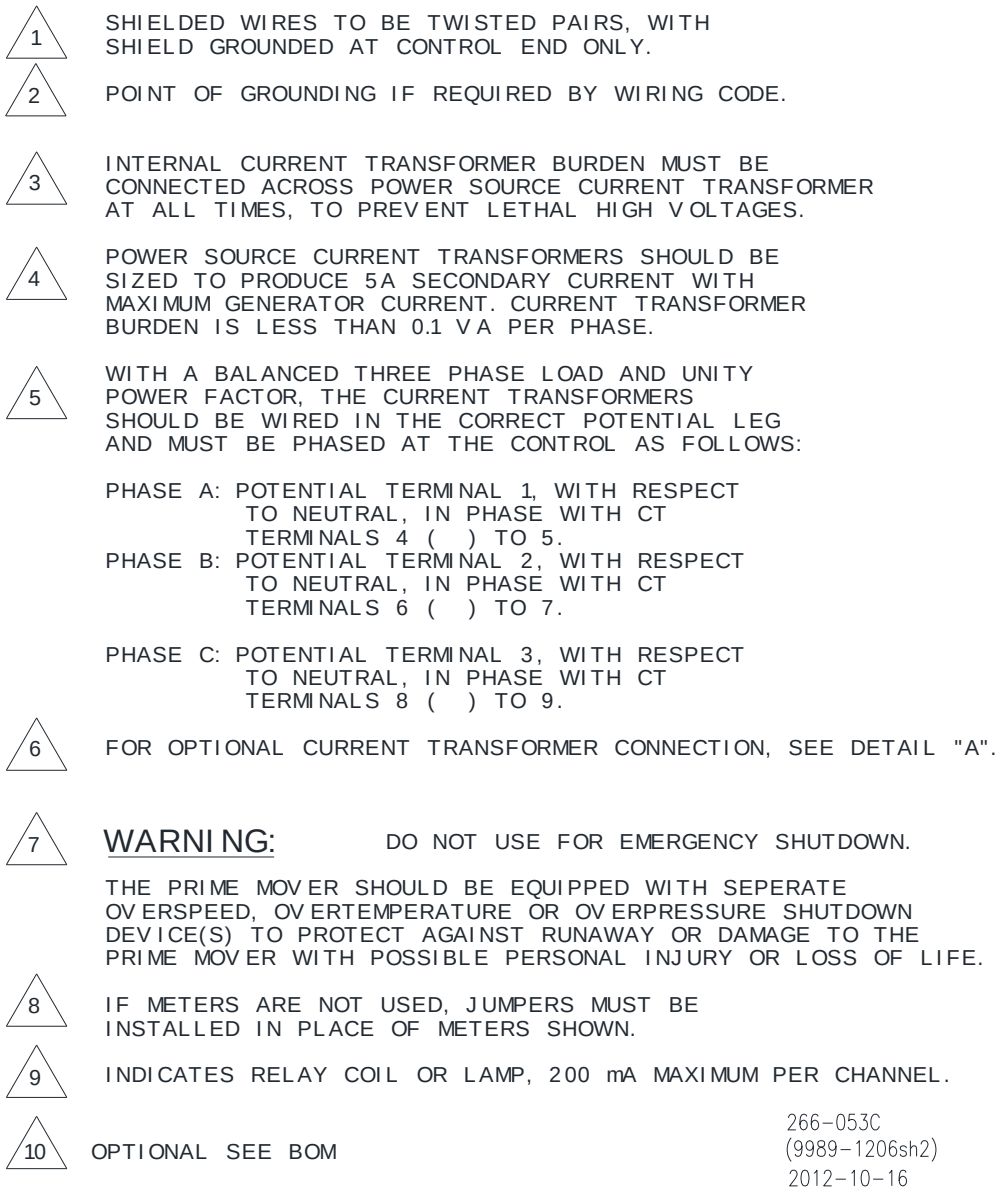

Figure 1-2c. 2300E Control Wiring Diagram (notes)

Chapter 2. Installation

Introduction

This chapter contains general installation instructions for the 2300E 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.

⚠WARNING

Due to typical noise levels in engine and turbine environments, hearing protection should be worn when working on or around the 2300E.

⚠WARNING

The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

⚠WARNING

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

Unpacking

Before handling the control, read all of this chapter and “Electrostatic Discharge Awareness” at the beginning of this manual. 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. Do not take the control out of the ESD bag it ships in until ESD precautions are in place. Keep yourself discharged while handing the unit outside the ESD bag, at least until it is grounded.

Power Requirements

The 2300E control requires a voltage source of 18 to 36 Vdc, with a current capacity of at least 600 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. The battery charging device should be suppressed from load dump events or the power bus must have central suppression. The 2300E does not have sufficient capability to withstand all battery load dump events.

NOTICE

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

Location Considerations

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 (segregate the unit and wiring by at least 15 cm (6 inches).
- Avoidance of vibration
- Selection of a location that will provide an operating ambient air temperature range of –40 to +70 °C (–40 to +158 °F) at the control
- The control must NOT be mounted on the engine.

Electrical Connections

All inputs and outputs are made through screwless spring-actuated terminal blocks. Use ESD precautions noted above when installing the wiring to prevent damage due to ESD.

The spring clamp can be actuated by 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 18 AWG or three 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

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.

⚠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 (Figures 1-2a/b/c).

Cabling and installation wiring can affect the Electromagnetic Compatibility (EMC) of the device, its ability to operate in an environment without being interfered with, or interfering with other devices. Often other controls are installed in the same enclosure, too. To address EMC concerns, it is recommended that all low-current wires be separated from all high-current wire and similarly for high-voltage and low-voltage wiring. For example, relay contact wiring and electric motor drive or ignition system wiring should be at least 30 cm (12 inches) from any 2300E wiring. And for example, analog inputs/output wiring should be separated from power wiring by at least 15 cm (6 inches).

Shields and Grounding

An individual shield termination is provided at the terminal block for each of the signals requiring shielding. All of the inputs having a shield pin should be wired using shielded, twisted-pair wiring. The optimum exposed wire length beyond the shield should be limited to 25 mm (1 inch); however, up to 75 mm (3 inches) may be used.

Relay outputs, contact inputs, and power supply wiring do not normally require shielding, but can be shielded if desired. Shields should terminate to chassis and may be direct or share a shield pin except the AI or CAN shields.

The 2300E 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 with a capacitor. All other shield terminations except at the control (in the field) should be ac coupled to earth through a capacitor. A 1000 pF, 500 V capacitor is typically sufficient, however 1–10 nF, 500–1500 V may be used or needed, and 1000 pF (1 nF) 1000 V is recommended. 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 (2300E and load) if the cable length is sufficiently short (i.e., within a cabinet, less than about 10 m straight line between the ground points) to prevent ground loop current in the shield.

IMPORTANT

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

Installation concerns associated with wiring in systems with other devices are addressed in the electrical connections section.

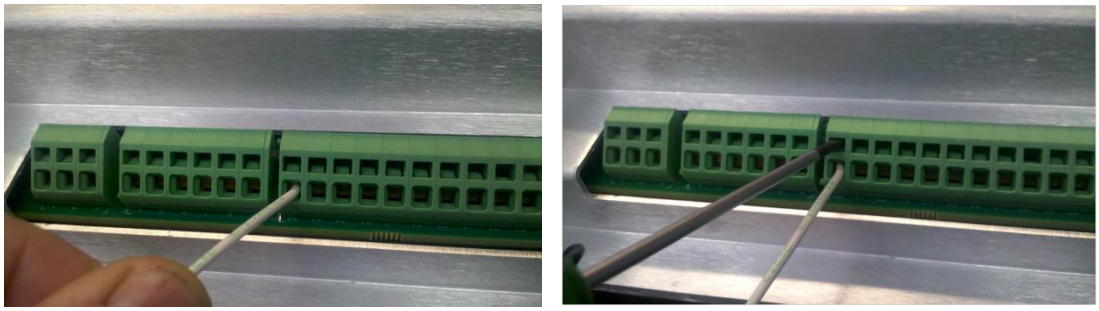

Figure 2-1. Installation of Wiring into Terminal

LED System Status Indicators

The LED located between terminals 30 and 31 is a two colored LED. The following provides the functions of the LED status:

- LED Off = Power Off
- LED Green = System On
- LED Solid Red = I/O Lock
- LED Flashing Red = Fault (This indicates a major problem and should be returned to Woodward for service).

Potential Transformer Connections (Terminals 1–3)

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

The potential transformer secondary line-to-line voltage must produce 90 to 120 Vac or 200 to 240 Vac. The PT and CT input connections are not needed if using a DSLC for load sharing or load control. Refer to the plant wiring diagram, Figure 1-2.

Current Transformer Connections (Terminals 4–9)

The standard method of connecting the current transformers is shown in the plant wiring diagram, Figure 1-2. An alternate method is the open delta connection shown in the insert in the plant wiring diagram.

Real Power Load Calculation

The control uses the equation Power = $\sqrt{3}$ * V * I * P.F. where V = Voltage, I = current, and P.F. = Power Factor. In the 2300E, the PT Voltage part of the equation is deemed to be constant. Therefore if the Voltage on the system changes, the calculated Power will change a small amount.

Load Share Lines (Terminals 10–12)

The Load Share Lines provide an analog communication path between compatible controls. The 2300E provides an internal relay for connecting the Load Share 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.

IMPORTANT

Do not touch Load Share pins without discharging ESD to physical earth first and making sure the control's PE terminal is connected to physical earth before wiring.

The load share signals have 4 kV ESD withstand when the control is not grounded rather than 8 kV or more on other pins. (Load Share Lines have at least 7 kV withstand when the control is grounded.)

Greater than 4 kV ESD events are uncommon in the typical installation environment, but may happen.

Use shielded cable and connect the load-sharing lines directly to terminals 10(+) and 11(–). Connect the shield to terminal 12(chassis). When all controls in the system are of the 2300E, 2301D, or 2301A types, 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 or if needed, connect only through a capacitor. The droop contact for selecting droop or isochronous operation is wired in series with the circuit-breaker auxiliary contact between terminal 37 and terminal 31 (see CB Aux/Droop contact).

When running a single unit on an infinite bus with an external load control device, terminals 37 and 40 must be connected to terminal 31 to connect the Load Matching Circuit to the load-sharing lines. The load-sharing lines must be wired to the external load control device. The circuit-breaker auxiliary contact will then be connected to this device and not to the 2300E.

Power Supply (Terminals 48–50)

Run the power leads directly from the power source to the control, connecting the negative lead to terminal 49, and the positive lead to terminal 48. Pin 50 is provided as an optional Physical Earth (PE) wire landing point in addition to the PE Ground stud, in case the particular installation requires a PE wire to be run with dc power. Either both grounds must be connected or just the PE stud connected to the cabinet/chassis, as Physical Earth though a 30 cm long by 13 mm wide (12 inches long, ½ inch wide) or shorter flat hollow braid or comparable surface area wire, the ratio of copper surface to length may be used to provide shorter smaller grounding wires.

When power is applied, the 2300E begins performing internal memory tests to 'boot-up' the processor, which takes approximately 2 seconds to complete. The CPU Status LED between terminals 30 and 31 remains on during this boot-up. The control will remain in I/O lock and will not control the prime mover until the boot-up is complete. For systems requiring fast start functions, it will be necessary to continuously power the 2300E.

⚠WARNING

DO NOT attempt to start the prime mover while the CPU Status LED is RED.

DO NOT apply power to the control at this time. Applying power before a control is completely connected may damage the control.

IMPORTANT

The 18–36 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.

Discrete Inputs (Terminals 34–41)

Discrete inputs are the switch or contact input commands to the 2300E control. They interact in such a way as to allow engine control and power management under a variety of conditions. (Note double pole configuration below for critical I/O going between points physically > 30 m in length apart.)

The following example is using the default logic for the discrete inputs. Positive Voltage is supplied to the discrete input terminal when an input switch or relay contact closes. This will cause the input state for that discrete input to be "TRUE". The input terminal will be open circuited when the input switch or relay contact opens. This will cause the input state for that discrete input to be "FALSE" . When the input switch or relay contact is closed, the voltage supplying the discrete inputs should be present from the appropriate discrete input (terminal 34, 35, 36, 37, 38, 39, 40, or 41) to terminal 33 (common). Terminal 33 is the common return path for all of the discrete input channels. A lower voltage indicates that the switch contacts have too high a resistance when closed and should be replaced. These terminals must be isolated from ground.

In systems that provide an external low voltage source to power the 2300E control, the discrete inputs may be powered by this external low voltage. The voltage source used must be capable of supplying 100 mA at a voltage level of 18 to 36 Vdc. Connect the external low voltage source negative to terminal 33(–). Connect the external low voltage source positive to the appropriate input switch or relay contact and connect the mated switch or relay contact to the corresponding discrete input terminal on the 2300E control.

In systems where the external low voltage dc power is not appropriate, the discrete inputs may be powered by the internal 24 Vdc Discrete Input Power source at terminal 31 and 32. This source is capable of supplying 100 mA at a voltage level of 24 Vdc. Connect the internal 24 Vdc voltage source positive from terminal 31 to the appropriate input switch or relay contact, and connect the mated switch or relay contact to the corresponding discrete input terminal on the 2300E control. Assure that a connection exists between terminal 32 and terminal 33 when using the internal Discrete Input Power. Do not power other devices with the internal discrete input power source, and assure that the switch or relay contacts used are isolated from any other circuit or system. The internally provided contact wetting voltage may not be used for anything other than DI Contact wetting; it is dedicated to this function.

IMPORTANT

Discrete inputs with cable lengths where the end points are physically greater than 30 meters apart and which 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 either +24 Vdc or ground, never floated or tied to reference with a resistor.

IMPORTANT

The discrete inputs are capable through software programming to change the logic or state of the input. Please verify the state of your input before starting the engine.

Actuator Output (Terminals 13–15)

The actuator wires connect to terminals 13(+) and 14(–). Use shielded wires with the shield connected to terminal 15 (chassis). Do not connect the shield to the actuator or any other point. The shield must have continuity the entire distance to the actuator, and must be insulated from all other conducting surfaces. Refer to the manuals listed in the “References” table for additional information on actuator installation.

The current range to the actuator output is configured in software for a 0–200 mA, 4-20 mA, 0–20 mA.

Analog Inputs (Terminals 19–24)

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.

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)

Speed Sensor (Terminals 25-30)

To sense speed, the control accepts signals 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) or 28, 29, and 30 (shield). Verify that the input's shield wire has continuity its entire distance to the input sensor and is insulated from all other conducting surfaces.

This input is limited to a frequency range of 100–24 950 Hz and a voltage range of 1.7–35 Vac. (The MPU voltage at the 2301E must be above 2.7 Vac in case of a signal above 13 000 Hz.)

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 42, 43, & 44–48)

The 2300E contains four discrete output driver channels. The discrete outputs are low-side drivers with a maximum output current of 200 mA. The discrete output drivers are not isolated from each other, and are powered by an external +12 Vdc or +24 Vdc source connected at terminals 42(+) and 43(–). The Relay Driver Output pins are: #1(44), #2(43), #3(46), and #4(47). The relay driver section is isolated from the internal power supplies of the 2300E control, but all drivers share a single common.

- Relay drivers can be used as a PWM actuator drivers or a relay drivers.
- When configured as a PWM, power wiring configuration is dictated.

Power wiring for using the PWM output function is required to be local and dedicated, only located on the engine skid or relatively close to the control and PWM load. The power connected to control 48(+) and 49(–) terminals must also be used for the relay driver external Vdc source connected at terminals 42(+) and 43(–). In addition, the PWM load device power must also be from the same source as the power connected to control terminals 48(+) and 49(–-).

IMPORTANT

The PWM functionality is limited to use on skid applications. When PWM drivers are used, the 2300E must be located on the same power bus as the driven circuitry. The 2300E and the device being driven need to be co-located on the same engine. In addition, the Power bus input for the 2300E must be used to power the DO signals.

4–20 mA Output (Terminals 16–17)

Connect readout wiring to terminals 16(+), 17(–), and 18(shield) to use the control's 4–20 mA Analog Output. Note that these terminals must be isolated from ground.

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 Ports

The control's two serial communication ports are used to configure and service the unit. These ports are on a common return and are isolated ports.

The RS-232 serial communication service port communicates using either the 2300E Toolkit Service Tool or the Control Assistant software. Refer to Figure 2-2 for plant wiring information.

The RS-422 serial communication port communicates using a Modbus RTU protocol, functioning as a Modbus Slave device, via a RS-422 driver. The 2300E can be fully operated and many values monitored via Modbus communications. Alternatively Modbus communications can be used to interface with a PLC or plant DCS. Refer to Figure 2-3 for plant wiring information.

IMPORTANT

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

RS-232

See Figure 2-2 for cable connection.

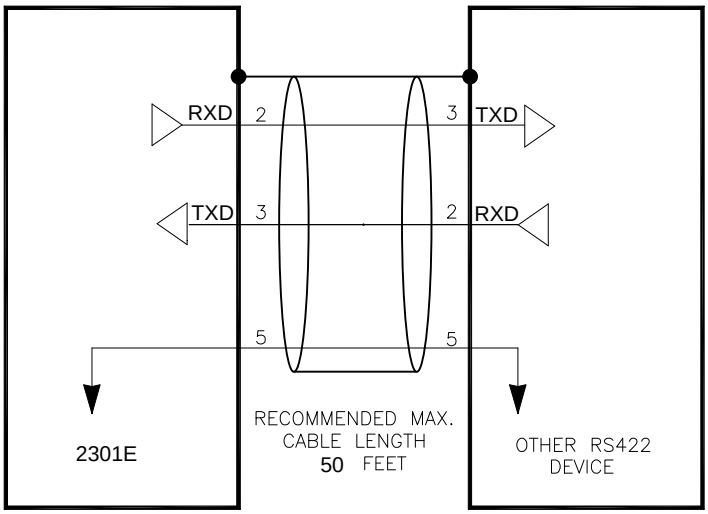

Figure 2-2. RS-232 Pin assignments for Serial Communication Cable

RS-422

See Figure 2-3 for termination and cable connection example.

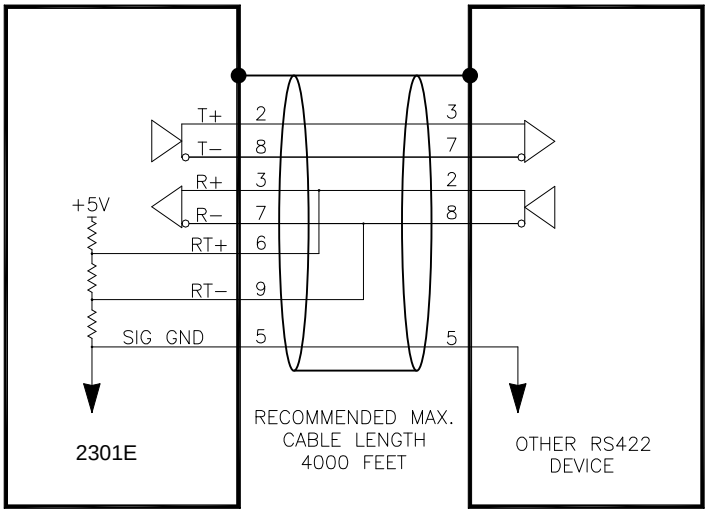

Figure 2-3. Typical RS-422 Communications Connections

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 2-4 is an example.

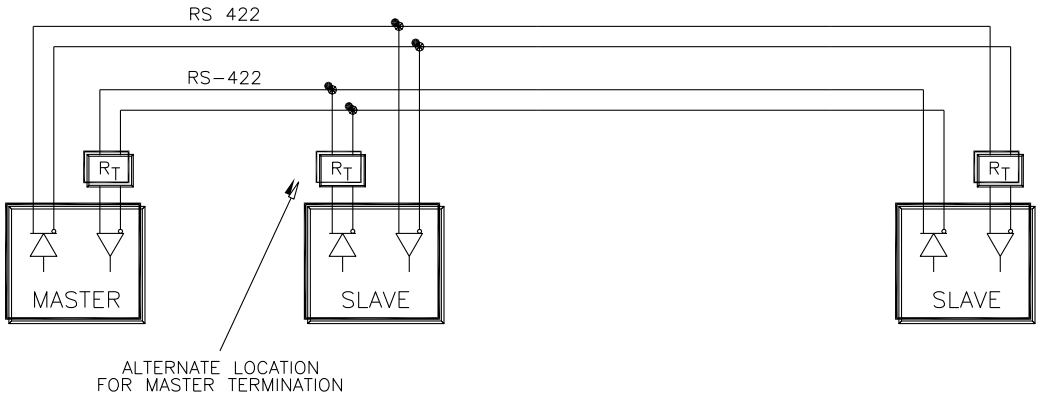

Figure 2-4. RS-422 Terminator Locations

Grounding and Shielding

The RS-422 specifications state that a common/RS-422 ground wire is needed if there is no other ground path between units. The RS-422 on the 2300E is isolated, so there is no other path for common other than wiring to the pin.

The preferred method for common wiring is to include a separate wire in the cable that connects the circuit grounds at each port together with a dedicated wire inside the cable shield.

If the total cabling is > 30 m (typical), the preferred shield connection is to connect the shield to earth ground (chassis) at one point (most critical port), using a capacitor to terminate the shield at the remaining ports. If the total cabling is < 30 m, connect the shield directly to the earth ground at each port.

The alternate, less robust, way to connect shield and common is to connect all circuit grounds/commons at each port to the shield instead of a separate wire, and then connect the shield to earth ground at one point (most critical port), using a capacitor to terminate the shield at the remaining ports.

If there are non-isolated nodes on the party line, connect the shield to earth ground at a non-isolated node, not at an isolated node. Figures 2-5 and 2-6 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 2-6 with the signal ground connection removed on those nodes only.

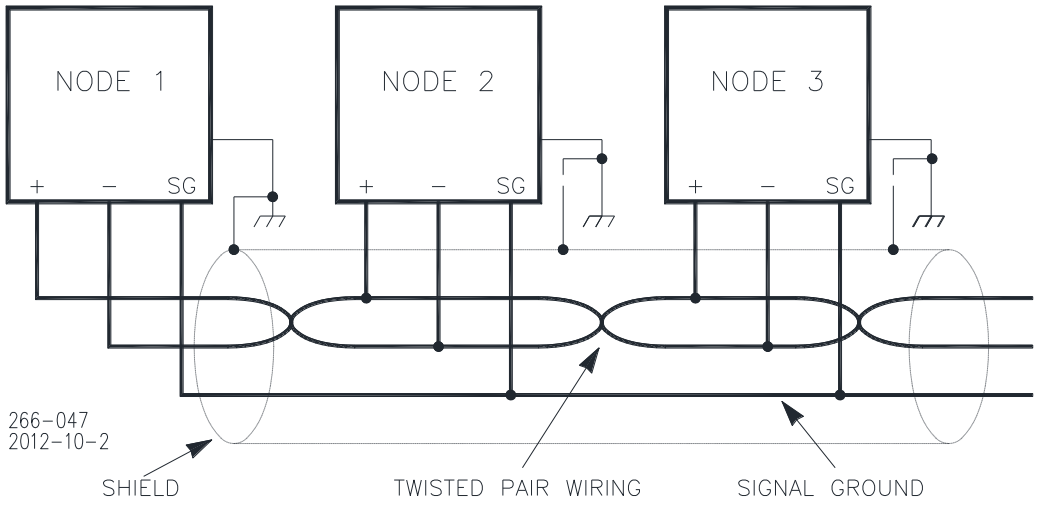

Figure 2-5. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

IMPORTANT

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

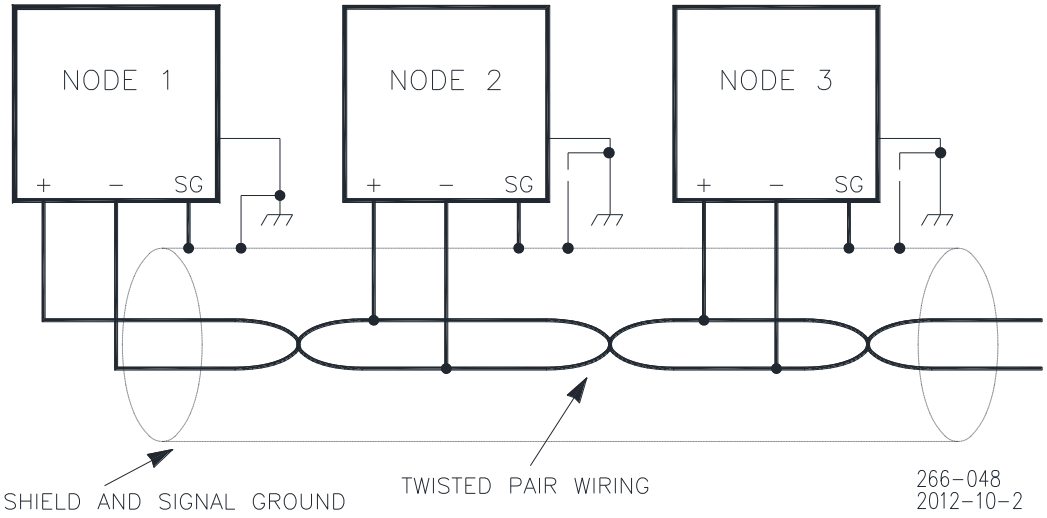

Figure 2-6. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

CAN Communication Port (Terminals 51–54)

There is one CAN port for distributed I/O, distributed control, and Human Machine Interface (HMI) purposes. The CAN cabling is wired to Common terminal (51), CAN_LO terminal (52), Shield Terminal (53), & CAN_HI terminal (54). Communications is controlled via GAP rate groups and is deterministic. Care should be given to the choice of devices used on each network. HMI devices should generally not be put on distributed control networks with real time control requirements.

The CAN Port is electrically isolated from all other circuits in the 2300E, requiring a common to be wired between this port and other ports on the CAN network. CAN common needs to be sent with the signal wires, but can be separately shielded. Isolation used on this port is SELV rated with respect to product safety requirements.

The CAN shield pin is AC coupled to chassis at the 2301E control. The shield must be directly connected to protective earth ground at one and only one point in the CAN network.

The CAN Port supports SAE J1939 and CiA CANopen network protocols.

Transceiver type CAN 2.0B
Isolation voltage 500 Vdc SELV rated (port #1)
500 Vdc hazardous live rated (ports #2 and #3)
Baud rates supported 125, 250, 500, and 1000 kbps
Protocols supported CANopen, SAE J1939

Table 2-1. CAN Specification

Recommended Bulk Cable

Use shielded CAN compatible cabling for all CAN networks. “DeviceNet” cable is a good example of CAN cable for use with isolated CAN ports, but caution should be used as most DeviceNet cables are not rated for on-engine temperatures. It is typically suitable for wiring between switchgear cabinets and an engine junction box where the temperatures are lower. Also, both the “thick” and “thin” DeviceNet cables have wire insulation and wire size that is not compatible with the 2300E connectors.

When using DeviceNet cables outside a vibration damped enclosure, use the “Thick” or “Trunk” cable. The “Thin” or “Drop” cables have very small wire sizes that fatigue easily. Below are two DeviceNet CAN cables that are compatible with isolated CAN use off engine.

Part Number	Description
Belden 7896A	PVC, 18 AWG shielded data pair, 16 AWG shielded power pair. NEC/UL TC-ER, CSA I/II, A/B.
Lapp Cable 2710-250	Halogen free, 18 AWG shielded data pair, 15 AWG shielded power pair. UL and CSA approved

Below are CAN cables that are compatible with isolated CAN use rated at high temp.

Part Number	Description
BELDEN YR58684	WWD p/n 2008-1512, Teflon, 22 AWG, 1.5 pair shielded, UL CL3, FT1 Flame, 120 Ohm characteristic impedance, 11 pF/ft, ,

“J1939” cable is a good example of CAN cable for use with un-isolated CAN ports and for on-engine use. This cable does not include the extra wire used to carry the common reference Raychem makes a compatible cable as do many other manufacturers.

Part Number	Description
Raychem 2019D0301	Cheminax, J1939-11, 0.75 mm², 120 Ω characteristic impedance, 10.5 pF/ft, 74% velocity of propagation

The basic cable requirements are listed below. When selecting other cables, be sure they meet these requirements.

Data pair impedance	120 Ω ±10% at 1 MHz
Cable capacitance	12 pF/ft at 1kHz (nominal)
Capacitive unbalance	1200 pF/1000 ft at 1 kHz (nominal)
Propagation delay	1.36 ns/ft (maximum)
DC Resistance	6.9Ω / 1000 ft @ 20°C (maximum)
Data Pair	0.75 mm^2 – 1.0 mm² corresponds to 20 – 18 AWG, individually tinned, 3 twists/foot
Power Pair (DeviceNet only)	0.75 mm^2 – 1.5 mm² corresponds to 20 – 16 AWG, individually tinned, 3 twists/foot
Drain / Shield Wire	0.75 mm^2 – 1.0 mm² Tinned Copper drain wire inside a braid or foil shield
Signal attenuation	0.13 dB/100 ft @ 125 kHz (maximum)
	0.25 dB/100 ft @ 500 kHz (maximum)
	0.40 dB/100 ft @ 1000 kHz (maximum)

Table 2-2. Cable Specification

Figure 2-7 illustrates what the DeviceNet cables will look like including shielding. There is a foil tape around each conductor pair as well as a braided shield around the entire group of conductors. J1939 cables will not include the DC power pair and related extra shielding.

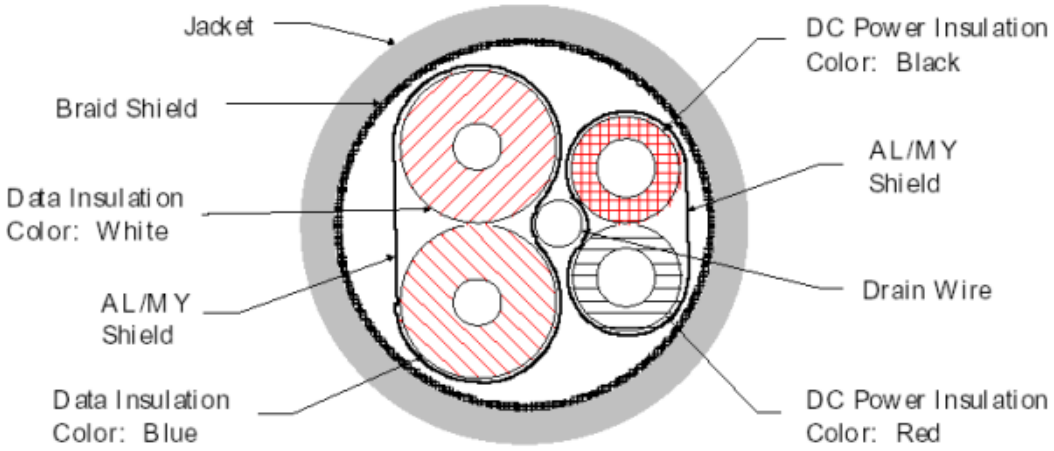

Figure 2-7. CAN Cable Cross-Section

Network Construction

There are several different ways to physically connect devices on a CAN network. Woodward recommends that multi-drop networks be constructed using either a “daisy chain” configuration (also called zero length drop line) or a “backbone” with very short drop lines for best performance. In a daisy chain configuration, wires are run from one device to the next device without drop lines.

In a backbone with stubs configuration, a main trunk line is run between the two devices that are physically farthest apart and have the physically longest cable. Stub lines are run from the intermediate devices to the trunk line. Stubs should be kept as short as possible and may never exceed 6 m (20 ft). As shown in Figure 2-8, it is acceptable to mix both methods on the same network.

A daisy chain (zero drop length) connection is not feasible at the 2300E connection due to the sealed connector design. The next best alternative is to use a very short drop line from the trunk into the 2300E. Special ‘T’ connectors (Tap in the diagram above) are available from multiple manufacturers to ease the wiring harness manufacture. Also available from the same manufacturers, are termination resistors that plug directly into the ‘T’ connectors for the network ends.

Due to the port isolation on this port, a common wire is needed between all units on the network. The preferred method for isolated ports is to include a separate wire within the CAN cable. This keeps the communications and ground reference at the same potential at all times. The DeviceNet cables listed in this manual have the common wire feature.

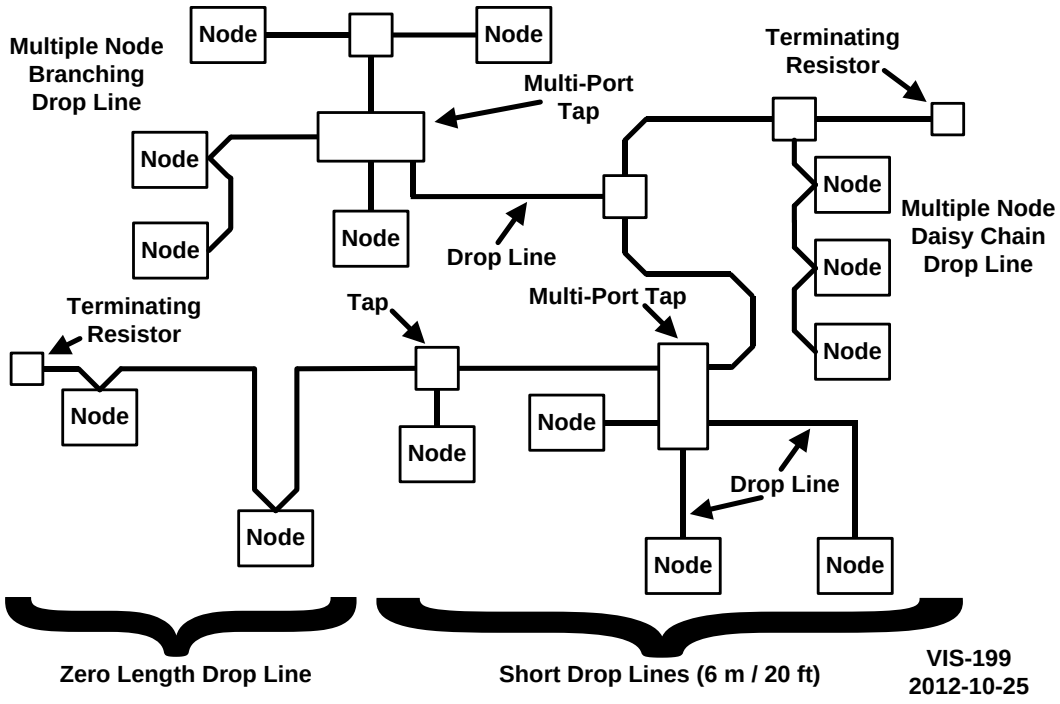

Figure 2-8. CAN System Wiring Example

Non-isolated nodes may not have a signal common available for connection. If a signal common is not available, use the alternate wiring scheme of connecting the CAN ground wire from the isolated nodes to the B- terminal at a non-isolated node. B– is typically the signal reference for CAN if isolation is not provided. The CAN common wire should not be grounded. The only exception to this rule is if one of the devices on the link is not isolated, then connecting CAN common to B– on that device may create a connection to the B- power supply ground, assuming the power supply has a connection to ground. Otherwise, no other connections to ground or physical earth should be provided.

Termination

It is necessary to terminate the network to prevent interference caused by signal reflections. Depending on network length, many CAN networks will not operate without proper termination.

In order to allow the possibility of removing and inserting a unit onto a running network, the CAN termination network is not included inside the 2300E control. An external CAN termination network must be provided.

As a rule, no matter how many units are on a network, there should never be more than two network terminations installed. Termination resistors must be installed only for the two units that are at the physical ends of the network. Terminating more than two units can overload the network and stop all communications.

Termination is a simple 121 Ohm, ¼ watt, 1% metal film resistor placed between CAN high and CAN low terminals at the two end units, a differential termination. Do not connect the termination resistor to anything besides the CAN high and CAN low wires.

Shielding

Shielded CAN cable is required between the 2300E and any other devices. Unshielded or improperly shielded cables are likely to cause communication problems and unreliable control operation. Improper shield termination to ground can also cause communication problems and unreliable control operation.

The standard for CAN networks is that each device will have an ac-coupled shield connection (ac-coupled: connected through a capacitor). Additionally a single direct network shield ground location may be provided in some situations. Typically the direct shield grounding location does not have to be at a unit connector; it can be any convenient place in the system, and is recommended to be used.

The 2300E has been constructed so that the CAN port shield connection is ac coupled to chassis ground, chassis ground must be tied directly to earth ground.

The CAN port may also have the CAN cable's shield tied directly to ground, but care must be taken in how this is accomplished. It is expected and recommended that each network have one direct connection to chassis ground. The chassis grounding point should be chosen nearest the most critical device on the network.

CAN Port Wiring

The CAN Port may be used for off-engine wiring to control rooms. It is electrically isolated from all other circuits in the 2300E. Isolation used on this port is SELV rated for product safety requirements.

Wiring length restrictions depend on the baud rate used. Table 2-3 is appropriate for CANopen, at the 4 supported baud rates. The "Trunk" is the length between the two units that are at the physical ends of the network. The "Cumulative Drop" is the added length of all drop wires from the trunk to the devices. This only applies to "backbone" type networks since Daisy chain networks do not have drops. The "Maximum Drop" is the maximum allowed for any 1 drop. Any network configured for 1000 kbps should use the daisy chain topology to reduce the possibility of reflections.

SAE J1939 protocol is restricted to 250 kbps and the SAE J1939 standard limits wiring distances to 40 meters, when un-isolated controls are connected on the link.

The limits below are the maximum allowed by the CAN standard. To maintain a high level of reliability in practice, shorter lengths are highly recommended.

Baud Rate	Trunk Length	Cumulative Drop	Maximum Drop
125 kbps	500 m (1640 ft)	156 m (512 ft)	6 m (20 ft)
250 kbps	250 m (820 ft)	78 m (256 ft)	6 m (20 ft)
500 kbps	100 m (328 ft)	39 m (128 ft)	6 m (20 ft)
1000 kbps	25 m (82 ft)	Not recommended	Not recommended

Table 2-3. CAN-1 Wiring Limitations

Installation Check-out Procedure

With the installation completed as described in this section, perform the following check-out procedure.

Visual Inspection

1. Check the linkage between the actuator and the prime mover for looseness or binding. Refer to the appropriate actuator manual and to manual 25070, *Electric Governor Installation Guide*, for additional information on the linkage.

WARNING

The actuator lever should be near but not at the minimum position when the fuel or steam rack is at the minimum position. If the actuator lever gets to its minimum position before completely shutting off fuel or steam, the control may not be able to shut down the prime mover, causing damage to equipment or injury or death.

2. Check for correct wiring in accordance with the plant wiring diagram, Figure 1-2.
3. Check for broken terminals and loose terminal screws.
4. Check the speed sensor for visible damage. Check the clearance of the magnetic pickup between the gear and the sensor, and adjust if necessary. Clearance should be between 0.25 and 1.0 mm (0.010 and 0.040 inch) at the closest point. Make sure the gear has less than 0.5 mm (0.020 inch) diametric run-out. See manual 82510, Magnetic Pickups and Proximity Switches for Electric Governors.

Chapter 3.
GAP Software and Communication Procedures

Introduction

WARNING

An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.

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

GAP Software

Woodward's GAP 3.x is a Windows based software program that allows controls engineers to create block format application programs for the 2300E. 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 will 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.

The 2300E has the following specifications:

- CPU: MPC5553
- Clock Speed: 70 Mhz
- Flash Memory - 1.5 Mbytes
  - Application software file size
  - Boot software file size
  - Service Interface Definition (SID) software file size
- RAM Memory – 68 Kbytes
  - Rate Group Allocations
  - Variables
- EE Memory – 16.0 Kbytes
  - Saved Tunables / Variables
  - Event Managers

The 2300E is a capable system but certain considerations need to be made when architecting the application to ensure that system resources are used in the most efficient manner. From the initial 68 Kbytes of RAM, an application defining the Inputs and Outputs and operating system overhead, the available RAM is 45 Kbytes.

GAP uses a Rate Group structure of the following times: 5 mSec, 10 mSec, 20 mSec, 40 mSec, 80 mSec, and 160 mSec. When adding a Rate Group to the application, the software will allocate approximately 1.6 Kbytes of overhead for these Rate Groups. Therefore adding all six Rate Groups will subtract 9.6 Kbytes of the available RAM of 45 Kbytes, leaving about 35 Kbytes. A suggestion when programming the 2300E would be to **not** use all of the Rate Groups available. In the Standard 2301E application, only two rate groups were used 5 mSec and 80 mSec. The application size is 200 Kbytes, the Total Load on the microprocessor is 10% and the RAM Available is at 7.3 Kbytes. The key is to manage the application so that the microprocessor is never loaded above 90% and the available RAM should be monitored carefully as it falls below 2 Kbytes. Be mindful when adding communications, as that functionality will consume additional RAM as well. Certain blocks in GAP can also use up more RAM, for instance a Curves Block, the Data Log Block or the Event Manager block. The Status_2301E block has this information available: RAM_AVAIL, FLASH_AVAIL, and EE_AVAIL.

If an application file is loaded that exceeds the RAM size limitation or causes an internal system fault, and causes the control to shut down, there is a backdoor boot up process. Shorting TP6 to TP8 and re-powering the control causes the control to automatically go into the boot mode. This boot mode allows you to download a corrected application.

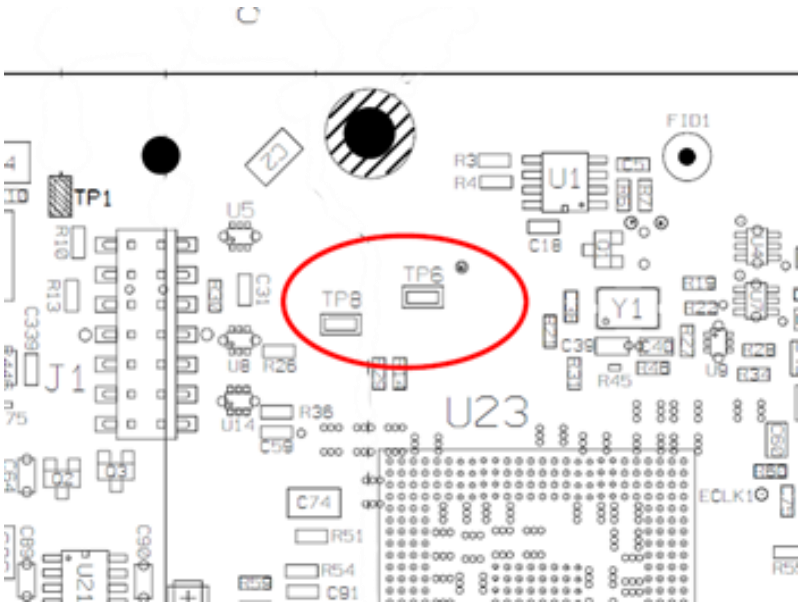

Figure 3-1. Boot Mode Jumpers

Control Assistant PC Interface

Woodward Control Assistant or Servlink OPC Server can be used to download a new application GAP compiled program into the 2300E.

The 2300E default baud rate is 115200, which can be entered in the SOS Servlink OPC Server window or it will automatically detect the correct baud rate.

Chapter 4.
Product Support and Service Options

Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in "like-new" condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

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

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

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 (124) 4399500
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 (124) 4399500
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 (124) 4399500
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

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.

Appendix A.
2300E Control Specifications

Woodward Part Numbers:	
8273-1011	2300E Load Sharing and Speed Control, 24 Vdc input, Ordinary Locations
8273-1012	2300E Load Sharing and Speed Control, 24 Vdc input, Hazardous Locations
8928-5014	Control Assistant
8928-1303	2300E Toolkit Service Tool
Power Supply Rating	18–36 Vdc (SELV)
Power Consumption	less than or equal 20 W nominal
Maximum Altitude	3000 m / 10 000 feet
Weight	1.75 kg / 3.86 lb
Input Supply Voltage	Typical 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
Steady State Speed Band	±0.25% of rated speed
Magnetic Pickup	100–25 000 Hz (300–3600 rpm)
3-phase Current Transformer Burden	3-7 A rms at full load, CT input burden at full load is 0.1 VA per phase
3-phase PT Burden	90–240 Vac line-to-line, 45–66 Hz. PT input burden is between 1.5 VA and 1.7 VA per phase at 240 Vac, and between 0.4 VA and 0.5 VA per phase at 120 Vac.
Discrete Inputs (8)	3 mA at 24 Vdc, impedance approximately 5.2 kA
Remote Reference Input	4–20 mA, 1–5 Vdc
SPM-A Input	±2.5 Vdc, externally powered
Analog Output #1	0–20 mA, 4–20 or 0–200 mA to actuator
Analog Output #2	0–20 or 4–20 mA, internally powered, 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 Ports	RS-232: 9-pin connector, RS-422: 9-pin connector, 9600 to 115 200 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	Lloyd's Register of Shipping, Test Specification No. 1, 1996, Humidity Test 1, 95% at +20 to +55 °C (+68 to +131 °F) condensing
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	Class 1 (grounded equipment)
EMC Immunity Environment	Marine Type Tests & EN 61000-6-2 IEC 61000-4-2, ESD ±6 kV/±8 kV IEC 61000-4-3, RS 10 V/m + AM 80-3000 MHz IEC 61000-4-4, EFT ±2 kV Power & I/O IEC 61000-4-5, Surge ±1 kV I/O CM, ±0.5/±1.0 kV dc power DM/CM, & ±1.0/±2.0 kV ac power DM/CM IEC 61000-4-6, CRF 10 Vrms + AM 0.150-80 MHz. Marine Type Test CLFI 3.6 Vrms or 2 W, 50 Hz to 20 kHz. WWD (Marine) CLFI 3.6-0.36 Vrms or 2.0–0.2 W, 20 kHz to 150 kHz.
EMC Emission Environment	Marine Type Tests & EN 61000-6-4 Marine General Distribution Zone per CISPR 16 EC EN 61000-6-4 Industrial Limits (Class A)

Revision History

Changes in Revision E—
- Updated Regulatory Compliance section
- Revised Declaration of Conformity

Changes in Revision D—
- Added information clarifying the memory structure of the 2300E.
- Revise Australia and New Zealand compliance information

Changes in Revision C—
- Corrected 3-phase PT Burden in Specifications section to 90–240 Vac line-to-line, 45–66 Hz

Changes in Revision B—
- Added new Marine certifications (BV, NKK, CCS)
- Added product weight

Changes in Revision A—
- Removed references to configurable inputs/outputs

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00448-04-EU-02-01
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	2301E & 2300E Family of Controls
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC) Directive 2014/35/EU on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
Markings in addition to CE marking:	Ⓔx Category 3 Group II G, Ex nA IIC T3 Gc X Ⓔx Category 3 Group II G, Ex nA IIC T4 Gc X
Applicable Standards:	EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN61000-6-4, 2007/A1:2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN50178, 1997: Electronic Equipment for Use in Power Installations EN60079-0, 2009: Explosive Atmospheres - Part 0: Equipment – General requirements EN60079-15, 2010: Explosive Atmospheres - Part 15: Equipment protection by type of protection "n"
Last two digits of the year in which the CE marking was affixed for the first time:	12

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

Christopher Perkins

Full Name

Engineering Manager

Position

Woodward, Fort Collins, CO, USA

Place

01-JUN-2016

Date

5-09-1183 Rev 26

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26691E.

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**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.