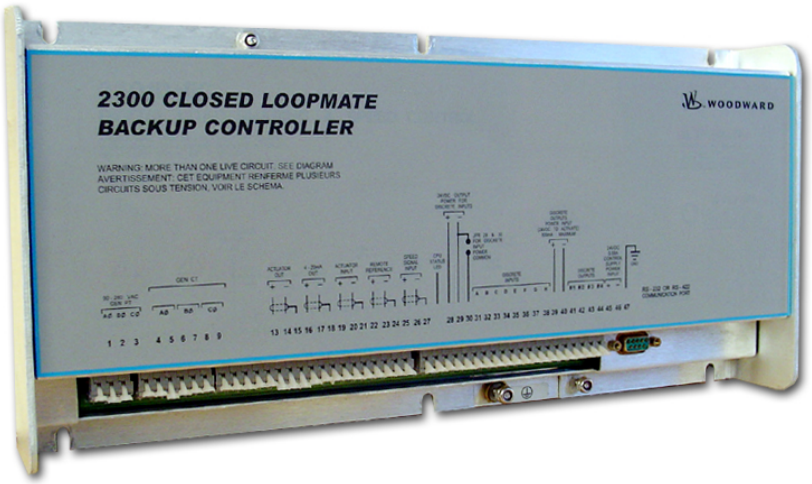
WOODWARD

Product Manual 26331
(Revision A, 12/2009)
Original Instructions



2300 Closed Loop Mate (2300 CLM) Backup Controller

8237-1132 (Ordinary Locations)
8237-1155 (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

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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

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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

General Installation and Operation Notes and Requirements:

The 2300 CLM is suitable for use in Class I, Division 2, Groups A, B, C, and D per CSA for Canada and U.S. or non-hazardous locations only. These listings are limited only to those units bearing the CSA agency identification and hazardous location markings.

The 2300 CLM is suitable for use in Ordinary Locations per UL and CSA for Canada and U.S. or non-hazardous locations only. These listings are limited only to those units bearing the UL and CSA agency identification and ordinary location markings.

Wiring must be in accordance with North American Class I, Division 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.

Connector J1 must not be used in hazardous locations.

The 2300 CLM shall be installed in a suitable enclosure. A local authority having jurisdiction shall approve the final combination.

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, or Zone 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, ou Zone 2.

Chapter 1.
General Information

General Description

The 2300 Closed Loop Mate (2300 CLM) is a backup controller that can be used with all types of applications (generators or mechanical loads) with engines or turbines. The meaning of the term *controller* indicates that this product can control the setpoints closed loop. It will not just keep the actuator at the same position when the master speed control fails, but will control the speed or kW setpoint with PID controller and will sustain the setpoint, changing the actuator demand reacting to load changes.

The 2300 CLM assumes two states: *Automatic Mode* and *Manual Mode*.

- **Automatic Mode:** The main speed controller is not tripped and is controlling the engine or turbine. The 2300 CLM is driving the actuator signal from the main speed controller to the actuator. In this mode, the 2300 CLM is monitoring both actuator current and the trip relay of the main speed controller.
- **Manual Mode:** The 2300 CLM has detected a master speed control failure. Because it has information about the actuator position and speed or kW, the 2300 CLM will start to control the prime mover at the same speed or kW demand before the failure.

Since it is a controller, the 2300 CLM has discrete inputs to change (raise/lower) the setpoints, It is possible to use 4–20 mA remote reference and also Modbus® * Communications to change the setpoints.

*—Modbus is a trademark of Schneider Automation Inc.

If failure occurs on the main speed controller, a bumpless control transfer to the 2300 CLM will be done at the same setpoint sensed milliseconds before the failure. This value will be used as the initial setpoint. While the problem with the master speed control continues, the 2300 CLM PID will change the actuator position based on load changes and will accept setpoint changes. When the problem with the master speed has been eliminated, the 2300 CLM will use the *actuator demand matching criteria* to return the control to master speed control. This means that the 2300 CLM will be waiting for the actuator demand from the main speed controller to reach the same value of the actuator demand that the 2300 CLM is using to control the speed/kW. When these values reach the same value, control will automatically be transferred from Manual Mode to Automatic Mode, without any disturbance.

When the driven load is a generator, the 2300 CLM can operate at island mode (frequency control) or in droop mode when working in parallel to the grid or other generator. It is possible to use actuator droop or kW droop. Usually actuator droop is used in parallel mode at constant fuel/steam demand for each speed setpoint and kW droop is used at constant kW demand with fuel/steam changes for each kW setpoint. The CB Aux digital input will inform (when it is TRUE) to operate at droop mode or frequency control (when it is FALSE).

This product can be used with mechanical loads or generators. Overspeed Protection and Loss of MPU signal protection are active in order to have a safe and stable control in manual mode. Other feature is that the Overspeed Protection is active in both Manual Mode and Automatic Mode, improving the system reliability.

When a master speed control fails, the 2300 CLM will keep the same setpoint and will provide setpoints changes. If it becomes necessary to switch off the 2300 CLM for any reason, or to remove and install it, this can be done easily because there are relays to change the actuator connection directly to the master speed control (see wiring diagram, Figure 2-3). In this case, the system will operate in the same way as when the 2300 CLM is not installed.

Finally, when the master speed control is tripped/removed and an external trip forces the prime mover to stop, the 2300 CLM will accept an emergency start command, which has 3 setpoints, each one with its own rate and controlled actuator opening ramp to start.

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/publications**) 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	*EG-3P/-6P/-10P Actuator*
82575	*EGB-1P/-2P Governor/Actuator*
03202	*Woodward Watch Window Standard*

Chapter 2.
Installation

Introduction

This chapter contains general installation instructions for the 2300 CLM 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 checkout 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.

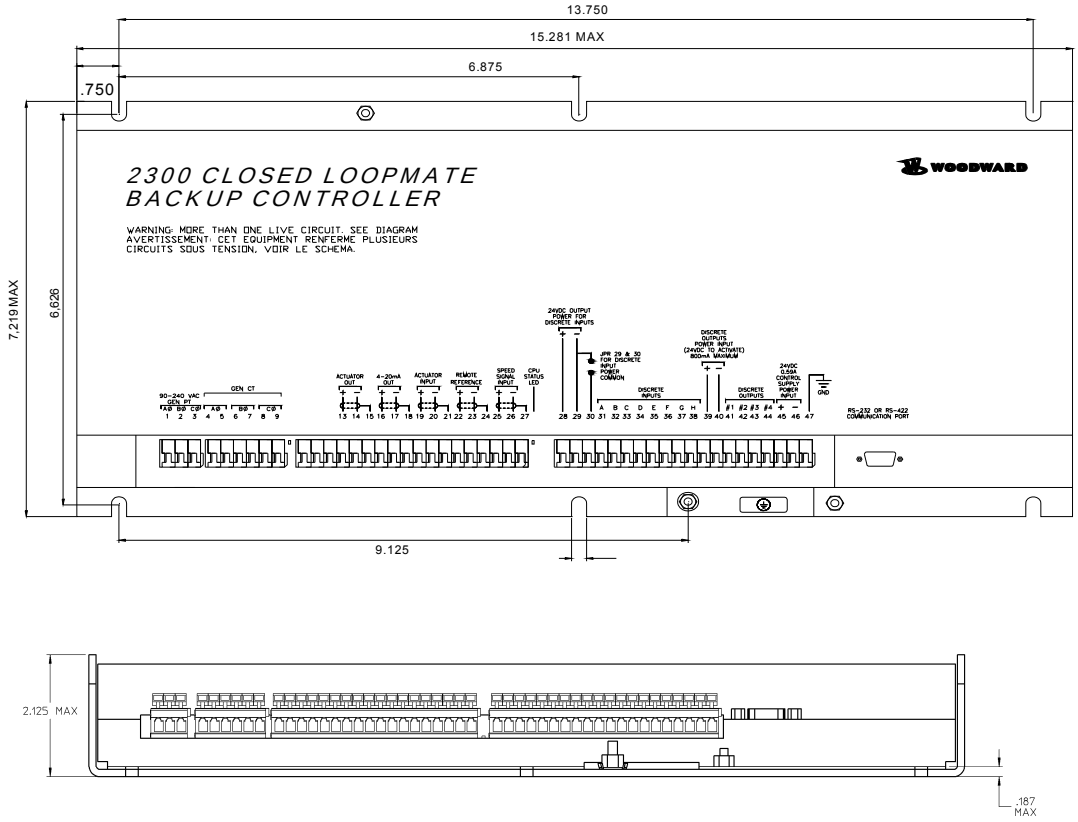


Figure 2-1. 2300 CLM Outline Drawing (8237-1132)

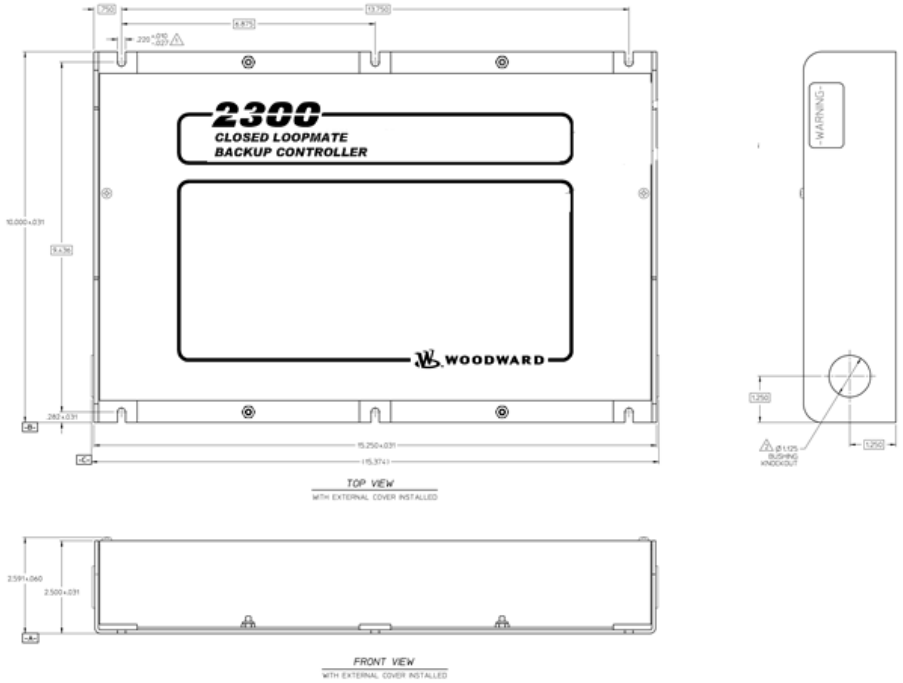


Figure 2-2. 2300 CLM Outline Drawing (8237-1155)
(Hazardous Locations, external cover installed)

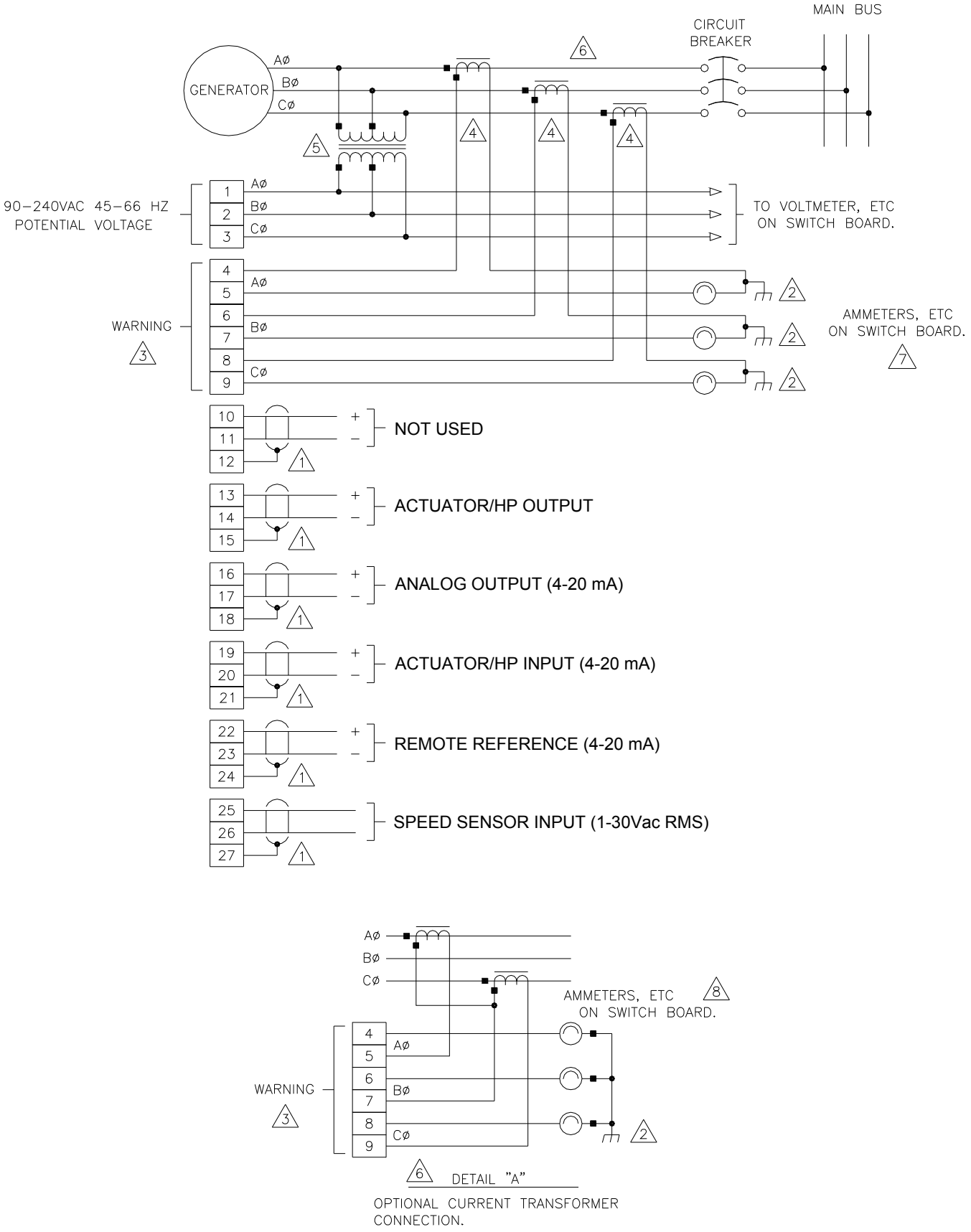
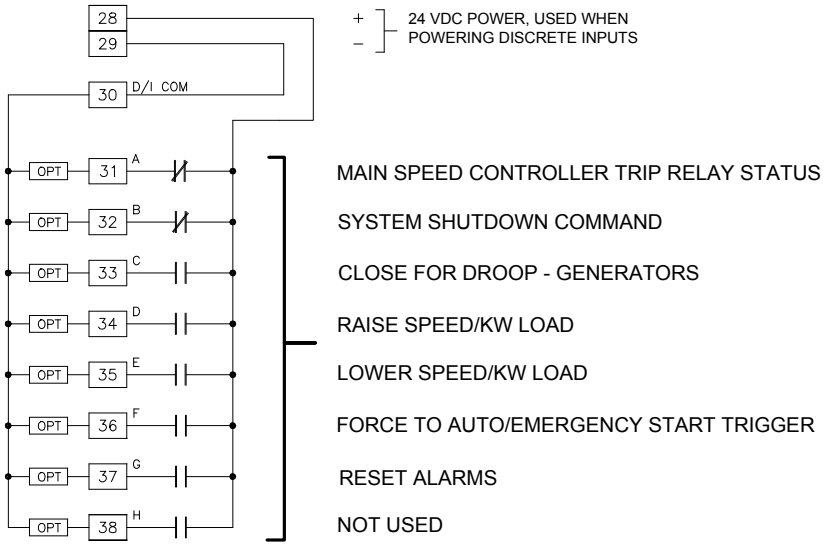


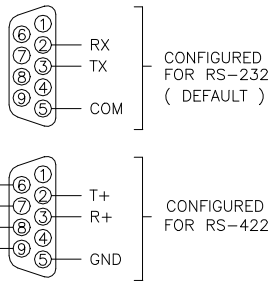
Figure 2-3a. 2300 CLM Plant Wiring Diagram (sheet 1)

DISCRETE INPUTS WITH INTERNAL POWER SUPPLY

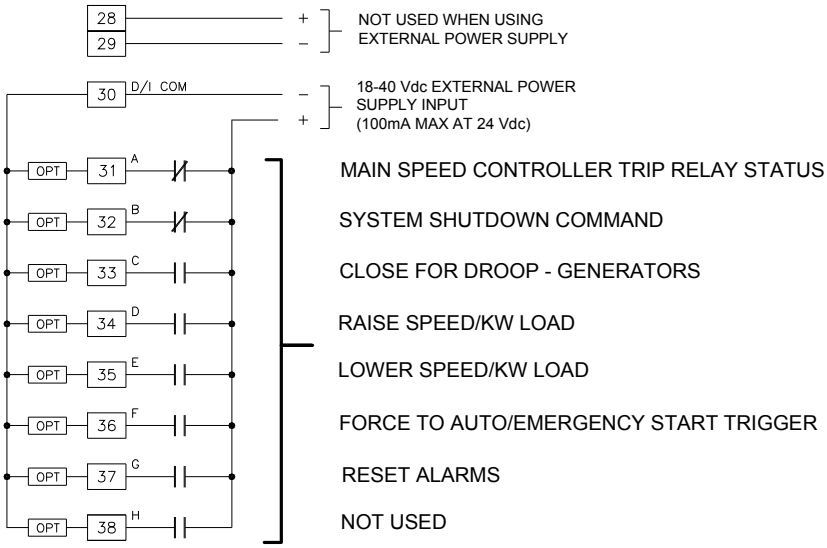


DISCRETE INPUTS

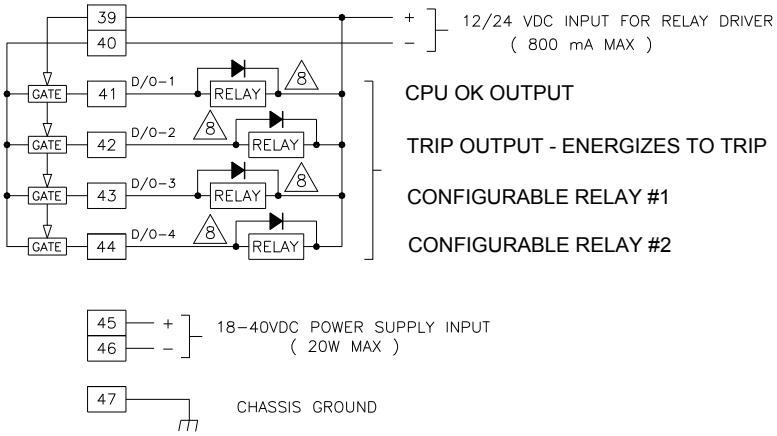
RS–232 OR RS–422
COMMUNICATION PORT
PIN ASSIGNMENT
(FOR SERVELINK/MODBUS)



DISCRETE INPUTS WITH EXTERNAL POWER SUPPLY



DISCRETE INPUTS



DISCRETE OUTPUTS
SOLID STATE RELAY DRIVERS

Figure 2-3b. 2300 CLM 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. IF METERS ARE NOT USED, JUMPERS MUST BE INSTALLED IN PLACE OF METERS SHOWN.
8. INDICATES RELAY COIL OR LAMP, 200 mA MAXIMUM PER CHANNEL.

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

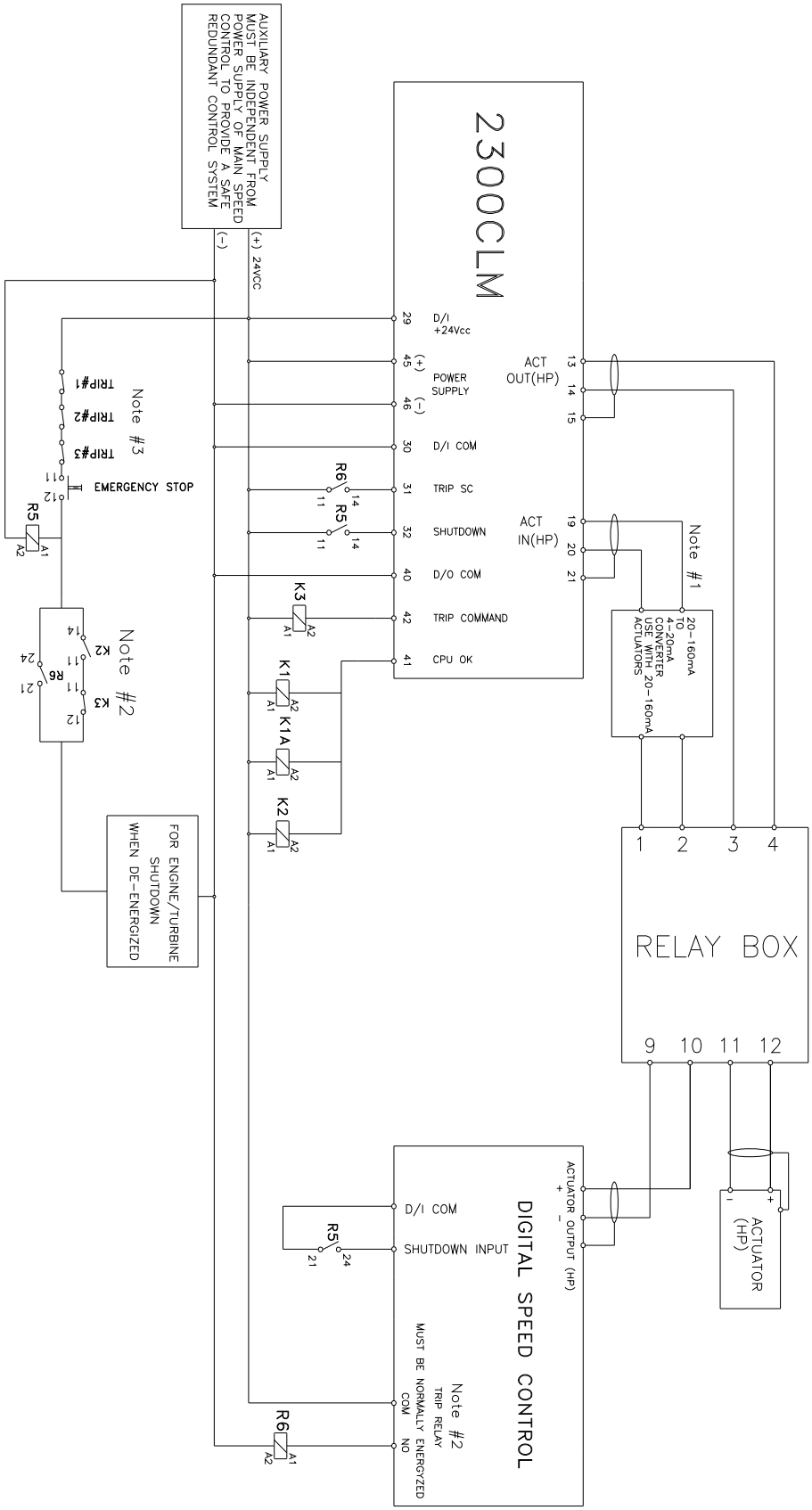


Figure 2-3d. 2300 CLM Relays Wiring Diagram

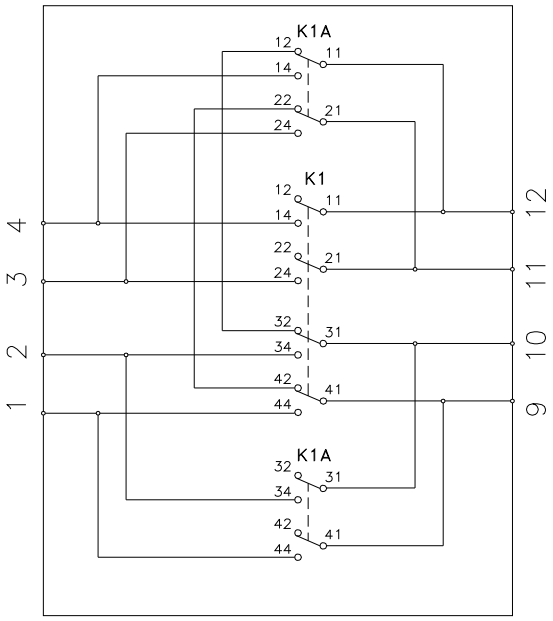
Note #1: Use this conversor with 20–160mA actuators.

Note #2: When using transistor output use the correct wiring to energize and de–energize R6

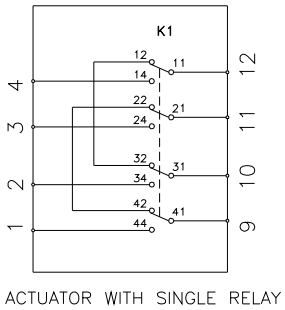
Note #3: External trip conditions and Emergency Stop

Figure 2-3e. 2300 CLM Relays Wiring Diagram Notes

Redundant Relay Wiring



Single Relay Wiring



Woodward reference for relays: P/N 1731-2065

Figure 2-3f. 2300 CLM Relay Box Wiring Diagram (Actuator Relays)

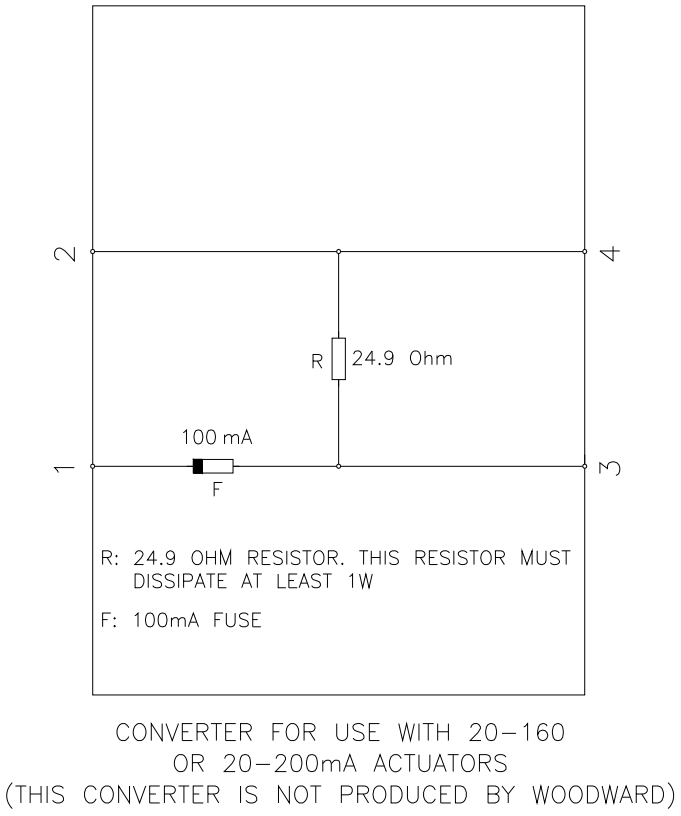


Figure 2-3g. 2300 CLM Converter – for 20–160 or 20–200 mA Actuators

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 CLM 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 CLM 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 CLM 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.

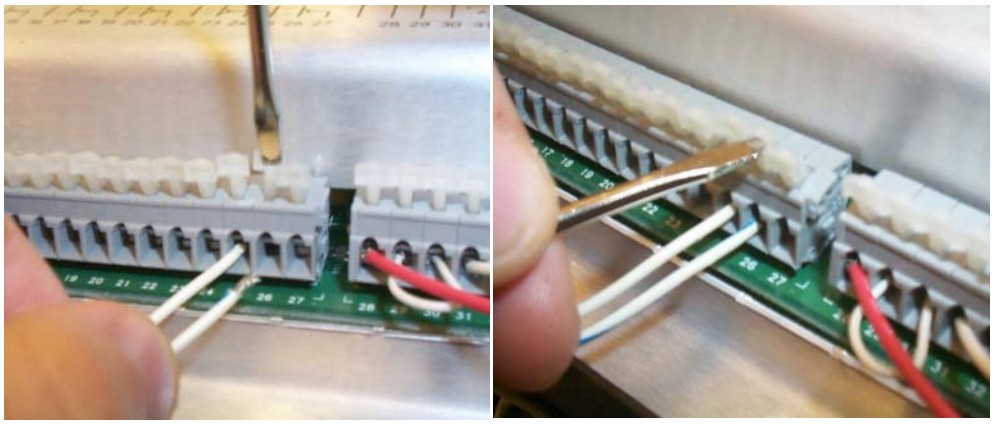


Figure 2-4. Installation of Wiring into Terminal

Power Supply Connections

The 2300 CLM 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.

Emergency Stop and External Trip

As indicated at Fig 2-3d all external trip conditions and the emergency stop button must be wired to both master speed control and 2300 CLM.

The trip command from master speed control is connected in parallel (AND Logic) to 2300 CLM. In this case, both master speed control and 2300 CLM must receive this command when the trip action is needed.

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

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 2-3b for wiring information and see the 2300 CLM 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 20–160 mA, or 4–20 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. The wiring diagram (Fig. 2-3c) will show how this output is connected.

Actuator Input

This input receives the actuator/HP demand from the main speed controller (terminals 19+ and 20-).

Remote Reference

This input is 4–20 mA type. It will accept a remote reference of speed or kW to change these setpoints when the 2300 CLM is at manual mode.

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 CLM 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 (4–20 mA)

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

The analog output can be programmed as readout of the following variables: actual speed, speed reference to the PID, actuator input (mA), actuator output (mA), PID output (%), remote reference (rpm), active power (kW).

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 CLM to prevent contact with other circuits.

RS-232

See Figure 2-5 for cable connection.

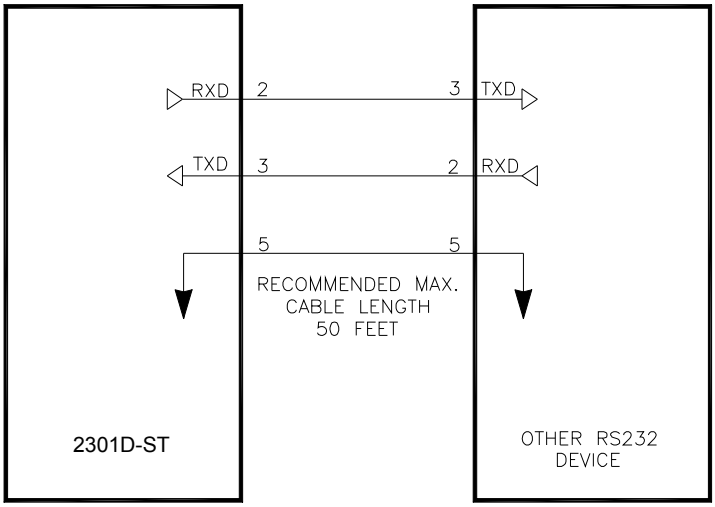


Figure 2-5. RS232 Pin assignments for Serial Communication Cable

RS-422

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

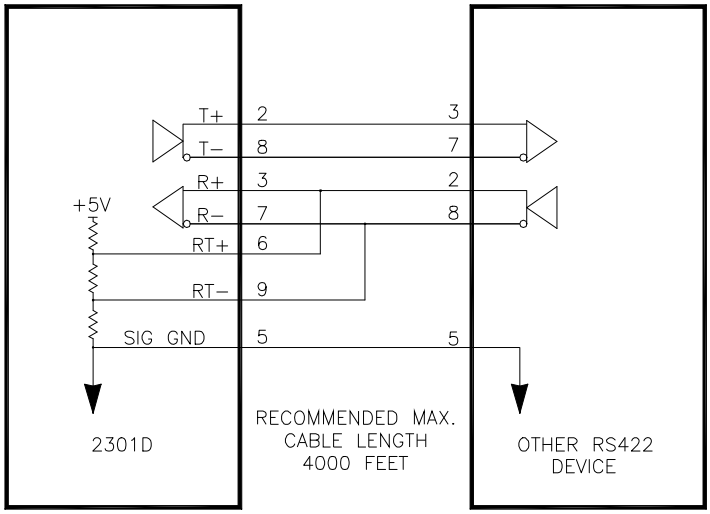


Figure 2-6. Typical RS-422 Communications Connections

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 2-7 is an example.

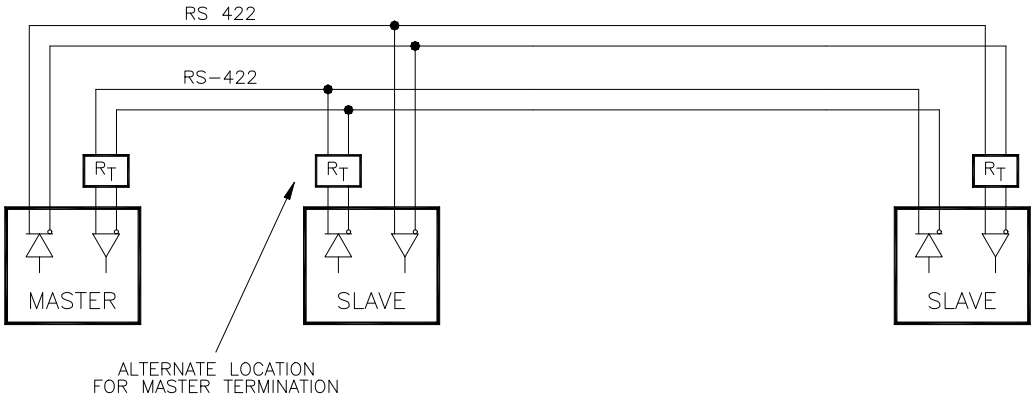


Figure 2-7. RS-422 Terminator Locations

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.

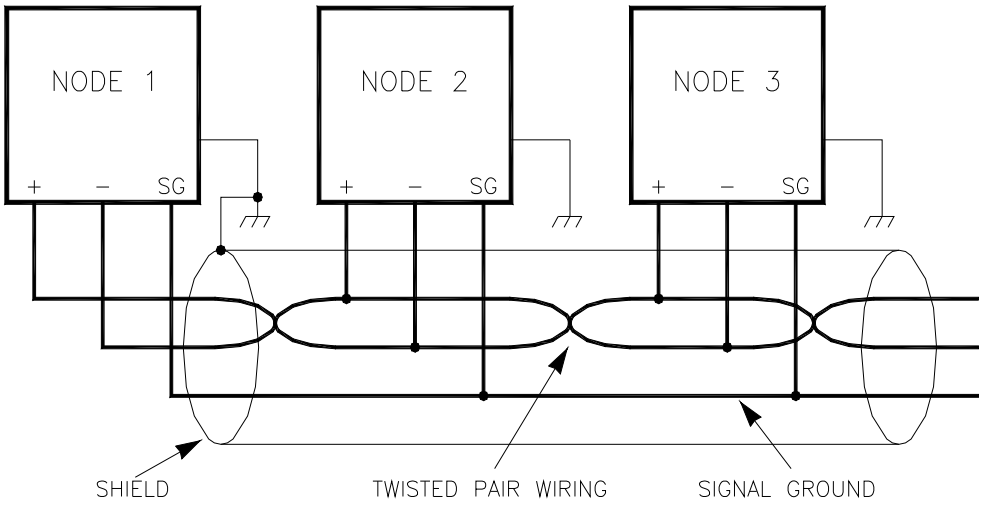


Figure 2-8. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

IMPORTANT

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

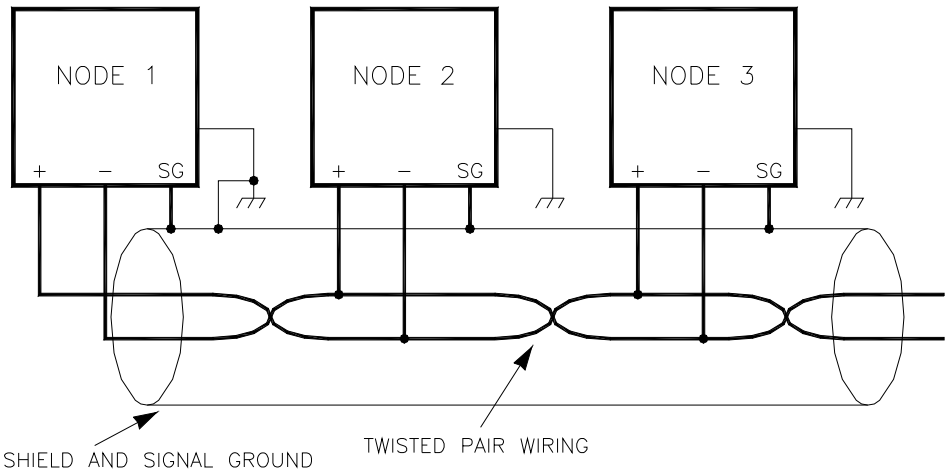


Figure 2-9. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

Chapter 3.
2300 CLM Machine State

2300 CLM State List

This chapter illustrates all control modes combinations when using the 2300 CLM backup controller.

Automatic Mode (Controlled by Main Speed Controller)

The conditions below indicate all cases when Automatic Mode is active in the 2300 CLM. This state means that the actuator output is equal to the actuator input.

The speed is below the threshold value programmed in the 2300 CLM. In this situation, the control mode will be forced to automatically ignore whether the main speed controller is tripped or not. This is a protection against loss of MPU signal. If the 2300 CLM loses the MPU signal and the control mode is manual, the mode will be forced to automatic. If the control mode is automatic it will be kept in automatic mode even with the main speed controller tripped. If the machine is being driven by the 2300 CLM at the time that the loss of MPU occurs, a shutdown will be indicated on the 2300 CLM as a warning of MPU loss.

The trip relay AND the actuator demand from the master speed control do not indicate a trip condition. The relay is closed and the actuator current is at the programmed range.

Manual Mode (Controlled by 2300 CLM)

The 2300 CLM is controlling all loops. The setpoints can be changed and the 2300 CLM will be analyzing the conditions to return from manual to automatic mode. The conditions to accept a manual mode are:

- The speed is greater than the threshold value
  AND
- The trip relay from the main speed controller is open
  OR
- The actuator current from the main speed controller is out of range

Emergency Start Sequence (Controlled by 2300 CLM)

In the situation when the main speed controller is tripped, and the prime mover was stopped by an external trip, it will be necessary to re-start the prime mover with the main speed controller not available. In this case, the 2300 CLM will accept an Emergency Start Command. The conditions and sequence are listed below:

- The prime mover is stopped and the main speed controller is tripped.
- Hold the *force to auto mode* (Digital Input F) at closed state for at least 5 seconds.
- The actuator will start to move from 0% to the maximum actuator position at start sequence (configurable) using the actuator rate value (%/s; also configurable).

- If the sensed speed is greater than *Override Speed,* the actuator ramp is disabled, the speed 2300 CLM PID will start to control the prime mover speed at Start Speed Setpoint.
- If the actuator reaches maximum position at start sequence but the override speed was not detected, automatically the actuator will return to 0% and an other command to Emergency Start Sequence will be necessary.
- If an MPU signal is sensed, the PID will use the Start Speed Setpoint to control the prime mover.
- Use the command Raise Speed/Load to Ramp from Start Speed to Low Idle Speed (this ramp has a configurable rate).
- Use the command Raise Speed/Load after reaching Low Idle Speed to move the setpoint to High Idle Speed (configurable rate).
- Use the Raise Speed/Load command to move from Hi-Idle to Sync/Rated Speed using a configurable rate to finish the emergency start sequence.
- If there are conditions to transfer from manual mode to automatic mode, the 2300 CLM will accept to change to automatic mode during the start sequence.

The Raise Command can be sent via Hardware, Modbus Comm, or ServLink/Watch Window.

Digital input F shares the *Force to Automatic Mode function* and *Emergency Start Sequence function*. These functions have an *Exclusive OR* logic. The conditions that are permissive for one are inhibiting the other one and vice-versa.

CPU OK is ON, the 2300 CLM control mode is Automatic and no trip exists on master speed control

The same actuator(s) current at the master speed control are being sent by the 2300 CLM to the actuator. The 2300 CLM will be monitoring the actuator current and the trip relay state to change to Manual Mode.

CPU OK is OFF
Offline State. A 2300 CLM hardware failure was detected or it has no power supply. In this case, the system will operate exactly at the same way when the 2300 CLM is not installed. The actuator relays provide this security action. No transfer is possible, and no backup exists.

CPU OK is ON, the 2300 CLM control mode is Manual, and the main speed controller is still tripped
The Speed/kW is active at 2300 CLM. It is possible to change setpoints (speed, kW). The 2300 CLM is waiting for a valid state of main speed controller trip relay and the actuator demand from main speed controller.

CPU OK is ON, the 2300 CLM control mode is Manual, and a trip state no longer exists at the main speed controller (Master Ready to Start)
The 2300 CLM will understand that the problem with the main speed controller was eliminated, and transferring to the main speed controller is possible. It means that the trip relay at master is closed, its actuator current is not out of range, and the 2300 CLM is controlling the loops. At this moment, the 2300 CLM will be waiting for the *actuator matching criteria* to change to Automatic Mode. This is the case when it waits until the actuator demand at main speed controller becomes equal to the actuator demand from 2300 CLM PID to do the transfer. It is a *bumpless transfer mode* because no speed/kW disturbance is sensed.

But if desired, after all the conditions described above, it is possible to bypass the *actuator matching criteria* using the *force to automatic mode* command. In this case, the control will be changed to manual mode and a speed/kW disturbance will be sensed.

Manual to Automatic Transfer Trend

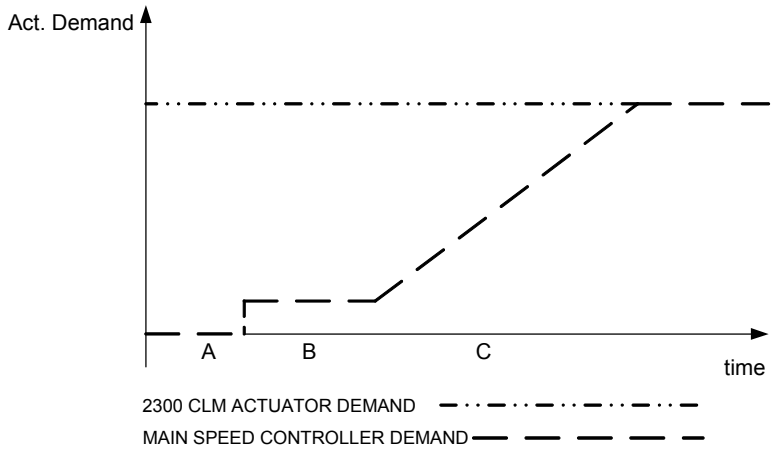


Figure 3-1. Actuator Matching Criteria

If a bumpless transfer is necessary to transfer the control from 2300 CLM to main speed controller, consider the trend above.

- A trip at main speed controller was detected and the 2300 CLM is controlling the prime mover.
- Time A: The main speed controller is still tripped.
- Time B: The main speed controller is operational, reset, and the actuator current is at minimum.
- Time C: The actuator demand from main speed controller is increasing and when it reaches the same value of actual position demand given by the 2300 CLM PID, the transfer to automatic mode will occur.

IMPORTANT

The actuator demand from main speed controller will increase if the speed setpoint at main speed controller is greater than the actual MPU measured value. If the controlled variable is the load (kW) the same concept is applied to the kW demand. To provide this condition use manual commands to raise the setpoint at main speed controller or at load controller. The raise and lower pulses to the main speed controller or to the load controller can be managed by the 2300 CLM via two discrete outputs that can be configured for this purpose.

The 2300 CLM can indicate via digital output (configurable) when this condition was reached (Time C). A digital output can be programmed as *transfer indicator*. It will emit pulses with variable frequency If the difference between the actuator input and the actuator output is big the pulses will have a slower frequency. When this difference becomes small the pulses will have a faster frequency. This indicator will only emit pulses when it's in Manual mode and a run command was set on the main speed controller.

If at time B a force to automatic mode command is sent to 2300 CLM, it will not wait for the current criteria and the control will be transferred automatically to the main speed controller (with disturbance).

Manual to Automatic Transfer Using Load Controllers

When the driven load is a generator and a Synchronizer/Load Controller is used to synchronize the generator with the grid and to control the active power (DSLC™, EGCP, GCP) some additional wiring is suggested. These considerations are only valid for load controllers. Consider this wiring example:

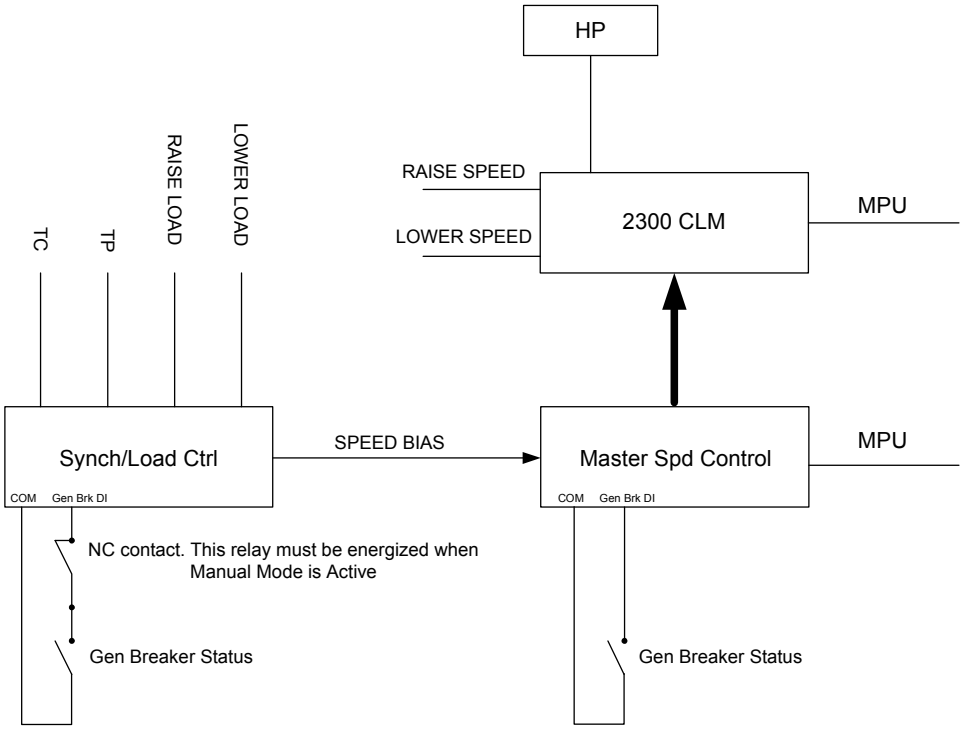


Figure 3-2. Example of Application with Load Controllers

Synchronizers and Load Controllers

Some conditions are presumed to be active:

- The Speed Bias is used to control the active power.
- The Gen Breaker status will determine if the speed control will accept the speed bias signal or not.
- With the Gen Breaker Open, working at Manual Mode and it is possible to transfer to Automatic Mode, do it before synchronization.
- With the Gen Breaker Closed and Manual Mode State but it is possible to transfer to Automatic Mode, the commands Raise/Lower must be sent to Load Controller. The Load Controller must be at Droop Mode (Manual Mode).
- If the Gen Breaker status is open for the load controller and it is has a valid TP and TC measurements, it will be operating at kW Droop Mode. This is the reason to install a contact as shown to open the breaker contact for the load controller when in manual mode. In this case, program one digital output at 2300 CLM for this function. If there are generators sharing the load, this procedure will inform to the load-sharing network that this specific generator is out of network control. It is being operated at manual mode.
- Commands to Raise/Lower Load at the Load Controller when in droop mode can increase/decrease the speed bias value at the situation described above.

- When 2300 CLM is in manual mode and the Gen Breaker is Closed, the speed bias can change the speed setpoint at the speed control, increasing the active power (actuator output) with Load Controller in Droop Mode.
- Normally the Generator Breaker Status can determine if the load controller is at Droop Mode or not. If the load controller cannot assume a droop state with this condition, use the available way to change the control mode to droop in function of the state of 2300 CLM (Auto Mode=Control ON, Manual Mode=Droop).

The conditions above are valid for a generator operating synchronized with other generators/grid. If the condition is a generator operating at island mode, be very careful with these commands to increase load because an overfrequency can occur if the increasing load pulses were sent many times.

If these all conditions are valid, use commands to increase the load at the load controller. When the speed bias starts to increase, the actuator current will start to increase at main speed controller and the transfer will occur at the same way as described for speed controllers (mechanical Loads).

Synchronizers Only

In this case, the synchronizer will send pulses or analog signal to adjust the generator frequency to the grid and will be waiting for synch window, dwell time, slip window to close the generator breaker. After this, the main speed controller will operate at droop mode (if in parallel mode), frequency control at island mode or isolated bus frequency controller (2 or more generators in parallel mode and out of the grid). If the system has this configuration, the pulses to raise speed/load will be sent only to the speed control. If the generator is operating at droop mode, it is indicated that it is in parallel with other generator in frequency mode or in parallel with the grid. If it is operating at island mode, there is an overfrequency possibility. Do not use a setpoint greater then 1% of synch. speed to the generator in frequency control to transfer the control. No problems are related to these commands to generators in droop mode.

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 Windows Explorer.

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 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 CLM 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 CLM, 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 CLM to reprogram it to the saved values or into another 2300 CLM 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 CLM

The connection of a computer is only required for calibration and setup of the 2300 CLM 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.

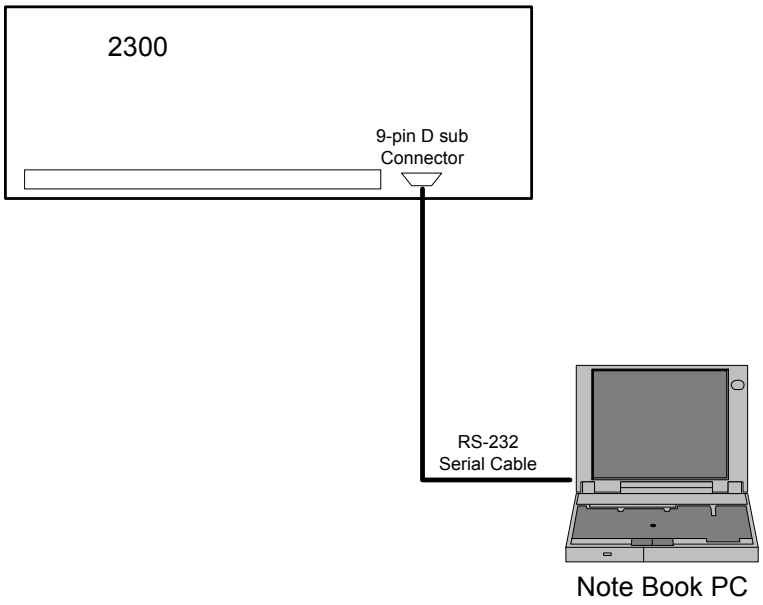


Figure 3-3. Connection between PC and 2300 CLM

Apply Power to the 2300 CLM

At power-up, the 2300 CLM 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 CLM 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.

The 2300 CLM will be changing the protocol mode between Modbus and ServLink Interface to check what mode is being requested. When a valid link is detected, it will stop to switch the protocol mode. If Modbus is detected and fails, it will re-start to check the link. If the ServLink Protocol has been detected, it is necessary to use a command at Watch Window to leave this mode and re-start to check the protocol mode, otherwise it will be locked at ServLink Mode.

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

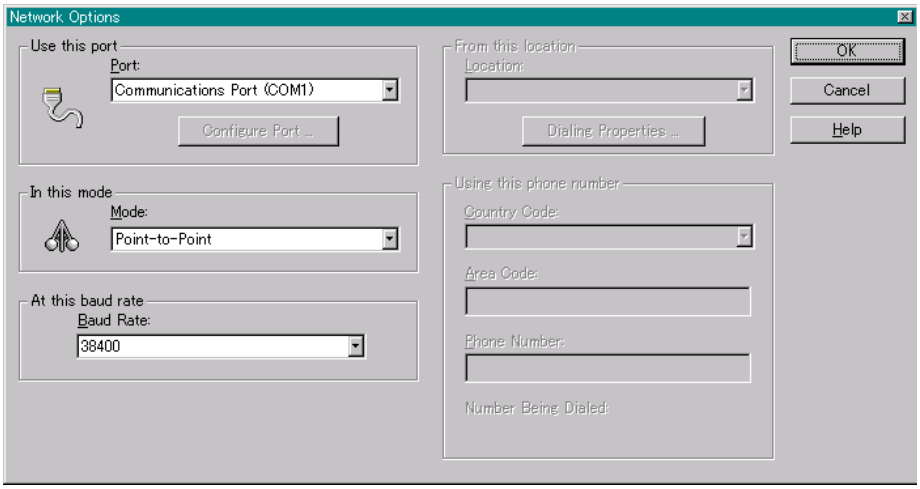


Figure 3-4. Setup ServLink Communication

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.)

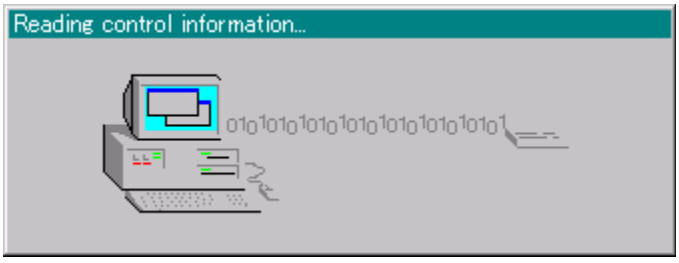


Figure 3-5. Reading Control Information

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.

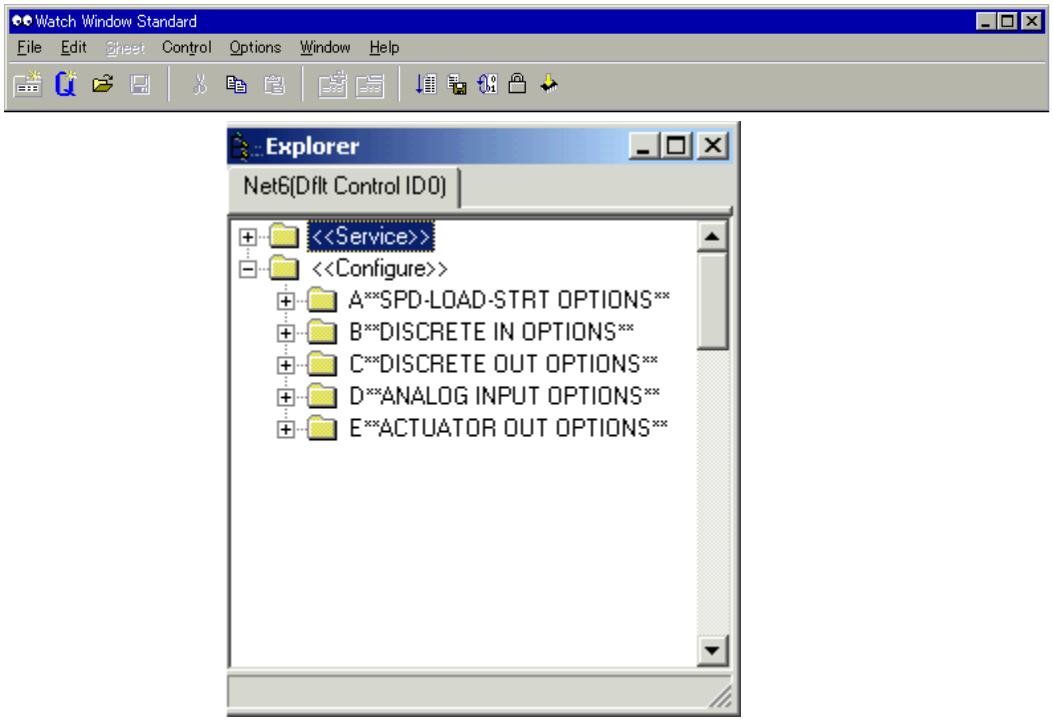


Figure 3-6. Watch Window Menu and Explore (Configure)

Chapter 4.
Service and Configuration

Introduction

This chapter provides information about all service and configure which will be found during the 2300 CLM configuration and adjustments

A**CONFIGURATION**

01 NUMBER OF TEETH ***60 (1,500)**
Enter the number of gear teeth seen by MPU.

02 TYPE OF ACTUATOR ***2 (1,2)**
This is an integer number that will change the hardware to 0–20 or 0–200 mA actuator. Number 1 selects a 0–200 mA type and the number 2 selects a 0–20 mA type. This field is valid only for the speed control actuator (HP).
These values can be adjusted for 4–20 or 20–160 if it is necessary.

03 ACTUATOR RANGE
This field will inform using a message (string) the actuator output selected

04 ACT OUT (4–20 mA) LV ***4 (0,8)**
Actuator current for 0% of position demand, when configured for 0–20 mA actuators. Program the minimum current value that the master speed control will generate when it is not tripped and ready to start. Use ammeters at master speed control to be sure about this value.

05 ACT OUT (4–20 mA) HV ***20 (0,50)**
Actuator current for 100% of position demand for 0–200 mA actuators. Program here the maximum actuator value that the master speed control will generate when it is not tripped and the actuator output is 100%. Use stroke actuator at master speed control to know this current value.

06 ACT OUT (0–200 mA) LV ***20 (15,24)**
The same procedure of item 04, used for 0–200 mA actuators.

07 ACT OUT (0–200 mA) HV ***160 (100,200)**
The same procedure of item 05, used for 0–200 mA actuators.

08 ACT IN (4–20 mA) LV ***4.0 (0.0, 8.0)**
Must be entered here the same value obtained at Configure field number 04. At most cases, the input actuator values must match the sent value via 2300 CLM but it is possible to program different values for both cases, depending of the application. This note can be applied to Config. Fields 9 to 11.

09 ACT IN (4–20 mA) HV ***20.0 (15.0, 24.0)**
Must be entered here the same value obtained at Configure field number 05
Additional considerations from field number 08 are valid.

10 ACT IN (0–200 mA) LV ***20.0 (0.0, 50.0)**
Must be entered here the same value obtained at Configure field number 06
Additional considerations from field number 08 are valid.

11 ACT IN (0–200 mA) HV ***160.0 (100.0, 200.0)**
Must be entered here the same value obtained at Configure field number 07 Additional considerations from field number 08 are valid.

12 GENERATOR APPLICATION? ***FALSE (TRUE, FALSE)**
If the load is a generator, set TRUE for this field. Otherwise leave it at FALSE state. Generators and Mechanical Loads are processed with different actions in each case.

13 OVERSPEED TRIP (RPM) ***5000.0 (100.0, 15000.0)**
Overspeed trip setpoint. When the MPU connected at 2300 CLM detects the speed value programmed here or above, it will latch the trip relay, forcing the primer move to stop. This protection is active in AUTO or MANUAL mode. Since the actuator output is sent by 2300 CLM the prime mover will stop ignoring the main speed controller state. If the main speed controller does not detect an overspeed and the 2300 CLM has been detected this situation, it will latch the trip state and the actuator output will be 0 mA until a reset command.

14 RATED kW ***1000.0 (0.0, 1000000.0)**
If the driven load is a generator, program here the maximum active power that the generator can produce. If the application is a mechanical load, this field will have no effect

15 REVERSE ACTUATOR? ***FALSE (TRUE, FALSE)**
A non-reverse actuator means that when the Speed PID increases it value, the speed or kW increases its value too. Actuator 100% = maximum fuel/steam and Actuator 0%=prime mover stopped. Otherwise the actuator decreases its position to increase the speed/kW/fuel/steam demand. Program the same action of the main speed controller.

16 ACTUATOR INPUT ***1 (1,3)**
This is an integer number that will change the hardware actuator input to 4–20, 20–160, or 20–200 mA. Number 1 selects a 4–20 mA actuator input, number 2 selects a 20–160 mA actuator input, and number 3 selects a 20–200 mA actuator input. If a 20–160 or 20–200 mA actuator input is used, a converter must be used in the actuator input pins of the 2300 CLM (see Figure 2-3g).

17 ACTUATOR INPUT
This field will inform using a message (string) the actuator input selected.

SERVLINK CONFIRMATION

01 SET TRUE TO LOCK SLINK ***FALSE (TRUE, FALSE)**
As soon as an entering in Watch Window is made is important to set this parameter to TRUE so you can navigate on Watch Window. If it's not done, when a certain time expires (parameter 3 of this menu) the communication with Watch Window will be lost.

02 SET TRUE TO EXIT SLINK ***FALSE (TRUE, FALSE)**
When all navigation on Watch Window is completed is possible to set this value to exit Watch Window. By setting this value the communication will be lost after a while (showed in parameter 4 of this menu). It's not mandatory to set this value to TRUE when it's wanted to get out of Watch Window.

03 TIME TO ENABLE
This is the remaining time until the communication with Watch Window is lost. It's the remaining time to set TRUE to the parameter 1 of this menu.

04 DISABLE TIMER
This is the remaining time until a communication is lost by setting the parameter 2 of this menu. When parameter 2 of this menu is set this parameter starts counting down. When it reaches zero the communication with Watch Window is lost.

B**SPEED SETPOINTS**

01 MINIMUM SPEED ***1000.0 (100.0, 15000.0)**
This is the minimum governor speed used when the 2300 CLM is at Manual Mode.

02 MAXIMUM SPEED ***4000.0 (100.0, 15000.0)**
This is the maximum governor speed used when the 2300 CLM is at Manual Mode.

03 4 mA SPEED ***1000.0 (100.0, 15000.0)**
This is the speed setpoint when 2300 CLM is at manual mode and the speed setpoint is being controlled via 4–20 mA input (Speed for 4 mA value). This setpoint control mode is obtained closing at same time Raise/Lower speed DI and it can be done via Modbus Boolean write. This value must be higher than the minimum speed.

04 20 mA SPEED ***4000.0 (100.0, 15000.0)**
This is the speed setpoint when 2300 CLM is at manual mode and the speed setpoint is being controlled via 4–20 mA input (Speed for 20 mA value). This setpoint control mode is obtained closing at same time Raise/Lower speed DI and it can be done via Modbus Boolean write. This value must be lower than maximum speed.

05 RAISE SPEED RATE ***2.5 (0.1, 1000.0)**
It is the speed setpoint increase rate for mechanical loads (RPM/S) when using DI commands or Modbus (Raise/Lower commands). Modbus commands have a programmable pulse time. See item B-11.

06 LOWER SPEED RATE ***2.5 (0.1, 1000.0)**
It is the speed setpoint decrease rate for mechanical loads (RPM/S) when using DI commands or Modbus (Raise/Lower commands). Modbus commands have a programmable pulse time. See item B-12.

07 REMOTE RATE ***2.5 (0.1, 1000.0)**
If both Raise/Lower DI are closed via Hardware or using a specific Modbus this field will provide the speed setpoint change rate applied to the value received via 4–20 mA input. This parameter is applicable for mechanical loads.

08 MODBUS RATE ***2.5 (0.1, 1000.0)**
When the Modbus Communications are active, there is one Boolean write that will activate the speed setpoint reference via an Analog Write. Then, the speed setpoint will increase or decrease to reach the wrote value observing the rate programmed here.

09 SPEED THRESHOLD ***100.0 (100.0, 250.0)**
Minimum Value Speed. Below this value, the software will understand a Loss of MPU signal and only the Automatic Mode will be possible, ignoring the master speed control state. In this case and with the master speed control in trip state, the Emergency Start Sequence is available and permissive (the Emergency Start Sequence will not be possible if it is solicited a stroke on the actuator or on the analog output or if it’s wanted to force relays).

10 USE kW DROOP? *FALSE

When 2300 CLM is running at manual mode, the driven load has been programmed for generator and the CB AUX input is TRUE, the software will understand that the generator must be controlled in Droop Mode. The kW Droop can be used only with TP and TC connected. If the software does not detect a valid kW reading, automatically it will switch to actuator droop.

Lets imagine that the generator is working in parallel mode with the grid or other turbine/engine. To program actuator droop (kW Droop=FALSE) means that the valve/actuator will assume a fixed position and the kW can change. The actuator droop is very useful when to control the fuel/steam demand has a high priority because the software will ignore the kW changes caused by disturbances at temperature, pressure, air, etc. Other situation is when is needed to have a stable kW generation independently of the fuel/steam consumption. If this is desired operational condition set true to kW Droop.

As a simple explanation, the actuator Droop provides a fixed valve/actuator position and the Load (kW) can change. The kW Droop provides a fixed kW value and the valve position can change.

11 MODBUS RAISE PULSE (s) *1.0 (0.1, 10.0)

Time delay at DCS systems can be a problem with these types of command. It is not possible to assure that each pulse (TRUE TIME) will be always the same and in most cases, these pulses have a low time delay (100–500 ms). To provide a stable and predictive action, when the Modbus Boolean Write Command is used to change the speed setpoint, the pulse time to the 2300 CLM speed setpoint block will use a pulse with the time programmed here. It will provide a very predictive response. In example, if the rate to raise speed is 2 RPM/S and the MODBUS RAISE PULSE(s) is programmed for 0.5 s, when a Boolean Write Command is sent to increase the speed/load, it does not matter if s this pulse was sent during 0.1 s, 0.5 s, 2 s, 10 s. The internal pulse generated by the software to move the setpoint will be the value programmed here. Using at this example (Rate=2, Time Pulse=0.5 s) the speed setpoint will change exactly 1 RPM.
This pulse is activated with a state change from False to True. It means that after each command, it is necessary to return to False and set to True again to validate a new command. It is not state sensitive, it is a positive edge sensitive command.

12 MODBUS LOWER PULSE (s) *1.0 (0.1, 10.0)

The same concept from field 11 to decrease the speed setpoint.

13 RECOVER RATE *10.0 (0.1, 1000.0)

This rate is used when the speed of the engine is below the minimum governor speed (for mechanical loads) or below synchronous speed (for electrical loads) and there is a problem in the main speed controller. At this point the control changes to the 2300 CLM and the speed reference goes to the minimum governor speed (for mechanical loads) or to the synchronous speed (for electrical loads) at this rate.

C**GENERATOR APPLICATION**

01 DROOP (%) ***5.0 (0.0, 10.0)**
This is the kW or Actuator Droop for generators applications. Used when the generator is in parallel to the grid or other isochronous machine.

02 DROOP ADJUST (RPM) ***15.0 (0.0, 100.0)**
This is an additional adjust to make sure that at rated power the actuator will be opened 100%. If it's not wanted set it to zero.

03 RAISE LOAD RATE ***10.0 (0.1, 1000.0)**
Using DI commands or Modbus Commands, this is the Raise Load Rate that will be applied to increase the Load. The pulse time for this application is the same of Service B-11 when is has been sent via Modbus.

04 LOWER LOAD RATE ***10.0 (0.1, 1000.0)**
Using DI commands or Modbus Commands, this is the Lower Load Rate that will be applied to decrease the Load. The pulse time for this application is the same of Service B-11 when it has been sent via Modbus.

05 REMOTE LOAD RATE ***10.0 (0.1, 1000.0)**
Closing either Raise/Lower DI or Modbus BW the load reference will be controlled via 4–20 mA input. The load change rate will be the value programmed here.

06 MODBUS LOAD RATE ***10.0 (0.1, 1000.0)**
When using an analog write via Modbus to change the setpoint at manual mode, the load reference sent via a Modbus Analog Write will move the setpoint at the rate programmed here.

07 SYNCHRONOUS SPEED ***1800.0 (100.0, 15000.0)**
This is the synchronous speed of the generator. It depends of the frequency and number of poles of generator and the gear. It is programmed in function of the MPU signal. The MPU can be installed at the generator or at the prime mover, if there is a gear installed.

08 USE MINIMUM BIAS? ***TRUE (TRUE, FALSE)**
When the transfer from the main speed controller occurs maybe it's desired that the engine absorbs a little more active power just to prevent reverse power in case of a fail in the main speed controller occurs and the active power of the engine is too low. This parameter says if it will be used a little increment on the load when a transference from the main speed controller to the 2300 CLM occurs.

09 MINIMUM BIAS (RPM) ***5.0 (0.0,100.0)**
This is the value incremented to speed reference when a transference from the main speed controller to the 2300 CLM occurs to prevent reverse power on the engine.

D**CALIBRATION**

01 ACTUATOR INPUT GAIN ***1.0 (0.0, 10.0)**
Use this field to match the actuator input current (measured) with the current shown at field D-03. Use 3 or 4 test points to calibrate. Fields D-01 and D-02 works together. Adjust both at same time.

02 ACTUATOR INPUT OFFSET ***0.0 (-100.0, 100.0)**
With zero mA input the field D-03 must indicate 0 mA and use this field to provide this value. It works with D-01 at same time and so, to have a correct adjustment use 0%-50%-100% of actuator output obtained via main speed controller to have a identical response of sensed current (D-03) in comparison of the current sent by the master speed control.

03 ACT CURRENT SENSED (mA)
Indication only. It will inform the current that the 2300 CLM is reading and processing. It must be exactly the same current sent by the master at any position demand.

04 ANALOG INPUT GAIN ***1.0 (0.0, 10.0)**
Use this field to match the analog input current (measured) with the current shown at field D-06. Use 3 or 4 test points to calibrate. Fields D-04 and D-05 works together. Adjust both at same time. It is necessary a milliamp generator to send many points between 4–20 mA to calibrate this input.

05 ANALOG INPUT OFFSET ***0.0 (-20.0, 20.0)**
With zero mA input the field D-06 must indicate 0 mA and use this field to provide this value. It works with D-04 at same time and so, to have a correct adjustment use 0%-50%-100% at the input to have a identical response of sensed current (D-06) in comparison of the current sent by current generator.

06 ANALOG INPUT SENSED (mA)
Indication only. This field must inform the same current at the 2300 CLM analog input.

07 STROKE ACTUATOR? ***FALSE (TRUE, FALSE)**
If the prime mover is stopped and the 2300 CLM and the main speed controller are tripped, set true to enable the actuator stroke for testing and calibration. Be sure that the steam valve is shut off.

08 STROKE ENABLED
Will indicate if the stroke actuation is enabled or not.

09 ACTUATOR OUTPUT (mA)
This field indicates the actuator output demand at 2300 CLM measured in milliamps.

10 ACTUATOR POSITION (%) ***(0.0, 100.0)**
With D-08 indicating TRUE, use this field to change the HP (ACT) position. The conditions for stroking the actuator must be fulfilled (see parameter D-07), otherwise this function will be automatically disabled.

11 ACTUATOR OUTPUT GAIN ***1.0 (0.01, 10.0)**
This value is the multiplier applied at the block output. It is the multiplier for the position demand received by the hardware driver. The calibration requires adjusting the zero output value and the output scale. This value (gain) is used at scale and the next one (D-12) is used to offset null. The actuator position is given by the equation:

MA_OUT=POS_DEM*GAIN+OFFSET

POS_DEM is the input value at driver output (0-100%)

The current at the actuator input must be equal to the actuator output.

12 ACTUATOR OUTPUT OFFSET ***0.0 (-20.0, 20.0)**
It is used to adjust the min current output for zero input. If the input is 0% the actuator output must generate the min current. Use this field to adjust the output driver to this condition.
Keep in mind that both gain and offset can change the output. Use one and other until adjust the output driver.

13 FORCE ANALOG OUT? ***FALSE (TRUE, FALSE)**
Set TRUE to manually change the output demand at the 4–20 mA output. Used for calibration purposes. The conditions to stroke the analog output are the same that the ones to stroke the actuator.

14 ANALOG FORCE ENABLED
Will indicate if the stroke actuation is enabled or not.

15 ANALOG OUT VALUE (%) ***0.0 (0.0, 100.0)**
Enter the desired position (0%=min current and 100%=max current). Only active if D-14 is TRUE

16 ANALOG OUT GAIN ***1.0 (0.01, 100.0)**
Used to calibrate the output in function of the entered position.

17 ANALOG OUT OFFSET ***0.0 (-100.0, 100.0)**
Used together D-16 to provide a correct output (mA values) in function of the desired output demand.

18 ANALOG OUT MIN CURRENT ***4.0 (0.0, 20.0)**
It is the current at 4–20 mA output when the desired position is 0%

19 ANALOG OUT MAX CURRENT ***20.0 (0.0, 22.0)**
The same concept of the field above, applied to 100%

E**MONITOR FUNC IN STATUS**

01 TRIP FROM SC
If this parameter is closed it means that there is a trip at main speed controller. To work properly the digital input A must indicate a FALSE status in case of a trip on the main controller.

02 2300 CLM TRIP
If this parameter is closed it means that no trip is being sent to 2300 CLM. In case of a trip on the 2300 CLM this field will indicate FALSE.

03 CB AUX
It will indicate the direct state of digital input C. A true indication will inform that the generator is at droop mode. It has no effect if the 2300 CLM was not configured for generator application.

04 RAISE SPEED/LOAD
Indicates the state of digital input D (True=Closed, False=Open)

05 LOWER SPEED/LOAD
Indicates the state of digital input E (True=Closed, False=Open)

06 FORCE AUTO / EMERG START
Indicates the state of digital input F (True=Closed, False=Open).

This input has 2 functions. It is used to force the 2300 CLM to Automatic Mode.

If the prime mover is stopped, always will be at automatic mode. Other situation is that the emergency start sequence is only possible with the prime mover stopped. It can be seen that these two situations have a logic of XOR (exclusive OR). The valid state for one automatically disables the other one. Since this, it was implemented two functions for this input.

A) If the control mode is Manual and the trip relay from master speed control is closed, it is possible to return the control from 2300 CLM to master speed control without the actuator input x actuator output matching criteria. At the same time it is impossible to do an emergency start sequence. While running in manual mode, this input will force to automatic mode if the conditions explained are valid.
B) If the prime mover is stopped (0 RPM) automatically the control mode will be automatic. If the trip relay is open (master tripped) or the actuator current from the master is out of range, one pulse of at least 5 seconds at this input will start to open the actuator, at a programmed rate and until a programmed maximum value. When the prime mover starts to run the 2300 CLM will detect the speed threshold and will switch to manual mode and will continue the start sequence until the rated/synch speed.

07 RESET
Indicates the state of digital input G (True=Closed, False=Open).
The alarm reset will eliminate any alarm or trip state:

- Loss of MPU Trip
- 2300 CLM TRIP (External Trip)
- Overspeed trip.
- Analog Inputs, Load Sensor failed

F**RELAYS**

01 CPU OK RELAY CLOSED
Indicates the state of digital output #1. It will be closed if the 2300 CLM has no hardware problems but it can be switched off using a Modbus command, to eliminate 2300 CLM from the actuator loop if this situation is desired.

02 TRIP RELAY CLOSED
An external trip command or overspeed trip occurred, indicated at digital output #2. The actuator output will be 0 mA and it does not depend of the state or actuator demand of main speed controller. To eliminate the trip condition and a reset command must be used. It energizes to trip.

03 RELAY #3 CLOSED
Will indicate the state of programmable digital output #3

04 RELAY #3 FUNCTION ***1 (1, 6)**
This is a configurable relay and may have one of the four functions described on the following item.

05 RELAY #3 PROG FOR
The options (1 up to 6) for digital output #3 are:

1) Auto/Man Indicator

Using this function, this digital output will be closed for Manual State and Open for Automatic State.

2) OSC transfer Indicator

This is an oscillator that indicates how far the transfer from Manual to Automatic is. When in Manual mode and the main speed controller is ready to control the machine again this output starts to emit pulses with frequency proportional to the difference between the actuator input (sent by the main speed controller) and the actuator output (sent by the internal PID of the 2300 CLM). When this difference is big the pulses have a slower frequency, when the difference is small the frequency of the pulses is faster. When the transference is finished the output doesn't send pulses anymore.

03) Alarm/Event Indicator

To indicate what alarm is active (it can be more than one alarm) flashes will indicate the alarm number. If there is more than one alarm, one pause between the flashes will separate the alarms. Observing the number of flashes and the pause between them, all alarms active will be indicated.

1 pulse = Manual Mode Active
2 pulses = Overspeed Trip
3 pulses = Modbus Link Failure
4 pulses = Remote Reference failed
5 pulses = Real Power Sensor Failed (Reverse Power)
6 pulses = Loss of MPU

04) Speed Switch

Programming for this function, the fields number 10 and 11 will determinate when the digital output activates and de-activates in function of the actual speed (MPU).

05) Auto Raise Setpoint

This function is used to program the configurable relay #3 to automatically send raise speed pulses to the main speed controller to perform an automatic transfer from Manual to Automatic Mode. See service menu R.

06) Auto Lower Setpoint

This function is used to program the configurable relay #3 to automatically send lower speed pulses to the main speed controller to perform an automatic transfer from Manual to Automatic Mode. See service menu R.

06 RELAY #4 CLOSED
Will indicate the state of programmable digital output #4.

07 RELAY #4 FUNCTION ***1 (1, 6)**
This is a configurable relay and may have the same functions of configurable relay 4.

08 RELAY #4 PROG FOR
Will indicate the current selection for relay 4, with the functions explained on item F-5.

09 LEVEL RLY SW ON ***1000.0 (0.0, 15000.0)**
Set the speed (MPU) that will turn on the relay output. Active if relay 03 is programmed for level switch.

10 LEVEL RLY SW OFF ***2000.0 (0.0, 15000.0)**
Set the speed (MPU) that will turn off the relay output. Active if relay 04 is programmed for level switch.

11 LEVEL SWITCH ON?
It indicates if the speed switch is activated.

G**ANALOG OUTPUT**

01 ANALOG OUTPUT SEL ***1 (1, 8)**
The options listed will be available at analog output (readout) with a programmed range:
1) Actual Speed
2) Speed Reference
3) Actuator Input (mA)
4) Actuator Output (mA)
5) PID output (0-100%)
6) Remote Reference (Units)
7) Read kW
8) Absolute Actuator Difference Between Input and Output (%)

02 ANALOG OUTPUT USED FOR
It will indicate (string) the option selected and described at the field above.

03 4 mA VALUE ***1000.0 (0.0, 30000.0)**
The value that generates 4 mA output for the programmed readout.

04 20 mA VALUE ***2000.0 (0.0, 30000.0)**
The value that generates 20 mA output for the programmed readout.

H**FORCE RELAYS**

01 FORCE OUTPUTS? ***FALSE**
Set true to force relays output. The only way to force relays is the prime mover is stopped and the main speed controller and the 2300 CLM are tripped.

02 FORCE ENABLED
It will indicate if the force relays command was accepted or not.

03 DO#1 ***FALSE**
Used to turn on/off this relay output when in force mode.

04 DO#2 ***FALSE**
Used to turn on/off this relay output when in force mode.

05 DO#3 ***FALSE**
Used to turn on/off this relay output when in force mode.

06 DO#4 ***FALSE**
Used to turn on/off this relay output when in force mode.

I**REAL POWER SENSOR**

01 RPS GAIN ***13.0 (5.0, 40.0)**
For generators, adjust these values if kW droop is used and since this, TC and TP are installed. Using one kW meter, adjust the gain value to have a correct measurement of active power. It can be necessary to adjust offset and gain together to have a correct calibration. The gain value must be used with some load at generator.

02 RPS OFFSET ***0.0 (-20.0, 20.0)**
With voltages at TP and TC at zero adjust this field to 0 kW indication.

03 GENERATOR OUTPUT (kW)
Will reflect the active power read in function of the active power and the adjustments above.

J**COMM PORT (MODBUS)**

01 PORT FAIL
Indicates a hardware fault of RS-232/RS-422 communication port.

02 LINK ERROR
Indicates that slave fails to answer a data request in specified number of time-out seconds.

03 ERROR PERCENT
Error outputs reflect communication quality as a percentage by dividing the number of exception error detected by the total number of communication transactions. This essentially gives the number of message/packet errors detected.

04 ERROR NUMBER
Error number outputs the code number of the communication/exception error that occurred.

00 (No Error) = Error Free
01 (ILLEGAL FUNCTION) = Message function received is not an allowable action for addressed slave. (Unsupported or illegal functional code)
02 (ILLEGAL DATA ADDRESS) = Address referenced in data field is not an allowable address for the addressed slave location. (Master requested data, which is not configured from slave)
03 (ILLEGAL DATA VALUE) = Amount of data requested from slave was too large for slave to return a single response. Woodward maximum is 118 registers
09 (CHECKSUM ERROR) = Error in the checksum. Can indicate link quality and/or noise problems.
10 GARBLED MESSAGE = Data received by the slave, but it is too short to be a valid Modbus message/command

05 BAUD RATE ***10 (1, 10)**
Set the Baud Rate, which defines the transfer rate for port communications.
1=110
2=300
3=600
4=1200
5=1800
6=2400
7=4800
8=9600
9=19200
10=38400

06 BAUD RATE IS SET FOR
Show the selected Baud Rate.

07 DATA BITS ***2 (1, 2)**
Set the Data bits input defines the protocol for the number of data bits in the data packets.
1=7
2=8

08 DATA BITS ARE SET FOR
Shows the selected data bits.

09 STOP BITS ***1 (1, 3)**
Set the Stop bits, which defines the number of stop bits for the communications protocol. Stop bits specify the time that elapses between transmitted characters.
1=1 Stop Bit
2=2 Stop Bits
3=1.5 Stop Bit

10 STOP BITS ARE SET FOR
Show the selected stop bits setting

11 PARITY ***1 (1, 3)**
Set the Parity input defines protocol for the parity. If you selected 8 data bits select “1” for none.
1=OFF (None)
2=ODD
3=EVEN

12 PARITY IS SET FOR
Shows the parity setting.

13 DRIVER ***1 (1, 2)**
Set the driver input defines the type of driver output for this port.
1=RS-232
2=RS-422

14 DRIVER IS SET FOR
Shows the selected driver

15 TIME OUT (SEC) ***4.0 (0.0, 100.0)**
Set the Time-out Number of seconds input defines the Modbus link dead time allowed before a link error occurs.

16 NETWORK ADDRESS ***1 (1, 247)**
Set the Network Address input defines the slave block address on the Modbus network. The network address may depend on master device allowable addresses.

17 kW MULTIPLIER ***1.0 (0.01, 1000.0)**
Modbus can indicate numbers from –32767 to +32678. The analog value read via Modbus can be multiplied by this number to increase the definition.

18 ANALOG INPUT MULTIPLIER ***1.0 (0.01, 1000.0)**
The value of the analog input can be read via Modbus multiplied by this value.

19 ANALOG OUTPUT MULTIPLIER ***100.0 (0.1, 1000.0)**
The value of the analog output can be read via Modbus multiplied by this value.

20 ACTIVATE MODBUS TRIG ***FALSE**
Use this command (rising edge) to leave ServLink mode when use Modbus comm was programmed TRUE, otherwise this mode will be locked and Modbus comm will be blocked. If the field below (21) if false, this command is not necessary because the ServLink mode will be always active. If you enter in ServLink it's mandatory to activate this parameter before trying to communicate via Modbus, otherwise the Modbus communication will not be possible.

21 USE MODBUS COMM? ***FALSE**
Set true if Modbus comm will be used.

K**DISPLAY MENU**

01 AUTOMATIC MODE
Will indicate if the control mode is automatic or not.

02 SPEED SETPOINT
Actual speed setpoint. At automatic mode will be tracking the actual speed, in manual mode is the setpoint at 2300 CLM control loop.

03 ACTUAL SPEED
Indicates the prime mover speed (RPM).

04 ACTUATOR INPUT (mA)
Indicates the actuator input in milliamps.

05 ACTUATOR OUTPUT (mA)
Indicates the actuator output in milliamps.

06 GENERATOR OUTPUT (kW)
Indicates the active power if the driven load is a generator.

07 ANALOG OUT (UNITS)
Reflects the analog output. The unit depends of the option chose for this readout.

08 REMOTE INPUT (RPM)
Indicates the remote speed reference.

09 SPEED REF (GEN)
With generators will indicate the virtual speed setpoint, that is the value before droop calculations or the synchronous speed at frequency control mode (CB Aux Open)

10 SPEED PID OUTPUT (%)
Indicates the speed PID output, when active at manual mode. At manual mode, it is equal to proportional demand from the actuator input (tracking mode forced by the automatic mode condition).

11 USING GAIN RATIO
If the PID error is greater than the programmed value for gain window, this field will indicate if the Kp is being multiplied by the gain ratio value or not. It is a Boolean indication (True or False).

12 PROP GAIN AT PID
Will indicate the effective gain at PID controller that is the programmed Kp value multiplied by the gain ratio, when it is activated by a PID error greater than the error window.

L**ALARMS**

01 EXTERNAL TRIP
Indicates if an external trip (2300 CLM tripped) is active. In this case the actuator output will be 0 mA at manual or automatic mode. A reset command is necessary.

02 OVERSPEED
An overspeed trip was detected. In this case, the actuator output is 0 mA. The controller is blocked and must be reset.

03 4–20 mA INPUT FAIL
It was detected that the remote input is receiving a current out of range. This input will be checked only if the remote reference is available.

04 LOAD SENSOR FAIL
Reverse Power Indication. Active for generators only.

05 LOSS OF MPU
Loss of MPU indication. This is active only if the loss of MPU occurs when in control by 2300 CLM.

06 RESET ALARMS ***FALSE**
All alarms, when detected, are latched and will block the functions related to them. It is necessary to eliminate the fail and reset. Modbus, DI, and Watch Window can do that. In this case, it is possible to reset the alarms at this field.

M**EMERGENCY START**

01 ACTUATOR RATE ***5.0 (0.01, 100.0)**
If the conditions below are true:
1) Prime mover stopped;
2) Main speed controller tripped;
3) Actuator or analog output stroke not active.

it is possible to use an emergency start sequence. In this case, this field will determine the rate what the actuator position will be increased to re-start the prime mover in emergency conditions.

Hold digital input F closed for more than 5 seconds, Modbus Command or ServLink Trigger to start this sequence.

02 OVERRIDE SPEED (RPM) ***500.0 (300.0, 1000.0)**
The actuator position will be increased until the value programmed here is sensed. Reaching this value, the PID will start to control the actuator and the ramp will be stopped.

03 MAX ACT POS AT STRT (%) ***20.0 (0.0, 100.0)**
It is the maximum position for emergency start. If the actuator reaches this value and the override speed was not reached, the actuator will return to 0% and a new command to emergency start sequence must be sent.

04 START TRIGGER ***FALSE**
It is the start trigger for emergency start via Watch Window.

05 START SPEED ***1000.0 (100.0, 15000.0)**
It is the setpoint that the speed PID will use after detecting the override speed at emergency start sequence (First Setpoint).

06 LOW IDLE SPEED ***1200.0 (100.0, 15000.0)**
It is the second setpoint used after reaching the start speed at the emergency start sequence.

07 HI IDLE SPEED ***1500.0 (100.0, 15000.0)**
It is the third setpoint used after reaching the low idle speed

08 RATED/SYNC SPEED ***1800.0 (1000.0, 15000.0)**
It is the value of Rated or Synchronous Speed after reaching the Hi Idle Setpoint. It is the last setpoint used by the emergency start sequence.

09 START-LOW IDLE RATE ***20.0 (1.0, 1000.0)**
It is the rate of setpoint change from Start Speed to Low Idle Speed.

10 LOW-HI IDLE RATE ***20.0 (1.0, 1000.0)**
It is the rate of setpoint change from Low Idle to High Idle Speed.

11 HI IDLE-RATED/SYNC RATE ***20.0 (1.0, 1000.0)**
It is the rate of setpoint change from Hi Idle to Rated/Synchronous Speed.

IMPORTANT

After reaching each setpoint, the start sequence will continue to the next setpoint after receiving a Raise Speed (Digital Input or Modbus). During this process is possible to transfer to master (Automatic Mode) if the required conditions are active.

N**MONITOR DI STATUS**

01 DIGITAL INPUT #1
Indicates if digital input #1 is opened (FALSE) or closed (TRUE).

02 DIGITAL INPUT #2
Indicates if digital input #2 is opened (FALSE) or closed (TRUE).

03 DIGITAL INPUT #3
Indicates if digital input #3 is opened (FALSE) or closed (TRUE).

04 DIGITAL INPUT #4
Indicates if digital input #1 is opened (FALSE) or closed (TRUE).

05 DIGITAL INPUT #5
Indicates if digital input #5 is opened (FALSE) or closed (TRUE).

06 DIGITAL INPUT #6
Indicates if digital input #6 is opened (FALSE) or closed (TRUE).

07 DIGITAL INPUT #7
Indicates if digital input #7 is opened (FALSE) or closed (TRUE).

O**SPEED PID**

01 PROPORTIONAL GAIN ***3.2 (0.01, 50.0)**
Proportional Gain of 2300 CLM PID. It represents the amount of actuator action in function of the error value.

02 INTEGRAL GAIN ***0.5 (0.01, 50.0)**
It is Integration Time. The integral value is the time during the error is integrated and is responsible to eliminate the stationary error, but high values can impose a delay at the response and the system will start to oscillate. This value is also multiplied by proportional gain.

03 S_D_R ***5.0 (0.01, 100.0)**
Speed Derivation Ratio. The derivation is responsible by the predictive action of controller. Values between 0.01 and 1 provide an input dominant action and values between 1 and 100 provide a feedback dominant action. If PI controller is desired, set 100 at this field

04 GAIN RATIO ***1.0 (0.01, 10.0)**
It is the value that will multiply the Proportional Gain when the speed error is greater that error window.

05 ERROR WINDOW (RPM) ***10.0 (0.0, 500.0)**
When the difference of actual speed and speed setpoint is greater than this value, the proportional gain at PID will be multiplied by the gain ratio value

IMPORTANT **All PID actions are only active in Manual Mode.**

P**ACTUATOR TRANSFER**

01 MAX ACT DIFF ON TRANSFR ***1.0 (1.0, 5.0)**
This is the maximum actuator difference between actuator input and output allowed to perform an automatic transfer from the 2300 CLM and the main controller.

02 ACT DLY ON AUTO TRANSFR ***0.1 (0.05, 1.0)**
This is the minimum time (in seconds) that the above parameter must be maintained to perform an automatic transfer from the 2300 CLM and the main controller.

03 MAX ACT DIFF ON FRC AUTO ***5.0 (0.5, 30.0)**
This is the maximum actuator difference between actuator input and output allowed to perform a force to automatic mode command.

Q**TIME DELAY**

01 SELECT TIME DELAY (MPU) ***4 (1, 7)**
At the moment of the trip, the speed can change and it could be a problem to keep the exact setpoint before the fail. Because this situation, it is possible to use the sensed value from 0 up to 0.96 s before the fail, in intervals of 0.16 s. Set the option at this field.

02 TIME DELAY FOR MPU
Will indicate the time delay at MPU. It means that if was programmed 0.16 s for this delay, the speed value considered by the 2300 CLM will be the speed read 0.16 s before the fail has been detected.

03 SELECT TIME DELAY (ACT) ***4 (1, 7)**
The same concept of fields above applied to the actuator demand.

04 TIME DELAY FOR ACT/kW
Will indicate the time delay selected for this variable. It can be Act demand or kW load depending of the droop mode selected.

R**AUTO RAISE/LOWER**

01 USE AUTO RAISE/LOWER? ***FALSE**
This item enables the auto raise/lower function. This function will manage the raise/lower pulses to the main speed controller or the load controller in order to help the transference from manual to automatic mode. If this parameter is set to TRUE and the programmable relays #3 and #4 are programmed to Auto Raise Setpoint and Auto Lower Setpoint there's no need to increase /decrease the speed/load setpoint in the main speed controller/load controller in order to transfer the 2300 CLM from Manual mode to Automatic mode; the 2300 CLM will do that job since the raise/lower outputs (programmable outputs #3 and #4) of the 2300 CLM are tied to the raise/lower speed/load of the main speed controller/load control.

02 DELAY FOR ACTION? *5.0 (0.0, 60.0)

After all the conditions of the auto raise/lower logic are fulfilled this parameter defines the delay (in minutes) for the raise/lower pulses to start acting. The conditions to start counting this delay are:

1) The control is in Manual Mode (controlled by the 2300 CLM)
2) There is no mere trip signal coming from the main speed controller.
3) The parameter 1 of this menu is set TRUE.

The definition of this parameter is important because some speed controllers don't do speed tracking when a start command is given and this time is used to wait until the speed reference of the main speed controller is in the minimum governor/synchronous value before start controlling the raise and lower programmable relays.

03 AUTO RAISE/LOWER STATUS

This item shows the status of the auto raise/lower logic. It can show one of the following four status:

1) Not active: the auto raise/lower logic conditions are not fulfilled.
2) Active – Raising Setpoint: the auto raise/lower logic is active and sending a raise setpoint command.
3) Active – Lowering Setpoint: the auto raise/lower logic is active and sending a lower setpoint command.
4) Active – Pause: the auto raise/lower logic is active but it's sending neither a raise nor a lower setpoint command.

04 ACTUATOR DERIV SETPOINT *0.5 (0.1, 5.0)

This parameter defines the rate of change of the actuator of the main speed controller (in %/sec) that the auto raise/lower logic tries to control. A low value in this parameter implies that the transference from Manual to Automatic Mode will take more time, but the main speed controller speed/load setpoint will be just slightly different from the speed/load setpoint of the 2300 CLM. A higher value of this parameter implies that the transference from Manual to Automatic Mode will take less time, but the difference between the main speed controller speed/load and the 2300 CLM setpoint will be higher.

05 ACT DIFF HYSTERESIS *4.0 (1.0, 10.0)

This parameter defines the difference between the actuator input and the actuator output of the 2300 CLM, expressed in %, at which the auto raise/lower logic will invert its action. In other words, if the Actuator Deriv Setpoint is set to 0.5%/sec and the Act Diff Hysteresis is set to 4% then the control will try to maintain 0.5%/sec as the rate of change of the actuator of the main speed controller. If the actuator of the main speed controller becomes 4% higher than the actuator output of the 2300 CLM and the transference doesn't occur the Actuator Deriv Setpoint changes to –0.5%/sec, so the main speed controller actuator starts to lower in order to make the transference from Manual to Automatic Mode. If the actuator of the main speed controller becomes 4% lower than the actuator output of the 2300 CLM and the transference doesn't occur the Actuator Deriv Setpoint changes back to 0.5%/sec.

06 PULSE TIME (s) *1.5 (0.1, 10.0)

This parameter defines the pulse time, in seconds, of the raise or lower pulse for the main speed controller or the load controller.

07 TIME BETWEEN PULSES (s) *1.5 (0.1, 10.0)

This parameter defines the time between pulses, in seconds, of the raise or lower pulse for the main speed controller or the load controller.

Chapter 5. Communications

Modbus Communication

The 2300 CLM 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 CLM 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 5-1. 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 CLM control is programmed to function as a slave unit only. As a slave unit, the 2300 CLM will only respond to a transaction request by a master device. The 2300 CLM 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 (2300 CLMs or other customer devices) can be connected to one Master device on a single network. The control address is programmed under the 2300 CLM'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 5-2. 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.

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 5-3. Modbus Function Codes

Port Adjustments

Before the 2300 CLM 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	RS-232 or RS-422

Table 5-4. 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 6.
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.

Appendix A.
Modbus Communication List

Boolean Writes

Address	Description
0:0001	Set digital input A (trip from main speed controller)
0:0002	Reset digital input A (trip from main speed controller)
0:0003	Set/reset digital input B (shutdown)
0:0004	Raise speed/kW command (pulse)
0:0005	Lower speed/kW command (pulse)
0:0006	Remote reference enable (generator or mechanical load)
0:0007	Emergency start trigger
0:0008	Turn off CPU OK relay
0:0009	Reset alarms
0:0010	Force to Automatic Mode
0:0011	Use Modbus Reference (generator or mechanical load)

Boolean Reads

Address	Description
1:0001	Relay 01 state
1:0002	Relay 02 state
1:0003	Relay 03 state
1:0004	Relay 04 state
1:0005	Hardware input 01
1:0006	Hardware input 02
1:0007	Hardware input 03
1:0008	Hardware input 04
1:0009	Hardware input 05
1:0010	Hardware input 06
1:0011	Hardware input 07
1:0012	Manual Mode on
1:0013	At error window
1:0014	Trip from main speed controller
1:0015	2300 CLM shutdown
1:0016	CB Aux (Droop / Isochronous)
1:0017	Overspeed trip
1:0018	Actuator ramp at emergency start
1:0019	Remote reference fail
1:0020	Reverse power
1:0021	Raise speed/kW command
1:0022	Lower speed/kW command
1:0023	Loss of MPU trip
1:0024	Speed switch on?

Analog Reads

Address	Description	Multiplier
3:0001	Speed setpoint (generators)	1.0
3:0002	Actual speed (rpm)	1.0
3:0003	Reference at PID	1.0
3:0004	Actuator input (mA)	100
3:0005	Actuator output (mA)	100
3:0006	Remote reference (rpm)	*1.0 (0.01 1000)
3:0007	Analog output (mA)	*1.0 (0.01 1000)
3:0008	kW load	*1.0 (0.01 1000)
3:0009	PID output (0-100%)	100
3:0010	Mech setpoint ramp position	1
3:0011	Speed setpoint (mech loads)	1
3:0012	Main controller/2300 CLM actuator difference (0-100%)	100
3:0013	Generator setpoint ramp position	1

Analog Writes

Address	Description	Multiplier
4:0001	Speed setpoint (mechanical loads)	1
4:0002	Speed setpoint (generators)	1

Appendix B.
Service / Configure Chart

CONFIGURE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE	
			MINIMUM	MAXIMUM
ACONFIGURATION**				
01 Number of teeth		60	1	500
02 Type of actuator		2	1	2
03 Actuator range	Monitor			
04 Act out (4-20mA) LV		4	0	8
05 Act out (4-20mA) HV		20	0	50
06 Act out (0-200mA) LV		20	15	24
07 Act out (0-200mA) HV		160	100	200
08 Act in (4-20mA) LV		4	0	8
09 Act in (4-20mA) HV		20	0	50
10 Act in (0-200mA) LV		20	15	24
11 Act in (0-200mA) HV		160	100	200
12 Generator application?		FALSE	FALSE	TRUE
13 Overspeed trip (rpm)		5000	100	15000
14 Rated kW		1000	0	1000000
15 Reverse actuator?		FALSE	FALSE	TRUE

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE	
			MINIMUM	MAXIMUM
SERVLINK CONFIRMATION				
01 Set true to lock slink		FALSE	FALSE	TRUE
02 Set true to exit slink		FALSE	FALSE	TRUE
03 Time to enable	Monitor			
04 Disable timer	Monitor			
BSPEED SETPOINTS**				
01 Minimum speed		1000	100	15000
02 Maximum speed		4000	100	15000
03 4mA speed		1000	100	15000
04 20mA speed		4000	100	15000
05 Raise speed rate		2.5	0.1	1000
06 Lower speed rate		2.5	0.1	1000
07 Remote rate		2.5	0.1	1000
08 Modbus rate		2.5	0.1	1000
09 Speed threshold		100	100	250
10 Use kW droop?		FALSE	FALSE	TRUE
11 Mdbus raise pulse (s)		1	0.1	10
12 Mdbus lower pulse (s)		1	0.1	10
13 Recover Rate		10	0.1	1000

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE	
			MINIMUM	MAXIMUM
CGENERATOR APPLICATION****				
01 Droop (%)		5	0	10
02 Droop adjust (rpm)		15	0	100
03 Raise load rate		10	0.1	1000
04 Lower load rate		10	0.1	1000
05 Remote load rate		10	0.1	1000
06 Modbus load rate		10	0.1	1000
07 Synchronous speed		1800	100	15000
08 Use minimum bias?		TRUE	FALSE	TRUE
09 Minimum bias (rpm)		5	0	100
DCALIBRATION****				
01 Actuator input gain		1	0	10
02 Actuator input offset		0	-100	100
03 Act current sensed (mA)	Monitor			
04 Analog input gain		1	0	10
05 Analog input offset		0	-20	20
06 Analog input sensed (mA)	Monitor			
07 Stroke actuator?		FALSE	FALSE	TRUE
08 Stroke enabled	Monitor			
09 Actuator output (mA)	Monitor			
10 Actuator position (%)		0	0	100
11 Actuator output gain		1	0.01	10
12 Actuator output offset		0	-20	20
13 Force analog out?		FALSE	FALSE	TRUE
14 Analog force enabled	Monitor			
15 Analog out value (%)		0	0	100
16 Analog out gain		1	0.01	100
17 Analog out offset		0	-100	100
18 Analog out min current		4	0	20
19 Analog out max current		20	0	22
EMONITOR FUNC IN STATUS****				
01 Trip from SC	Monitor			
02 2300 CLM trip	Monitor			
03 CB_Aux	Monitor			
04 Raise speed/load	Monitor			
05 Lower speed/load	Monitor			
06 Force auto / emerg start	Monitor			
07 Reset	Monitor			

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE	
			MINIMUM	MAXIMUM
FRELAYS****				
01 CPU OK relay closed	Monitor			
02 Trip relay closed	Monitor			
03 Relay #3 closed	Monitor			
04 Relay #3 function		1	1	6
05 Relay #3 prog for	Monitor			
06 Relay #4 closed	Monitor			
07 Relay #4 function		1	1	6
08 Relay #4 prog for	Monitor			
09 Level rly sw on		2000	0	15000
10 Level rly sw off		1000	0	15000
11 Level switch on?	Monitor			
GANALOG OUTPUT****				
01 Analog output sel		1	1	7
02 Analog output used for	Monitor			
03 4mA value		1000	0	30000
04 20mA value		1000	0	30000
HFORCE RELAYS****				
01 Force outputs?		FALSE	FALSE	TRUE
02 Force enabled	Monitor			
03 DO#1		FALSE	FALSE	TRUE
04 DO#2		FALSE	FALSE	TRUE
05 DO#3		FALSE	FALSE	TRUE
06 DO#4		FALSE	FALSE	TRUE
IREAL POWER SENSOR****				
01 RPS gain		13	5	40
02 RPS offset		0	-20	20
03 Generator output (kW)	Monitor			

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE	
			MINIMUM	MAXIMUM
JCOMM PORT (MODBUS)****				
01 Port fail	Monitor			
02 Link error	Monitor			
03 Error percent	Monitor			
04 Error number	Monitor			
05 Baud rate		10	1	10
06 Baud rate is set for	Monitor			
07 Data bits		2	1	2
08 Data bits are set for	Monitor			
09 Stop bits		1	1	3
10 Stop bits are set for	Monitor			
11 Parity		1	1	3
12 Parity is set for	Monitor			
13 Driver		1	1	2
14 Driver is set for	Monitor			
15 Time out (sec)		4	1	10
16 Network address		1	1	247
17 kW multiplier		1	0.01	1000
18 Analog in multiplier		1	0.01	1000
19 Analog out multiplier		1	0.01	1000
20 Activate modbus trig		FALSE	FALSE	TRUE
21 Use modbus comm?		TRUE	FALSE	TRUE
KDISPLAY MENU****				
01 Automatic Mode	Monitor			
02 Speed setpoint	Monitor			
03 Actual speed	Monitor			
04 Actuator input (mA)	Monitor			
05 Actuator output (mA)	Monitor			
06 Generator output (kW)	Monitor			
07 Analog out (units)	Monitor			
08 Remote input (rpm)	Monitor			
09 Speed ref gen	Monitor			
10 Speed PID output (%)	Monitor			
11 Using gain ratio	Monitor			
12 Prop gain at PID	Monitor			
LALARMS****				
01 External trip	Monitor			
02 Overspeed	Monitor			
03 4-20mA input fail	Monitor			
04 Load sensor fail	Monitor			
05 Loss of MPU	Monitor			
06 Reset alarms		FALSE	FALSE	TRUE

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE	
			MINIMUM	MAXIMUM
MEMERGENCY START****				
01 Actuator rate		5	0.01	100
02 Override speed (rpm)		500	300	1000
03 Max act pos at strt (%)		20	0	100
04 Start trigger		FALSE	FALSE	TRUE
05 Start speed		1000	100	15000
06 Low idle speed		1200	100	15000
07 High idle speed		1500	100	15000
08 Rated/sync speed		1800	1000	15000
09 Start-low idle rate		20	1	1000
10 Low-high idle rate		20	1	1000
11 Hi idle-rated/sync rate		20	1	1000
NMONITOR DI STATUS****				
01 Digital Input #1	Monitor			
02 Digital Input #2	Monitor			
03 Digital Input #3	Monitor			
04 Digital Input #4	Monitor			
05 Digital Input #5	Monitor			
06 Digital Input #6	Monitor			
07 Digital Input #7	Monitor			
OSPEED PID****				
01 Proportional gain		3.2	0.01	50
02 Integral gain		0.5	0.01	50
03 S_D_R		5	0.01	100
04 Gain ratio		1	0.01	10
05 Error window (rpm)		10	0	500
PTRANSFER ACTUATOR****				
01 Max Act difference on transfer		0.5	0.1	5
02 Act delay on auto transfer		0.1	0.05	1
03 Max Act difference on ForceAuto		5	0.5	30
QTIME DELAY****				
01 Select time delay (MPU)		4	1	7
02 Time delay for MPU	Monitor			
03 Select time delay (ACT)		4	1	7
04 Time delay for ACT/kW	Monitor			
RAUTO RAISE/LOWER****				
01 Use Auto Raise/Lower?				
02 Delay for Action				
03 Auto Raise/Lower Status	Monitor			
04 Actuator Deriv Setpoint		0.5	0.1	5
05 Act Diff Hysteresis		4	1	10
06 Pulse Time (s)		1.5	0.1	10
07 Time Between Pulses (s)		1.5	0.1	10

2300 CLM Control Specifications

Woodward Part Numbers:	
8237-1132	2300 CLM certified for ordinary locations
8237-1155	2300 CLM 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)

Regulatory Compliance

European Compliance for CE Mark:

EMC Directive	Declared to 89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the member states relating to electromagnetic compatibility.
Low Voltage Directive	Declared to the 73/23/EEC COUNCIL DIRECTIVE of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

Marine Compliance:

Bureau Veritas	BV Rules Part C, June 2000
Germanischer Lloyd	Additional Rules and Guidelines, Part 1, 2001
Lloyd's Register of Shipping	Type Approval System, Test Specification Number 1, 2002
NOTE	These certifications apply to specific models only.

North American Compliance:

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

This listing is limited only to those units bearing the CSA agency identification and hazardous location markings.

CSA:	CSA Certified for Ordinary Locations. For use in Canada and the United States Certificate 1150575
UL:	UL Listed for Ordinary Locations. For use in Canada and the United States. UL File E97763
NOTE	Wiring must be in accordance with applicable electric codes with the authority having jurisdiction.

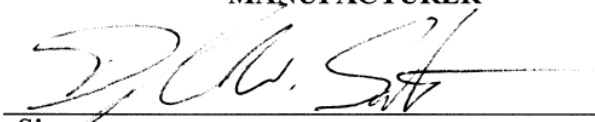
Declarations

DECLARATION OF CONFORMITY
According to EN 45014

Manufacturer's Name:	WOODWARD GOVERNOR COMPANY (WGC) Industrial Controls Group
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	2300 / 2300-059, 2300-061 and similar
Conformance to Directive(s):	89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility. 73/23/EEC COUNCIL DIRECTIVE of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.
Applicable Standards:	EN61000-6-4, 2001: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN61000-6-2, 2001: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN50178, 1997: Electronic Equipment for Use in Power Installations

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER



Signature

Douglas W. Salter
Full Name

Engineering Manager
Position

WIC, Fort Collins, CO, USA
Place

4/21/03
Date

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26331A.

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