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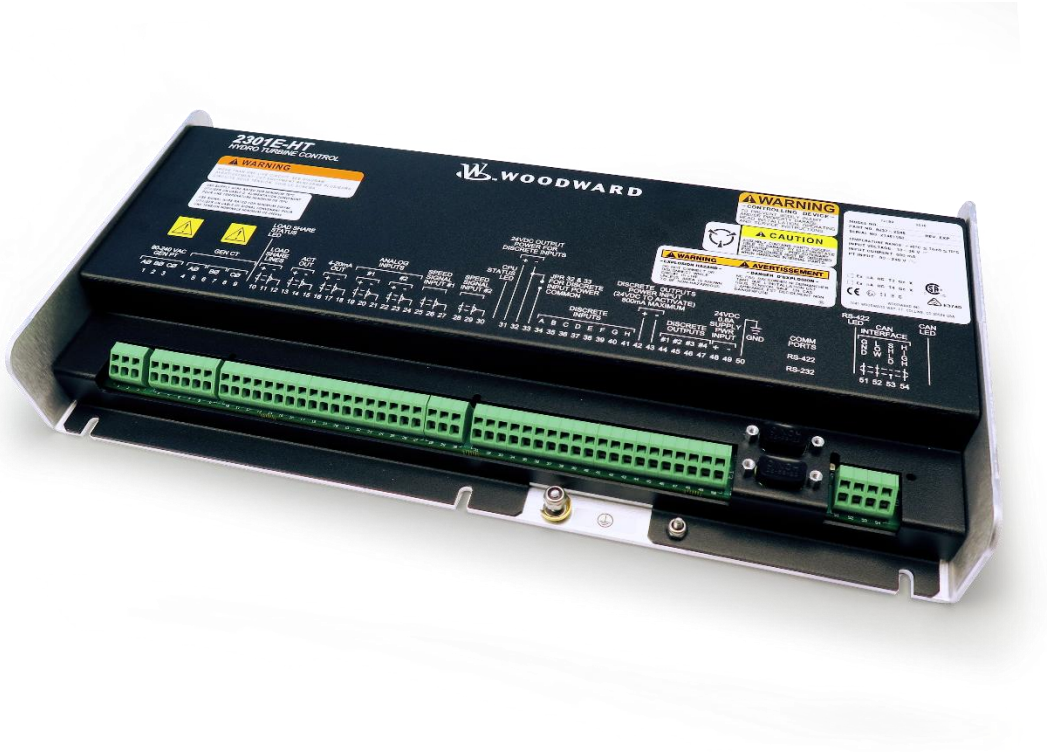
WOODWARD

Product Manual 35092
(Revision D, 4/2025)
Original Instructions



2301E-HT Hydro (Francis Turbines)
P/N 8237-2046

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. The latest version of most publications is available on the Woodward website.

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If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. The latest version of most publications is available on the Woodward website.

Woodward Industrial Support: Get Help

Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

If your publication is not on the Woodward website, please contact your customer service representative to get the latest copy.

Revisions— A bold, black line alongside the text identifies changes in this publication since the last revision.

Manual 35092

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

This is the safety alert symbol 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

Lockout/Tagout (LOTO)

Ensure that personnel are fully trained on LOTO procedures prior to attempting to replace or service a 2301E-HT Hydro on a "live" running engine. All safety protective systems (overspeed, over temperature, overpressure, etc.) must be in the proper operational condition prior to the start or operation of a running engine. Personnel should be equipped with appropriate personal protective equipment to minimize the potential for injury due to release of hot hydraulic fluids, exposure to hot surfaces and/or moving parts, or any moving parts that may be activated and are located in the area of control of the 2301E-HT Hydro.

⚠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.

WARNING

IOLOCK

IOLOCK: driving I/O into a known state condition. When a control fails to have all the conditions for normal operation, watchdog logic drives it into an IOLOCK condition where all output circuits and signals will default to their de-energized state as described below. *The system MUST be applied such that IOLOCK and power OFF states will result in a SAFE condition of the controlled device.*

- **Microprocessor failures will send the module into an IOLOCK state.**
- **Discrete outputs / relay drivers will be non-active and de-energized.**
- **Analog and actuator outputs will be non-active and de-energized with zero voltage or zero current.**

Network connections like CAN stay active during IOLOCK. This is up to the application to drive actuators controlled over network into a safe state.

The IOLOCK state is asserted under various conditions, including:

- **Watchdog detected failures**
- **Microprocessor failure**
- **PowerUp and PowerDown conditions**
- **System reset and hardware/software initialization**
- **PC tool initiated**

NOTE—Additional watchdog details and any exceptions to these failure states are specified in the related section of the product manual.

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. Touch your finger to a grounded surface to discharge any potential before touching the control, smart valve, or valve driver, or installing cabling connectors. Alternatively, ESD mitigation may be used as well: ESD smocks, ankle or wrist straps and discharging to a reference grounds surface like chassis or earth are examples of ESD mitigation.
    - ESD build up can be substantial in some environments: the unit has been designed for immunity deemed to be satisfactory for most environments. ESD levels are extremely variable and, in some situations, may exceed the level of robustness designed into the control. Follow all ESD precautions when handling the unit or any electronics.
        - I/O pins within connectors have had ESD testing to a significant level of immunity to ESD, however do not touch these pins if it can be avoided.
            - Discharge yourself after picking up the cable harness before installing it as a precaution.
        - The unit is capable of not being damaged or improper operation when installed to a level of ESD immunity for most installation as described in the EMC specifications. Mitigation is needed beyond these specification levels.

IMPORTANT

External wiring connections for reverse-acting controls are identical to those for direct-acting controls.

Regulatory Compliance

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

Low Voltage Directive: Directive 2014/35/EU on the harmonisation of the laws of the Member States relating to making electrical equipment available on the market that is designed for use within certain voltage limits.

ATEX – Potentially Explosive Atmospheres Directive: Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
Zone 2, Category 3, Group II G, Ex ec IIC T3 Gc
Zone 2, Category 3, Group II G, Ex ec IIC T4 Gc

EMC Directive: Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC).

Other European Compliance:
Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking.

RoHS Directive: Restriction of Hazardous Substances 2011/65/EU:
This product is intended to be sold and used only as equipment that is specifically designed, and is to be installed, as part of another type of equipment that is excluded or does not fall within the scope of this Directive, which can fulfil its function only if it is part of that equipment, and which can be replaced only by the same specifically designed equipment, and therefore fulfills the requirements stated in Art.2.4(c), and as such, is excluded from the scope of the Directive.

United Kingdom Compliance for UKCA Marking:
These listings are limited only to those units bearing the UKCA Marking.
Units bearing the UKCA Mark in addition to the marking indicating Zone 2 are acceptable for use in UKEX Hazardous Locations.

EMC: S.I. 2016 No. 1091: Electromagnetic Compatibility Regulations 2016 and all applicable amendments.

UKEX: S.I. 2016 No.1107: Equipment and Protective Systems intended for use in Potentially Explosive Atmospheres Regulations 2016.

RoHS Directive: S.I. 2020 No. 1647: The Hazardous Substances and Packaging (Legislative Functions and Amendments) (EU Exit) Regulations 2020.

This product is intended to be sold and used only as equipment that is specifically designed, and is to be installed, as part of another type of equipment that is excluded or does not fall within the scope of this Regulation, which can fulfil its function only if it is part of that equipment, and which can be replaced only by the same specifically designed equipment and therefore fulfills the requirements stated in Part 2 of Schedule1 clause 16, and as such, is excluded from the scope of the Regulation.

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

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, D, T3 or T4 Hazardous Locations and ordinary locations at 70 °C ambient. For use in Canada and the United States.
Certificate 1150575

NOTE—Wiring must be in accordance with applicable electric codes with the authority having jurisdiction.
T3 when the Potential Transformer input is 240 Vac
T4 when the Potential Transformer input is 120 Vac or less

Marine Compliance

American Bureau of Shipping: ABS Rules 2020 SVR 1-1-4/7.7, 1-1-A3, 4-2-1/7.3, 7.5.1; 4-9-3/17, 4-9-4/23 & 4-9-7/Table 9 (as appropriate).

Bureau Veritas: BV Rules for the Classification of Steel Ships, Approval valid for ships intended to be granted with the following additional class notations: AUT- UMS, AUT-CCS, AUT-PORT and AUT-IMS.

China Classification Society: CCS Chapter 2, Part Seven of CCS ~ “Rules for Classification of Sea-going Steel Ships~” 2021.

Del Norske Veritas: Type Approval Certification No. TAA000000H, 2022 Temperature Class B, Humidity Class B, Vibration Class A, EMC Class A, Enclosure required protection according to the rules to be provided upon installation onboard.

Lloyd’s Register of Shipping: LR Type Approval Test Specification No. 1, 2020 for Shipping: Environmental Categories ENV1, ENV2, ENV3 and ENV4.

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

Australia & New Zealand Compliance
These listings are limited to those units bearing the C-Tick mark:

C-Tick (ACA/RSM): Declared Separately to the Australian Radiocommunications Act of 1992 and the New Zealand Radiocommunications Act of 1989.

Special Conditions for Safe Use

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

Connect the ground terminal to earth ground. Use supply wire rated for minimum 75 °C
Use signal wire rated for a minimum of 240 Vac.

ATEX/IECEx Zone 2, Category 3G applications require the final installation location provide a IP-54 or higher ingress protection enclosure against dust and water per IEC 60529. The enclosure must meet IEC 60079-0 Design & Test Requirements.

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

⚠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.

Chapter 1.
General Information

This manual describes the installation and configuration procedures for the Woodward 2301E-HT digital speed control for Francis turbines (p/n 8237-2046).

The 2301E-HT controls the speed and load of Francis hydraulic turbines with one gate analog output in generator applications.

The control hardware includes:

- 1 Load Sensor
- 1 Actuator Driver
- 2 MPU Speed Sensors
- 1 Configurable Analog Output
- 2 Configurable Analog Inputs
- 8 Discrete (Switch) Inputs (3 inputs are configurable)
- 4 Configurable Discrete (Relay Driver) Outputs
- 2 Serial Ports (RS-232 and RS-422)
- 1 CAN Port

Refer to Manual 26691 (2300E Digital Control) for further hardware specifications of the 2301E-HT.

Chapter 2.

Installation

WARNING

Qualified Personnel

Only qualified and trained personnel must prepare and install the unit.

This chapter provides general information about how to install the 2301E-HT digital control for Francis turbines. For detailed information about how to perform the product installation, see Manual 26691 (2300E Hardware Manual).

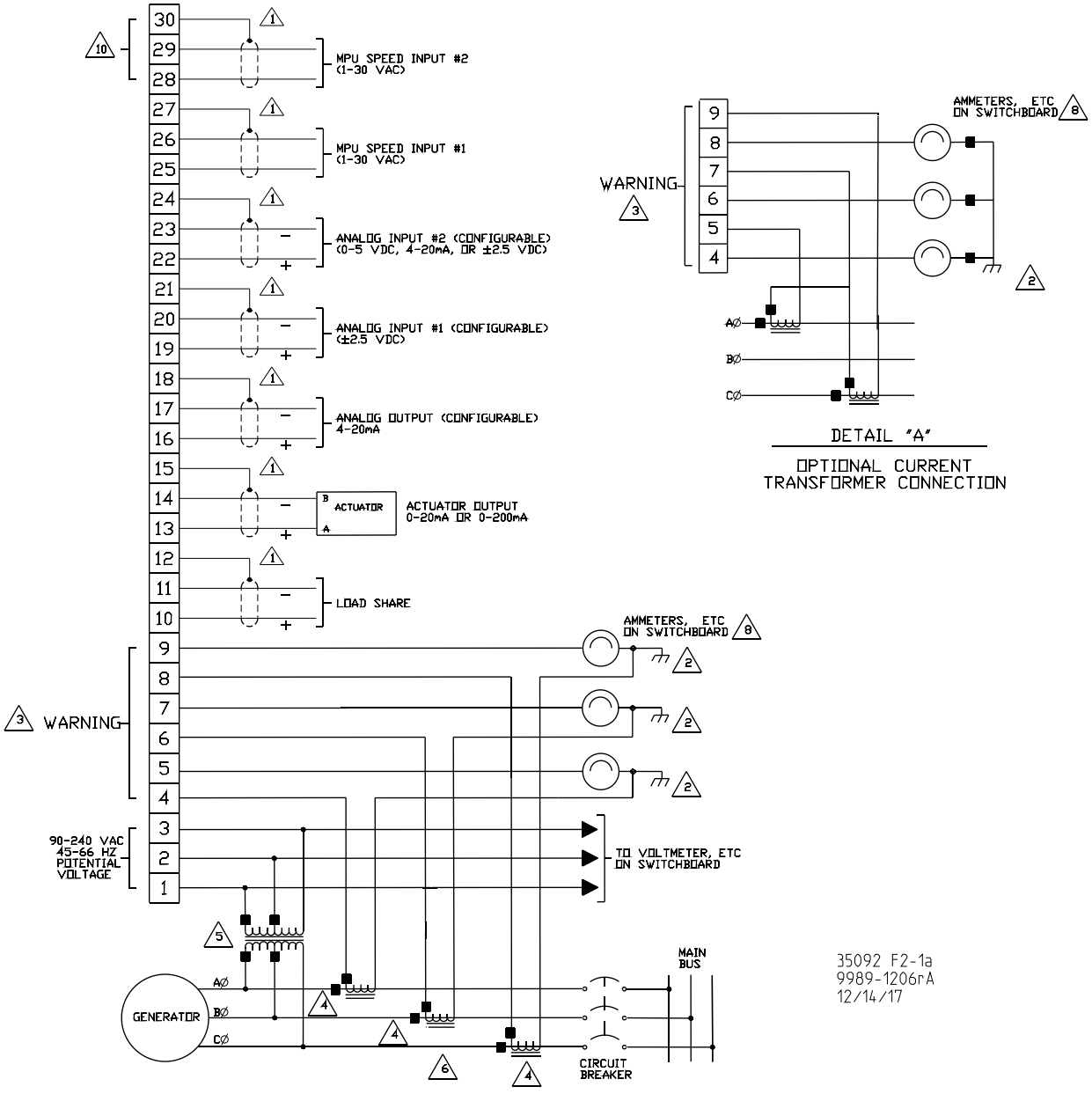

Figure 2-1a. 2301E-HT Control Wiring Diagram (1 of 3)

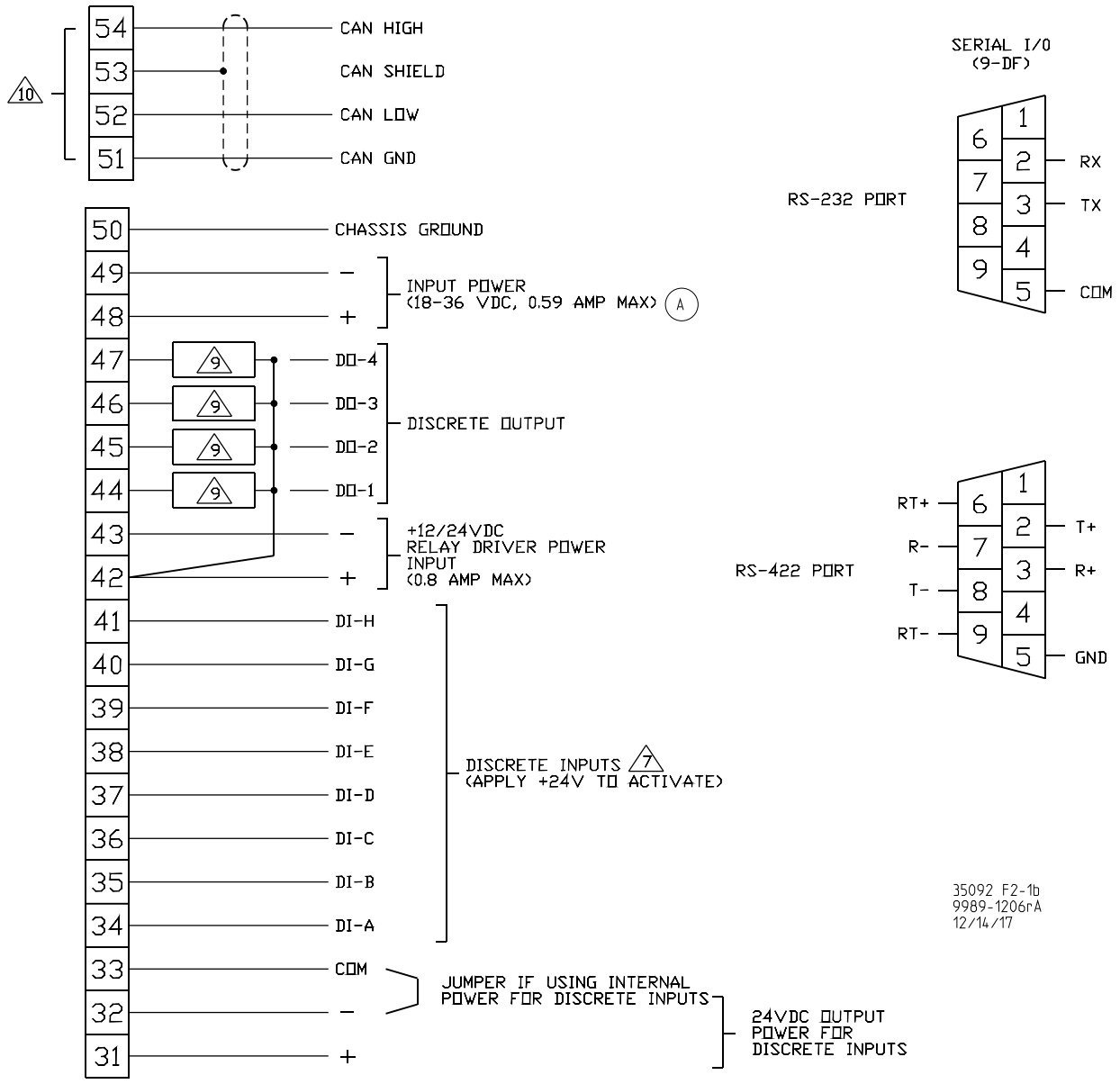

Figure 2-1b. 2301E-HT Control Wiring Diagram (2 of 3)

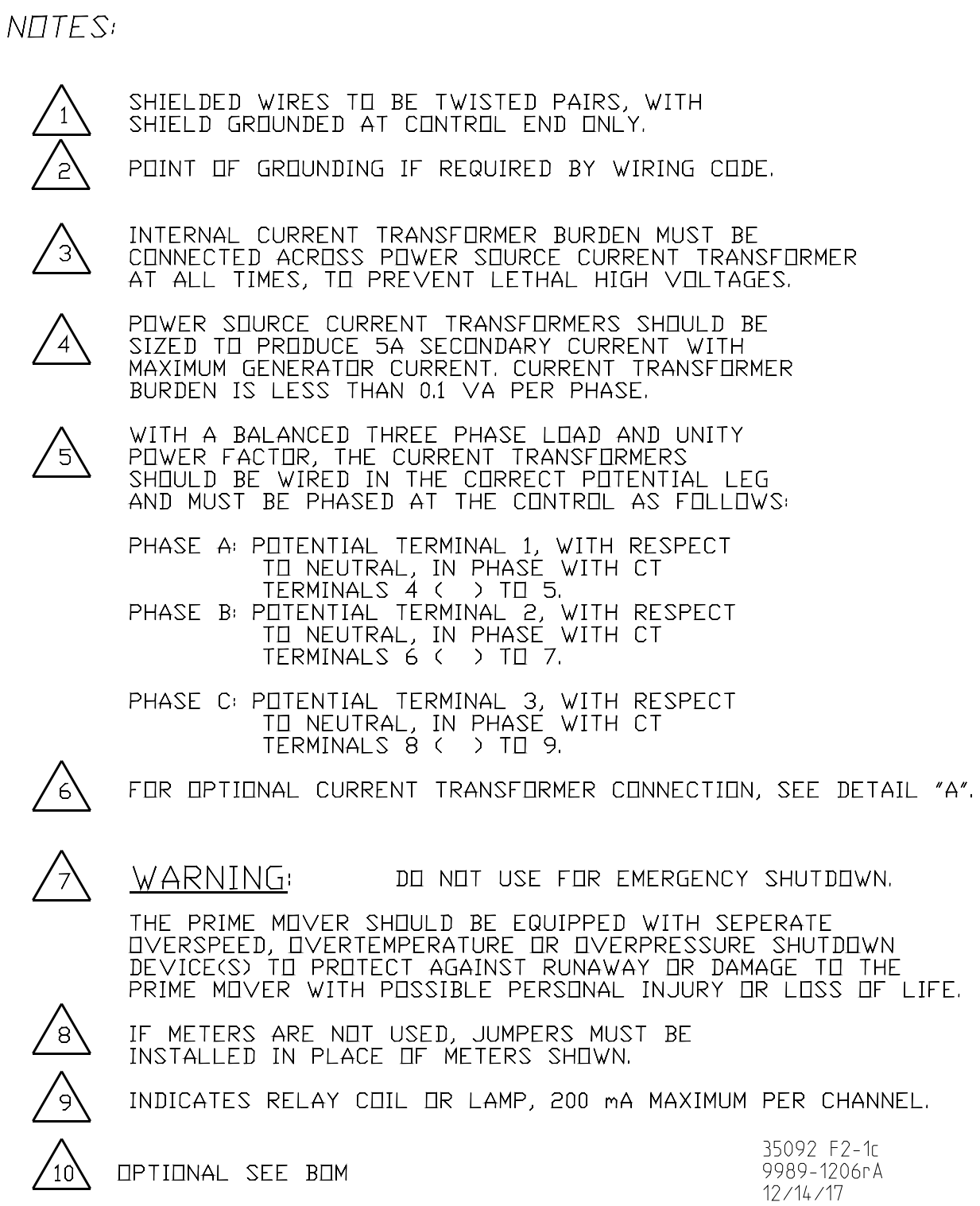

Figure 2-1c. 2301E-HT Control Wiring Diagram Notes

IMPORTANT **In this application the load share lines are not used. The CAN communication is also not used.**

Chapter 3.
Control Overview

Introduction

The 2301E-HT is a digital speed control designed for Francis hydraulic turbines with one analog gate position output. It can be configured to perform several site-specific functions dependent upon the application. This chapter describes the control's I/O (input/output) and functions, including: start and stop sequencing, different control modes, alarms, shutdowns, communications, and other functions.

Description of I/O

The 2301E-HT digital speed control has a wide selection of functions from a fixed amount of I/O (inputs and outputs). The control can be configured in the field to use the I/O to best fit the specific application. During the initial setup of the control, the functions that are needed for the specific application are selected and the necessary I/O points are assigned accordingly.

Control Inputs

Speed Inputs

Two speed inputs are available. The use of a magnetic pickup is necessary for this application.
The control can be configured to work with one or two (redundant) speed inputs. If configured for two sensors the controller will always use the highest signal to control. If one of the speed inputs is lost the control will keep running with just one signal and generate an alarm. If the second signal is lost then the control will generate a trip and stop the turbine.

NOTICE

It is not possible to change a damaged sensor with the turbine running.

Analog Inputs

Two analog inputs are available (4–20 mA).Their functions can be chosen from one of the below listed.

- **Pond/Tail Level:** This analog input is mandatory if pond/tail level control is desired.
- **Speed Bias:** This analog input comes from a synchronizer/load controller. If the synchronizer/load controller doesn't have an analog speed bias output, digital inputs in the 2301E-HT can alternatively be used to perform this function (called Speed Bias Raise and Speed Bias Lower).
- **Gate Position Feedback:** This analog input provides information about gate actual position. This is mandatory if an Integrating Gate Actuator is used. If a Proportional Gate Actuator is used, this input can be used as well just for monitoring purposes.
- **Remote Speed Reference:** This analog input is used to provide a remote speed reference if droop control is used (either actuator droop or kW droop).
- **Gate Position Limiter:** This analog input is used if it's necessary for any reason to limit the gate position to a certain value. If this gate limit is desired but an analog input is not available, there are two digital inputs that can be used alternatively (gate limit raise and gate limit lower).
- **Remote Baseload Reference:** This analog input is used if the control is in Baseload mode and a remote Baseload reference is enabled.
- **Remote Level Reference:** This analog input is used to provide a remote level reference, if level control is used and remote level reference is enabled.

- **kW Input:** This analog input is used to provide the actual generator load to the control. If this option is used, the Current Transformer (CT) and Potential Transformer (PT) will be ignored by the control. If there is no analog input programmed to this function the control will assume the CT and PT inputs as generator load measurement.

IMPORTANT

The first analog input can have a special function: if the Speed Bias is configured to come from an analog source and it's going to be used only for synchronizing, then this analog input is used as a Speed Bias input if the generator breaker is opened and one of the options listed above if the generator breaker is closed.

The second analog input will always be the selected function.

Discrete Inputs

Eight discrete inputs (on/off switches) are available. Five of them are dedicated to the following functions: Run/Stop, Raise Speed/Load, Lower Speed/Load, Generator Breaker Status, and Emergency Shutdown. The other three discrete inputs on the 2301E-HT for Francis turbines are configurable.

The following options are available:

- **Manual Gate Control Enable**: When this discrete input is closed, the gates can be controlled "manually" with the Raise and Lower discrete inputs. Manual Gate control can also be enabled through Modbus.
- **Pond/Tail Level Control Enable**: When this discrete input is closed, the control will switch into pond/tail level control. The Raise and Lower discrete inputs will raise and lower the pond level set point. Pond/Tail Level Control can also be enabled through Modbus.
- **Auto Follow Enable**: This input should be used when the 2301E-HT is being used as a back-up governor. When this discrete input is closed, the control will track current gate position in all control modes, and the Raise and Lower inputs are disabled. When this discrete input opens, the 2301E-HT will assume control of the unit in whatever control mode is selected. Auto Follow control can also be enabled through Modbus.
- **Gate Limit Raise & Gate Limit Lower**: When one of these discrete inputs is closed, the Gate Limit ramps up or down at a configurable rate. The 2301E-HT is designed so that Gate Limit control is not necessary, but it is available if required by the application. Gate Limit Raise and Lower can also be done through Modbus.
- **Creep Input #1 & Creep Input #2**: Creep detection requires two inputs from proximity probes (or from ZVPU interface modules). By monitoring the Creep #1 and Creep #2 discrete inputs, the control can detect when the unit is creeping.
- **Dirty Oil Switch Input**: This input is intended to be used when a dirty oil indicator has a contact switch on it. When this discrete input closes, it triggers the governor alarm "Dirty Oil Filter," and the alarm is also sent to Modbus.
- **Governor Reset**: All shutdowns and alarms are latched until the fault condition clears and the control is reset. When this input is closed, it resets the control. The control can be reset through Modbus or by using the Woodward Watch Window.
- **External Start Permissive**: After a start input, the control waits for a momentary closure of this discrete input before starting the unit if this function is used or this input must be closed before the start command.
- **Speed Bias Raise & Speed Bias Lower:** When one of these discrete inputs is closed, the Speed Bias internal ramp ramps up or down at a configurable rate. For using these discrete inputs the speed bias source must be configured to digital. Speed Bias Raise and Lower can also be done through Modbus.
- **Baseload Enable:** This input is used to enable the Baseload control mode. In Baseload the generator load will stay in a determined setpoint either by the Raise Speed/Load inputs, or by a remote Baseload input or by a Baseload Modbus reference. The following conditions must also be present in order to the baseload control be enabled: the generator breaker must be closed and the

manual, auto-follow and level control modes must be disabled. Baseload Enable can also be done through Modbus.

- **Unload:** When in parallel and baseload operation, it may be desired to unload the engine and open the generator breaker. When the unload contact is closed (rising edge triggered) the control starts to slowly decrease the load reference and, either when it reaches a minimum value (unload trip level) or a certain maximum delay after the reference reaches the unload trip level (configurable), it gives an open breaker command (if configured). After that the engine stays in its rated speed waiting for another command.
- **Local/Remote:** When this discrete input is closed, the 2301E-HT controller will only accept Modbus commands (the analog write Modbus commands don't use this logic; there are specific Modbus addresses to define if a given Modbus analog write is going to be used or not). If this discrete input is opened, the 2301E-HT controller will only accept discrete commands. If there isn't any discrete input configured for Local/Remote function, then the commands can come either by discrete inputs or by Modbus commands.
- **Position/kW Droop:** This input is used to switch between valve position or kW droop. When in valve position droop, the controller will use the gate position feedback as a droop feedback to calculate the online reference. When in kW droop, this feedback calculation will be done based on the generator load.

⚠WARNING

Once one of the above mentioned options is selected, ALL inputs are active and should be treated as active inputs WHETHER OR NOT they are wired.

Control Outputs

Actuator Output Analog Outputs

Two analog outputs are available -- Actuator output and Analog #1 output.

The Actuator output can be configured either for 4–20 mA, 0–20 mA, or for 0–200 mA.

Analog Output #1 is 4–20 mA only and it is a configurable analog output. This output has the following options:

- Tachometer (Analog Output default)
- Gate Position
- Gate Limit
- Speed Adjustment
- Pond/Tail Level
- Pond/Tail Level Setpoint
- Speed Bias
- Generator Power
- Actuator output
- Baseload Reference

Relay Outputs

Four relay outputs are available. All relay outputs can be used as normally open or normally closed (configurable).

The first discrete output is Shutdown indication. The others discrete outputs are configurable and the available configuration is shown below:

- **Gate Position Switch #1**: This switch can be set to trigger at a specific gate position as the gates go open or as they close.
- **Gate Position Switch #2**: This switch can be set to trigger at a specific gate position as the gates go open or as they close.
- **Speed Switch #1**: This switch can be set to trigger at a specific % of rated speed as the speed increases or decreases.

- **Speed Switch #2**: This switch can be set to trigger at a specific % of rated speed as the speed increases or decreases.
- **Speed Switch #3**: This switch can be set to trigger at a specific % of rated speed as the speed increases or decreases.
- **General Governor Alarm**: This relay option closes the relay when an alarm condition is present. All shutdown conditions are also considered alarms.
- **Brake Permissive**: This relay option closes the relay when the control is in the “STOP” mode, the gates are closed, speed and gate position signals are valid, and the speed is below a configurable value.
- **Creep Indication**: This relay option closes the relay when creep is detected on the unit. The relay will stay closed until a configurable time after the unit stops creeping. At that point the relay will open and the control will continue monitoring the unit for another creep condition.
- **Speed Bias Enabled**: This relay option closes to inform if the Speed Bias signal (either analog or digital) is enabled and in use at the moment.
- **Gate Position Signal Failure:** This relay option closes when the Gate position signal is enabled and its input is failed. Input failed means that the current in this input is below 2 mA or above 22 mA.
- **Level Signal Failure:** This relay option closes when the Level signal is enabled and its input is failed. Input failed means that the current in this input is below 2 mA or above 22 mA.
- **Remote Signal Failure:** This relay option closes when the Remote signal is enabled and its input is failed. Input failed means that the current in this input is below 2 mA or above 22 mA.
- **Speed Bias Signal Failure:** This relay option closes when the Speed Bias signal is enabled and its input is failed. Input failed means that the current in this input is below 2 mA or above 22 mA.
- **Incomplete Start:** This relay is closed when a incomplete start is detected. Incomplete Start is detected when a start command is issued and the turbine speed does not reach a configured value in a configured time.
- **Minor gate Position Mismatch:** The control continuously compares the actual gate position to the gate position demand in the control. If they do not match within the “Minor Mismatch Window” for more than the “Minor Mismatch Delay” time, the control will issue a “Minor Mismatch” alarm.
- **Overspeed Shutdown**: This relay option closes the relay there is an Overspeed Shutdown.
- **Dirty oil indication:** This output will be closed when the discrete input for dirty oil is closed.
- **Modbus Link Error:** This output will be closed when there is an Modbus link error.
- **Speed Input #1 Fault:** This output will be closed when there is a Speed input #1 error.
- **Speed Input #2 Fault:** This output will be closed when there is a Speed input #1 error.
- **Generator CB_Aux Open Command**: This relay option sends a generator opening command if an unload command is given and the unload conditions are fulfilled in order to open the breaker.
- **kW Switch #1**: This switch can be set to trigger at a specific kW as the kW increases or decreases.
- **kW Switch #2**: This switch can be set to trigger at a specific kW as the kW increases or decreases.
- **Remote Level Reference Signal Failure:** This relay option closes when the Remote Level Reference signal is enabled and its input is failed. Input failed means that the current in this input is below 2 mA or above 22 mA.

External I/O

The control has the possibility to add one Analog Input/Output LINKnet HT, which adds eight configurable Analog Inputs and two configurable Analog Outputs. The configuration possibilities for these I/O’s are the same of the analog inputs/outputs that are embedded on the 2301E-HT hardware. This module communicates with the 2301E-HT hardware through CAN bus. The figures below show the types of LINKnet HT modules allowed to work with this 2301E-HT:

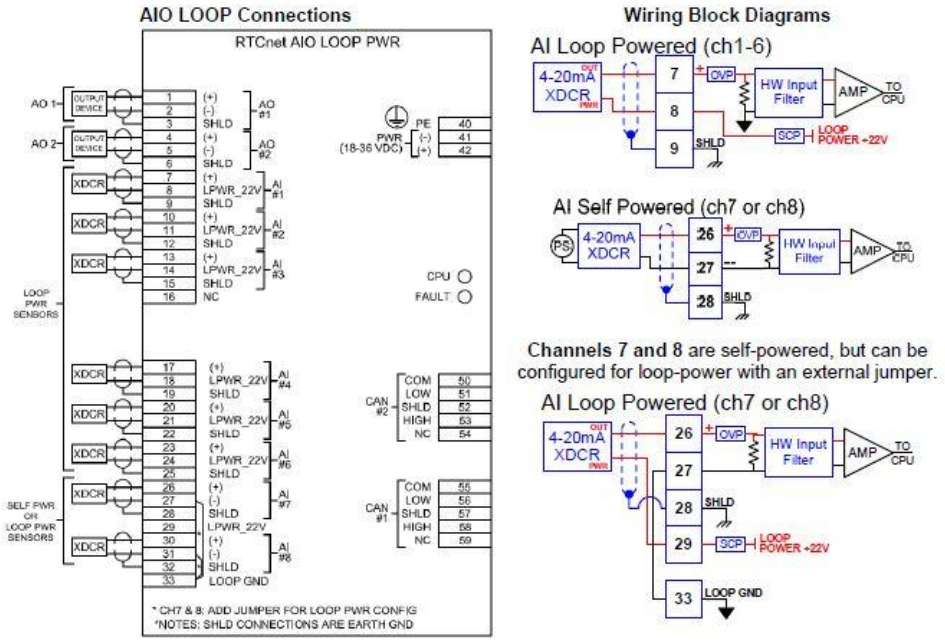

Figure 3-1. AIO Loop-Powered LINKnet HT

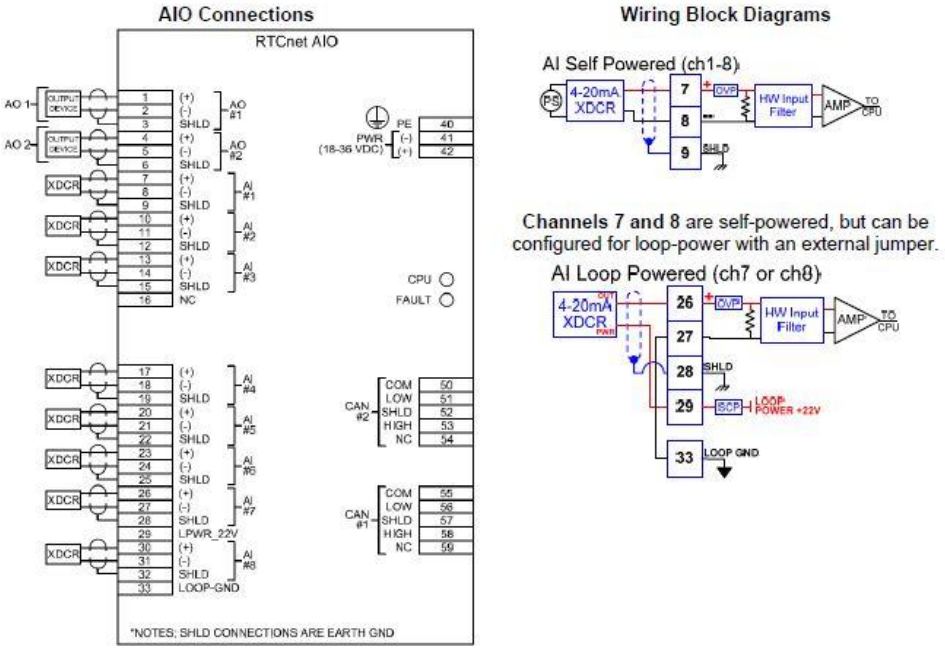

Figure 3-2. AIO Self-Powered LINKnet HT

For more information regarding the LINKnet HT, refer to Manual 26640.

Communications

WARNING

Control Input

When a discrete input is configured to "Local / Remote" the start and stop commands can be issued from Modbus 1 when in local mode or from Modbus 2 or discrete input when in remote mode. When in remote mode it is not possible to assure if the command came from Modbus 2 or discrete input.

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

The RS-232 serial communication service port communicates using the Control Assistant (Servlink) software. It can also be used as a Modbus RTU port. To change the port from Servlink to Modbus the command is issued in the menu "25 MODBUS" parameter "CHOOSE MODBUS COMM." At this moment you will lose the communication with Servlink and the port will be ready to use Modbus communication. To change back from Modbus to Servlink you should send the command in the address 17 of the Modbus list. If the control is in Local mode the command needs to be sent from port 2 (RS-422): if the control is in remote mode the command needs to be sent from port 1 (RS-232).

The user can choose what the default communication is when the control is turned on.

Remember that if the default communication is selected to Modbus, the user will need to set the Modbus bit 17 in order to be able to communicate with Servlink and configure the control. And if the default communication is set to Servlink and the user has an HMI and needs to restart the control the communication between the control and the HMI will be lost and the user will need to communicate with Servlink to enable the Modbus communication back.

The RS-422 serial communication port communicates using a Modbus RTU protocol, functioning as a Modbus Slave device, via a RS-422 driver. The 2301E-HT can be fully operated and many values monitored via Modbus communications.

The proper connection for RS-232 and RS-422 can be found in the 2301E hardware manual.

IMPORTANT

The communication ports must be connected with an approved jacketed serial communication cable. The connector must be secured to the 2301E-HT to prevent contact with other circuits.

There is also a CAN port available for I/O expansion with an AIO (8 AI and 2 AO) LINKnet HT module.

2301E-HT Functions

WARNING

Commissioning

While working on the 2301E-HT and turbine area, make sure personnel are following Lock Out Tag Out procedures set by the facility.

During commissioning/troubleshooting if speed = 0 the actuator position (Gate valve) can be overridden to a manual position from the PC interface.

In application we can select Local/Remote command from digital inputs or communication command.

For troubleshooting, connect to 2301E-HT on DB9 connector inside the cabinet with the service tool. Make sure area is free from hazards as it is indeterminate whether the PLC or the local operator has control of the turbine.

The functions of the 2301E-HT speed control for Francis turbines are described in detail in this section. The values that are in “quotes” can be configured for the specific application. Configuration of these values is discussed in greater detail in this manual.

Start, Stop and Gate Limit

When the 2301E-HT control is given a start command, the control resets itself and pauses for 4 to 5 seconds. This allows time for the alarms and shutdown conditions to clear. Once all shutdowns have cleared and the optional input “Start Permissive” is true (if used), the Gate Limit steps to the “Breakaway Limit,” and stays there for the “Hold at Breakaway Time” (see Figure 3-3). Since the control does not have any speed signal yet, the gates will follow the Gate Limit. After the “Hold at Breakaway Time” expires, the Gate Limit ramps to the “Speed-No-Load Limit” at the “Start Gate Rate.” It will remain there while the control is synchronizing. At some point during this sequence, the turbine should reach its rated speed and the 2301E-HT will start controlling speed. If the control does not sense at least the “Start Speed” by the time the “Time to Start Speed” timer has expired, then the control issues an emergency shutdown due to an Incomplete Start.

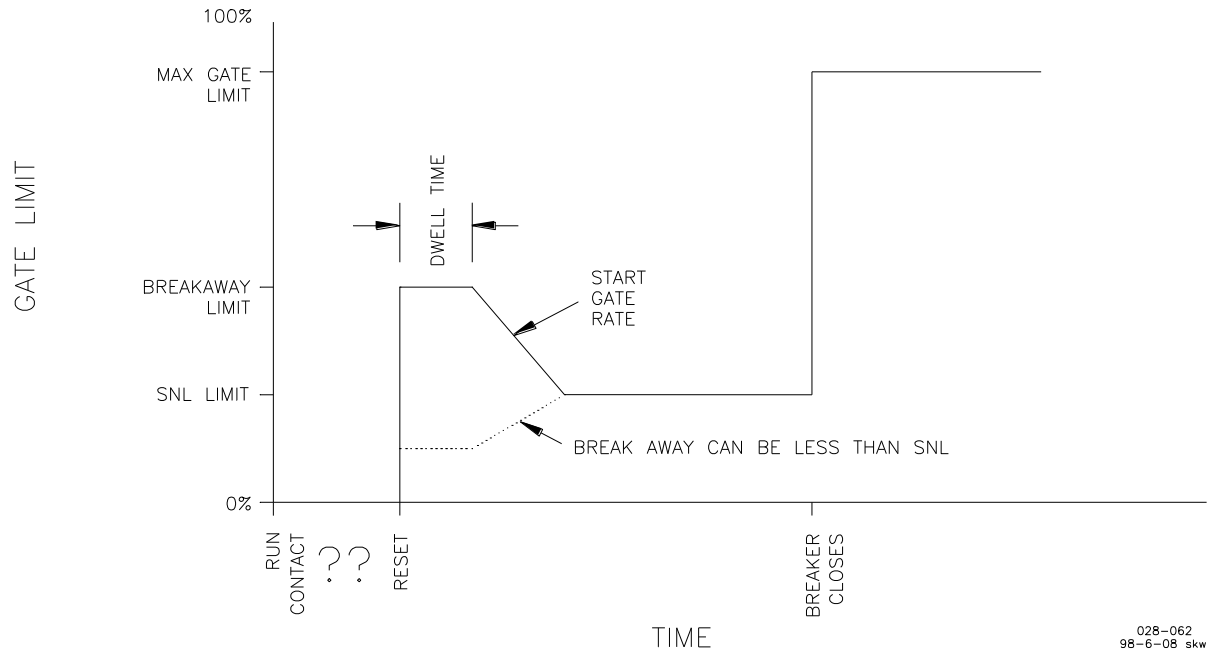

Figure 3-3. Gate Limit

If the turbine has unusually low head conditions and is not able to reach rated speed in order to synchronize, the control will automatically ramp the gate limit up. This only happens after the “Auto Raise Delay” time has expired. The rate at which the control raises the gate limit is configured as “Auto Raise Rate.”

When the breaker closes, the gate limit steps to the “Maximum Gate Limit.”

If the unit experiences a load rejection, the gate limit will automatically step to the “Speed-No-Load Limit.”

When the 2301E-HT is given a stop command and the unit is on-line, the Gate Limit steps to the actual gate position and ramps to 0% at the “Stop Rate.” There is an option available to select between a fast offline stop and a stop at the stop rate. If the “FAST OFFLINE STOP?” option under the MAIN CONTROL service header is selected, the gates will close at the hydraulic rate when the breaker is open. If this option is set false, the gates will always close at the stop rate regardless of the breaker status. If the unit is off-line when the stop command is given, then the Gate Limit goes to 0% instantly.

The start and stop sequences discussed above occur automatically. The Gate Limit can be controlled manually at any time if necessary. Two discrete inputs can be configured as Gate Limit Raise and Gate

Limit Lower, or the Woodward Watch Window can be used. The rate at which the Gate Limit will change is dictated by the “Man R/L Ramp Rate.”

When the control is in Manual, Maintenance, or Follow Mode, the Gate Limit is raised to 100%.

External Start Permissive

An external start permissive is available when one of the configurable inputs is configured to do it. When the unit is started up and the control resets, the start permissive contact must be closed before the unit issues a governor run command.

Speed Signal Processing

The 2301E-HT for Francis turbines has two speed signal inputs. The 2301E-HT accepts any sine wave or square wave provided by a speed sensor that is proportional to the speed of the turbine. This can come from magnetic pickups.

The 2301E-HT control must be configured according to the type of speed signal being provided, the rated speed (rpm) of the turbine, the number of gear teeth (if applicable), and the system frequency (60 Hz, 50 Hz, etc.). The 2301E-HT then converts the speed signal frequency into percent of rated speed. All speed values during the configuration and operation of the control are in terms of percent of rated speed unless stated otherwise.

The 2301E-HT monitors speed signal failures and overspeed. When the turbine is stopped or moving very slowly, the control will not have a valid speed signal, but the control should not see this as a speed signal failure. When the turbine is started, the speed signal is ignored by the control until the “Time to Start Speed” expires. When the turbine is stopped, the speed signal is ignored once the speed drops below 50% and the gates are closed.

The 2301E-HT has an electronic overspeed detection, which issues a shutdown to the control. The “Overspeed” value configured in the control is in percent of rated speed. The overspeed detection is also ignored at the same time the speed signal failure is ignored, as mentioned above. In addition, it is delayed by one second in order to avoid nuisance trips due to electrical noise on the speed signal. When the control is in Maintenance Mode, all speed signals, speed signal failures, and overspeeds are ignored.

An overspeed test feature is available so that the mechanical overspeed (or independent secondary overspeed) trip can be easily tested. To enable the overspeed test, set “Mech Overspd Test” to true under the service menu. The test enable switch is hooked up to a 30-minute timer so that the test is not accidentally left enabled. When the overspeed test is enabled, the electronic overspeed trip is disabled, the isochronous speed reference ceiling is raised to 200%, and the raise/lower rate on the isochronous speed reference is increased to 10% per second. To perform the overspeed test, the test must be enabled and the turbine must be running off-line. The speed reference must be raised until the turbine trips from the mechanical overspeed. The mechanical overspeed should be wired in series with the ESD input string so that an ESD is issued to the control.

The 2301E-HT has a speed deadband function that can be enabled. The speed deadband function is a configurable window around rated speed within which the 2301E-HT will not respond to speed changes. The deadband window has configurable set points above and below rated speed. In the example below, the high set point is 100.05% rated speed (60.03 Hz on a 60 Hz system), and the low set point is 99.97% rated speed (59.98 Hz on a 60 Hz system). When the unit’s speed fluctuates around rated speed the control will not respond unless the speed gets outside the configurable window.

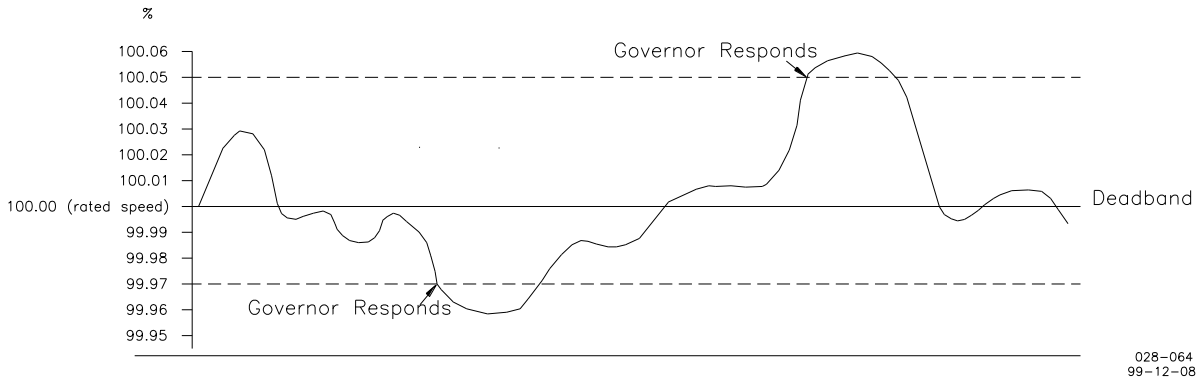

Figure 3-4. Speed Deadband Function

Sometimes it is not desirable to have the unit responding to these slight frequency fluctuations. The speed deadband can be enabled and the deadband window adjusted accordingly. When the speed deadband function is set up, there are three options. The speed deadband function can be enabled at all times, disabled at all times, or only when the unit is online.

Off-line/Isochronous Speed Control

The 2301E-HT control for Francis turbines has two PID control algorithms, an on-line/droop algorithm and an off-line/isochronous algorithm. When the unit is off-line or in isochronous on-line control, the Off-line/ Isochronous algorithm is used. The Off-line/Isochronous algorithm controls the turbine speed to a set point determined by the operator. The droop setting does not affect off-line or isochronous control.

For example, if the unit is off-line and the operator adjusts the set point to 95% rated speed, the 2301E-HT will position the gates appropriately to control the turbine speed at 95% rated speed. If the operator raises the set point to 100% rated speed, the control reacts by opening the gates and raising the turbine speed to 100%. The operator can synchronize the turbine to the system and close the generator breaker. The control functions exactly the same way when the turbine is on-line and in isochronous control (isochronous controls means that the unit is acting as a slave of a load controller).

When the control is given a Start command, the control pre-positions the speed set point to the “Speed-No-Load Ref.” The speed set point can be adjusted from the Raise and Lower discrete inputs, or Modbus. The rate at which the set point changes is configured as the “Off-line/Isoch Raise/Lower Rate.” (This rate is in percent of rated speed/second) The high and low limits for the speed set point are set up as “Upper Limit-Ref” and “Lower Limit-Ref.”

The speed set point follows actual speed when the turbine is on-line and not in isochronous control, or when the turbine is off-line and in Manual or Auto-Follow control. This provides a bumpless transfer into Off-line or Isochronous control.

When the generator breaker opens, the speed set point returns to the “Speed-No-Load Ref.”

The 2301E-HT digital control has two sets of PID gains, off-line and on-line. The only difference between off-line control and isochronous control is that the off-line gains are used during off-line control and the on-line gains are used during isochronous control.

When the off-line/isochronous PID algorithm is in control, a temporary compensation function is available to help dampen any control instability. The PID gains should be tuned properly for optimum control response before the “Temporary Compensation” is adjusted. The temporary compensation acts much like a mechanical dashpot. As the gates open or close, the speed set point is temporarily lowered or raised depending on the speed of the gates to slightly dampen the control’s response.

When a Synchronizer/Load Control unit is used with the 2301E-HT, the speed reference in the internal ramp of the control is fixed to 100%, so the final speed reference becomes 100% ± Speed Bias, and the off-line/isochronous PID algorithm is used to control the unit. The Synchronizer/Load Control unit controls the turbine by biasing the fixed speed set point through the Synchronizer/Load Control signal input. The Synchronizer/Load Control signal input can be scaled by the “SPEED BIAS ANALOG GAIN” in the 2301E-HT. The Synchronizer/Load Control speed set point biasing is ignored by the 2301E-HT if it isn’t being used with a Synchronizer/Load Control unit, if the speed is not stable, or if the unit is on-line but not in Synchronizer/Load Control.

On-line/Droop Speed Control

The On-line/Droop PID algorithm is used when the unit is on-line and in Level Control, Remote Reference Control, or Droop Speed Control. The On-line/Droop PID algorithm allow the unit to be paralleled with other units and still remain stable. The droop value, the droop speed set point, and the turbine speed, together determine how far the gates move, or how much load the turbine picks up.

For example, if the speed is fixed at 100% rated speed and the droop is set to 5%, a 1% droop speed set point change will move the gates 20%. If the droop is set to 3%, the gates will move 33.3% for a 1% change in the droop speed set point. The speed is always being monitored and reacted to by the control, but the control will only respond by an amount determined by the droop setting. For example, at 5% droop a +0.1% speed change (60.00 Hz to 60.06 Hz) will result in a gate position change of 2.0%. At 3% droop, the same speed fluctuation would result in a gate position change of 3.3%.

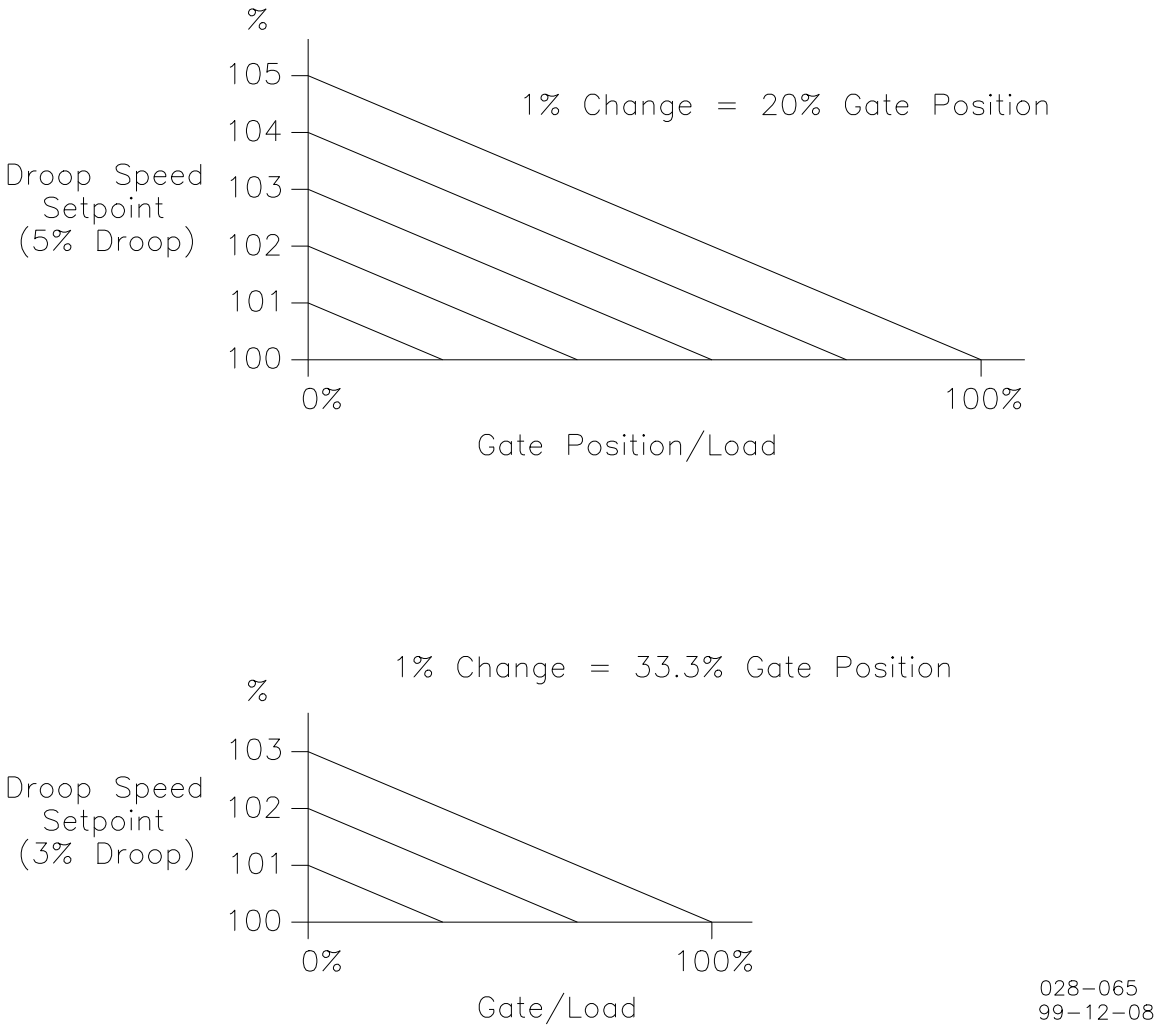

Figure 3-5. Gate Position

The Level Control and Remote Reference Control algorithms calculate a droop speed set point to position the gates to a desired position.

When the generator breaker closes, the default control mode is Droop Speed Control. The droop speed set point can be raised and lowered using the Raise/Lower discrete inputs or Modbus. The Low Limit is 85%, and the High Limit is 100% plus the Droop percentage. For example, at 5% Droop, the High Limit would be 105%.

When the on-line/Droop PID algorithm is not in control (Manual, Maintenance, Auto-Follow, Isochronous control modes, Baseload), it calculates a droop speed set point based on the current speed and gate position. This provides a bumpless transfer into On-line/Droop speed control.

The Droop Speed Set Point, or Speed Adjust, can be sent to the configurable analog output channel.

The on-line/Droop PID algorithm has a Feed Forward function that manipulates the PID feedback to accelerate the control's response to set point changes. Feed Forward is only enabled when the control is using the On-line/Droop PID algorithm. The Feed Forward can be scaled by the "Feed Forward Gain," or it can be disabled by tuning "Disable Feed Forward?" to TRUE.

The output of the On-line/Droop PID is also clamped by a "PID Clamp Window" value to eliminate set point wind up in the control.

Remote Speed Reference Control Mode

The Remote Speed Reference control mode provides a way of directly controlling the 2301E-HT set point remotely. The Remote Speed Reference can be the 4 to 20 mA from one of the analog inputs or it can be a value from Modbus. The Remote Speed Reference Control Mode can be enabled by closing BOTH the Raise and Lower discrete inputs at the same time. It can also be enabled through Modbus. If the analog input signal is selected for control and it fails, Remote Reference Control Mode is disabled and an alarm will indicate the signal failure.

The 4 to 20 mA signal (if used) is scaled to 0 to 100%. The Modbus Remote Reference Set Point is the first analog write value in the Modbus block and is divided by 100 at the control. This provides two decimals of precision to the set point. The Modbus device must send 0 to 10000 for 0 to 100%.

The remote speed setpoint can be set to follow either the analog input (4–20 mA) or a Modbus value. The option is chosen only by Modbus and if the Modbus communications is loosen then the analog input option is selected. If the analog input is failed then the remote reference is disabled.

When the Remote Reference is enabled, the Remote Reference (0 to 100%) is converted to a Droop Speed set point. For example, if the droop is set to 5% and the unit is at rated speed, a Remote Reference of 20.00% would result in a Droop Speed Set Point of 101.0%. This will result in a gate position of 20%. If the Remote Reference is raised to 55%, the Droop Speed Set Point will increase to 102.75%. This will result in a gate position of 55%. The Remote Reference is essentially the gate position set point, but remember that the control is always monitoring the unit speed. Any speed error will result in a slightly different gate position, depending on the droop set point.

Remote Pond/Tail Level Reference Control Mode

The Remote Pond/Tail Level Reference control mode provides a way of directly controlling the 2301E-HT set point remotely. The Remote Pond/Tail Level Reference can be the 4 to 20 mA from one of the analog inputs, or it can be a value from Modbus. The Remote Pond/Tail Level Reference Control Mode can be enabled by closing BOTH the Raise and Lower discrete inputs at the same time. It can also be enabled through Modbus. The pre-requisite in order to enable the remote pond/tail level reference control mode is that the pond/tail level control is enabled. If the analog input signal is selected for control and it fails, Remote Reference Control Mode is disabled and an alarm will indicate the signal failure.

The 4 to 20 mA signal (if used) is scaled to 0 to 100%. The Modbus Pond/Tail Level Remote Reference Set Point is the fourth analog write value in the Modbus block and is divided by 10 at the control. This provides one decimal of precision to the set point. The Modbus device must send based on the pond/tail level in engineering units.

The remote Pond/Tail setpoint can be set to follow either the analog input (4–20 mA) or a Modbus value. The option is chosen only by Modbus and if the Modbus communications is loosen then the analog input option is selected. If the analog input is failed then the remote reference is disabled.

When the control is in Pond/Tail Level Control and Remote Reference is enabled, the Remote Reference (0 to 100%) is converted to a Pond/Tail Level Set Point. The Pond/Tail Level Set Point is based on the Pond/Tail Level transducer limits. The Level Set Point is calculated as a percentage of the full transducer range plus the low limit. The Pond/Tail Level Set Point is calculated using the following equation:

$$\text{Level Setpoint} = \frac{(\text{Rem Ref}) \text{ x } (\text{Max Val} - \text{Min Val})}{100} + (\text{Min Val})$$

For example, if the transducer is calibrated for 4 to 20 mA for 500 ft. to 540 ft. respectively, a Remote Reference of 35% would result in a Pond/Tail Level set point of 514 ft.

Manual/Maintenance Gate Modes

The 2301E-HT control for Francis turbines has two “manual” modes for the gate operation, Manual and Maintenance that allow the operator to manually position the gates. The biggest difference between Manual and Maintenance is that the control still monitors speed failures and overspeed in Manual control. Manual control can be enabled using the discrete inputs or Modbus, but Maintenance control can only be enabled using the Woodward Watch Window.

⚠WARNING

Maintenance mode should only be enabled when the unit is de-watered. No speed monitoring functions are active when the control is in Maintenance mode.

Maintenance Mode

Manual control mode can be enabled when the unit is running or when the unit is stopped. Both Manual and Maintenance modes follow the actual set point when they are not enabled. This provides a bumpless transfer into Manual and Maintenance control modes.

The rate at which the manual position moves the gates is the same rate that the Gate Limit ramps up and down. If the 2301E-HT control is in Manual mode and a Stop command is issued, the unit will stop at the “Unit Stop Rate.”

The Manual and Maintenance control modes can be forced to go to a preset value. The “Manual Preset Value” can be adjusted to an exact gate position, and the control can then be forced to go to that set point by setting “Goto Preset Value” TRUE. This is useful when an exact gate position is needed, and cannot be easily achieved by using Raise and Lower commands.

NOTICE

The “Goto Preset Value” in Manual and Maintenance modes will position the gate position at the fastest hydraulic rate possible. No ramp rate in the control is used to go to this “preset” position.

Auto-Follow Control Mode

The 2301E-HTcontrol for Francis turbines has an Auto-Follow control mode which is used when the control is used as a backup governor. When this mode has been configured and the discrete input is closed, the 2301E-HT tracks current gate position and forces all control modes to follow. When the discrete input opens up, the 2301E-HT will assume control in the control mode that is selected at the time the “Auto-Follow” discrete input opened up. The same contact that controls the “Auto-Follow” discrete input must control the transfer relay which switches the actuator control current from the primary control to the 2301E-HT Actuator Output.

When the 2301E-HT is used as a backup governor, independent speed signals and gate position transducers should always be used. This will provide true governor redundancy, and eliminate the possibility of single point failure. If the speed signal or the gate position signal to the primary control fail, it would be less likely to shut down the 2301E-HT.

When the actuator control current is switched from the primary control to the 2301E-HT, the actuator current will be zero for an instant, and the gates will "bump" slightly. The amplitude of the "bump" on the actuator will vary depending on the relay used to transfer the actuator control current. When the 2301E-HT is tracking the gate position, the actuator output is forced to 0 mA. This keeps the control from saturating the output voltage trying to drive the current through an open circuit. Without this, the actuator would bump open during the actuator control transfer. Forcing the actuator output to 0 mA when the 2301E-HT is not in control forces the gates to bump closed during the transfer from the primary controller to the 2301E-HT control.

For the 2301E-HT to function as a backup governor, it must be used with a customizable Woodward digital control as the primary control. This primary control will support the software algorithms to allow the 2301E-HT to be used as a backup governor.

Pond/Tail Level Control

The Pond/Tail Level Control mode can control the forebay level (pond level) or the tailbay level to a set point by opening and closing the gates. Level Control can be enabled using the "Pond/Tail Level Control Enable" discrete input or Modbus. The pond/tail level input signal must be valid for Level Control mode to be enabled. If the level signal is lost, an alarm will indicate the failure, and the control will disable Level Control.

The only difference between Pond and Tail Level control is that the gates will move in opposite directions as a result of the Level Error. If the control is configured for Tail Level control and the level is greater than the set point, the gates must close to reduce the error. However, if the control is configured for Pond Level control and the level is greater than the set point, the gates must open to reduce the error.

⚠WARNING

If you are controlling the Pond Level (forebay level), be aware that increasing your Pond Level set point results in decreasing the gate position, and vice-versa. Thus, the Raise input will result in moving the gates in the closing direction.

When Level Control is enabled, the Raise and Lower contact inputs control the Level Set Point. The Level Set Point "Raise/Lower Rate" controls how fast the set point ramps up and down. The level set point can also be adjusted using the Woodward Watch Window or Modbus.

When Level Control is enabled, there are two options. The control can be configured to maintain a preset level set point, or it can be configured to "follow" actual level and gate position. If the application always requires the same level set point when in Level Control, the control should be set up to maintain the preset level set point. Each time the Level Control mode is enabled, the control will use the preset level set point. The set point can still be adjusted using the Raise and Lower commands. If a bumpless transfer is needed or desired when Level Control is enabled, the control should be set to "follow" actual level and gate position. When Level Control is enabled, the gates will stay where they are at that time.

The level transducer range must also be entered into the 2301E-HT during the initial configuration. The "Elevation at 4 mA" and the "Elevation at 20 mA" refer to the elevation of the water level when the level transducer is generating 4 and 20 mA. These high and low limits become the limits of the Level set point, and they are also used to calculate the Remote Reference for Level Control (if used). The elevations can be in any unit of measurement, but the units must stay consistent for all other values relating to Pond/Tail Level control (level feedback signal, level set point, and desired accuracy). The "Maximum Gate Position" and "Minimum Gate Position" in Level Control mode must also be configured. This can prevent the unit from motoring or from overloading in Level Control.

The Level Control algorithm is designed so that several units can be controlling pond/tail level together without any communication between controls and without fighting each other. However, the consequence of being able to do this is that the control does not integrate out all error between actual level and the level reference. By design, the only gate position where there will not be any level error is the midpoint between “Maximum Gate Position” and “Minimum Gate Position.” Therefore, the “Desired Control Accuracy” must be configured. This desired control accuracy has the same units as the elevation levels discussed above. If the desired control accuracy is 1 foot, the 2301E-HT will control the level, but there may be some error (less than one foot) remaining during steady state.

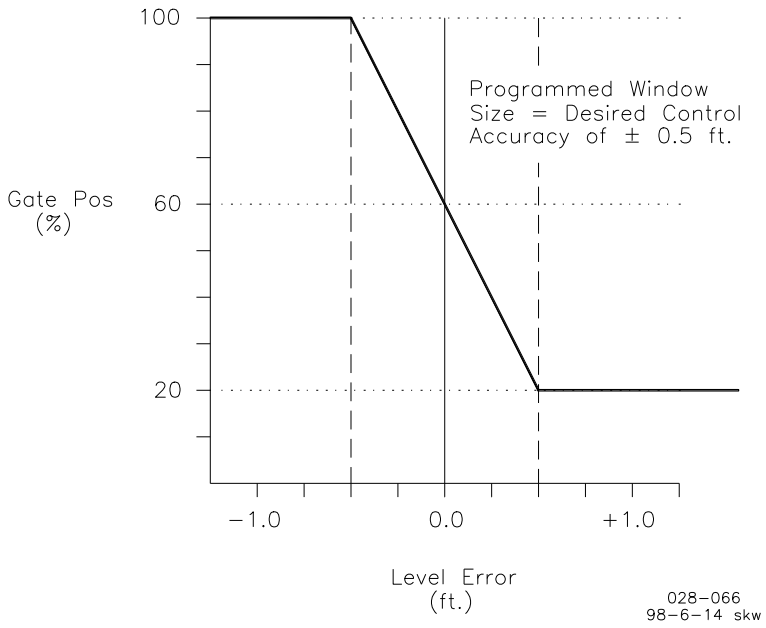

Figure 3-6. Pond Level Control Accuracy

For example, assume the control is configured for Pond Level control. The “Maximum Gate Position” has been configured for 100% and the “Minimum Gate Position” has been configured for 20%. The “Desired Control Accuracy” has been configured for 0.5 feet. If the level error (level set point - actual level) is greater than +0.5, the gates will close to the minimum gate position (20%). If the level error is less than –0.5, the gates will open to the maximum gate position (100%). As the actual level approaches the set point and the error is reduced, the gate position will find an equilibrium value along the curve shown below. The only time the level error will be zero is when the equilibrium point falls on the midpoint of the “Minimum” and “Maximum” gate position values.

The smaller the “Desired Control Accuracy” value is, the steeper the slope will be on the above graph. This will result in a very high “gain” on the gate position, and small error fluctuations in the Pond/Tail Level will move the gates very quickly. The “Desired Control Accuracy” value should be made as large as possible for each given application.

First Control Mode

It is possible to choose which control mode the control will assume just after the breaker is closed. The options are position control, baseload control, level control or remote baseload control. One of these controls will be enabled after the breaker closes and it is possible to switch between these control modes at any time.

Valve Driver (Gate)

The 2301E-HT digital control's valve driver can be configured for many different applications. The valve driver (actuator output) can be configured as a proportional signal or as an integrating signal.

For explaining purposes, let us suppose that the actuator output has been configured for 4–20 mA.

A proportional signal is a 4 to 20 mA signal that is proportional to the actuator set point, 0 to 100%. The proportional signal is 4 mA for 0% gate position, 12 mA for 50% gate position, and 20 mA for 100% gate position. No gain or offset adjustments are available in the 2301E-HT when a proportional signal is supplied due to the nature of the signal.

An integrating signal is a 4 to 20 mA signal that positions a proportional valve, or pilot stage valve. The integrating signal is about 12 mA to center the proportional, or pilot stage, valve. When the current is less than 12 mA the valve moves one way, and when the current is greater than 12 mA the valve moves the other way. The further the signal is from the null current, the further the proportional valve plunger moves from its center position. Typically, the proportional valve ports oil to another valve, or hydraulic amplifier, which then positions the servomotor.

The integrating signal has three adjustments that must be made. The first adjustment is to configure the control for a reverse acting valve or a forward acting valve. Most valves will be forward acting, meaning that an increase in the actuator control current (greater than the null current, 12 mA) results in the gates opening. If the system is reverse acting, meaning that a decrease in the control current results in the gates opening, then "Reverse Acting" must be tuned TRUE. The second adjustment is the "Valve Offset." The null current will probably never be equal to exactly 12.00 mA, so the valve offset makes up for this difference. If this is not adjusted properly, the gate position will not match the gate position demand. The third adjustment that needs to be made to the integrating signal is the "Valve Gain." This controls how much the current deviates from the null current for a given gate position error. If the gates are sluggish to step changes, the gain can be adjusted to increase the gate response, or if the gates overshoot during a step change, the gain can be adjusted to decrease the response.

The 2301E-HT control has a dither function designed into its valve driver output. The valve dither function induces an ac current on the actuator output. Valve dither accomplishes two things. First, it keeps the valve plunger(s) constantly moving which reduces "stiction," or static friction. "Stiction" can cause gate hunting if the valve does not respond correctly to the electronic signal. Second, dither makes a positive lap valve respond as though it were a zero lap valve.

The 2301E-HT continuously compares the actual gate position to the gate position demand in the control. If they do not match within the "Minor Mismatch Window" for more than the "Minor Mismatch Delay" time, the control will issue a "Minor Mismatch" alarm. If the gate position does not match the demand within the "Gross Mismatch Window" for more than the "Gross Mismatch Delay" time, the control will issue a "Gross Mismatch" Shutdown.

Brake Permissive

One of the 2301E-HT relay outputs can be configured to act as a Brake Permissive. If this function is configured, the relay output will close when five conditions are met:

1. the control has to receive a "Stop" command
2. the speed must be below the "Brake Enable Speed"
3. the gate position must be less than the "Brake Enable Gate Position"
4. the gate position signal must be valid
5. the speed signal must be valid

The relay output opens when the "Brake On Time" has expired. Additionally, the brakes can be configured to pulse on and off by setting "Pulse On Time" and "Pulse Off Time" under the Brake Service header.

Due to slight fluctuations in the calibration of gate position transducers, it is recommended that the "Brake Enable Gate Position" be set slightly above zero percent gate position. The default value is 2%.

Creep

The 2301E-HT can be configured to detect unit creep. Two discrete inputs are required to use this function. The inputs come from proximity switches focused on the speed gear. One proximity switch must be centered on a gear tooth, and the other proximity switch must be centered on a gear trough (or in between two gear teeth). The 2301E-HT will detect a creep as slight as one gear tooth of rotation.

When creep has been configured, the 2301E-HT will start looking for creep once the unit is given a “Stop” command, the speed has decreased below the “Creep Speed,” and the “Dead Stop Time” has expired. Once a creep is detected, the control will stay in the alarm condition until the “Reset Creep Time” expires. The 2301E-HT will look for creep again when the “Look Again Time” has expired.

The creep alarm is sent to the general governor alarms and to Modbus. A configurable relay output can be configured to energize upon a Creep Detection.

Overspeed Test

When the overspeed test is enabled, the **electronic overspeed trip is disabled**, the isochronous speed reference ceiling is raised to 200%, and the raise/lower rate on the isochronous speed reference is increased to 10% per second. To enable this test the “MECH OVERSPD TEST” [TRUE *FALSE] must be tuned from false to TRUE. This is found under the SPEED category in service. This mode has a 30 minute timer on it to prevent it from being accidentally left enabled.

To perform the overspeed test, the test must be enabled and the unit must be running off-line. The speed reference must be raised until the unit trips from the **mechanical overspeed**. The mechanical overspeed should be wired in series with the ESD (Emergency Shutdown) input string so that an ESD is issued to the control. If the mechanical overspeed device does not trip the unit, the speed reference will have to be manually lowered or the unit can be tripped manually. When the test is complete, tune “MECH OVERSPD TEST” [TRUE *FALSE] back to FALSE.

⚠WARNING

When this test is performed, there is NO internal overspeed protection in the 2301E-HT control. If the mechanical overspeed device does NOT trip the unit, the speed reference will have to be manually lowered or the unit can be tripped manually.

To prevent possible serious damage or injury from an overspeeding engine, be prepared to make an EMERGENCY SHUTDOWN when performing this test, to protect against runaway or failure of mechanical or other secondary overspeed devices.

Speed Switches

There are three speed switches that can be used in one of the configurable relays outputs. All speed switches are also passed along to Modbus.

The speed switches can be configured as increasing switches or decreasing switches. This means that the relay energizes as the unit speed is increasing above the set point for a determined time or decreasing below the set point during a determined time. Each speed switch has a High set point, High Delay, Low set point and Low Delay.

When the speed switch is configured as an increasing switch, the High set point is the trigger point and the Low set point is the switch’s reset point. The trigger will be triggered if the speed keeps above the High set point for the High Delay Time and it will be reset if the speed keeps below the Low set point for Low Delay Time.

When the speed switch is configured as a decreasing switch, the Low set point is the trigger point, and the High set point is the reset point. The trigger will be triggered if the speed keeps below the Low set point for the Low Delay Time and it will be reset if the speed keeps above the High set point for High Delay Time.

Example of a speed switch setup: A speed switch is desired to turn on the unit's exciter when the unit reaches 90% rated and keeps at this value for 5 seconds speed after a startup. Configurable relay #1 is configured as speed switch #1. The speed switch is configured as an increasing switch. The High set point is adjusted to 90% and the High Delay is configured to five. It is decided that the switch should reset at 80% rated speed instantly, so the Low set point is adjusted to 80% and the Low Delay is configured to zero.

In case both speed inputs fail, failsafe logic ("Use SW Failsafe," "Fail Safe State SW," and "Time to Disable Fail Safe SW") can be used to bring the turbine to a complete stop. "Time to Disable Fail Safe SW" is set in minutes and is the known amount of time for the turbine to come to a complete stop. When "Time to Disable Fail Safe SW" times out, failsafe logic is cleared and the turbine can be put in a known stopped safe mode. If for any reason the speed inputs become valid before the "Time to Disable Fail Safe SW" clears, a start command can override the failsafe logic and the turbine can be restarted. Otherwise, the turbine can be restarted after "Time to Disable Fail Safe SW" clears.

Gate Position Switches

There are two gate switches that can be used in one of the configurable relays outputs. All gate position switches are also passed along to Modbus.

The gate switches can be configured as increasing switches or decreasing switches. This means that the relay energizes as the unit gate is increasing above the set point for a determined time or decreasing below the set point during a determined time. Each gate switch has a High set point, High Delay, Low set point and Low Delay.

When the gate switch is configured as an increasing switch, the High set point is the trigger point and the Low set point is the switch's reset point. The trigger will be triggered if the gate keeps above the High set point for the High Delay Time and it will be reset if the gate keeps below the Low set point for Low Delay Time.

When the gate switch is configured as a decreasing switch, the Low set point is the trigger point, and the High set point is the reset point. The trigger will be triggered if the gate keeps below the Low set point for the Low Delay Time and it will be reset if the gate keeps above the High set point for High Delay Time.

Example of a gate position switch setup: A gate position switch is desired to turn on a light when the gates are closed. Configurable relay #1 (or #2) is configured as gate position switch #1. The gate position switch is configured as a decreasing switch. The Low set point is adjusted to 1%, setting this switch slightly above zero will take care of any drifting calibration of the gate position transducer. It is decided that the switch should reset at 4% gate position, so the High set point is adjusted to 4%.

kW Switches

There are two kW switches that can be used in one of the configurable relays outputs. All kW switches are also passed along to Modbus.

The kW switches can be configured as increasing switches or decreasing switches. This means that the relay energizes as the unit kW is increasing above the set point for a determined time or decreasing below the set point during a determined time. Each kW switch has a High set point, High Delay, Low set point and Low Delay.

When the kW switch is configured as an increasing switch, the High set point is the trigger point and the Low set point is the switch's reset point. The trigger will be triggered if the kW keeps above the High set point for the High Delay Time and it will be reset if the kW keeps below the Low set point for Low Delay Time.

When the kW switch is configured as a decreasing switch, the Low set point is the trigger point, and the High set point is the reset point. The trigger will be triggered if the kW keeps below the Low set point for the Low Delay Time and it will be reset if the kW keeps above the High set point for High Delay Time.

Baseload Control

When the unit is in parallel with the grid it may be desired to put it into Baseload control. In this mode the unit will assume a fixed amount of load given by the Baseload Reference. In order to perform that action the CTs and PTs must be correctly connected to the controller and a PID that compares the actual load with the Baseload Reference in order to generate a speed setpoint to the controller will do this function. At the moment that the Baseload mode is enabled the load reference ramps to the “Initial Baseload Reference” at a configurable rate.

The initial baseload reference can be set from an internal value configured under the service menu or can be a Modbus value.

After that, the baseload reference can be raised or lowered by the Raise and Lower inputs, respectively.

A Remote Baseload Reference can be used as well. There are two ways to enable the Remote Baseload Reference: closing both the Raise and Lower inputs when in Baseload Mode, or by enabling it via a Modbus Command. The remote baseload reference can either come from a 4–20 mA analog input or through Modbus communication.

If there’s a failure in the Remote Baseload signal the remote baseload control is automatically disabled and an alarm is given.

When the baseload control is disabled the control tracks the generator load and maintain it, making a bumpless transfer between the baseload mode and the other control modes.

Unload and Generator Breaker Open Commands

The 2301E-HT has a configurable input that can be used as an unload command. It has also a configurable output that can be used as a generator breaker open command. When the unit is in parallel with the grid in Baseload mode and an unload command is set the baseload reference starts lowering slowly (configurable rate) in order to unload the unit. When the generator load reaches the load Unload Trip Level (configurable) the control sets a generator breaker command, if a discrete input is programmed with this function. It also send the generator breaker opening command if the load reference is at the Unload Trip Level value and a maximum delay expires (configurable). When the generator breaker opens, the unit stays isolated waiting for a stop command or a command to re-synchronize to the grid.

If the generator breaker command is issued and the generator breaker status is not open until a configured time, then an alarm is generated.

Alarms and Shutdowns

⚠WARNING

Lock Out Tag Out

Use of this equipment by untrained or unqualified personnel could result in damage to the control or the installation's equipment and possible loss of life or personal injury. Make sure personnel using or working on this equipment are properly trained.

The 2301E-HT monitors several control functions and issues an Alarm when something goes wrong with a control parameter. When the control parameter(s) in question are crucial to the safe operation of the unit, the control will issue a Shutdown and an Alarm.

All Alarms and Shutdowns are latched until the condition is cleared and the control is given a “Reset” command. A reset command can be issued to the control through a configurable discrete input or Modbus. A reset is automatically issued during every “Start” command to the control.

The following is a list of conditions that result in an Alarm only:

- **Level Signal Failure**: If the Pond/Tail Level control input signal fails, this alarm goes TRUE. Pond/Tail Level control mode is also disabled.
- **Remote Reference Signal Failure**: If the Remote Reference input signal fails, this alarm goes TRUE. Remote Reference control mode is also disabled.

- **Speed Bias Signal Failure**: If the Synchronizer/Load Control input signal fails, this alarm goes TRUE.
- **Minor/Small Gate Position Mismatch**: If the gate position does not match the control's gate position demand within the "Minor Mismatch Window" for the "Minor Mismatch Delay Time," this alarm goes TRUE.
- **Modbus Link Error #1 or #2** (unless calibrated as a shutdown): When a Modbus link error occurs, this alarm goes TRUE.
- **Dirty Oil Switch Input Alarm**: If a discrete input is configured for the Dirty Oil Switch, this alarm will go TRUE when the discrete input is closed.
- **Creep Detected**: When creep is detected, this alarm goes TRUE.
- **Breaker Open Time Exceeded**: When an open generator breaker command is issued and the breaker does not open, this alarm goes TRUE.
- **Remote Baseload Signal Failure**: If the Remote Baseload input signal fails, this alarm goes TRUE. Remote Baseload control mode is also disabled, if the remote baseload is being controlled trough analog Input.
- **Gate Limiter Signal Failure**: If the Gate Limiter input signal fails, this alarm goes TRUE.
- **Remote Level Signal Failure**: If the Remote Level input signal fails, this alarm goes TRUE. Remote Level control mode is also disabled, if the remote level is being controlled trough analog Input.
- **Speed Signal #1 Failure**: When the speed signal #1 fails, this alarm will go TRUE
- **Speed Signal #2 Failure**: When the speed signal #2 fails, this alarm will go TRUE
- **kW Input Failure:** If the kW input signal fails, this alarm goes TRUE**.**

Any of these alarm conditions can be corrected while the unit is running and the control can be given a "Reset" command.

Shutdown conditions will de-energize the ESD (Emergency Shutdown) relay. (one of the programmable functions of the relay outputs). This relay should be tied to the application's Emergency Shutdown circuit. The control cannot be started after an emergency shutdown until a "Stop" command is given and then another "Start" command is issued.

The following is a list of conditions that result in a Shutdown and a "Governor Shutdown" alarm:

- **Speed Signal Failure**: When the speed signal fails, the control will shut down the unit.
- **Unit Overspeed**: When the unit's speed exceeds the "Overspeed Set Point," the control will shut down the unit.
- **Gross/Large Gate Position Mismatch**: When the gate position does not match the control's gate position demand within the "Gross Mismatch Window" for the "Gross Mismatch Delay Time," the control will shut down the unit.
- **Gate Position Signal Failure**: When the gate position signal is lost, the control will shut down the unit.
- **Incomplete Start**: When the unit is given a "Start" command and does not reach the "Start Speed" set point before the "Time to Start Speed" timer expires, the control will shut down the unit.
- **Local Modbus Input Shutdown:** When the unit is given an "Emergency Shutdown" command through Local Modbus communications, the control will shut down the unit.
- **Remote Modbus Input Shutdown:** When the unit is given an "Emergency Shutdown" command through Remote Modbus communications, the control will shut down the unit.
- **ESD Discrete Input:** When the unit is given an "Emergency Shutdown" command through a discrete input, the control will shut down the unit.
- **Power up Trip**: This shutdown occurs when the 2301E-HT is turned on or reset.

WARNING

If the ESD Discrete Input occurs the 2301E-HT will be tripped but the ESD discrete output won't de-energize. This is used to prevent trip loops.

Emergency Shutdown

Calibrate Mode

The 2301E-HT has a Calibrate Mode to assist with the system's control calibration. The Calibrate Mode can be enabled only from the Configuration Menus, and can be operated only from the Service Menus. Calibrate Mode must be disabled from the Configuration Menus in order to return to the normal run operation mode or to issue a start.

WARNING

The Calibrate Mode should only be entered when the unit is shut down, de-watered, and it is safe to move the gates. All I/O points will be under complete manual control!

When the Calibrate Mode is enabled, all analog outputs can be forced to output 0%, 25%, 50%, 75%, 100%, or a custom percentage of full scale current, the relay outputs can be manually energized, the analog input current can be directly monitored, and the discrete inputs can be directly monitored.

Step Test

During the initial calibration of the control system, the 2301E-HT must be calibrated for optimum performance. Step test logic is built into the 2301E-HT to aid in the tuning of the off-line PID gains and the intermediate valve gains.

The off-line PID gains must be tuned when the unit is off-line or in isochronous mode on an isolated system. When the step test is enabled, the step test logic introduces a step change, in percent of rated speed, to the speed reference. The step change causes the control to respond and correct the resulting speed error, and the PID gains can be adjusted until the optimum control response is observed.

The intermediate valve gain can also be adjusted using this step test. This gain should only be adjusted when the unit is de-watered and it is safe to operate the gates. If the 2301E-HT is in Manual or Maintenance Mode of operation, the step test introduces a step change, in percent gate position, to the manual gate position.

The step change can be positive or negative. The duration of the step can be adjusted, and when this adjustable time expires, the step change will always return to zero. This avoids an offset in the speed reference, in case the step test is accidentally left enabled.

Gate Timer

The 2301E-HT can be used to time the gates when gate timing is being adjusted.

WARNING

Gate timing can only be done when the unit is de-watered and it is safe to operate the gates. Gate timing should only be set to the turbine manufacturer's specifications.

In order to use the Gate Timer, the 2301E-HT must be in Manual mode. Also, the Gate Timer must be turned on in the GATE TIMER service menu. In this same menu, the gates can be manually forced to go to 5% or 95% at the full hydraulic rate.

To measure the opening timing, the gates must be forced to 5%. The timer must be reset in case any time has been accumulated on the timer. The gates must then be forced from 5% to 95% at full hydraulic rate. The 2301E-HT measures the time that it takes to the gates to get from 25% gate position to 75% gate position. This time is then multiplied by two to get the gate timing in the opening direction. This time can be recorded, or adjustments can be made to the timing.

To measure the closing timing, the timer must be reset to clear the timer value. The gates must then be forced from 95% to 5% at the full hydraulic rate. The control measures the time it takes for the gates to go from 75% to 25% and multiplies it by two to get the gate timing in the opening direction.

Table 3-1. Commands

Input/Output	Function I/O Description	Sequence to Start	Sequence/ Status to Run	Sequence to Stop	Emergency Stop
Input	Run/Stop	Goes High	Stays High	Goes Low	Goes low
Input	Raise Speed/Load	Goes Low	Indetermined/Depends on conditions	Goes Low	Goes Low
Input	Lower Speed/Load	Goes Low	Indetermined/Depends on conditions	Goes Low	Goes Low
Input	Generator Breaker Status	Goes Low	Goes High	Goes Low	Goes Low
Input	Emergency Shutdown	Goes High	Stays High	Stays High	Goes Low
	Whatever other I/O is needed to get initial start	XX	XX	XX	XX
Output	Discrete Ouput 1 Shutdown	Is High	Is High	Is High	Is Low

Control Diagram

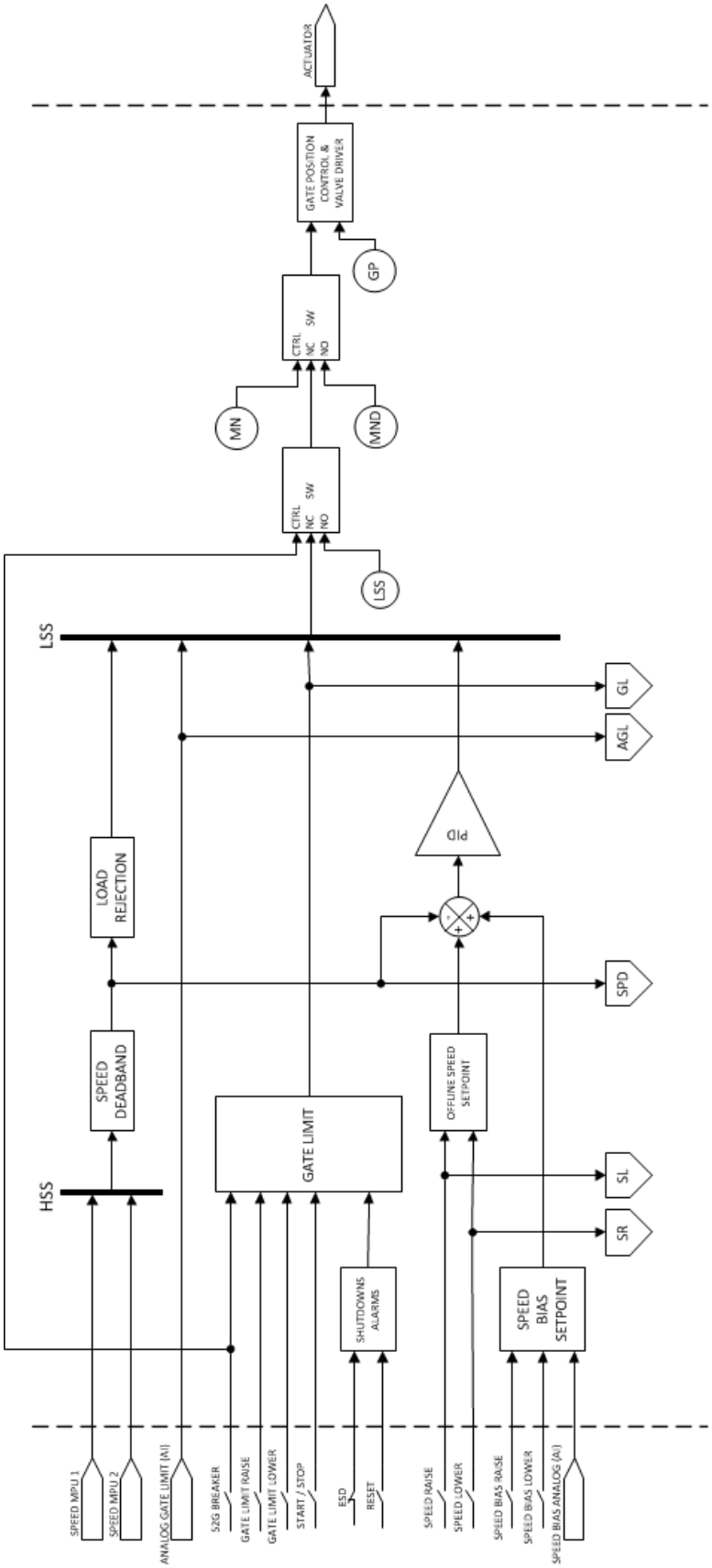

Figure 3-7a. Control Diagram (1 of 2)

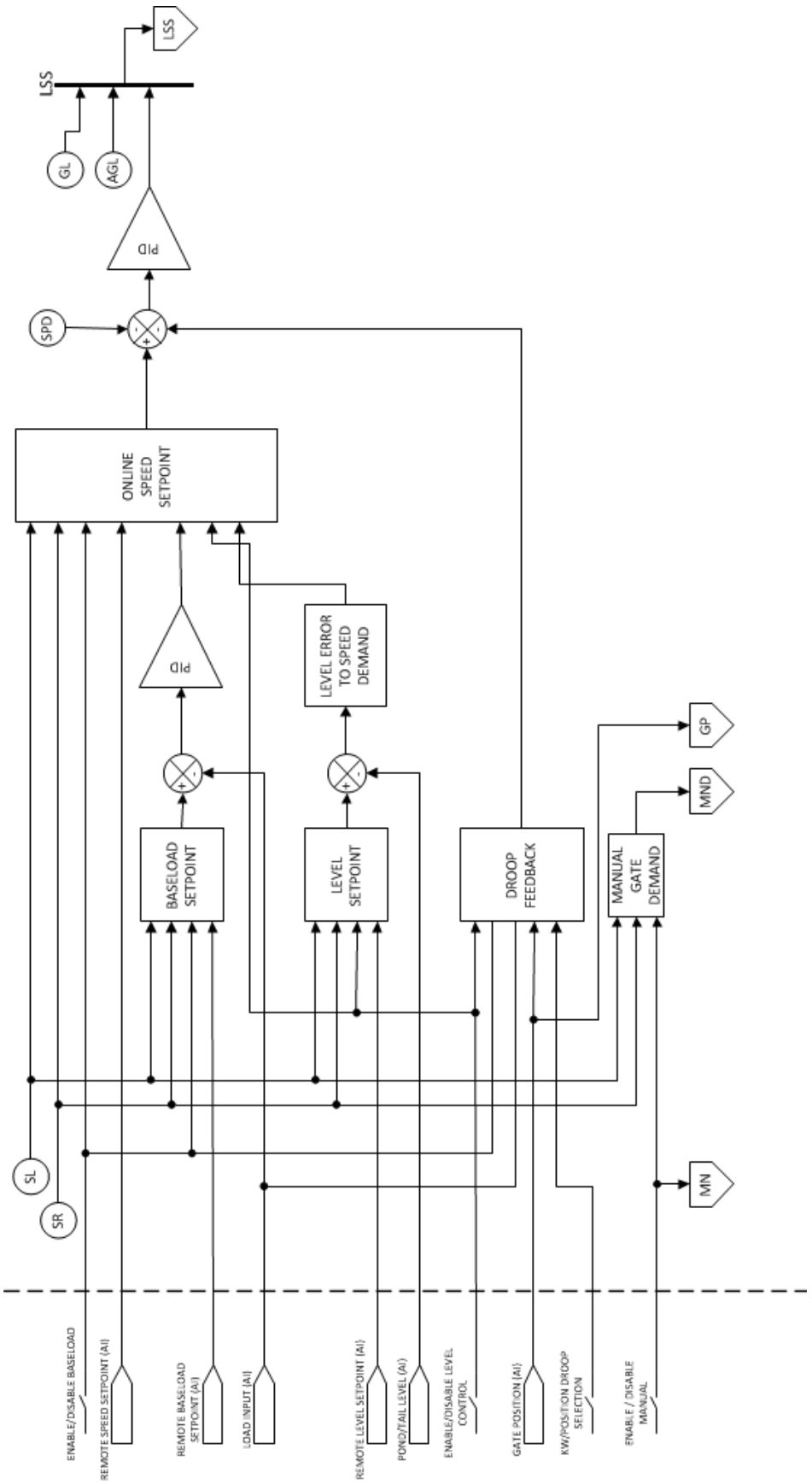

Figure 3-7b. Control diagram (2 of 2)

Chapter 4.
Entering Control Setpoints

Introduction

This chapter contains information on control calibration. It includes initial prestart-up and start-up settings and adjustments, and a current transformer phasing procedure. Because of the variety of installations, plus system and component tolerances, the 2301E-HT control must be tuned and configured for each system to obtain optimum performance.

⚠WARNING

An improperly calibrated control could cause an overspeed or other damage to the prime mover. To prevent possible serious injury from an overspeeding prime mover, read this entire procedure before starting the prime mover.

Control Assistant PC Interface

The connection of a computer is only required for calibration and setup of the 2301E-HT control on a prime mover. The computer and Control Assistant software is not required and not necessary for normal operation of the prime mover, unless Modbus is being used for monitoring.

Control Assistant was developed by Woodward to be a Servlink OpcServer client software product that provides a generic PC interface to any control, and is a very powerful setup, testing, and troubleshooting tool. Control Assistant provides a means of shutting down and placing the control in the I/O Lock mode for Configuration, saving values in the control EEPROM and resetting the control. Application tunable values can be uploaded, downloaded and saved to a file.

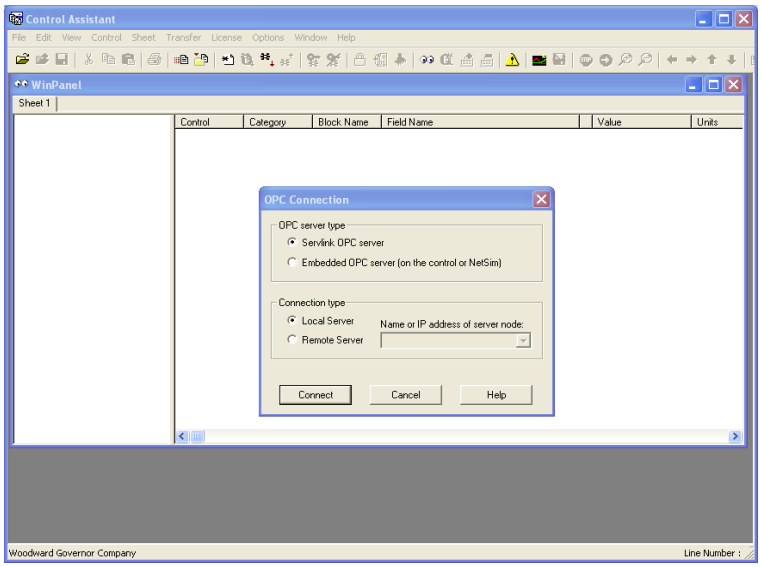

Figure 4-1. Control Assistant

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. Control Assistant communicates to the control through an RS-232 cable connection to the comm port which is configured as a point-to-point only Servlink OpcServer.

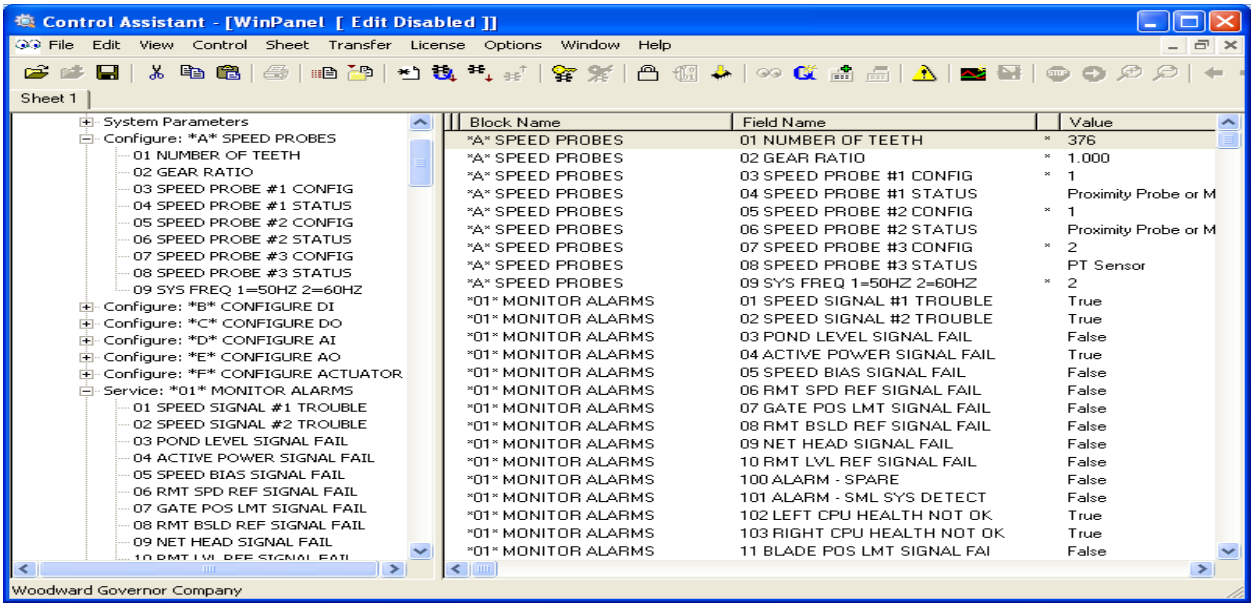

Figure 4-2. Inspector

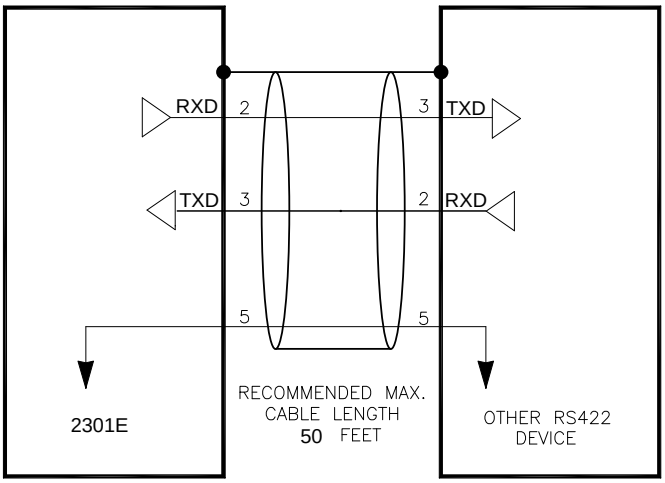

Figure 4-3. RS-232

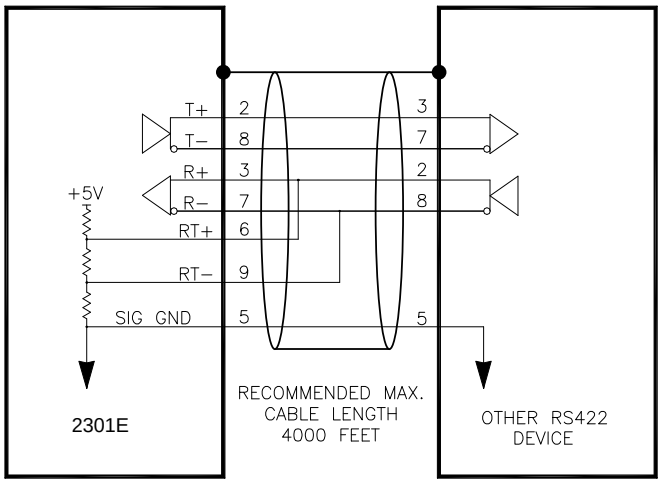

Figure 4-4. RS-422

 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 engine operation, it is not safe to operate the prime mover while these parameters are being configured. In the Configure mode the control outputs will be set to their off state, and the microprocessor will stop executing the application code. The control will have to be Reset to continue operation.

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

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

 If an application configuration has been previously saved to a *.tc file, the saved set of parameters can be loaded into the 2301E-HT 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 2301E-HT when a similar system is being set up, 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 2301E-HT control to reprogram it to the saved values or into another 2301E-HT at a later time.

Configure Menu Descriptions

When the user enters on this menu the 2301E-HT hardware will shut down all inputs and then the turbine will be stopped. Remember that the turbine will stop abruptly.

01 FUNCTION SELECT

The functions that will be used in the 2301E-HT for Francis turbines are selected in this menu.

01 ENABLE CALIBRATE? [TRUE or *FALSE] pulse to enable the calibrate mode. This value can only be changed in the Configure menus, and Calibrate Mode can only be operated from the Service menus. The "Start" command is disabled if the control is in the Calibrate Mode.
02 DISABLE CALIBRATE? [TRUE or FALSE] Pulse to disable the calibrate mode
03 USE BRAKE PERM? [TRUE or *FALSE] If the Brake Permissive function in the 2301E-HT is going to be used this value must be tuned to TRUE. The Brake Permissive function closes a relay when the governor is issued a stop command, the gates are below a preset value, speed and gate position signals are valid, and the speed is below a preset value.
04 USE AIO LINKNET? [TRUE or *FALSE] If the external LINKnet HT AIO module is used, configure this parameter to TRUE.

⚠WARNING **Pay close attention to the contact ratings on the 2301E-HT relay outputs. An interposing relay will be necessary for brake permissive applications.**

02A CONFIG ACTUATOR

This menu is used to configure the actuator driver (gate).

01 1=0–200 / 2=4–20 / 3=0–20 [*2 (1,3)] This integer selects the actuator output current. If the number is tuned to 1, the software is configured for a 0 to 200 mA actuator driver. If the number is tuned to 2, the software is configured for a 4 to 20 mA actuator driver. If the number is tuned to 3, the software is configured for a 0 to 20 mA actuator driver.
02 1=PROP / 2=INTEG [*2 (1,2)] This integer selects the type of actuator driver used by the 2301E-HT. If the number is tuned to 1, the software will send the low limit current for 0% actuator demand (4 mA for 4–20) and the high limit current for 100% actuator demand (200 mA for 20–200). If the integer is tuned to 2, the software will integrate the valve open and closed by manipulating the output current around the null current (12 mA for 4–20 and 110 mA for 0–200).
03 REVERSE ACTING? [TRUE or *FALSE] This should be tuned TRUE if the valve is integrating and "reverse acting." Reverse acting means that when the control outputs an actuator current BELOW the null current the gates OPEN.

03 CONFIG SPEED SIGS

This menu is used to configure the speed signals. The type of speed signals and the number of speed signals are entered at this menu.

01 ENTER RATED RPM #1[*100 (10,2000)] This number must be tuned to the rated RPM of the unit.
02 TEETH NUMBER #1 [*60 (15,720)] this is the teeth number of the flywheel.
03 GEAR RATIO #1 [*1(1,10)] Enter the gear ratio

04 CONFIG ANALOG IN

This menu is used to configure the analog inputs. The functions that each analog input can assume are listed below:

1- NOT USED
2- POND/TAIL LEVEL
3- REMOTE SPEED REFERENCE
4- REMOTE BASELOAD REFERENCE
5- ANALOG SPEED BIAS
6- GATE POSITION FEEDBACK
7- ANALOG GATE POSITION LIMITER
8- REMOTE LEVEL REFERENCE
9- kW Input

IMPORTANT

The first analog input can have a special function: if the Speed Bias is configured to come from an analog source (parameter "02 SIG TYPE - 2=AN / 3=DIG" on "09 CONFIG SYNC_LOAD CONTROL" configure menu) and it's going to be used for synchronizing only (parameter "01 SYNCHRONIZE ONLY?" on "09 CONFIG SYNC_LOAD CONTROL" configure menu), then this analog input is used as a Speed Bias input if the generator breaker is opened and one of the options listed above if the generator breaker is closed. Proper external connections must be made to allow two different analog signals to be multiplexed into one 2301E-HT analog input.

01 CNFG ANALOG IN #1: [*1 (1,9)] See list above for options
02 ANALOG IN #1 FUNCTION: The user can see the programmed function
03 CNFG ANALOG IN #2: [*6 (1,9)] See list above for options
04 ANALOG IN #2 FUNCTION: The user can see the programmed function

04A CONFIG AN IN LINKNET

This menu is used to configure the analog inputs for the LINKnet HT module. The functions that each analog input can assume are listed below:

1- NOT USED
2- POND/TAIL LEVEL
3- REMOTE SPEED REFERENCE
4- REMOTE BASELOAD REFERENCE
5- ANALOG SPEED BIAS
6- GATE POSITION FEEDBACK
7- ANALOG GATE POSITION LIMITER
8- REMOTE LEVEL REFERENCE
9- kW Input

01 CNFG ANALOG IN #1: [*1 (1,9)] See list above for options
02 ANALOG IN #1 FUNCTION: The user can see the programmed function
03 CNFG ANALOG IN #2: [*1 (1,9)] See list above for options
04 ANALOG IN #2 FUNCTION: The user can see the programmed function
05 CNFG ANALOG IN #3: [*1 (1,9)] See list above for options
06 ANALOG IN #3 FUNCTION: The user can see the programmed function
07 CNFG ANALOG IN #4: [*1 (1,9)] See list above for options
08 ANALOG IN #4 FUNCTION: The user can see the programmed function
09 CNFG ANALOG IN #5: [*1 (1,9)] See list above for options
10 ANALOG IN #5 FUNCTION: The user can see the programmed function
11 CNFG ANALOG IN #6: [*1 (1,9)] See list above for options
12 ANALOG IN #6 FUNCTION: The user can see the programmed function
13 CNFG ANALOG IN #7: [*1 (1,9)] See list above for options
14 ANALOG IN #7 FUNCTION: The user can see the programmed function
15 CNFG ANALOG IN #8: [*1 (1,9)] See list above for options
16 ANALOG IN #8 FUNCTION: The user can see the programmed function

05 CONFIG CONTACT IN

This menu determines the functionality of discrete inputs 6-8. The integer for each discrete input below must be tuned to the number that corresponds to the function desired. Each input can be used for any of the following options:

1- NOT USED
2- MANUAL CONTROL ENABLE
3- POND/TAIL LEVEL CONTROL ENABLE
4- AUTO FOLLOW ENABLE
5- GATE LIMIT RAISE
6- GATE LIMIT LOWER
7- CREEP INPUT #1
8- CREEP INPUT #2
9- DIRTY OIL SWITCH INPUT
10- GOVERNOR RESET
11- EXTERNAL START PERMISSIVE
12- UNLOAD
13- BASELOAD ENABLE
14- SPEED BIAS RAISE
15- SPEED BIAS LOWER
16- LOCAL/REMOTE
17- ENABLE kW DROOP

01 CONFIG DI #6 (F): [*1 (1,17)] See list above for options.
02 DI#6 FUNCTION: The user can see the programmed function
03 CONFIG DI #7 (G): [*1 (1,17)] See list above for options.
04 DI#7 FUNCTION: The user can see the programmed function
05 CONFIG DI #8 (H): [*1 (1,17)] See list above for options.
06 DI#8 FUNCTION: The user can see the programmed function

07 USE DI1 NC? [TRUE or *FALSE] If the discrete input#1 action is to be inverted put this variable to TRUE.
08 USE DI2 NC? [TRUE or *FALSE] If the discrete input#2 action is to be inverted put this variable to TRUE.
09 USE DI3 NC? [TRUE or *FALSE] If the discrete input#3 action is to be inverted put this variable to TRUE.
10 USE DI4 NC? [TRUE or *FALSE] If the discrete input#4 action is to be inverted put this variable to TRUE.
11 USE DI5 NC? [TRUE or *FALSE] If the discrete input#5 action is to be inverted put this variable to TRUE.
12 USE DI6 NC? [TRUE or *FALSE] If the discrete input#6 action is to be inverted put this variable to TRUE.
13 USE DI7 NC? [TRUE or *FALSE] If the discrete input#7 action is to be inverted put this variable to TRUE.
14 USE DI8 NC? [TRUE or *FALSE] If the discrete input#8 action is to be inverted put this variable to TRUE.

06 CONFIG DIGITAL OUT

This menu configures the three configurable relay outputs. The integer for each option below must be tuned to the value which corresponds to the desired function.

For the relays, the following options are available:
1- NOT USED
2- GATE POSITION SWITCH #1
3- GATE POSITION SWITCH #2
4- SPEED SWITCH #1
5- SPEED SWITCH #2
6- GENERAL GOVERNOR ALARM
7- BRAKE PERMISSIVE
8- CREEP INDICATION
9- SPEED BIAS ENABLED
10- GATE POSITION SIGNAL FAILURE
11- LEVEL SIGNAL FAILURE
12- REMOTE SIGNAL FAILURE
13- SPEED BIAS INPUT SIGNAL FAILURE
14- INCOMPLETE START
15- MINOR GATE POSITION MISMATCH
16- OVERSPEED
17- DIRTY OIL INDICATION
18- MODBUS LINK ERROR
19- SPEED INPUT #1 FAULT
20- GENERATOR BREAKER OPEN
21- KW SWITCH #1
22- KW SWITCH #2
23- REMOTE LEVEL REFERENCE INPUT FAILURE
24- SPEED SWITCH #3
25- SPEED INPUT #2 FAULT

01 CONFIG RELAY #2: [*1 (1,25)] See relay option list above.
02 RELAY #2 FUNCTION: The user can see the programmed function
03 CONFIG RELAY #3: [*1 (1,25)] See relay option list above.
04 RELAY #3 FUNCTION: The user can see the programmed function
05 CONFIG RELAY #4: [*1 (1,25)] See relay option list above.
06 RELAY #4 FUNCTION: The user can see the programmed function

07 CONFIG ANALOG OUT

This menu is used to configure the analog outputs. The functions that each analog input can assume are listed below

1- NOT USED (This analog output will not be used)
2- TACHOMETER
3- GATE POSITION
4- GATE LIMIT
5- SPEED ADJUSTMENT
6- POND/TAIL LEVEL
7- POND/TAIL LEVEL SET POINT
8- SPEED BIAS
9- ACTUATOR OUTPUT
10- GENERATOR POWER
11- BASELOAD REFERENCE

01 CONFIG AO#1: [*2 (1,11)] This integer is used to define the function of analog output #1. Tune this integer to one of the values in the beginning of this menu.
02 AO#1 FUNCTION: The user can see the programmed function
03 AO CURRENT OUTPUT: The user can see the actual current (mA)

07A CONFIG AN OUT LINKNET

This menu is used to configure the analog outputs for the LINKnet HT module. The functions that each analog input can assume are listed below

1- NOT USED (This analog output will not be used)
2- TACHOMETER
3- GATE POSITION
4- GATE LIMIT
5- SPEED ADJUSTMENT
6- POND/TAIL LEVEL
7- POND/TAIL LEVEL SET POINT
8- SPEED BIAS
9- ACTUATOR OUTPUT
10- GENERATOR POWER
11- BASELOAD REFERENCE

01 CONFIG AO#1: [*1 (1,11)] This integer is used to define the function of analog output #1.
02 AO#1 FUNCTION: The user can see the programmed function
03 AO CURRENT OUTPUT: The user can see the actual current (mA)
04 CONFIG AO#2: [*1 (1,11)] This integer is used to define the function of analog output #2.
05 AO#2 FUNCTION: The user can see the programmed function
06 AO CURRENT OUTPUT: The user can see the actual current (mA)

08 CONFIG LEVEL CTRL

Level control is configured in these menu items.

01 MINIMUM ELEVATION: [*4.0 (-30000,30000)] Enter the elevation of the water when the level transducer outputs exactly 4 mA. The units do not matter as long as they are consistent throughout the use of the control. (Ex. The elevation can be entered in feet, but then all other elevations and set points related to pond level control must be in terms of feet)
02 MAXIMUM ELEVATION: [*20.0 (-30000,30000)] Enter the elevation of the water when the level transducer outputs exactly 20 mA. The elevation units do not matter as long as they are consistent throughout the use of the control. (Ex. The elevation can be entered in feet, but then all other elevations and set points related to pond level control must be in terms of feet)
03 1=HEAD / 2=TAIL: [*1 (1,2)] Enter 1 if the 2301E-HT will be used for HEAD Level control, or enter a 2 if it will be used for TAIL level control.
04 CONFIG SET POINT: [*1 (1,2)] This option selects what set point is used when Level control is initially enabled. If this value is set to 1, the pond level set point will be calculated so that the transfer into Level Control mode is “BUMPLESS.” If the integer is set to 2, the pond level set point will always be the set

point entered in service mode. This does not result in a “bumpless” transfer into Level Control mode, and the wicket gates may move suddenly.
05 FIX SPD IN LEVEL?: [TRUE or *FALSE] This should be set to TRUE if the control should ignore speed fluctuations when in Level Control mode. If it is set to FALSE, the control will control the Pond/Tail level and still respond to speed fluctuations.

09 CONFIG MODBUS

Modbus configuration is done in this menu.

01 NETWORK ADDRESS RS-422: [*1 (1,247)] This integer must be tuned to the Network Address of the 2301E-HT RS-422 port.
02 1=ASCII / 2=RTU RS-422: [*2 (1,2)] This integer selects the format of the communication. If the value is tuned to 1, the Modbus will communicate in ASCII format. If the value is tuned to 2, the Modbus will communicate in RTU (Remote Terminal Unit) format.
03 TIMEOUT (sec) RS-422: [*10 (0.5,30)] This value is the number of seconds the 2301E-HT will wait before it results in an Exception or Link Error.
04 NETWORK ADDRESS RS-232: [*1 (1,247)] This integer must be tuned to the Network Address of the 2301E-HT RS-422 port.
05 1=ASCII / 2=RTU RS-232: [*2 (1,2)] This integer selects the format of the communication. If the value is tuned to 1, the Modbus will communicate in ASCII format. If the value is tuned to 2, the Modbus will communicate in RTU (Remote Terminal Unit) format.
06 TIMEOUT (sec) RS-232: [*10 (0.5,30)] This value is the number of seconds the 2301E-HT will wait before it results in an Exception or Link Error.

10 CONFIG SYNC_LOAD CONTROL

This menu needs to be configured if a speed bias bias signal is going to be used in the control.

01 SYNCHRONIZE ONLY?: [TRUE or *FALSE] If the Synchronizer/Load Control is only going to be used to synchronize the unit, then this value should be set to TRUE.
02 SIG TYPE – 2=AN / 3=DIG:[*1 (1,3)] If the speed bias signal source is coming from an analog input this variable must be configured to 2. In this case an analog input must be configured as a speed bias input. If the speed bias signal source is coming from digital inputs this variable must be configured to 3. In this case two digital inputs must be configured, one for speed bias raise and another for speed bias lower. A value 1 says that neither analog nor digital inputs are going to be programmed for speed bias function.

Service Menu Descriptions

01 MONITOR ALARMS

This menu displays all governor alarms and the current condition. A TRUE indication next to any alarm indicates the alarm condition is present, and a FALSE indicates the alarm condition is not present.

01 GOVERNOR RESET: [TRUE or *FALSE]. This value can be tuned TRUE and then back to FALSE to reset the 2301E-HT digital control.
02 GOVERNOR ALARM: [MONITOR]
03 LEVEL SIGNAL FAIL: [MONITOR]
04 REM REF SIG FAIL: [MONITOR]
05 SPEED BIAS SIG FAIL: [MONITOR]
06 SM GATE MISMATCH: [MONITOR]
07 MODBUS LINK ERROR: [MONITOR]
08 DIRTY OIL SWITCH: [MONITOR]
09 GOVERNOR SHUTDOWN: [MONITOR]
10 CREEP DETECTED: [MONITOR]
11 BREAKER OPEN TIME EXCEED: [MONITOR]
12 BASE LOAD REF SIG FAIL: [MONITOR]
13 GATE LIMIT SIG FAIL: [MONITOR]
14 RMT LEVEL REF SIG FAIL: [MONITOR]
15 SPEED SIGNAL MPU#1 FAIL: [MONITOR]
16 SPEED SIGNAL MPU#2 FAIL: [MONITOR]

17 AIO LINKNET COMM ALARM: [MONITOR]
18 AIO LINKNET TEMP ALARM: [MONITOR]
19 LOAD KW INPUT FAIL: [MONITOR**]**

02 MONITOR SHUTDOWNS

This menu displays all governor shutdowns and the current condition. A TRUE indication next to any alarm indicates the shutdown condition is present, and a FALSE indicates the shutdown condition is not present

01 GOVERNOR RESET: [TRUE or *FALSE]. This value can be tuned TRUE and then back to FALSE to reset the 2301E-HT digital control.
02 GOVERNOR SHUTDOWN: [MONITOR]
03 FIRST SHUTDOWN: [MONITOR]. This value shows the first shutdown that is active according to the table below:
0- NO SHUTDOWNS
1- SPEED SIGNAL FAILURE (ALL)
2- OVERSPEED
3- GROSS GATE MISMATCH
4- GATE POSITION FEEDBACK FAIL
5- INCOMPLETE START TIMEOUT
6- MODBUS 1 INPUT SHUTDOWN
7- ESD DISCRETE INPUT
8- POWER UP SHUTDOWN
9- MODBUS 2 INPUT SHUTDOWN

04 SPEED SIGNAL FAIL (ALL): [MONITOR]
05 UNIT OVERSPEED: [MONITOR]
06 LRG GATE MISMATCH: [MONITOR]
07 GATE POS SIG FAIL: [MONITOR]
08 INCOMPLETE START: [MONITOR]
09 LOCAL MODBUS INPUT SD: [MONITOR]
10 ESD INPUT SD: [MONITOR]
11 POWERUP TRIP: [MONITOR]
12 REMOTE MODBUS INPUT SD: [MONITOR]

03 CAL ANALOG INPUTS

This menu allows you to directly monitor the number generated by the current on all two analog inputs. Each analog input channel has a gain adjustment and an offset adjustment, which allows you to calibrate the numerical value generated by each analog input.

01 AN IN #1: [MONITOR] This menu item monitors the current on analog input #1.
02 AN IN #1-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
03 AN IN #1-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
04 AN IN #2: [MONITOR] This menu item monitors the current on analog input #2.
05 AN IN #2-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
06 AN IN #2-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
07 LOAD SENSE OFFSET: [*0 (-100, 100)] This menu item is the number used to calibrate the zero power value of the 2301E-HT. Adjust this value when the generator is with no load in order to read zero power in the 2301E-HT. This parameter only makes sense when CT and PT are being used as the generator power measurement, if an analog input is used to provide the generator load then this parameter can be ignored.

08 LOAD SENSE GAIN: [*13 (0, 100)] This menu item is the number used to calibrate the full power value of the 2301E-HT. Adjust this value when the generator is with full power in order to read the correct full power in the 2301E-HT. This parameter only makes sense when CT and PT are being used as the generator power measurement, if an analog input is used to provide the generator load then this parameter can be ignored.

03A CAL AN IN LINKNET

This menu allows you to directly monitor the number generated by the current on all eight analog inputson the LINKnet HT module. Each analog input channel has a gain adjustment and an offset adjustment, which allows you to calibrate the numerical value generated by each analog input.

01 AN IN #1: [MONITOR] This menu item monitors the current on analog input #1.
02 AN IN #1-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
03 AN IN #1-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
04 AN IN #2: [MONITOR] This menu item monitors the current on analog input #2.
05 AN IN #2-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
06 AN IN #2-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
07 AN IN #3: [MONITOR] This menu item monitors the current on analog input #3.
08 AN IN #3-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
09 AN IN #3-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
10 AN IN #4: [MONITOR] This menu item monitors the current on analog input #4.
11 AN IN #4-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
12 AN IN #4-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
13 AN IN #5: [MONITOR] This menu item monitors the current on analog input #5.
14 AN IN #5-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
15 AN IN #5-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
16 AN IN #6: [MONITOR] This menu item monitors the current on analog input #6.
17 AN IN #6-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
18 AN IN #6-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
19 AN IN #7: [MONITOR] This menu item monitors the current on analog input #7.
20 AN IN #7-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
21 AN IN #7-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.
22 AN IN #8: [MONITOR] This menu item monitors the current on analog input #8.
23 AN IN #8-OFFSET: [*0 (-100,100)] This menu item is the number added to the raw current throughout the current range. This is used to adjust the current's y-axis intercept for proper calibration.
24 AN IN #8-GAIN: [*1 (0.5, 2)] This menu item is the number that is multiplied by the raw current throughout the range. This is used to adjust the slope of the linear current for proper calibration.

04 CAL ANALOG OUTPUTS

This menu allows you to force the analog output to any value.

⚠WARNING **The Calibrate Mode should only be entered when the unit is shut down, de-watered, and it is safe to move the gates. All I/O points will be under complete manual control!**

01 CALIBRATE ENABLED: [MONITOR] This item displays if the calibrate mode is enabled.
02 FORCED AN OUT #1: [MONITOR] This menu item displays the value (in percent of full scale range) that the analog output are being forced to. For example, if this menu item is displaying 25, then analog output will be 8 mA (25% of 16 mA plus 4 mA).
03 SELECT ANALOG OUT #1: [*1 (1,6)] This menu item selects the output current %. The integer can be set to any of the following:

	4–20 mA
1 = 0%	4 mA
2 = 25%	8 mA
3 = 50%	12 mA
4 = 75%	16 mA
5 = 100%	20 mA
6 = Manually controlled analog value	

04 MANUAL AO#1 VALUE: [*0 (-10,110)] This menu item can be adjusted to any value between -10% and 110% of full scale. If the previous menu item, “SELECT ANALOG OUT,” is tuned to 6, then this number is used to control the analog output.
05 FORCED ACTUATOR: [MONITOR] This menu item displays the value (in percent of full scale range) that the analog output are being forced to. For example, if this menu item is displaying 25, then analog output will be 8 mA (25% of 16 mA plus 4 mA), if the actuator is configured to 4–20 mA.
06 SELECT ACTUATOR OUT: [*1 (1,6)] This menu item selects the output current %. The integer can be set to any of the following:

	4–20 mA	0–20 mA	0–200 mA
1 = 0%	4 mA	0 mA	0 mA
2 = 25%	8 mA	5 mA	50 mA
3 = 50%	12 mA	10 mA	100 mA
4 = 75%	16 mA	15 mA	150 mA
5 = 100%	20 mA	20 mA	200 mA
6 = Manually controlled analog value			

07 MANUAL ACTUATOR VALUE: [*0 (-10,110)] This menu item can be adjusted to any value between -10% and 110% of full scale. If the previous menu item, “SELECT ACTUATOR OUT,” is tuned to 6, then this number is used to control the actuator output. This parameter is only used when the Calibrate Mode is enabled via Watch Window. If the Calibration Mode is enabled via Modbus then the actuator stroke can only be performed via Modbus.

04A CAL AN OUT LINKNET

This menu allows you to force the analog outputs of the LINKnet HT module to any value.

⚠WARNING

The Calibrate Mode should only be entered when the unit is shut down, de-watered, and it is safe to move the gates. All I/O points will be under complete manual control!

01 CALIBRATE ENABLED: [MONITOR] This item displays if the calibrate mode is enabled.
02 FORCED AN OUT #1: [MONITOR] This menu item displays the value (in percent of full scale range) that the analog output are being forced to. For example, if this menu item is displaying 25, then analog output will be 8 mA (25% of 16 mA plus 4 mA).

03 SELECT ANALOG OUT #1: [*1 (1,6)] This menu item selects the output current %. The integer can be set to any of the following:

	4–20 mA	0–20 mA	0–200 mA
1 = 0%	4 mA	0 mA	0 mA
2 = 25%	8 mA	5 mA	50 mA
3 = 50%	12 mA	10 mA	100 mA
4 = 75%	16 mA	15 mA	150 mA
5 = 100%	20 mA	20 mA	200 mA
6 = Manually controlled analog value			

04 MANUAL AO#1 VALUE: [*0 (-10,110)] This menu item can be adjusted to any value between -10% and 110% of full scale. If the previous menu item, “SELECT ANALOG OUT,” is tuned to 6, then this number is used to control the analog output.
05 FORCED AN OUT #2: [MONITOR] This menu item displays the value (in percent of full scale range) that the analog output are being forced to. For example, if this menu item is displaying 25, then analog output will be 8 mA (25% of 16 mA plus 4 mA).
06 SELECT ANALOG OUT #2: [*1 (1,6)] This menu item selects the output current %. The integer can be set to any of the following:

	4–20 mA	0–20 mA	0–200 mA
1 = 0%	4 mA	0 mA	0 mA
2 = 25%	8 mA	5 mA	50 mA
3 = 50%	12 mA	10 mA	100 mA
4 = 75%	16 mA	15 mA	150 mA
5 = 100%	20 mA	20 mA	200 mA
6 = Manually controlled analog value			

07 MANUAL AO#2 VALUE: [*0 (-10,110)] This menu item can be adjusted to any value between -10% and 110% of full scale. If the previous menu item, “SELECT ANALOG OUT,” is tuned to 6, then this number is used to control the analog output.

05 CAL DISCRETE INs

This menu allows you to monitor the condition of all discrete inputs. When any of these menu items display TRUE, the contacts for that discrete input are closed.

01 DI #1(A) RUN/STOP: [MONITOR]
02 DI #2(B) RAISE: [MONITOR]
03 DI #3(C) LOWER: [MONITOR]
04 DI #4(D) BREAKER: [MONITOR]
05 DI #5(E) EMERGENCY SHUTDOWN: [MONITOR]
06 DI #6(F) CONFIG 1: [MONITOR]
07 DI #7(G) CONFIG 2: [MONITOR]
08 DI #8(H) CONFIG 3: [MONITOR]

06 CAL RELAY OUTPUTS

This menu allows you to manually energize each relay individually. This menu allows you to manually energize each relay individually. When the any of the following menu items are tune to TRUE, the corresponding relay or LED will be energized.

01 CALIBRATE ENABLED: [MONITOR] This item displays if the calibrate mode is enabled
02 FORCE RELAY OUT 1: [TRUE or *FALSE]
03 FORCE RELAY OUT 2: [TRUE or *FALSE]
04 FORCE RELAY OUT 3: [TRUE or *FALSE]
05 FORCE RELAY OUT 4: [TRUE or *FALSE]
06 USE DO#1 NC?: Select TRUE if you want digital output #1 normally closed or leave FALSE if you want normally open
07 USE DO#2 NC?: Select TRUE if you want digital output #2 normally closed or leave FALSE if you want normally open

08 USE DO#3 NC?: Select TRUE if you want digital output #3 normally closed or leave FALSE if you want normally open
09 USE DO#4 NC?: Select TRUE if you want digital output #1 normally closed or leave FALSE if you want normally open

07 CONFIG ANALOG OUT

This menu allows you to define the scale of the analog output.

01 - ANALOG OUT #1 FUNCTION: [MONITOR] The user can see the programmed function for the analog output #1.
02 AO1 LOW LIM VAL=:[*0(-30000,30000)] Configure the low value of this analog output (4 mA)
03 AO1 HIGH LIM VAL=:[*0(-30000,30000)] Configure the high value of this analog output (20 mA)

07A CONFIG AN OUT LINKNET

This menu allows you to define the scale of the analog outputs for the LINKnet HT module.

01 - ANALOG OUT #1 FUNCTION: [MONITOR] The user can see the programmed function for the analog output #1.
02 AO1 LOW LIM VAL=:[*0(-30000,30000)] Configure the low value of this analog output (4 mA)
03 AO1 HIGH LIM VAL=:[*0(-30000,30000)] Configure the high value of this analog output (20 mA)
04 - ANALOG OUT #2 FUNCTION: [MONITOR] The user can see the programmed function for the analog output #2.
05 AO2 LOW LIM VAL=:[*0(-30000,30000)] Configure the low value of this analog output (4 mA)
06 AO2 HIGH LIM VAL=:[*0(-30000,30000)] Configure the high value of this analog output (20 mA)

08 MAIN CONTROL

The main unit controls are available in this menu.

01 GOVERNOR RUN: [MONITOR] This menu item monitors the RUN/STOP state of the control. When TRUE, the unit is in RUN mode, when FALSE, the unit is in STOP mode.
02 UNIT ONLINE: [MONITOR] This menu item monitors the generator breaker's status. TRUE indicates that the unit is ONLINE (generator breaker is closed), and FALSE indicates that the unit is OFFLINE (generator breaker is open).
03 START GATE RATE: [*1 (0.01,100)] This is the rate at which the gate limit ramps from the "Breakaway" gate limit to the "Speed-No-Load" gate limit during startup. The rate is gate position percent/second.
04 UNIT STOP RATE: [*5 (0.01,100)] This is the rate at which the 2301E-HT ramps the gate limit to 0% during a unit STOP command if a slow stop is issued or during an UNLOAD command. The rate is in gate position percent/second.
05 RESET PULSE TIME: [*3 (0.01,10)] This is the time, in seconds, that a reset is held in each time a RESET command is given to the 2301E-HT.
06 FAST OFFLINE STOP: [*TRUE or FALSE] Tune TRUE to ramp gate limit to zero at very fast rate when breaker opens. This fast rate will essentially be the maximum hydraulic rate.
07 USE LOAD REJ GATE LIMIT?: [*TRUE or FALSE] Tune TRUE to enable the gate load rejection algorithm.
08 LOAD REJ GATE VALUE: [*6 (0,100)] This value defines the gate demand when the load rejection algorithm is triggered
09 LOAD REJ MAX TIME: [*7 (0,100)] This parameter defines the maximum amount of time that the control shall stay on the load rejection algorithm. When the load rejection algorithm is triggered it stays on it until the turbine speed falls below 102% or the "Load rejection Maximum Time" expires, whichever comes first.
10 FRST MODE WHEN BRK CLOSE: [*2 (1,4)] This parameter defines the first control mode when the generator breaker closes. The possibilities are: position control, baseload control, level control or remote baseload control.
11 FRST MODE WHEN BRK CLOSE: [MONITOR]
12 LOCAL / REMOTE / BOTH: [MONITOR] This menu item monitors the local / remote function. If there is no discrete input configured for this function both commands will be accepted.

09 UNIT SPEED

This service menu contains items that are related to the unit's speed.

01 UNIT SPEED (SS1): [MONITOR] This menu item displays the speed of the first pickup .This is the speed input #1 that the 2301E-HT uses in its speed control algorithm.
02 UNIT SPEED (SS2): [MONITOR] This menu item displays the speed of the first pickup .This is the speed input #1 that the 2301E-HT uses in its speed control algorithm.
03 USE SPD DEADBAND?: [*1 (1,3)] This menu item enables or disables the speed deadband.
1 = Not used.
2 = Deadband on-line.
3 = Deadband always.
04 HIGH DEADBAND (%): [*0.05 (0,5)] This menu item defines the top portion of the deadband window, in percent of rated speed.
05 LOW DEADBAND (%): [*0.05 (0,5)] This menu item defines the bottom portion of the #1 deadband window, in percent of rated speed.
06 START SPEED (%): [*50 (-10,100)] This menu item defines the speed at which the control is seeing a valid speed signal upon startup. This number should be tuned to a speed slightly higher than the lowest valid speed signal during every startup.
07 TIME TO START SPD: [*20 (1,600)] This menu item defines the time, in seconds, it takes for the control to start monitoring the pickup input for pickup failure.
08 TOP-SPEED WINDOW: [*110 (98,110)] The 2301E-HT tries to identify when the speed has stabilized during startup or after a load rejection by waiting for the speed to stay within a speed window for a user defined time period. This menu item defines the top limit for the stable speed window.
09 BOTM-SPEED WINDOW: [*90 (90,102)] The 2301E-HT tries to identify when the speed has stabilized during startup or after a load rejection by waiting for the speed to stay within a speed window for a user defined time period. This menu item defines the bottom limit for the stable speed window.
10 TIME TO STABL SPD: [*15 (1,120)] The 2301E-HT tries to identify when the speed has stabilized during startup or after a load rejection by waiting for the speed to stay within a speed window for a user defined time period. This menu item defines the time period that the speed must remain in the window.
11 OVERSPEED SETPNT: [*120 (0,300)] This menu item defines the overspeed trip set point. The set point is in percent (%) of rated RPM.
12 OVERSPEED DELAY: [*1 (0.01,2)] This is the delay time on the overspeed trip detection. This can avoid problems encountered with occasional speed spikes.
13 ENABLE OS BLOCK: [*TRUE or FALSE] This menu item enables or disables the overspeed block. Unless special circumstances are present, this value should be left at TRUE.
14 TIME TO INCOMPLETE START: [*100 (1,600)] This menu item defines the time, in seconds, it takes to get from the initial START command to the "START SPEED" mentioned in the previous item.
15 SPEED SS1 FILTER: [*0.01 (0.0,10)] This menu item is the time constant for the Lag Tau filter used to filter the speed input #1 signal. When this number is tuned to 0.01, then the filter is basically turned off. It is recommended that this value remain at 0.01 unless noise problems are present on the speed #1 signal.
16 SPEED SS2 FILTER: [*0.01 (0.0,10)] This menu item is the time constant for the Lag Tau filter used to filter the speed input #2 signal. When this number is tuned to 0.01, then the filter is basically turned off. It is recommended that this value remain at 0.01 unless noise problems are present on the speed #2 signal.

10 GATE POSITION

This menu contains items related to Gate Position control.

01 GATE POSITION: [MONITOR] This menu item displays current gate position.
02 VALUE @ 4 mA: [*0,(-200,200)] Defines the value when the current is 4 mA
03 VALUE @ 20 mA: [*100,(-200,200)] Defines the value when the current is 20 mA
04 USE SML MISMATCH: [*TRUE or FALSE] This parameter defines if the Small Gate Mismatch alarm is going to be used.
05 SML MISMATCH WIN: [*3 (1,10)] This menu item defines the size of the "Small Mismatch" window. The units are in gate position percent.
06 SML MISMATCH TIM: [*10 (0,60)] This menu item defines the time, in seconds, the control waits before issuing a "Small Mismatch" alarm.
07 USE LRG MISMATCH: [*TRUE or FALSE] This parameter defines if the Large Gate Mismatch alarm is going to be used.

08 LRG MISMATCH WIN: [*5 (1,10)] This menu item defines the size of the “Large Mismatch” window. The units are in gate position percent.
09 LRG MISMATCH TIM: [*10 (0,60)] This menu item defines the time, in seconds, that the control waits before issuing a “Large Mismatch” shut down.
10 GATES CLOSED %: [*2 (0,5)] This menu item defines the gate position at which the 2301E-HT considers the gates to be closed. It is recommended that this number be above zero to allow for slight drifting in the gate position transducer.
11 GP SIG FILTER TC: [*0.01 (0.001,5)] This menu item is the time constant for the Lag Tau filter used to filter the gate position signal from the transducer. When this number is tuned to 0.01, then the filter is basically turned off. It is recommended that this value remain at 0.01 unless noise problems are present on the gate position signal.

11 GATE LIMIT

This menu contains items related to the gate limit function.

01 GATE LIMIT: [MONITOR] This menu item displays the current gate limit.
02 GATE LIMIT COINC.: [MONITOR] This menu item displays the condition when gate limit is equal to the gate position. TRUE means that the gate limit equals the gate position.
03 ANALOG IN LIMIT ALL TIME: [TRUE or *FALSE] If this value is set to FALSE then the analog gate limiter will be evaluated only when the unit in online. If this value is set to FALSE then the analog gate limiter will be evaluated all the time.
04 ANALOG IN @ 4 mA: [*0 (0, 100)] This value represents gate limiter value (in percentage) if the analog input is equal to 4 mA.
05 ANALOG IN @ 20 mA: [*100 (0, 100)] This value represents gate limiter value (in percentage) if the analog input is equal to 20 mA.
06 BREAKAWAY GL: [*30 (0,100)] This menu item defines the “Breakaway” gate limit used during startup of the unit. This value should be set to the gate position it takes to break the unit away from its stopped position.
07 HOLD@BRKAWY TIME: [*1 (0.001,30)] This menu item defines the time, in seconds, that the gate limit stays at the “Breakaway” position before it starts ramping toward the “Speed-No-Load” gate limit.
08 SPEED-NO-LOAD GL: [*15 (0,100)] This menu item defines the “Speed- No-Load” gate limit used during startups and load rejections. This value should be set slightly higher than the actual Speed-No-Load gate position.
09 PREPOS ONLINE GATE LIM: [*100 (0,100)] This menu item defines the “Maximum On-Line Gate Position.” This value will pre-position the gate limit to this valve once the breaker closes. Once on-line, for example, if the pre-position value is set to 80% and the gate limit is at 75%. If a gate limit raise command is issued, the gate limit will raise until it reaches 80%.
10 AUTO RAISE DELAY: [*120 (0,600)] When the unit is started, the gate limit goes to the “Breakaway” gate limit and is held there for a specified time. Then the gate limit ramps to the “Speed-No-Load” gate limit, and stays there until the generator breaker is closed. If the “Speed-No-Load” gate limit is set too low, the unit will not be able to synchronize. If the “AUTO RAISE DELAY” timer expires, the 2301E-HT will automatically start ramping the gate limit up. This timer set point is in seconds.
11 AUTO RAISE RATE: [*0.5 (0,100)] This menu item defines the rate at which the “AUTO RAISE” function raises the gate limit. See previous menu item.
12 MAN R/L RAMP RATE: [*2 (0.01,100)] This menu item defines the rate at which a manual gate limit “RAISE” and “LOWER” adjust the gate limit.

12 VALVE DRIVER (I)

This menu contains items related to the integrating valve driver. It shall be used only if an integrating valve driver controls the hydraulic turbine.

01 ACTUATOR DEMAND: [MONITOR] This menu item displays 2301E-HT digital control’s actuator/ gate “demand.” The units of this menu item are in percent (%) gate position.
02 VALVE OFFSET: [*0 (-100,100)] This menu item defines the valve offset for the integrating actuator. It is used to adjust the null current of the actuator.
03 OFFLINE VALVE GAIN: [*1 (0,50)] This menu item defines the valve gain for the integrating actuator when the generator breaker is opened. It is used to tune the response of the actuator.
04 ONLINE VALVE GAIN: [*1 (0,50)] This menu item defines the valve gain for the integrating actuator when the generator breaker is closed. It is used to tune the response of the actuator.

05 DITHER FREQUENCY: [*2 (1,5)] This menu item defines the dither amplitude frequency. The options are: 20, 40, 80, 160 and 320Hz
06 DITHER FREQUENCY: [MONITOR] This menu item displays the dither frequency that is being used.
07 DITHER AMPLITUDE: [*0 (0,100)] This menu item defines the dither amplitude, in %.

13 GATE VALVE DRIVER (P)

This menu contains items related to the proportional valve driver.

01 ACTUATOR DEMAND: [MONITOR] This menu item displays the 2301E-HT digital control's actuator/ gate "demand." The units of this menu item are in percent (%) gate position.

14 MANUAL AND MAINT

This menu contains items related to the gate Manual and Maintenance modes available in the 2301E-HT.

01 MANUAL MODE ENABLED: [MONITOR]
02 ENABLE MAINT MODE: [TRUE or *FALSE] This menu item activates/ enables MAINTENANCE mode in the 2301E-HT when the value is tuned to TRUE.
03 PRESET VALUE: [*0 (-10,110)] This menu item defines a "preset" gate position. The units of this value are in gate position percent (%).
04 GOTO PRESET VALUE: [TRUE or *FALSE] This menu item forces the demand to the preset value (the previous menu item).

15 OFFLIN/ISOCH CTRL

This menu contains items related to off-line and isochronous control.

01 OFFLINE/ISOCH REF: [MONITOR] This menu item displays the off-line or isochronous speed reference.
02 I'M IN CONTROL: [MONITOR] This menu item displays a TRUE when the off-line or isochronous algorithms are in control of the unit.
03 PID OUTPUT: [MONITOR] This is the actuator demand from the off-line/ isochronous PID algorithm.
04 RAISE/LOWER RATE: [*0.01 (0.001,100)] This menu item defines the rate at which the off-line/isochronous RAISE and LOWER commands adjust the speed reference.
05 SPEED-NO-LOAD REF: [*100.05 (75,125)] This menu item defines the speed reference that the 2301E-HT uses when it initially starts the unit. It should be tuned as close to the synchronous speed reference for normal conditions.
06 UPPER LIMIT - REF: [*110 (75,250)] This menu item defines the upper limit of the off-line/isochronous speed reference.
07 LOWER LIMIT - REF: [*20.0 (0, 100)] This menu item defines the lower limit of the off-line/isochronous speed reference.
08 ENABLE SDR INVERS: [*TRUE or FALSE] This menu item can be used to disable the inversion of the SDR during starts and load rejections. This should be left TRUE unless stability problems are being experienced during starts and load rejections.
09 PID CLAMP WIN +/-: [*4 (0,5)] This menu item defines the window size for the PID clamp.

16 ONLINE/DROOP CTRL

This menu contains items related to on-line droop control.

01 SPEED ADJUST: [MONITOR] This menu item displays the droop speed reference.
02 I'M IN CONTROL: [MONITOR] This menu item displays a TRUE when the on-line/droop speed control algorithms are in control.
03 GATE POS SET POINT: [MONITOR] This menu item displays the on-line/ droop gate position set point.
04 PID OUTPUT: [MONITOR] This menu item displays the on-line/droop PID controller output.
05 RAISE/LOWER RATE: [*0.1 (0,1000)] This menu item defines the rate at which the on-line/droop RAISE and LOWER commands adjust the droop speed reference.
06 SET POINT DERIV TC: [*0.96 (0.001,5)] This menu item defines the time constant for the set point derivative calculation. This number should be left at 0.96, unless problems are experienced with the Feed Forward control.
07 PID CLAMP WIN +/-: [*4 (0,5)] This menu item defines the window size for the PID clamp.

17 REMOTE CONTROL

This menu contains items related to remote control.

01 REM SPD ENABLED: [MONITOR] This menu item displays when remote speed control is enabled.
02 REM SPD ANLG IN ENABLED: [MONITOR] It displays if the accepted remote speed value will be from analog input
03 RMT SPD ANALOG IN: [MONITOR] It displays the value of the Remote Control analog input (scaled)
04 REM SPD MODBUS #1 ENABLED: [MONITOR] It displays if the accepted remote speed value will be from Modbus #1
05 REM SPD MODBUS #2 ENABLED: [MONITOR] It displays if the accepted remote speed value will be from Modbus #2
06 REMOTE SPD REFERENCE: [MONITOR] Is displays the actual value of the Remote speed reference
07 AI VALUE @ 4 mA:[*0(-200,200)] Configure the value of the Remote reference when the current input is 4 mA
08 AI VALUE @ 20 mA: [*100(-200,200)] Configure the value of the Remote reference when the current input is 20 mA
09 REMOTE SPEED RAMP RATE: [*0.2 (0.0, 100.0)] This parameter defines the rate of change (in %/s) that the online ramp is changed when there is a change in the remote setpoint.

18 LEVEL CONTROL

It contains items related to the Pond/Tail level control function.

01 LVL CNTRL ENABLED: [MONITOR] This menu item displays TRUE when level control is enabled.
02 POND/TAIL LEVEL: [MONITOR] This menu item displays the pond/tail level.
03 LEVEL SET POINT: [MONITOR] This menu item displays the level set point.
04 PRESET VALUE: [*0 (0,100000)] This menu item defines the pond/tail level preset set point. This value is only used if Level control is configured to go to a preset set point each time level control is enabled. If the level control set point is configured to “follow” the actual level, then this menu item is not used.
05 MAX GATE POSITION: [*100 (0,100)] This menu item defines the maximum gate position allowed when controlling pond or tail level. The units of this value are gate position percent (%).
06 MIN GATE POSITION: [*20 (0,100)] This menu item defines the minimum gate position allowed when controlling pond or tail level. The units of this value are gate position percent (%).
07 CONTROL WINDOW: [*0.5 (0,10000)] This menu item defines the desired accuracy of the pond/tail level control circuit. This smaller this window is set for, the more the wicket gates will move to control the level. See Chapter 3.
08 GATE POSITION SET: [MONITOR] This menu item displays the gate position set point resulting from the level control algorithm.
09 SIGNAL FILTER TC: [*2 (0.01,7200)] This menu item defines the time constant for the Lag Filter for the pond/tail level signal. When this value is left at 0.01, the filter is basically turned off. This number should only be increased if the level signal is noisy.
10 RAISE/LOWER RATE: [*1 (0.01,1000)] This menu item defines the rate at which the RAISE and LOWER commands adjust the pond/tail level reference.
11 LEVEL GATE RATE: [*0.05 (0.001,100)] This menu item defines the rate at which the level reference is adjusted by the RAISE and LOWER commands.

19 REMOTE LEVEL CTRL

This menu contains items related to remote level control.

01 REM LEVEL ENABLED: [MONITOR] This menu item displays when remote level control is enabled.
02 REM LVL ANLG IN ENABLED: [MONITOR] It displays if the accepted remote level value will be from analog input
03 RMT LVL ANALOG IN: [MONITOR] It displays the value of the Remote level Control analog input (scaled)
04 REM LVL MODBUS #1 ENABLED: [MONITOR] It displays if the accepted remote level value will be from Modbus #1
05 REM LVL MODBUS #2 ENABLED: [MONITOR] It displays if the accepted remote level value will be from Modbus #2

06 REMOTE LEVEL REFERENCE:[MONITOR] Is displays the actual value of the Remote level reference
07 AI VALUE @ 4 mA:[*0(-200,200)] Configure the value of the Remote level reference when the current input is 4 mA
08 AI VALUE @ 20 mA:[*100(-200,200)] Configure the value of the Remote level reference when the current input is 20 mA

20 GAINS

This menu contains items related to the gains in the 2301E-HT digital control.

01 DROOP: [*5 (0,10)] This menu item defines the droop percent in the 2301E-HT.
02 OFFLINE P GAIN: [*1 (0.001,50)] This menu item defines the proportional gain used when the unit is off-line or in isochronous mode.
03 OFFLINE I GAIN: [*0.2 (0.001,50)] This menu item defines the integral gain used when the unit is off-line or in isochronous mode.
04 OFFLINE D GAIN: [*100 (0.001, 50)] This menu item defines the derivative gain used when the unit is off-line or in isochronous mode. In order to disable this gain this parameter must stay on 100.
05 ONLINE P GAIN: [*1.0 (0.001,50)] This menu item defines the proportional gain used when the unit is on-line/droop mode.
06 ONLINE I GAIN: [*0.2 (0.001,50)] This menu item defines the integral gain used when the unit is on-line/droop mode.
07 ONLINE D GAIN: [*100 (0.001, 50)] This menu item defines the derivative gain used when the unit is on-line/droop mode. In order to disable this gain this parameter must stay on 100.
08 DISABLE FEED FWD?: [TRUE or *FALSE] This menu item disables Feed Forward when tuned to TRUE. This menu item should be left FALSE in most applications.
09 FEED FORWARD GAIN: [*1 (0,5)] This menu item defines the Feed Forward Gain. This gain picks the derivative of the on-line speed setpoint and moves the gate in the proper direction This is used in on-line/droop mode.
10 TEMPORARY COMP: [*0.05 (0,10)] This menu item defines the temporary compensation adjustment. This is used off-line or in isochronous mode.
11 ERROR GAIN: [*1 (1,100)] This menu item defines the Error Gain. This gain multiplies the P, I and D gain. This is used in on-line/droop mode.

21 GATE TIMER

This menu contains items related to the gate timer function.

01 TURN ON GATE TIMER: [TRUE or *FALSE] This menu item activates the gate timer function.
02 GATE TIME (SEC): [MONITOR] This menu item displays, in seconds, the gate time from 0% to 100% or 100% to 0%.
03 RESET GATE TIME: [TRUE or *FALSE] This menu item resets the gate time timer back to 0 seconds.
04 GOTO 5% GATE POS: [TRUE or *FALSE] This menu item forces the gates to 5% when the 2301E-HT is in manual control mode.
05 GOTO 95% GATE POS: [TRUE or *FALSE] This menu item forces the gates to 95% when the 2301E-HT is in manual control mode.

22 STEP TEST

This menu contains items related to the Step Test function in the 2301E-HT digital control.

01 ENABLE STEP TEST: [TRUE or *FALSE] This menu item enables/activates the step test. Be aware that this will induce a step change in the speed reference when this value is tuned from FALSE to TRUE. This step change steps the gate position demand directly when in manual or maintenance mode.
02 STEP DURATION: [*30.0 (0.0, 1200.0)] This menu item defines the duration of the step change in the speed reference (or gate position demand when in manual or maintenance mode). Once this time has expired, the step test must be disabled and then enabled again to repeat the test.
03 STEP VALUE (%): [*3.0 (-10.0, 10.0)] This menu item defines the amplitude of the step change. The units of the step change are in speed reference percent (%) when in speed control, and they are in gate position percent when in manual or maintenance mode.
04 NEGATIVE STEP?: [TRUE or *FALSE] This menu item, when tuned to TRUE, makes the step change negative.

23 BRAKES

This menu is only applicable when the Brake Permissive function is enabled in the FUNCTION SELECT menu in the Configure mode (only when programming using Hand Held Programmer). This menu contains items related to the Brake Permissive function.

01 BRAKE PERMS MET: [MONITOR] This menu item displays TRUE when the brake permissives have all been met.
02 BRAKE ENABLE SPD: [*50 (0,100)] This menu item defines the speed at which the brakes can be enabled.
03 BRAKE ENABLE GPOS: [*2 (0,100)] This menu item defines the gate position at which the brakes can be enabled. This value should be set slightly higher than 0 to allow for gate position transducer drifting.
04 BRAKE ON TIMER [*60 (0, 10000)] This menu item defines how long the brakes will be applied once all permissives have been met.
05 BRAKE ON PULSE TIME [*15 (0,10000)] This menu item defines the on time pulse once the brakes permissives are met and the brakes are applied.
06 BRAKE OFF PULSE TIME [10 (0,10000)] This menu item defines the off time pulse once the brakes permissives are met and the brakes are applied. Set this value to " 0 " for Brakes to be in a steady ON state.

24 CREEP

This menu contains items related to the Creep Detection function.

01 UNIT CREEPING?: [MONITOR] This menu item displays TRUE when a unit creep is detected.
02 CREEP SPEED (%): [*5 (0,10)] This menu item defines the speed at which the control starts the Dead Stop timer.
03 DEAD STOP (SEC): [*60 (10,600)] This menu item defines the normal time between the creep speed (previous menu item) and a dead stop.
04 RESET CREEP (SEC): [*5 (0,600)] This menu item defines the time, in seconds, the control waits before it automatically resets the creep detection.
05 LOOK AGAIN (SEC): [*5 (0,600)] This menu item defines the time, in seconds, the control waits before it starts looking for creep again.

25 MODBUS

This menu contains items related to the Modbus communication.

01 BAUD RATE: [*10 (1,12)] This menu item defines the baud rate for the Modbus communications. 1=110 / 2=300 / 3=600 / 4=1200 bps / 5=1800 bps / 6=2400 bps / 7=4800 bps / 8=9600 bps / 9=19200 bps / 10=38400 bps / 11=57600 / 12=115200
02 STOP BITS: [*1 (1,3)] This menu item defines the stop bits for the Modbus communications. 1=1 Stop Bit / 2=1.5 Stop Bits / 3=2 Stop Bits
03 PARITY BITS: [*1 (1,3)] This menu item defines the parity used for the Modbus communications. 1=Parity Off / 2=Odd Parity/ 3=Even Parity
04 BITS: [*1(1,2)] It defines the bits for the Modbus. 1=7 / 2=8
05 DRIVER [*2 (1,2)] DO NOT CHANGE THIS PARAMETER
06 FREEZE REMOTE SETPOINT: [TRUE or *FALSE] This menu item, when set to TRUE, freezes the remote speed set point when communications are lost. If this value is set to FALSE, the remote set point goes to 0 when communications are lost.
07 FREEZE INITIAL BSLD REF: [TRUE or *FALSE] This menu item, when set to TRUE, freezes the initial baseload set point when communications are lost. If this value is set to FALSE, the initial Modbus baseload set point goes to 0 when communications are lost. This is applicable if the control mode is Local.
08 FREEZE BSLD REF: [TRUE or *FALSE] This menu item, when set to TRUE, freezes the remote baseload set point when communications are lost. If this value is set to FALSE, the remote baseload set point goes to 0 when communications are lost.
09 FREEZE LEVEL REF: [TRUE or *FALSE] This menu item, when set to TRUE, freezes the remote level set point when communications are lost. If this value is set to FALSE, the remote level set point goes to 0 when communications are lost.

10 FREEZE STROKE ACTUATOR: [TRUE or *FALSE] This menu item, when set to TRUE, freezes the actuator stroke value when communications are lost. If this value is set to FALSE, the remote level set point goes to 0 when communications are lost.
11 CHOOSE MODBUS COMM: [TRUE or *FALSE] This menu item, when set to TRUE, enables the Modbus communication on the RS-232 port. This will deactivate the Servlink communication.
12 IS MODBUS DEFAULT COMMUNICATION [TRUE or *FALSE]: Choose this option if the control should start in Modbus communication mode. Remember that if this option is selected the servlink will not communicate anymore, until selected back trough Modbus.
13 ENABLE MODBUS 1 COMM FAULT [*TRUE or FALSE]: Select this function to enable the Modbus communication #1 fault
14 ENABLE MODBUS 2 COMM FAULT [*TRUE or FALSE]: Select this function to enable the Modbus communication #2 fault

26 SYNCHRONIZE

01 SPEED BIAS: [MONITOR] This menu item displays the Synchronizer/Load Control bias value.
02 SPEED BIAS ANALOG GAIN: [*1 (0.001,100)] This menu item defines the Synchronizer/Load Control bias gain. This number is multiplied by the Speed Bias signal.
03 SPD BIAS AN SIG FILTR TC: [*0.01 (0.001,3)] This menu item defines the time constant for the Lag Tau filter for the Speed Bias Control signal. When this value is left at 0.01, the lag filter is basically turned off. This value should be left at 0.01 unless noise is present on the speed bias signal.
04 SPEED BIAS DIGITAL RATE: [*0.1 (0.01,1)] This is the rate (%/s) at which the speed bias raises or lowers the speed of the 2301E-HT when digital inputs are used as the speed bias (Speed Bias Raise and Speed Bias Lower).

27 CONFIG SPD SW

If any relay output is configured as a speed switch, then the speed switches are configured here. If no relay outputs are configured as speed switches, then this menu does not affect the control and can be skipped.

01 SW1 - DECREASING?: [TRUE or *FALSE] This determines if Speed Switch #1 is an increasing switch or a decreasing switch. If the switch should trigger when the unit is slowing down, then this value should be set to TRUE. If the switch should trigger when the unit is speeding up, then this value should be set to FALSE.
02 SPD SW1 - HI SET: [*100.0 (0.0,200.0)] This is the high % of rated set point for the speed switch. When the switch is increasing, this set point is the trip point of the speed switch. When the switch is decreasing, this set point is the reset point of the speed switch.
03 SPD SW1 - HI DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the speed should be greater than HI SET to energize the relay when configured to Increasing or to de-energize the relay when configured to decreasing.
04 SPD SW1 - LOW SET: [*98.0 (0.0,200.0)] This is the low % of rated set point for the speed switch. When the switch is increasing, this set point is the reset point of the speed switch. When the switch is decreasing, this set point is the trip point of the speed switch.
05 SPD SW1 - LO DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the speed should be less than LO SET to de-energize the relay when configured to Increasing or to energize the relay when configured to decreasing.
06 USE SW1 FAILSAFE: [*FALSE or TRUE] Select this option to enable the failsafe condition.
07 FAIL SAFE STATE SW1: [*FALSE or TRUE] Choose the fail-safe condition in case of both speed signal fail.
08 TIME TO DISABLE FAIL SAFE SW1: [*20.0 (0.0, 300.0)] Time (in minutes) to disable fail safe condition since both speed signals fail. After this time the switch will go back to its normal state.
09 SW2 - DECREASING?: [TRUE or *FALSE] This determines if Speed Switch #2 is an increasing switch or a decreasing switch. If the switch should trigger when the unit is slowing down, then this value should be set to TRUE. If the switch should trigger when the unit is speeding up, then this value should be set to FALSE.
10 SPD SW2 - HI SET: [*100.0 (0.0,200.0)] This is the high % of rated set point for the speed switch. When the switch is increasing, this set point is the trip point of the speed switch. When the switch is decreasing, this set point is the reset point of the speed switch.

11 SPD SW2 - HI DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the speed should be greater than HI SET to energize the relay when configured to Increasing or to de-energize the relay when configured to decreasing.
12 SPD SW2 - LOW SET: [*98.0 (0.0,200.0)] This is the low % of rated set point for the speed switch. When the switch is increasing, this set point is the reset point of the speed switch. When the switch is decreasing, this set point is the trip point of the speed switch.
13 SPD SW2 - LO DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the speed should be less than LO SET to de-energize the relay when configured to Increasing or to energize the relay when configured to decreasing.
14 USE SW2 FAILSAFE: [*FALSE or TRUE] Select this option to enable the failsafe condition.
15 FAIL SAFE STATE SW2: [*FALSE or TRUE] Choose the fail-safe condition in case of both speed signal fail.
16 TIME TO DISABLE FAIL SAFE SW2: [*20.0 (0.0, 300.0)] Time (in minutes) to disable fail safe condition since both speed signals fail. After this time the switch will go back to its normal state.
17 SW3 - DECREASING?: [TRUE or *FALSE] This determines if Speed Switch #3 is an increasing switch or a decreasing switch. If the switch should trigger when the unit is slowing down, then this value should be set to TRUE. If the switch should trigger when the unit is speeding up, then this value should be set to FALSE.
18 SPD SW3 - HI SET: [*100.0 (0.0,200.0)] This is the high % of rated set point for the speed switch. When the switch is increasing, this set point is the trip point of the speed switch. When the switch is decreasing, this set point is the reset point of the speed switch.
19 SPD SW3 - HI DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the speed should be greater than HI SET to energize the relay when configured to Increasing or to de-energize the relay when configured to decreasing.
20 SPD SW3 - LOW SET: [*98.0 (0.0,200.0)] This is the low % of rated set point for the speed switch. When the switch is increasing, this set point is the reset point of the speed switch. When the switch is decreasing, this set point is the trip point of the speed switch.
21 SPD SW3 - LO DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the speed should be less than LO SET to de-energize the relay when configured to Increasing or to energize the relay when configured to decreasing.
22 USE SW3 FAILSAFE: [*FALSE or TRUE] Select this option to enable the failsafe condition.
23 FAIL SAFE STATE SW3: [*FALSE or TRUE] Choose the fail-safe condition in case of both speed signal fail.
24 TIME TO DISABLE FAIL SAFE SW3: [*20.0 (0.0, 300.0)] Time (in minutes) to disable fail safe condition since both speed signals fail. After this time the switch will go back to its normal state.

28 CONFIG GP SW

If any relay output is configured as gate position switch, then the gate position switches are configured here. If no relay outputs are configured as gate position switches, then this menu does not affect the control and can be skipped.

01 SW1 - DECREASING?: [TRUE or *FALSE] This determines if Gate Position Switch #1 is an increasing switch or a decreasing switch. If the switch should trigger when the gates are closing, then this value should be set to TRUE. If the switch should trigger when the gates are opening, then this value should be set to FALSE.
02 GP SW1 - HI SET: [*50 (0.0,100.0)] This is the high set point for the gate position switch. When the switch is increasing, this set point is the trip point of the gate position switch. When the switch is decreasing, this set point is the reset point of the gate position switch.
03 GP SW1 - HI DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the gate position should be greater than HI SET to energize the relay when configured to increasing or to de-energize the relay when configured to decreasing.
04 GP SW1 - LOW SET: [*45.0 (0.0,100.0)] This is the low set point for the gate position switch. When the switch is increasing, this set point is the reset point of the gate position switch. When the switch is decreasing, this set point is the trip point of the gate position switch.
05 GP SW1 - LO DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the gate position should be less than LO SET to de-energize the relay when configured to increasing or to energize the relay when configured to decreasing.

06 SW2 - DECREASING?: [TRUE or *FALSE] This determines if Gate Position Switch #2 is an increasing switch or a decreasing switch. If the switch should trigger when the gates are closing, then this value should be set to TRUE. If the switch should trigger when the gates are opening, then this value should be set to FALSE.
07 GP SW2 - HI SET: [*50.0 (0.0,100.0)] This is the high set point for the gate position switch. When the switch is increasing, this set point is the trip point of the gate position switch. When the switch is decreasing, this set point is the reset point of the gate position switch.
08 GP SW2 - HI DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the gate position should be greater than HI SET to energize the relay when configured to increasing or to de-energize the relay when configured to decreasing.
09 GP SW2 - LOW SET: [*45.0 (0.0,100.0)] This is the low set point for the gate position switch. When the switch is increasing, this set point is the reset point of the gate position switch. When the switch is decreasing, this set point is the trip point of the gate position switch.
10 GP SW2 - LO DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the gate position should be less than LO SET to de-energize the relay when configured to increasing or to energize the relay when configured to decreasing.

29 CONFIG kW SW

If any relay output is configured as kW switch, then the kW switches are configured here. If no relay outputs are configured as kW switches, then this menu does not affect the control and can be skipped.

01 SW1 - DECREASING?: [TRUE or *FALSE] This determines if kW Switch #1 is an increasing switch or a decreasing switch. If the switch should trigger when the kW is decreasing, then this value should be set to TRUE. If the switch should trigger when the kW is increasing, then this value should be set to FALSE.
02 kW SW1 - HI SET: [*50 (0.0,100.0)] This is the high set point for the kW switch. When the switch is increasing, this set point is the trip point of the kW switch. When the switch is decreasing, this set point is the reset point of the kW switch.
03 kW SW1 - HI DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the kW should be greater than HI SET to energize the relay when configured to increasing or to de-energize the relay when configured to decreasing.
04 kW SW1 - LOW SET: [*45.0 (0.0,100.0)] This is the low set point for the kW switch. When the switch is increasing, this set point is the reset point of the kW switch. When the switch is decreasing, this set point is the trip point of the kW switch.
05 kW SW1 - LO DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the kW should be less than LO SET to de-energize the relay when configured to increasing or to energize the relay when configured to decreasing.
06 SW2 - DECREASING?: [TRUE or *FALSE] This determines if kW Switch #2 is an increasing switch or a decreasing switch. If the switch should trigger when the kW is decreasing, then this value should be set to TRUE. If the switch should trigger when the kW is increasing, then this value should be set to FALSE.
07 kW SW2 - HI SET: [*50.0 (0.0,100.0)] This is the high set point for the kW switch. When the switch is increasing, this set point is the trip point of the kW switch. When the switch is decreasing, this set point is the reset point of the kW switch.
08 kW SW2 - HI DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the kW should be greater than HI SET to energize the relay when configured to increasing or to de-energize the relay when configured to decreasing.
09 kW SW2 - LOW SET: [*45.0 (0.0,100.0)] This is the low set point for the kW switch. When the switch is increasing, this set point is the reset point of the kW switch. When the switch is decreasing, this set point is the trip point of the kW switch.
10 kW SW2 - LO DELAY: [*0.0 (0.0, 600.0)] This is the time (in seconds) that the kW should be less than LO SET to de-energize the relay when configured to increasing or to energize the relay when configured to decreasing.

30 MON ANALOG OUT

This menu allows all analog output mA current signals to be monitored.

01 AO #1 - mA: [MONITOR] This menu item displays the Analog Output #1 in mA.
02 ACTUATOR - mA: [MONITOR] This menu item displays the Actuator Output (Gate) in mA.

30A MON AN OUT LINKNET

This menu allows all analog output mA current signals to be monitored from the LINKnet HT module.

01 AO #1 - mA: [MONITOR] This menu item displays the Analog Output #1 in mA.
02 AO #2 - mA: [MONITOR] This menu item displays the Analog Output #2 in mA.

31 MON ANALOG INPUT

This menu allows all analog input mA current signals to be monitored.

01 AI #1 - mA: [MONITOR] This menu item displays the Analog Input #1 in mA.
02 AI #2 - mA: [MONITOR] This menu item displays the Analog Input #2 in mA.

31A MON AN IN LINKNET

This menu allows all analog input mA current signals to be monitored from the LINKnet HT module.

01 AI #1 - mA: [MONITOR] This menu item displays the Analog Input #1 in mA.
02 AI #2 - mA: [MONITOR] This menu item displays the Analog Input #2 in mA
03 AI #1 - mA: [MONITOR] This menu item displays the Analog Input #3 in mA.
04 AI #2 - mA: [MONITOR] This menu item displays the Analog Input #4 in mA
05 AI #1 - mA: [MONITOR] This menu item displays the Analog Input #5 in mA.
06 AI #2 - mA: [MONITOR] This menu item displays the Analog Input #6 in mA
07 AI #1 - mA: [MONITOR] This menu item displays the Analog Input #7 in mA.
08 AI #2 - mA: [MONITOR] This menu item displays the Analog Input #8 in mA

32 BSLD CTRL (STPTS & RATES)

This menu is used to configure the Baseload parameters.

01 GEN UNLOAD TRIP LEVEL: [*100 (0,30000)] This menu item defines the Generator Unload Trip Level Load, in kW. This value is used as the load level at which a generator circuit breaker open command is given when an unload command is given.
02 GENERATOR MAXIMUM LOAD: [*5000 (10,30000)] This menu item defines the Generator Maximum Load, in kW, i.e., the generator rated load.
03 GEN MAX BASELOAD VALUE: [*4000 (10,30000)] This menu item defines the Generator Maximum Baseload value, in kW.
04 GEN MIN BASELOAD VALUE: [*200 (10,30000)] This menu item defines the Generator Minimum Baseload value, in kW.
05 GEN MAX REM BSLD VALUE: [*5000 (10,30000)] This menu item defines the Generator Maximum Remote Baseload value, in kW.
06 GEN MIN REM BSLD VALUE: [*500 (0,30000)] This menu item defines the Generator Minimum Remote Baseload value, in kW.
07 GEN INITIAL BSLD VALUE: [*1000 (0,30000)] This menu item defines the Generator Initial Baseload value, in kW. This value is used as the Baseload setpoint every time the Baseload mode is enabled, unless the Remote Baseload mode is enabled (in this case the initial value will be the remote baseload value) or the Modbus baseload setpoint is used (in this case the initial value will be the remote Modbus baseload setpoint value)
08 BASELOAD RAISE TIME (SEC): [*60 (1,600)] This menu item defines the necessary time to the baseload reference to go from the minimum baseload value to the maximum baseload value.
09 BASELOAD LOWER TIME (SEC): [*60 (1,600)] This menu item defines the necessary time to the baseload reference to go from the maximum baseload value to the minimum baseload value.
10 RMT BSLOAD INC TIME (SEC): [*60 (1,600)] This menu item defines the necessary time to the remote baseload reference to go from the minimum remote baseload value to the maximum remote baseload value.
11 RMT BSLOAD DEC TIME (SEC): [*60 (1,600)] This menu item defines the necessary time to the remote baseload reference to go from the maximum remote baseload value to the minimum remote baseload value.
12 BREAKER OPEN TIME (SEC): [*1 (0.8,60)] This menu item defines the generator breaker open time when an unload command is given and the breaker opening conditions are fulfilled.

13 RAMP @ MIN, CB DELAY (SEC): [*5 (1,10)] This menu item defines the maximum delay between the load reference reaching the unload trip level and the generator breaker open command. If the generator load reaches the unload trip level load before this time expires the breaker open command is given sooner.

33 BSLD CTRL (PID & MONITOR)

This menu is used to configure the baseload controller.

01 BASELOAD REFERENCE (kW): [MONITOR]
02 GENERATOR LOAD (kW): [MONITOR]
03 BASELOAD REFERENCE (%): [MONITOR]
04 GENERATOR LOAD (%): [MONITOR]
05 BASELOAD PID OUTPUT (%): [MONITOR]
06 BSLD PROPORTIONAL GAIN : [*0.7 (0,100)] This parameter defines the proportional gain of the baseload controller PID.
07 BSLD INTEGRAL GAIN : [*0.2 (0,100)] This parameter defines the integral gain of the baseload controller PID.
08 BASELOAD SPEED RAMP RATE: [*0.2 (0.001,100)] This menu item defines the rate at which the baseload speed reference is passed to the on-line speed ramp.

34 OVERSPEED TEST

This menu is used to configure and command the overspeed test.

01 OVERSPEED TEST ENABLED: [MONITOR]
02 ACTUAL SPEED: [MONITOR]
03 MAX SPEED REACHED: [MONITOR]
04 RESET MAX SPEED: [TRUE or *FALSE] This menu item will reset the item (MAXIMUM SPEED REACHED) when it is tuned from FALSE to TRUE.
05 OST REMMAINING TIME: [MONITOR] This is the remaining time to the overspeed test be disabled automatically, if the test is not completed or forgotten for the operator.
06 TURBINE RUNNING (PERMISSIVE 1): [MONITOR] There are some permissives to allow the user to enable the overspeed test. This is one of these permissives (the turbine should be running).
07 UNIT OFFLINE (PERMISSIVE 2): [MONITOR] There are some permissives to allow the user to enable the overspeed test. This is one of these permissives (the unit should be offline).
08 SPEED > 95% (PERMISSIVE 3): [MONITOR] There are some permissives to allow the user to enable the overspeed test. This is one of these permissives (the speed should be greater then 95% of the rated speed).
09 OVERSPEED TEST LIMIT: [*200.0 (75.0, 250.0)] This is the maximum value that the user can raise the speed reference while the overspeed test is enabled.
10 OVERSPEED TEST MAXIMUM TIME: [*1800.0 (1.0, 7200.0)] This is the maximum time that the control will wait until the test is finished. If the test is not finished before this time expires the test will be automatically disabled.
11 ENABLE OVERSPEED TEST: [TRUE or *FALSE] Pulse this parameter (true and back to false) to start the overspeed test.
12 DISABLE OVERSPEED TEST: [TRUE or *FALSE] Pulse this parameter (true and back to false) to stop the overspeed test.

Chapter 5.
Product Support and Service Options

Product Support Options

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

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

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

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.

A current list of Woodward Business Partners is available at:
https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner

Product Service 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 (Woodward North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690).

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 North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690). 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 one of the Full-Service Distributors listed at **https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner**

Contacting Woodward's Support Organization

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

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+ 82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

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

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

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

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

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

Appendix A. Modbus List

Boolean Writes

Modbus ID	Item Function	Semantics
0:0001	Emergency Shutdown	0=False, 1=True
0:0002	SPARE	0=False, 1=True
0:0003	Speed/Load Raise	0=False, 1=True
0:0004	Speed/Load Lower	0=False, 1=True
0:0005	Manual Control Enable	0=False, 1=True
0:0006	AUTO FOLLOW ENABLE	0=False, 1=True
0:0007	SPARE	0=False, 1=True
0:0008	SPARE	0=False, 1=True
0:0009	Level Control Enable	0=False, 1=True
0:0010	Enable Unload	0=False, 1=True
0:0011	Gate Limit Raise	0=False, 1=True
0:0012	Gate Limit Lower	0=False, 1=True
0:0013	Governor Reset	0=False, 1=True
0:0014	Momentary START	0=False, 1=True
0:0015	Momentary STOP	0=False, 1=True
0:0016	Enable Overspeed Test	0=False, 1=True
0:0017	Choose Servlink	0=False, 1=True
0:0018	Enable Baseload	0=False, 1=True
0:0019	Enable Baseload Remote Reference	0=False, 1=True
0:0020	RESET MAX SPEED REACHED	0=False, 1=True
0:0021	Disable Manual Control	0=False, 1=True
0:0022	DISABLE AUTO FOLLOW	0=False, 1=True
0:0023	Disable Level Control	0=False, 1=True
0:0024	Disable Baseload	0=False, 1=True
0:0025	SPARE	0=False, 1=True
0:0026	Disable Baseload Remote Reference	0=False, 1=True
0:0027	Use Modbus Initial Baseload Reference?	0=False, 1=True
0:0028	Use Modbus Baseload Reference?	0=False, 1=True
0:0029	Enable Remote Reference	0=False, 1=True
0:0030	Disable Remote Reference	0=False, 1=True
0:0031	Use Modbus Level Reference?	0=False, 1=True
0:0032	Use Modbus Remote Reference?	0=False, 1=True
0:0033	Enable Remote Level reference	0=False, 1=True
0:0034	Disable Remote Level reference	0=False, 1=True
0:0035	Enable Stroke	0=False, 1=True
0:0036	Enable kW Droop	0=False, 1=True
0 :0037	Disable kW Droop	0=False, 1=True

Modbus ID	Item Function	Semantics
0:0038	Use AI Level Reference	0=False, 1=True
0:0039	Use AI Baseload Reference	0=False, 1=True
0:0040	Use AI Remote Reference	0=False, 1=True
0:0041	Do not use MB Baseload Initial Reference	0=False, 1=True
0:0042	Disable Stroke	0=False, 1=True
0:0043	Disable Unload	0=False, 1=True

Boolean Reads

Modbus ID	Item Function	Semantics
1:0001	Shutdown Indication	0=False, 1=True
1:0002	Shutdown - Speed Signal Failure	0=False, 1=True
1:0003	Shutdown - Overspeed	0=False, 1=True
1:0004	Shutdown - Gate Pos Gross Mismatch	0=False, 1=True
1:0005	Shutdown - Gate Pos Feedback Fail	0=False, 1=True
1:0006	Shutdown - Incomplete Start	0=False, 1=True
1:0007	Shutdown – Local Modbus Input Shutdown	0=False, 1=True
1:0008	Shutdown - ESD Input Shutdown	0=False, 1=True
1:0009	POWER UP SHUTDOWN	0=False, 1=True
1:0010	Shutdown - Remote Modbus Input Shutdown	0=False, 1=True
1:0011	NOT USED	0=False, 1=True
1:0012	NOT USED	0=False, 1=True
1:0013	NOT USED	0=False, 1=True
1:0014	NOT USED	0=False, 1=True
1:0015	NOT USED	0=False, 1=True
1:0016	NOT USED	0=False, 1=True
1:0017	NOT USED	0=False, 1=True
1:0018	NOT USED	0=False, 1=True
1:0019	NOT USED	0=False, 1=True
1:0020	NOT USED	0=False, 1=True
1:0021	Alarm - General Governor Alarm	0=False, 1=True
1:0022	Alarm - Level Signal Failure	0=False, 1=True
1:0023	Alarm - Remote Reference Signal Fail	0=False, 1=True
1:0024	Alarm - Auxiliary/DSLC Bias Sign Fail	0=False, 1=True
1:0025	Alarm - Gate Position Minor Mismatch	0=False, 1=True
1:0026	Alarm - Modbus #1 Link Error	0=False, 1=True
1:0027	Alarm - Dirty Oil Indication	0=False, 1=True
1:0028	Alarm - Governor Shutdown	0=False, 1=True
1:0029	Alarm - Creep Detected	0=False, 1=True
1:0030	Alarm - Breaker Open Time Exceeded	0=False, 1=True
1:0031	Alarm - Baseload Rem Ref Signal Fail	0=False, 1=True

Modbus ID	Item Function	Semantics
1:0032	Alarm - Gate Limit Signal Fail	0=False, 1=True
1:0033	Alarm - Remote Level Ref Signal Fail	0=False, 1=True
1:0034	Alarm - Speed Signal MPU #1 Fail	0=False, 1=True
1:0035	Alarm - Speed Signal MPU #2 Fail	0=False, 1=True
1:0036	Alarm - AIO LINKnet Card Comm Fault	0=False, 1=True
1:0037	Alarm - AIO LINKnet Card Temp Alarm	0=False, 1=True
1:0038	Alarm - Load kW Input Fail	0=False, 1=True
1:0039	Alarm - Modbus 2 Link Error	0=False, 1=True
1:0040	A - Run/Stop Contact (closed)	0=False, 1=True
1:0041	B - Speed/Load Raise Contact (closed)	0=False, 1=True
1:0042	C - Speed/Load Lower Contact (closed)	0=False, 1=True
1:0043	D - Generator Breaker Contact (closed)	0=False, 1=True
1:0044	E - ESD Input (closed)	0=False, 1=True
1:0045	F - Configurable Contact #1 (closed)	0=False, 1=True
1:0046	G - Configurable Contact #2 (closed)	0=False, 1=True
1:0047	H - Configurable Contact #3 (closed)	0=False, 1=True
1:0048	ESD - Relay Output #1 (energized)	0=False, 1=True
1:0049	Config - Relay Output #2 (energized)	0=False, 1=True
1:0050	Config - Relay Output #3 (energized)	0=False, 1=True
1:0051	Config - Relay Output #4 (energized)	0=False, 1=True
1:0052	HARDWARE - ANALOG INPUT #1 FAULT	0=False, 1=True
1:0053	HARDWARE - ANALOG INPUT #2 FAULT	0=False, 1=True
1:0054	HARDWARE - SPEED #1 FAULT	0=False, 1=True
1:0055	kW Droop Enabled	0=False, 1=True
1:0056	IN REMOTE MODE	0=False, 1=True
1:0057	IN LOCAL MODE	0=False, 1=True
1:0058	LOCAL/REMOTE NOT USED	0=False, 1=True
1:0059	Governor Run	0=False, 1=True
1:0060	Governor Stop	0=False, 1=True
1:0061	Baseload Enabled	0=False, 1=True
1:0062	Baseload Remote reference Enabled	0=False, 1=True
1:0063	Baseload Rem Ref (Modbus1)	0=False, 1=True
1:0064	Baseload Rem Ref (Analog)	0=False, 1=True
1:0065	Head Control (1) or Tail Control (0)	0=False, 1=True
1:0066	Level Rem Ref (Modbus 1)	0=False, 1=True
1:0067	Level Rem Ref (Analog)	0=False, 1=True
1:0068	Calibrate Mode Enabled	0=False, 1=True
1:0069	Maintenance Mode Enabled	0=False, 1=True
1:0070	Manual Mode Enabled	0=False, 1=True
1:0071	DSLC Mode Enabled	0=False, 1=True
1:0072	Auto-Follow Mode Enabled	0=False, 1=True

Modbus ID	Item Function	Semantics
1:0073	Remote Reference Mode Enabled	0=False, 1=True
1:0074	Level Rem Ref Mode Enabled	0=False, 1=True
1:0075	Pond/Tail Level Control Enabled	0=False, 1=True
1:0076	Brake Permissive	0=False, 1=True
1:0077	In Control - Gate Limit	0=False, 1=True
1:0078	In Control - On-Line/Droop PID	0=False, 1=True
1:0079	In Control - Off-Line/Isoch PID	0=False, 1=True
1:0080	Speed Fault/Overspeed Override	0=False, 1=True
1:0081	Gate Limit - At 0%	0=False, 1=True
1:0082	Gate Limit - At 100%	0=False, 1=True
1:0083	Gate Limit - At Breakaway	0=False, 1=True
1:0084	Gate Limit - At Speed-No-Load/Off-Line	0=False, 1=True
1:0085	Gate Limit - At Max Gate Pos/On-Line	0=False, 1=True
1:0086	Gate Limit - Actual gate Position	0=False, 1=True
1:0087	Gate Limit - Use Analog Input	0=False, 1=True
1:0088	Remote Ref (Modbus 1)	0=False, 1=True
1:0089	Remote Ref (Analog)	0=False, 1=True
1:0090	PID On Line Selected	0=False, 1=True
1:0091	Turbine Stopped (speed less than 2%)	0=False, 1=True
1:0092	Off-Ln/Isoch Spd Ref - At Lower Limit	0=False, 1=True
1:0093	Off-Ln/Isoch Spd Ref - Follow Actl Pos	0=False, 1=True
1:0094	Off-Ln/Isoch Spd Ref - At Start Up	0=False, 1=True
1:0095	Off-Ln/Isoch Spd Ref - At SNL Setpoint	0=False, 1=True
1:0096	Off-Ln/Isoch Spd Ref - At Upper Limit	0=False, 1=True
1:0097	On-Ln/Droop Spd Ref - Follow Actl Pos	0=False, 1=True
1:0098	On-Ln/Droop Spd Ref - At Rem Stpnt	0=False, 1=True
1:0099	On-Ln/Droop Spd Ref - At Lvl Stpnt	0=False, 1=True
1:0100	On-Ln/Droop Spd Ref - At Lower Lim	0=False, 1=True
1:0101	On-Ln/Droop Spd Ref - At Upper Lim	0=False, 1=True
1:0102	Speed Switch #1	0=False, 1=True
1:0103	Speed Switch #2	0=False, 1=True
1:0104	Gate Position Switch #1	0=False, 1=True
1:0105	Gate Position Switch #2	0=False, 1=True
1:0106	KW Switch #1	0=False, 1=True
1:0107	KW Switch #2	0=False, 1=True
1:0108	Speed Switch #3	0=False, 1=True
1:0109	Enable Overspeed - Permissive #1	0=False, 1=True
1:0110	Enable Overspeed - Permissive #2	0=False, 1=True
1:0111	Enable Overspeed - Permissive #3	0=False, 1=True
1:0112	Enable Overspeed - Permissive #4	0=False, 1=True
1:0113	Enable Overspeed - Permissive #5	0=False, 1=True
1:0114	Hardware – Speed #2 Fault	0=False, 1=True

Modbus ID	Item Function	Semantics
1:0115	Comm Port Selected to Servlink	0=False, 1=True
1:0116	Comm Port Selected to Modbus	0=False, 1=True
1:0117	LINKnet - Analog Input #1 Fault	0=False, 1=True
1:0118	LINKnet - Analog Input #2 Fault	0=False, 1=True
1:0119	LINKnet - Analog Input #3 Fault	0=False, 1=True
1:0120	LINKnet - Analog Input #4 Fault	0=False, 1=True
1:0121	LINKnet - Analog Input #5 Fault	0=False, 1=True
1:0122	LINKnet - Analog Input #6 Fault	0=False, 1=True
1:0123	LINKnet - Analog Input #7 Fault	0=False, 1=True
1:0124	LINKnet - Analog Input #8 Fault	0=False, 1=True
1:0125	Overspeed Test Enabled	0=False, 1=True
1:0126	Level Rem Ref (Modbus 2)	0=False, 1=True
1:0127	Baseload Rem Ref (Modbus 2)	0=False, 1=True
1:0128	Remote Ref (Modbus 2)	0=False, 1=True
1:0129	Calibrate Mode Enabled Via Modbus 1	0=False, 1=True
1:0130	Calibrate Mode Enabled Via Modbus 2	0=False, 1=True
1:0131	Calibrate Mode Enabled Via SL	0=False, 1=True
1:0132	Unload in progress	0=False, 1=True

Analog Reads

Modbus ID	Item	Semantics	Scale
3:0001	Gate Position	Scaled (programmed)	100
3:0002	Gate Limit	Percentage	100
3:0003	Unit Speed	Percentage	10
3:0004	Maximum Speed Since Last Start	RPM	10
3:0005	Pond/Tail Level	Scaled (programmed)	10
3:0006	Pond/Tail Level Setpoint	Scaled (programmed)	10
3:0007	Pond/Tail Level Gate Position Setpoint	Scaled (programmed)	100
3:0008	Remote Reference	Scaled (programmed)	100
3:0009	DSLC Speed Bias	-5 to 5	100
3:0010	Auxiliary Input	Scaled (programmed)	10
3:0011	Actuator Demand Signal	Percentage	100
3:0012	Online/Droop Speed Reference	Percentage	100
3:0013	Online/Droop PID Output	Percentage	100
3:0014	Offline/Isoch Speed Reference	RPM	1
3:0015	Offline/Isoch PID Output	Percentage	100
3:0016	Generator Load (kW)	kW	1
3:0017	LOAD SETPOINT (KW)	kW	1
3:0018	REMOTE LEVEL REFERENCE (AI)	Scaled (programmed)	10
3:0019	GATE LIMIT - ANALOG INPUT	Percentage	100
3:0020	BASELOAD RMT REFERENCE (AI)	Scaled (programmed)	10
3:0021	REMOTE REFERENCE (AI)	Scaled (programmed)	10

Modbus ID	Item	Semantics	Scale
3:0022	Load Rejection Demand	Percentage	100
3:0023	Offline/Isoch Speed Reference	Percentage	10
3:0024	Speed Setpoint (Offline or Online)	Percentage	10
3:0025	CONFIG - DISCRETE INPUT #6	N/A	1
3:0026	CONFIG - DISCRETE INPUT #7	N/A	1
3:0027	CONFIG - DISCRETE INPUT #8	N/A	1
3:0028	CONFIG - DISCRETE OUTPUT #2	N/A	1
3:0029	CONFIG - DISCRETE OUTPUT #3	N/A	1
3:0030	CONFIG - DISCRETE OUTPUT #4	N/A	1
3:0031	HARDWARE - ANALOG INPUT #1 (mA)	mA	10
3:0032	HARDWARE - ANALOG INPUT #2 (mA)	mA	10
3:0033	HARDWARE - SPEED INPUT #1 (RPM)	RPM	1
3:0034	CONFIG - ANALOG INPUT #1	N/A	1
3:0035	CONFIG - ANALOG INPUT #2	N/A	1
3:0036	HARDWARE - ACTUATOR OUTPUT (%)	Percentage	10
3:0037	HARDWARE - ANALOG OUTPUT	Percentage	10
3:0038	CONFIG - ANALOG OUTPUT	N/A	1
3:0039	HARDWARE - ACTUATOR OUTPUT (%)	Percentage	100
3:0040	HARDWARE - ACTUATOR OUTPUT (mA)	mA	100
3:0041	Overspeed Test Remaining Time	Seconds	1
3:0042	Online Speed Reference	rpm	10
3:0043	HARDWARE - SPEED INPUT #2 (RPM)	RPM	1
3:0044	Analog Input #1 - LINKnet (mA)	mA	10
3:0045	Analog Input #2 - LINKnet (mA)	mA	10
3:0046	Analog Input #3 - LINKnet (mA)	mA	10
3:0047	Analog Input #4 - LINKnet (mA)	mA	10
3:0048	Analog Input #5 - LINKnet (mA)	mA	10
3:0049	Analog Input #6 - LINKnet (mA)	mA	10
3:0050	Analog Input #7 - LINKnet (mA)	mA	10
3:0051	Analog Input #8 - LINKnet (mA)	mA	10
3:0052	Analog Output #1 - LINKnet (%)	Percentage	10
3:0053	Analog Output #2 - LINKnet (%)	Percentage	10
3:0054	Config - Analog Input #1 – LINKnet	N/A	1
3:0055	Config - Analog Input #2 – LINKnet	N/A	1
3:0056	Config - Analog Input #3 – LINKnet	N/A	1
3:0057	Config - Analog Input #4 – LINKnet	N/A	1
3:0058	Config - Analog Input #5 – LINKnet	N/A	1
3:0059	Config - Analog Input #6 – LINKnet	N/A	1
3:0060	Config - Analog Input #7 – LINKnet	N/A	1
3:0061	Config - Analog Input #8 - LINKnet	N/A	1
3:0062	Config - Analog Output #1 - LINKnet	N/A	1
3:0063	Config - Analog Output #2 - LINKnet	N/A	1

Modbus ID	Item	Semantics	Scale
3:0064	Speed Input #1	RPM	1
3:0065	Speed Input #2	RPM	1

Analog Writes

Modbus ID	Item	Semantics	Scale
4:0001	Modbus - Remote Setpoint	Percentage	100
4:0002	Modbus - Initial Baseload Reference	kW	1
4:0003	Modbus - Baseload Reference	kW	1
4:0004	Modbus - Level Reference	Engineering Units	10
4:0005	Actuator Stroke	Percentage	1

Analog Reads Description

For analog reads 25 through 27 (30025–30027), the discrete inputs configuration are defined as follows:

1	NOT USED	10	GOVERNOR RESET
2	MANUAL CONTROL ENABLE	11	EXTERNAL START PERMISSIVE
3	POND/TAIL LEVEL CONTROL ENABLE	12	UNLOAD
4	AUTO FOLLOW ENABLE	13	ENABLE BASELOAD
5	GATE LIMIT RAISE	14	SPEED BIAS RAISE
6	GATE LIMIT LOWER	15	SPEED BIAS LOWER
7	CREEP INPUT #1	16	LOCAL / REMOTE
8	CREEP INPUT #2	17	ENABLE kW DROOP
9	DIRTY OIL SWITCH INPUT		

For analog reads 28 through 30 (30028–30030), the discrete outputs configurations are defined as follows:

1	NOT USED	14	INCOMPLETE START
2	GATE POSITION SWITCH #1	15	MINOR GATE POSITION MISMATCH
3	GATE POSITION SWITCH #2	16	OVERSPEED
4	SPEED SWITCH #1	17	DIRTY OIL INDICATION
5	SPEED SWITCH #2	18	MODBUS LINK ERROR
6	GENERAL GOVERNOR ALARM	19	SPEED INPUT #1 FAULT
7	BRAKE PERMISSIVE	20	GENERATOR BREAKER OPEN
8	CREEP INDICATION	21	KW SWITCH #1
9	SPEED BIAS ENABLE	22	KW SWITCH #2
10	GATE POSITION SIGNAL FAILURE	23	REMOTE LEVEL REF INPUT FAILURE
11	LEVEL SIGNAL FAILURE	24	SPEED SWITCH #3
12	REMOTE SIGNAL FAILURE	25	SPEED INPUT #2 FAULT
13	AUX/DSLC INPUT SIGNAL FAILURE		

For analog reads 34 through 35 (30034–30035) and 54 through 61 (30054-30061) , the analog input configurations are defined as follows:

1	NOT USED	5	SPEED BIAS
2	LEVEL	6	GATE POSITION
3	REMOTE REFERENCE	7	GATE LIMIT
4	BASELOAD REFERENCE	8	REMOTE LEVEL REFERENCE
		9	KW INPUT (kW)

For analog read 38 (30038) and 62 through 63 (30062-30063), the analog output configuration is defined as follows:

1	NOT USED	7	POND/TAIL LEVEL SETPOINT
2	TACHOMETER	8	AUX INPUT/DSLC BIAS
3	GATE POSITION	9	ACTUATOR OUTPUT (%)
4	GATE LIMIT	10	ACTIVE POWER (%)
5	SPEED ADJUSTMENT	11	BASELOAD REFERENCE (kW)
6	POND/TAIL LEVEL		

Appendix B.
Service/Configuration Chart

CONFIGURE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE	
			MINIMUM	MAXIMUM
01 FUNCTION SELECT				
01 Enable Calibrate?		FALSE	FALSE	TRUE
02 Disable Calibrate		FALSE	FALSE	TRUE
03 Use Brake Perm?		FALSE	FALSE	TRUE
04 Use AIO LINKnet?		FALSE	FALSE	TRUE
02A CONFIG ACTUATOR				
01 1=0–200/2=4–20/3=0–20		FALSE	FALSE	TRUE
02 1=Prop / 2=Integ		FALSE	FALSE	TRUE
03 Reverse Acting?		FALSE	FALSE	TRUE
03 CONFIG SPEED SIGS				
01 Enter Rated RPM		100	10	2000
02 Teeth Number		60	15	720
03 Gear Ratio		1	1	10
04 CONFIG ANALOG IN				
01 Cnfg Analog In #1		1	1	8
02 Analog In #1 Function	Monitor			
03 Cnfg Analog In #2		6	1	8
04 Analog In #2 Function	Monitor			
04A CONFIG AN IN LINKNET				
01 Cnfg Analog In #1		1	1	8
02 Analog In #1 Function	Monitor			
03 Cnfg Analog In #2		1	1	8
04 Analog In #2 Function	Monitor			
05 Cnfg Analog In #3		1	1	8
06 Analog In #3 Function	Monitor			
07 Cnfg Analog In #4		1	1	8
08 Analog In #4 Function	Monitor			
09 Cnfg Analog In #5		1	1	8
10 Analog In #5 Function	Monitor			
11 Cnfg Analog In #6		1	1	8
12 Analog In #6 Function	Monitor			
13 Cnfg Analog In #7		1	1	8
14 Analog In #7 Function	Monitor			
15 Cnfg Analog In #8		1	1	8
16 Analog In #8 Function	Monitor			
05 CONFIG CONTACT IN				
01 Config DI #6 (F)		11	1	17
02 DI#6 Function	Monitor			
03 Config DI #7 (G)				
04 DI#7 Function	Monitor			
05 Config DI #8 (H)				
06 DI#8 Function	Monitor			
07 Use DI1 NC?		FALSE	FALSE	TRUE
08 Use DI2 NC?		FALSE	FALSE	TRUE

CONFIGURE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	TUNABLE RANGE MAXIMUM
09 Use DI3 NC?		FALSE	FALSE	TRUE
10 Use DI4 NC?		FALSE	FALSE	TRUE
11 Use DI5 NC?		FALSE	FALSE	TRUE
12 Use DI6 NC?		FALSE	FALSE	TRUE
13 Use DI7 NC?		FALSE	FALSE	TRUE
14 Use DI8 NC?		FALSE	FALSE	TRUE
06 CONFIG DIGITAL OUT				
01 Config Relay #2		1	1	25
02 Relay #2 Function	Monitor			
03 Config Relay #3		1	1	25
04 Relay #3 Function	Monitor			
05 Config Relay #4		1	1	25
06 Relay #4 Function	Monitor			
07 CONFIG ANALOG OUT				
01 Config AO#1		2	1	11
02 AO#1 Function	Monitor			
03 AO#1 Current Output	Monitor			
07A CONFIG AN OUT LINKNET				
01 Config AO#1		1	1	11
02 AO#1 Function	Monitor			
03 AO#1 Current Output	Monitor			
04 Config AO#2		1	1	11
05 AO#2 Function	Monitor			
06 AO#2 Current Output	Monitor			
08 CONFIG LEVEL CTRL				
01 Minimum Elevation		4	-30000	30000
02 Maximum Elevation		20	-30000	30000
03 1=Head / 2=Tail		1	1	2
04 Config Setpoint		1	1	2
05 Fix Spd in Level?		FALSE	FALSE	TRUE
09 CONFIG MODBUS				
01 Network Address RS-422		1	1	247
02 1=ASCII / 2=RTU RS-422		2	1	2
03 Timeout (sec) RS-422		1	0.5	30
04 Network Address RS-232		1	1	247
05 1=ASCII / 2=RTU RS-232		2	1	2
06 Timeout (sec) RS-232		1	0.5	30
10 CONFIG SYNC LOAD CONTROL				
01 Synchronize Only?		TRUE	FALSE	TRUE
02 Sig Type – 2=An / 3=Dig		1	1	3

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	MAXIMUM
01 MONITOR ALARMS				
01 Governor Reset		FALSE	FALSE	TRUE
02 Governor Alarm	Monitor			
03 Level Signal Fail	Monitor			
04 Rem Ref Sig Fail	Monitor			
05 Speed Bias Sig Fail	Monitor			
06 Sm Gate Mismatch	Monitor			
07 Modbus Link Error	Monitor			
08 Dirty Oil Switch	Monitor			
09 Governor Shutdown	Monitor			
10 Creep Detected	Monitor			
11 Breaker Open Time Exceed	Monitor			
12 Base Load Ref Sig Fail	Monitor			
13 Gate Limit Sig Fail	Monitor			
14 Rmt Level Ref Sig Fail	Monitor			
15 Speed Sensor #1 Fail	Monitor			
16 Speed Sensor #2 Fail	Monitor			
17 AIO LINKnet Comm Alarm	Monitor			
18 AIO LINKnet Temp Alarm	Monitor			
19 Load kW Input Fail	Monitor			
02 MONITOR SHUTDOWNS				
01 Governor Reset		FALSE	FALSE	TRUE
02 Governor Shutdown	Monitor			
03 First Shutdown	Monitor			
04 Speed Signal Fail	Monitor			
05 Unit Overspeed	Monitor			
06 Lrg Gate Mismatch	Monitor			
07 Gate Pos Sig Fail	Monitor			
08 Incomplete Start	Monitor			
09 Local Modbus Input Sd	Monitor			
10 ESD Input Sd	Monitor			
11 Power Up Shutdown	Monitor			
12 Remote Modbus Input SD	Monitor			
03 CAL ANALOG INPUTS				
01 AN IN #1	Monitor			
02 AN IN #1-Offset		0	-100	100
03 AN IN #1-Gain		1	0,5	2
04 AN IN #2	Monitor			
05 AN IN #2-Offset		0	-100	100
06 AN IN #2-Gain		1	0,5	2
07 Load Sense Offset		0	-100	100
08 Load Sense Gain		13	0	100
03A CAL AN IN LINKNET				
01 AN IN #1	Monitor			
02 AN IN #1-Offset		0	-100	100
03 AN IN #1-Gain		1	0.5	2
04 AN IN #2	Monitor			
05 AN IN #2-Offset		0	-100	100
06 AN IN #2-Gain		1	0.5	2
07 AN IN #3	Monitor			
08 AN IN #3-Offset		0	-100	100
09 AN IN #3-Gain		1	0.5	2

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	MAXIMUM
10 AN IN #4	Monitor			
11 AN IN #4-Offset		0	-100	100
12 AN IN #4-Gain		1	0.5	2
13 AN IN #5	Monitor			
14 AN IN #5-Offset		0	-100	100
15 AN IN #5-Gain		1	0.5	2
16 AN IN #6	Monitor			
17 AN IN #6-Offset		0	-100	100
18 AN IN #6-Gain		1	0.5	2
19 AN IN #7	Monitor			
20 AN IN #7-Offset		0	-100	100
21 AN IN #7-Gain		1	0.5	2
22 AN IN #8	Monitor			
23 AN IN #8-Offset		0	-100	100
24 AN IN #8-Gain		1	0.5	2
04 CAL ANALOG OUTPUTS				
01 Calibrate Enabled	Monitor			
02 Forced An Out#1	Monitor			
03 Select Analog Out #1		1	1	6
04 Manual AO #1 Value		0	-10	110
05 Forced Actuator	Monitor			
06 Select Actuator Out		1	1	6
07 Manual Actuator Value		0	-10	110
04A CAL AN OUT LINKNET				
01 Calibrate Enabled	Monitor			
02 Forced An Out#1	Monitor			
03 Select Analog Out #1		1	1	6
04 Manual AO #1 Value		0	-10	110
05 Forced An Out#2	Monitor			
06 Select Analog Out #2		1	1	6
07 Manual AO #2 Value		0	-10	110
05 CAL DISCRETE INPUTS				
01 DI #1(A) Run/Stop	Monitor			
02 DI #2(B) Raise	Monitor			
03 DI #3(C) Lower	Monitor			
04 DI #4(D) Breaker	Monitor			
05 DI #5(E) ESD Input	Monitor			
06 DI #6(F) Config 1	Monitor			
07 DI #7(G) Config 2	Monitor			
08 DI #8(H) Config 3	Monitor			
06 CAL RELAY OUTPUTS				
01 Calibrate Enabled	Monitor			
02 Force Relay Out 1		FALSE	FALSE	TRUE
03 Force Relay Out 2		FALSE	FALSE	TRUE
04 Force Relay Out 3		FALSE	FALSE	TRUE
05 Force Relay Out 4		FALSE	FALSE	TRUE
06 USE DO1 NC?		FALSE	FALSE	TRUE
07 USE DO2 NC?		FALSE	FALSE	TRUE
08 USE DO3 NC?		FALSE	FALSE	TRUE
09 USE DO4 NC?		FALSE	FALSE	TRUE

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	TUNABLE RANGE MAXIMUM
07 CONFIG ANALOG OUT				
01 - Analog Out #1 Function	Monitor			
02 AO1 Low Lim Val=		0	-30000	30000
03 AO1 Hi Lim Val=		200	-30000	30000
07A CONFIG AN OUT LINKNET				
01 - Analog Out #1 Function	Monitor			
02 AO1 Low Lim Val=		0	-30000	30000
03 AO1 Hi Lim Val=		200	-30000	30000
04 - Analog Out #2 Function	Monitor			
05 AO2 Low Lim Val=		0	-30000	30000
06 AO2 Hi Lim Val=		200	-30000	30000
08 MAIN CONTROL				
01 Governor Run	Monitor			
02 Unit Online	Monitor			
03 Start Gate Rate		1	0.01	100
04 Unit Stop Rate		5	0.01	100
05 Reset Pulse Time		3	0.01	10
06 Fast Offline Stop?		TRUE	FALSE	TRUE
07 Use Load Rej Gate Limit?		TRUE	FALSE	TRUE
08 Load Rej Gate Value		6	0	100
09 Load Rej Max Time		7	0	100
10 Frst Mode When Brk Close		2	1	4
11 Frst Mode When Brk Close	Monitor			
12 Local / Remote / Both	Monitor			
09 UNIT SPEED				
01 Unit Speed (SS1)	Monitor			
02 Unit Speed (SS2)	Monitor			
03 Use Spd Deadband?		1	1	3
04 High Deadband (%)		0.05	0	5
05 Low Deadband (%)		0.05	0	5
06 Start Speed		50	-10	100
07 Time to Start Spd		20	1	600
08 Top-Speed Window		110	98	110
09 Botm-Speed Window		90	90	102
10 Time to Stabl Spd		15	1	120
11 Overspeed Setpnt		120	0	300
12 Overspeed Delay		1	0.01	2
13 Enable OS Block		TRUE	FALSE	TRUE
14 Time to Incomplete Start		100	1	600
15 Speed SS1 Filter		0.01	0	10
16 Speed SS2 Filter		0.01	0	10
10 GATE POSITION				
01 Gate Position	Monitor			
02 Value @ 4 mA		0	-200	200
03 Value @ 20 mA		100	-200	200
04 Use Sml Mismatch		TRUE	FALSE	TRUE
05 Sml Mismatch Win		3	1	10
06 Sml Mismatch Tim		10	0	60
07 Use Lrg Mismatch		TRUE	FALSE	TRUE
08 Lrg Mismatch Win		5	1	10
09 Lrg Mismatch Tim		10	0	60

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	TUNABLE RANGE MAXIMUM
10 Gates Closed %		2	0	5
11 GP Sig Filter TC		0.01	0.001	5
11 GATE LIMIT				
01 Gate Limit	Monitor			
04 Gate Limit Coinc.	Monitor			
03 Analog In Limit All Time		FALSE	FALSE	TRUE
04 Analog In @ 4 mA		0	0	100
05 Analog In @ 20 mA		100	0	100
06 Breakaway GL		30	0	100
07 Hold@Brkawy Time		1	0.001	30
08 Speed-no-Load GL		15	0	100
09 Prepos Online Gate Lim		100	0	100
10 Auto Raise Delay		120	0	600
11 Auto Raise Rate		0.5	0.01	100
12 Man R/L Ramp Rate		2	0.01	100
12 VALVE DRIVER (I)				
01 Actuator Demand	Monitor			
02 Valve Offset		0	-100	100
03 Offline Valve Gain		1	0	50
04 Online Valve Gain		1	0	50
05 Dither Frequency		2	1	5
06 Dither Frequency	Monitor			
07 Dither Amplitude		0	0	100
13 VALVE DRIVER (P)				
01 Actuator Demand	Monitor			
14 MANUAL AND MAINT				
01 Manual Mode Enabled	Monitor			
02 Enable Maint Mode		FALSE	FALSE	TRUE
03 Preset Value		0	-10	110
04 GoTo Preset Value		FALSE	FALSE	TRUE
15 OFFLIN/ISOCH CTRL				
01 Offline/Isoch Ref	Monitor			
02 I'm in Control	Monitor			
03 PID Output	Monitor			
04 Raise/Lower Rate		0.01	0.001	100
05 Speed-no-Load Ref		100.05	75	125
06 Upper Limit – Ref		110	75	250
07 Lower Limit – Ref		20	0	100
08 Enable SDR Invers		TRUE	FALSE	TRUE
09 PID Clamp Win +/-		4	0	5
16 ONLIN/DROOP CTRL				
01 Speed Adjust	Monitor			
02 I'm in Control	Monitor			
03 Gate Pos Setpoint	Monitor			
04 PID Output	Monitor			
05 Raise/Lower Rate		0.1	0	1000
06 Setpoint Deriv TC		0.96	0.001	5
07 PID Clamp Win +/-		4	0	5

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	MAXIMUM
17 REMOTE CONTROL				
01 Rem Spd Enabled	Monitor			
02 Rem Spd Anlg In Enabled	Monitor			
03 Rmt Spd Analog In	Monitor			
04 Rem Spd Modbus 1 Enabled	Monitor			
05 Rem Spd Modbus 2 Enabled	Monitor			
06 Remote Spd Reference	Monitor			
07 AI Value @ 4 mA		0	-200	200
08 AI Value @ 20 mA		100	-200	200
09 Remote Speed Ramp Rate		0.2	0	100
18 LEVEL CONTROL				
01 Lvl Cntrl Enabled	Monitor			
02 Pond/Tail Level	Monitor			
03 Level Setpoint	Monitor			
04 Preset Value		0	0	100000
05 Max Gate Position		100	0	100
06 Min Gate Position		20	0	100
07 Control Window		0.5	0	10000
08 Gate Position Set	Monitor			
09 Signal Filter TC		2	0.01	7200
10 Raise/Lower Rate		1	0.01	1000
11 Level Gate Rate		0.05	0.001	100
19 REMOTE LEVEL CTRL				
01 Rem Level Enabled	Monitor			
02 Rem Lvl Anlg In Enabled	Monitor			
03 Rmt Lvl Analog In	Monitor			
04 Rem Lvl Modbus 1 Enabled	Monitor			
05 Rem Lvl Modbus 2 Enabled	Monitor			
06 Remote Level Reference	Monitor			
07 AI Value @ 4 mA		4	-30000	30000
08 AI Value @ 20 mA		20	-30000	30000
20 GAINS				
01 Droop		5	0	10
02 Offline P Gain		1	0.001	50
03 Offline I Gain		0.2	0.001	50
04 Offline D Gain		100	0.001	50
05 Online P Gain		1	0.001	50
06 Online I Gain		0.2	0.001	50
07 Online D Gain		100	0.001	50
08 Disable Feed Fwd?		FALSE	FALSE	TRUE
09 Feed Forward Gain		1	0	1
10 Temporary Comp		0.05	0	10
11 Error Gain		1	1	100
21 GATE TIMER				
01 Turn on Gate Timer		FALSE	FALSE	TRUE
02 Gate Time (sec)	Monitor			
03 Reset Gate Time		FALSE	FALSE	TRUE
04 GoTo 5% Gate Pos		FALSE	FALSE	TRUE
05 GoTo 95% Gate Pos		FALSE	FALSE	TRUE

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	TUNABLE RANGE MAXIMUM
22 STEP TEST				
01 Enable Step Test		FALSE	FALSE	TRUE
02 Step Duration		30	0	1200
03 Step Value (%)		3	-10	10
04 Negative Step?		FALSE	FALSE	TRUE
23 BRAKE				
01 Brake Perms Met	Monitor			
02 Brake Enable Spd		50	0	100
03 Brake Enable Gpos		2	0	100
04 Brake on Timer		60	0	10000
05 Brake on Pulse Time		15	0	10000
06 Brake off Pulse Time		10	0	10000
24 CREEP				
01 Unit Creeping?	Monitor			
02 Creep Speed (%)		5	0	10
03 Dead Stop (sec)		60	10	600
04 Reset Creep (sec)		5	0	600
05 Look Again (sec)		5	0	600
25 MODBUS				
01 Baud Rate		6	1	7
02 Stop Bits		1	1	3
03 Parity Bits		1	1	3
04 Bits		2	1	2
05 Driver		1	1	2
06 Freeze Remote Setpoint		FALSE	FALSE	TRUE
07 Freeze Remote Init Bsld Ref		FALSE	FALSE	TRUE
08 Freeze Baseload Ref		FALSE	FALSE	TRUE
09 Freeze Level Ref		FALSE	FALSE	TRUE
10 Freeze Stroke Actuator		FALSE	FALSE	TRUE
11 Choose Modbus Comm		FALSE	FALSE	TRUE
12 Is Modbus Default Communication		FALSE	FALSE	TRUE
13 Enable Modbus 1 Comm Fault		TRUE	FALSE	TRUE
14 Enable Modbus 2 Comm Fault		TRUE	FALSE	TRUE
26 SYNCHRONIZE				
01 Speed Bias	Monitor			
02 Speed Bias Analog Gain		1	0.001	100
03 Spd Bias An Sig Filtr TC		0.01	0.001	3
04 Speed Bias Digital Rate		0.1	0.01	1
27 CONFIG SPD SW				
01 SW1 – Decreasing?		FALSE	FALSE	TRUE
02 Spd SW1 – Hi Set		100	0	200
03 Spd SW1 – Hi Delay		0	0	600
04 Spd SW1 – Low Set		98	0	200
05 Spd SW1 – Low Delay		0	0	600
06 USE SW1 FAIL SAFE		FALSE	FALSE	TRUE
07 FAIL SAFE STATE SW1		FALSE	FALSE	TRUE
08 Time To Disable Fail Safe SW1		20	0	300
09 SW2 – Decreasing?		FALSE	FALSE	TRUE
10 Spd SW2 – Hi Set		100	0	200

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	TUNABLE RANGE MAXIMUM
11 Spd SW2 – Hi Delay		0	0	600
12 Spd SW2 – Low Set		98	0	200
13 Spd SW2 – Low Delay		0	0	600
14 Use SW2 Fail Safe		FALSE	FALSE	TRUE
15 Fail Safe State SW2		FALSE	FALSE	TRUE
16 Time To Disable Fail Safe SW2		20	0	300
17 SW3 – Decreasing?		FALSE	FALSE	TRUE
18 Spd SW3 – Hi Set		100	0	200
19 Spd SW3 – Hi Delay		0	0	600
20 Spd SW3 – Low Set		98	0	200
21 Spd SW3 – Low Delay		0	0	600
22 Use SW3 Fail Safe		FALSE	FALSE	TRUE
23 Fail Safe State SW3		FALSE	FALSE	TRUE
24 Time To Disable Fail Safe SW3		20	0	300
28 CONFIG GP SW				
01 SW1 – Decreasing?		FALSE	FALSE	TRUE
02 GP SW1 – Hi Set		50	0	100
03 GP SW1 – Hi Delay		0	0	600
04 GP SW1 – Low Set		45	0	100
05 GP SW1 – Low Delay		0	0	600
06 SW2 – Decreasing?		FALSE	FALSE	TRUE
07 GP SW2 – Hi Set		50	0	100
08 GP SW2 – Hi Delay		0	0	600
09 GP SW2 – Low Set		45	0	100
10 GP SW2 – Low Delay		0	0	600
29 CONFIG KW SW				
01 SW1 – Decreasing?		FALSE	FALSE	TRUE
02 KW SW1 – Hi Set		50	0	100
03 KW SW1 – Hi Delay		0	0	600
04 KW SW1 – Low Set		45	0	100
05 KW SW1 – Low Delay		0	0	600
06 SW2 – Decreasing?		FALSE	FALSE	TRUE
07 KW SW2 – Hi Set		50	0	100
08 KW SW2 – Hi Delay		0	0	600
09 KW SW2 – Low Set		45	0	100
10 KW SW2 – Low Delay		0	0	600
30 MON ANALOG OUT				
01 AO #1 – mA	Monitor			
02 Actuator – Ma	Monitor			
30A MON AN OUT LINKNET				
01 AO #1 – mA	Monitor			
02 AO #2 – mA	Monitor			
31 MON ANALOG INPUT				
01 AI #1 - mA	Monitor			
02 AI #2 – mA	Monitor			
31A MON AN IN LINKNET				
01 AI #1 - mA	Monitor			
02 AI #2 - mA	Monitor			
03 AI #3 - mA	Monitor			

SERVICE MENU	PROGRAMMED VALUE	DEFAULT VALUE	TUNABLE RANGE MINIMUM	MAXIMUM
04 AI #4 - mA	Monitor			
05 AI #5 - mA	Monitor			
06 AI #6 - mA	Monitor			
07 AI #7 - mA	Monitor			
08 AI #8 - mA	Monitor			
32 BSLD CTRL (STPTS & RATES)				
01 Gen Unload Trip Level		100	0	30000
02 Generator Maximum Load		5000	10	30000
03 Gen Max Baseload Value		4000	10	30000
04 Gen Min Baseload Value		200	10	30000
05 Gen Max Rem Bsld Value		5000	10	30000
06 Gen Min Rem Bsld Value		500	0	30000
07 Gen Initial Baseload Value		1000	0	30000
08 Baseload Raise Time (sec)		60	1	600
09 Baseload Lower Time (sec)		60	1	600
10 Rmt Bsload Inc Time (sec)		60	1	600
11 Rmt Bsload Dec Time (sec)		60	1	600
12 Breaker Open Time (sec)		1	0.8	6
13 Ramp @ Min, CB Delay (sec)		5	1	10
33 BSLD CTRL (PID & MONITOR)				
01 Baseload Reference (kW)	Monitor			
02 Generator Load (kW)	Monitor			
03 Baseload Reference (%)	Monitor			
04 Generator Load (%)	Monitor			
05 Baseload PID Output (%)	Monitor			
06 Bsld Proportional Gain		0.7	0	100
07 Bsld Integral Gain		0.2	0	10
08 Baseload Speed Ramp Rate		0.2	0	100
34 OVERSPEED TEST				
01 Overspeed Test Enabled	Monitor			
02 Actual Speed	Monitor			
03 Max Speed Reached	Monitor			
04 Reset Max Speed		FALSE	FALSE	TRUE
05 OST Remaining Time	Monitor			
06 Turbine Running (Permissive 1)	Monitor			
07 Unit Offline (Permissive 2)	Monitor			
08 Speed > 95% (Permissive 3)	Monitor			
09 Overspeed Test Limit		200	75	250
10 Overspeed Test Maximum Time		1800	1	7200
11 Enable Overspeed Test		FALSE	FALSE	TRUE
12 Disable Overspeed Test		FALSE	FALSE	TRUE

Specifications

Power Supply Rating	18–36 Vdc (SELV)
Power Consumption	less than or equal 20 W nominal
Maximum Altitude	3000 m / 10 000 feet
Weight	1.75 kg / 3.86 lb
Input Supply Voltage	Typical Input Supply Current
18 V	589 mA
24 V (nominal)	431 mA
32 V	319.6 mA
Inrush Current	7 A for 0.1 ms
Steady State Speed Band	±0.25% of rated speed
Magnetic Pickup	100–25 000 Hz (300–3600 rpm)
3-phase Current Transformer Burden	3-7 A rms at full load, CT input burden at full load is 0.1 VA per phase
3-phase PT Burden	100–240 Vac line-to-line, 45–66 Hz. PT input burden is between 1.5 VA and 1.7 VA per phase at 240 Vac, and between 0.4 VA and 0.5 VA per phase at 120 Vac.
Discrete Inputs (8)	3 mA at 24 Vdc, impedance approximately 5.2 kΩ
Remote Reference Input	4–20 mA, 0–5 Vdc
SPM-A Input	±2.5 Vdc, externally powered
Actuator Output	0–20 mA, 4–20 or 0–200 mA to actuator
Analog Output	0–20 or 4–20 mA, internally powered, power by external +12 Vdc or +24 Vdc source, max output current 200 mA
Discrete Output Ratings	Low-side drivers with overvoltage protection, 200 mA maximum
Communication Ports	RS-232: 9-pin connector, RS-422: 9-pin connector, 9600 to 115 200 baud, full duplex
Ambient Operating Temp	–40 to +70 °C (–40 to +158 °F)
Storage Temp	–40 to +105 °C (–40 to +221 °F)
Humidity	Lloyd's Register of Shipping, Test Specification No. 1, 1996, Humidity Test 1, 95% at +20 to +55 °C (+68 to +131 °F) condensing
Mechanical Shock	US MIL-STD 810C, Method 516.2, Procedure I (basic design test), Procedure II (transit drop test, packaged), Procedure V (bench handling)
Equipment Classification	Class 1 (grounded equipment)
EMC Immunity Environment	Marine Type Tests & EN 61000-6-2 IEC 61000-4-2, ESD ±6 kV/±8 kV IEC 61000-4-3, RS 10 V/m + AM 80-3000 MHz IEC 61000-4-4, EFT ±2 kV Power & I/O IEC 61000-4-5, Surge ±1 kV I/O CM, ±0.5/±1.0 kV dc power DM/CM, & ±1.0/±2.0 kV ac power DM/CM IEC 61000-4-6, CRF 10 Vrms + AM 0.150-80 MHz. Marine Type Test CLFI 3.6 Vrms or 2 W, 50 Hz to 20 kHz. WWD (Marine) CLFI 3.6-0.36 Vrms or 2.0–0.2 W, 20 kHz to 150 kHz.
EMC Emission Environment	Marine Type Tests & EN 61000-6-4 Marine General Distribution Zone per CISPR 16 EC EN 61000-6-4 Industrial Limits (Class A)

Revision History

Changes in Revision D—
- Revised control hardware list in Chapter 1

Changes in Revision C—
- Added in Regulatory Compliance section
- Replaced EU DoC and added in UKCA DoC
- Edit to Specifications table

Changes in Revision B—
- Replaced Regulatory Compliance information with a reference to a source manual
- Added LOTO Warning to the Warnings and Notices section
- Added the analog Input option for generator load (kW)
- Added fail safe to the speed switches
- Added all commands to the Modbus 2
- Added the possibility of having Modbus as the default communication when the control is restarted
- Corrections on remote setpoints from Modbus

Changes in Revision A—
- Changed 2300E references to 2301E throughout manual
- Added hardware components (Chapter 1)
- Added table of commands (Chapter 3)
- Added Specifications
- Added Declaration of Conformity and Declaration of Incorporation

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00448-04-EU-02-01
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	2300E, 2301E
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC) Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
Markings in addition to CE marking:	Ex II 3 G, Ex ec IIC T3 Gc Ex II 3 G, Ex ec IIC T4 Gc
Applicable Standards:	
ATEX:	EN IEC 60079-0, 2018: Explosive Atmospheres - Part 0: Equipment – General requirements EN 60079-7:2015, EN IEC 60079-7:2015/A1:2018: Explosive Atmospheres - Part 7: Equipment protection by type of protection "ec"
EMC:	EN 61000-6-2:2005, EN61000-6-2:2005/AC: 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN 61000-6-4:2007, EN 61000-6-4:2007/A1:2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments
LVD:	EN 61010-1:2010, EN 61010-1:2010/A1:2019/AC:2019-04, EN 61010-1:2010/A1:2019 - Electrical Equipment for measurement, control, and laboratory use – Part 1: General requirements

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

MANUFACTURER

Annette Lynch
Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

07 July 2023
Date

5-09-1183 Rev 39

UKCA DECLARATION OF CONFORMITY

UKCA DoC No.: 00448-04-UKCA-02-01
Manufacturer's Name: WOODWARD INC.

Manufacturer's Contact Address: 1041 Woodward Way
Fort Collins, CO 80524 USA

Model Name(s)/Number(s): 2300E, 2301E

Markings in addition to CE marking: Ex II 3 G, Ex ec IIC T3 Gc
Ex II 3 G, Ex ec IIC T4 Gc

The object of this Declaration is in full conformity with the following UK Statutory Instruments (and their amendments):

S.I. 2016 No. 1107	Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016
S.I. 2016 No. 1091	Electromagnetic Compatibility Regulations 2016
S.I. 2016 No. 1101	Electrical Equipment (Safety) Regulations 2016

The Object of this Declaration is in conformity with the applicable requirements of the following designated standards and technical specifications.

EN IEC 60079-0:2018	Explosive Atmospheres - Part 0: Equipment – General requirements
EN 60079-7:2015, EN IEC 60079-7:2015/A1:2018	Explosive Atmospheres - Part 7: Equipment protection by type of protection "ec"
EN 61000-6-2:2005, EN 61000-6-2:2005/AC:2005	EMC Part 6-2: Generic Standards - Immunity for Industrial Environments
EN 61000-6-4:2007, EN 61000-6-4:2007/A1:2011	EMC Part 6-4: Generic Standards - Emissions for Industrial Environments
EN 61010-1:2010, EN 61010-1-2010/A1:2019/AC:2019-04, EN 61010-1:2010/A1:2019	Electrical Equipment for measurement, control, and laboratory use – Part 1: General requirements

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

MANUFACTURER

Annette Lynch
Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

07 July 2023
Date

5-09-1183 Rev 39

Released

We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 35092.

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