WOODWARD

Product Manual 26477
(Revision NEW)
Original Instructions

GTC250A_FC Gas Turbine Fuel Control for Generator or Compressor Applications

8262-1036

Installation and Operation Manual

General Precautions

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

Practice all plant and safety instructions and precautions.

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

Revisions

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Proper Use

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

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Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

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Warnings and Notices

Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

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

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Chapter 1.
General Information

Introduction

This manual describes the GTC250A_FC Digital Control System designed to control two-shaft gas turbines for compressor or generator applications. The manual should be used along with the standard Atlas-II™ hardware manual (26415), and therefore the scope of this document is only to describe details of the GTC250A_FC application software functionality and assist the customer in configuration and start-up of the control. Refer to manual 26415 for information on hardware specifications, mounting information, wiring details, and adding distributed I/O to the system.

Scope of Supply

Item #	Description
8262-1036	GTC250A_FC—Atlas-II (Fuel Control Only)
BCD85244	CD—System Documentation & Software Tools

Optional Add-ons

Item #	Description
8928-5005	NetSim™ Basic Simulation License
8900-067	Ambient Air Temperature Sensor (AD590)
1784-505	Moore Industries AD590 Ambient Temperature Signal Converter
5441-699	Relay Interface (12) FTM
5417-747	Relay FTM Interface Cable
8200-224	Servo Position Controller (SPC)

General Description

The Woodward GTC250A_FC Atlas-II Digital Control System is a configurable control system for gas turbines that produces a fuel demand output to control speed, load, pressure, and temperature. For a given GTC model, the maximum I/O available is fixed and has been pre-programmed into the unit. If additional I/O is required, the customer should inquire about other models of the GTC family.

Hardware

The GTC250A_FC Atlas-II Digital Control is designed to be bulkhead mounted in a control panel. The complete unit contains an A5200 CPU module with actuators, and 1 Analog Combo module, and a Power Supply board. In addition, the system can include an optional relay Field Termination Module (FTM) and cable. These components are designed for DIN rail mounting in the control cabinet.

The CPU module controls the system. The I/O modules interface the CPU module to the outside world, permitting it to sense digital and analog inputs and to issue analog and discrete outputs.

Optional relays are available for the system to isolate the system's discrete output circuits from the field wiring.

Power Requirements
The Atlas-II Digital Control System requires an 18-32 Vdc input supply voltage.

Physical Description
For further details on the physical hardware, refer to the Atlas-II product manual 26415.

A5200 CPU Module
The A5200 CPU runs under a VxWorks® * real time operating system and follows the instructions of the application program, which controls all of the input and output circuits of the GTC250A_FC Atlas-II Control.

*—VxWorks is a trademark of Wind River Systems, Inc.

The CPU module has the following Communications Ports:

Ethernet 100BT
4-10/100 Base-TX Ethernet ports used for Modbus® * communication and service tools.

*—Modbus is a trademark of Schneider Automation Inc.

Serial COM 1
This port is a dedicated operating system debug port and should not be used.

Serial COM 2
The COM 2 Serial Port is configured for use as a Modbus interface on this control. If used, a serial isolation adapter must be used.

I/O Modules
The analog I/O module has a FAULT LED that is controlled by the CPU. During every initialization of the system, the CPU turns this LED on. The CPU then individually tests each I/O module. If an I/O module fails any test, the FAULT LED remains on. The FAULT LED remaining on after the diagnostics have run may mean that the module has failed a test, or it may mean that the module is not correctly declared in the GAP application.

For further details on the specific hardware modules installed in this system refer to the Atlas-II product manual 26415.

The I/O signals for GTC systems are divided into two groups, the Atlas-II I/O and the Distributed I/O.

Atlas-II I/O

Inputs
This control can receive inputs from the following devices:
- 4 Magnetic pickups
- 11 Temperature sensors (K-type Thermocouples)
- 8 Analog Input Sensors (4 to 20 mA dc signals)
- 2 RTD Inputs
- 24 Discrete Input Contacts

Outputs
The following outputs are provided:

- 2 actuator driver channels (0 to 20 mA dc or 0 to 200 mA dc maximum range)
- 12 Discrete Relay Outputs
- 6 Analog Current Outputs (4 to 20 mA dc)

Serial Communications
The Atlas-II SmartCore module contains the following communications ports:

- 2 RS-232/RS-485/RS-422 ports with terminal connections
- 2 CAN Open protocol ports (Digital interface to Woodward fuel valves)

Software Application Program

The application program is designed by using the Woodward GAP™ Graphical Application Program. The GAP program, which runs on a standard PC (personal computer), builds and compiles the application program file. This application code is then processed through a coder/compiler, which generates the application program code. This executable code is then loaded into flash memory on the CPU module circuit board. The GTC250A_FC application is designed as a fuel control for a two-shaft gas turbine and is intended to provide proper fuel demand control from the initial ‘Fuel On’ signal to ‘Fuel Off’. The GTC250A_FC control, as delivered from Woodward, is not designed to provide any turbine start permissive or sequencing logic, off-turbine package sub-system control, or plant process requirements.

Chapter 2.
Description of Operation

Introduction

This chapter describes the operation and features included in the GTC250A_FC system for control of a gas turbine driving a generator or a compressor.

Scope

The control has been divided into major functions for this description. Many of these functions have sub-functions, and all of these may not be utilized in your specific unit. The major function of the GTC250A_FC Atlas-II™ Digital Control System is to control the metered fuel demand to the turbine under all operating conditions. The CORE Fuel Control / Combustor logic algorithms include:

- Start Ramp and Start Control Logic
- Speed Reference Logic for both Shafts
- Speed Control of Gas Generator Shaft (GG)
- Speed/Load Control of Power Turbine Shaft (PT)
- EGT or TIT Temperature Limiting Control
- CDP Limiting Control
- Megawatt Limiting Control
- Acceleration and Deceleration Control
- Fuel Transfer Logic
- NO_X Valve Demand
- VG Actuator Demand (single drive signal via a curve schedule)
- Flameout Detection (both UV detectors and EGT temp sensing)
- Compressor Stall Detection Trip (optionally available for some turbines)

Functional Block Diagram

The following diagram shows a general outline of the functionality of the GTC250A_FC control (Figure 2-1).

Control Loops

Start Ramp/Start Control

The control contains options for Start mode, including an open loop start ramp, a closed loop GG acceleration schedule, and an EGT-temperature-controlled start. This control mode accelerates the turbine from initial ‘Lite-off’ to a point where the GG control PID can take control of the fuel valve demand.

Speed Reference Setpoint Ramps (both GG and PT)

The control has logic to determine the PID speed reference setpoint for both shafts. This value can be driven by discrete inputs for analog signals sent from the sequencer device. It is managed in the fuel control logic to insure appropriate action for transient response due to system disturbances, such as breaker state changes, load steps/drops, and turbine trips.

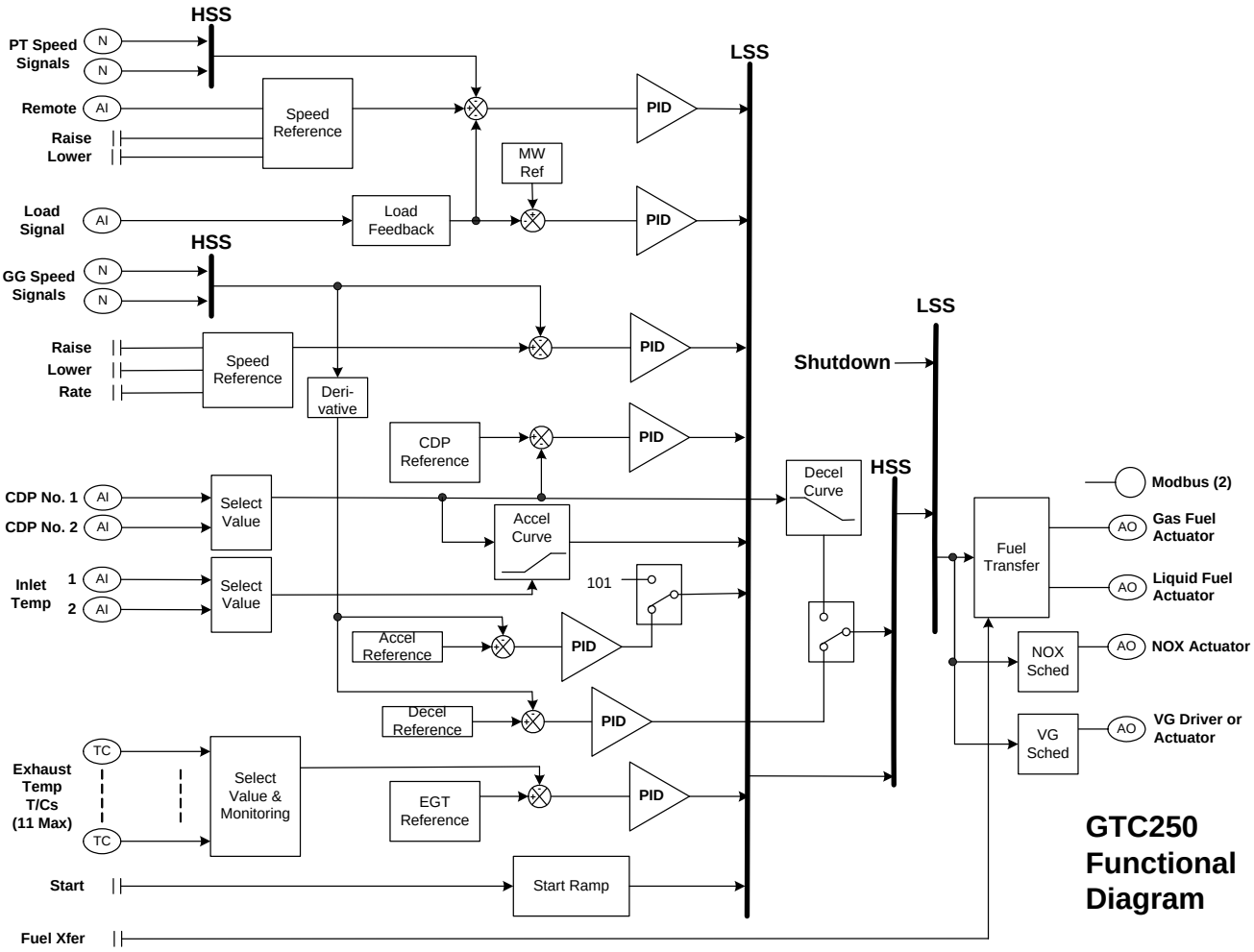


Figure 2-1. GTC250A_FC Functional Block Diagram

Gas Generator Control (GG) PID

The intent of this controller is to keep the turbine GG speed equal to the GG speed reference. This control loop will typically accelerate the turbine up to the rated PT speed. The GG control PID (proportional-integral-derivative) function block compares the GG actual speed signal with the GG speed reference and calculates an appropriate output response. The GG control PID has three inputs:

- Actual speed input from the GG scalar
- GG speed reference input
- Feedback input from the LSS

Power Turbine Control (PT) PID

The intent of this controller is to maintain desired speed of the PT shaft. Under normal operating conditions, the unit will be loaded while in this mode and maintain speed control from zero load to maximum load. The PT control PID compares the PT actual speed signal with the PT speed reference and calculates an appropriate output response. The PT control PID has three inputs:

- Actual speed input from the PT scalar
- PT speed reference input
- Feedback input from the LSS

Temperature Limiting Control (EGT) PID

The EGT PID block compares the actual EGT signal with the reference EGT signal and generates an appropriate output response signal. The EGT control PID is typically used as a limiter on the high end of the load curve of the turbine. It is also used in the GTC as an option on startup to limit the fuel flow until closed loop speed control can be reached (typically at GG idle). It will limit the fuel demand to the turbine once the EGT temperature reaches the EGT reference setpoint. The EGT Control PID has three inputs:

- Calculated average temperature from all validated EGT T/C inputs
- EGT temperature reference setpoint
- Feedback from the LSS

Pressure Limiting Control (CDP) PID

The CDP PID block compares the actual CDP signal with the reference CDP signal and generates an appropriate output response signal. The CDP control PID is typically used as a limiter on the high end of the load curve of the turbine. It will limit the fuel demand to the turbine once the CDP pressure reaches the CDP reference setpoint. The CDP Control PID has three inputs:

- Validated CDP from all valid CDP inputs:
- CDP reference setpoint
- Feedback from the LSS

Megawatt Control or Limiting (MW_LIM) PID

Active MW Control can be selected and is accomplished as a cascade setpoint into the PT Speed PID controller and will maintain a desired MW setpoint regardless of ambient conditions.

The MW Limiter PID block compares the actual MW signal (or calculated MW load based on turbine CDP) with the reference MW signal and generates an appropriate output response signal. The MW control PID is used as a limiter on the high end of the load curve of the turbine. It will limit the fuel demand to the turbine once the MW output reaches the MW reference setpoint. The MW Control PID has three inputs:

- Actual or calculated MW load input
- MW limiter reference setpoint
- Feedback from the LSS

ACCEL Control (Curve Schedule & PID)

The accel schedule determines the maximum amount of fuel allowed, during acceleration. This demand is driven by either a configurable curve (based on CDP) or by a PID control on the GG speed derivative. The CDP versus Fuel Demand accel limit curve is a required configuration by the user. It will determine the maximum amount of fuel allowed for the current CDP. The speed derivative accel PID is an option that can also be used. The maximum amount of fuel allowed is determined by a speed vs. speed derivative curve. Both of these control parameters feed into the LSS bus. If the value is the lowest on the LSS, then its schedule controls the LSS. The PID option can be selected during the configuration of the unit.

DECEL Control (Curve Schedule or PID)

The decel schedule determines the minimum amount of fuel allowed during deceleration. This demand is determined by a curve that is based on CDP as the forcing function or by a PID control on the GG speed derivative signal. It uses one of these signals to determine the minimum amount of fuel allowed. It then outputs this value to the HSS. If the value is the highest on the HSS, the decel schedule controls the HSS.

Fuel Transfer Logic

The control has the capability to run on gas or liquid fuel and the ability to make on-line fuel transfers between the two fuels. It is important to note that the packager/user will need to gather the necessary fuel property and valve flow schedule information to correctly configure the unit to make smooth on-line fuel transfers, if that is a desired operational function. There are separate rates available for transferring fuels in either direction.

NO_X Valve Demand

The control has the capability to control the turbine emissions through the modulation of a NO_X control valve. This logic provides a 4–20 mA output that is designed to be the demand signal to a driver for positioning of a water or steam injection valve. The logic has configuration choices for the forcing function input to a tunable curve schedule blocks. There are separate schedule curves for gas and liquid fuel as well as ‘ratio multipliers’ and raise and lower ramps to adjust the NO_X flow to the desired demand.

Variable Geometry Actuator Demand

The control has the capability to control the turbine variable geometry through the modulation of a VG control valve. This logic provides a 4–20 mA output that is designed to be the demand signal to a driver for positioning of variable geometry actuator/valve. The logic uses corrected GG speed as the forcing function input to a tunable curve schedule block (either 2D or a series of 2D curves biased by ambient temperature). The most common use would be for positioning of Inlet guide vanes.

Flame Established and Flameout Detection

The control has multiple user options available for detecting that a flame exists in the combustor. Discrete input or Analog 4–20 mA input flame detectors are supported as well as EGT temperature threshold or GG Speed threshold settings. The active signals (DI or AI) provide flameout detection as well as flame established indications. There are shutdown indications related to these conditions.

Compressor Stall Detection Logic

The control includes the option of using Compressor Stall Detection algorithms. The control monitors the CDP signals at a very high-speed data rate and then calculates a derivative of this signal. When this calculation exceeds the OEM defined limits of this turbine parameter, a control shutdown is initiated.
To utilize this function the CDP must be configured to be wired into channel(s) Analog Input #5 and/or Analog Input #6.

LSS Bus

The low signal select (LSS) bus selects the lowest of the GG PID, PT PID, EGT PID, CDP PID, MW Limiter, Start Ramp, or the accel schedule signals, and passes it to the HSS bus. Whichever signal is calling for the lowest fuel is the one used for LSS bus output.

HSS Bus

The HSS bus receives the output of the LSS bus and the decel schedule as input. Whichever of these inputs is higher will be the signal sent to the output of the HSS bus. This output is responsible for setting the turbine fuel valve position to maintain the requested turbine parameter.

LSS Bus (LSS_2)

A second low signal select (LSS) bus exists downstream of the HSS. This is where the Shutdown command is invoked to chop fuel flow to the turbine.

Fuel Demand

This block is the true 0–100% fuel demand being commanded from the fuel control.

Actuator Driver

The actuator driver converts the 0-to-100% software control signal to a proportional actuator drive current signal. This can be configured for a 4–20 mA or 0–200 mA drive signal. An input from the shutdown input can override the control signal and cause the actuator to go to minimum-fuel position or shutdown. The shutdown circuit also has short and open coil fault detection. The actuator translates the signal from the electronic control into mechanical force to position the fuel valve. There are separate actuator drive outputs for gas and liquid fuel. There is also an option to output the Gas fuel demand via a CAN link to a Woodward Gas Fuel Valve.

Chapter 3.
Installation

Introduction

A detailed list of the Atlas-II™ I/O signal layout , wiring terminations, descriptions, and range information is found in Appendix A. This chapter describes details of the signals that the GTC250A_FC is programmed to handle.

Fuel Control Input Signals

The primary turbine signals required by the control to perform the functions detailed in the last chapter are listed and described below.

- Speed Sensing of both Shafts
- Exhaust Gas (or Turbine Inlet) Temperature (EGT) Sensing
- Compressor Discharge Pressure (CDP) Sensing
- Ambient / Compressor Inlet Temperature Sensing
- MW Load Sensing (for Generator units)
- Flame Detection Sensors (for Flameout protection)

Speed Sensing

The function of speed sensing is to monitor turbine speed. The sub-functions are:

- Speed Sensors
- Speed Derivative
- Sensor Fault Detection
- Speed Switches

Speed Sensors
There are four speed sensors in this system, two for GG and two for PT. The digital speed sensor I/O board receives input from the speed sensors on the turbine and converts this speed signal to a usable form for the control. The two speed signals for each shaft are high-signal selected with only the one indicating the higher speed being sent to the control PIDs.

Speed Derivative
The speed sensor input blocks also generate a derivative of the speed, which gives the control a high frequency calculation of the rate of change in speed over time. This signal is high signal selected, and this value is used to control acceleration and deceleration of the turbine.

Sensor Fault Detection
Sensor fault detection is done in the application software. On detection of a sensor fault, a signal is generated for activation of associated indicators and alarms. Failure of both signals from the same shaft will cause a shutdown. An alarm also exists for annunciating a speed difference between redundant sensors.

Speed Switches
In the software there are three speed switches for GG and three speed switches for PT. These speed switches are configurable for any speed and are used to drive relay outputs. These outputs can be used by other systems. There is also an overspeed switch for GG and one for PT. Each of these switches can be configured to activate at any speed. Each switch also initiates a potential shutdown or alarm when activated.

Analog Inputs

Eight analog 4–20 mA inputs are available as direct inputs into the Atlas-II I/O. These 'high-speed' input signals are used to direct the actions and functions of the fuel control. Each of these outputs is configured from a menu on the Analog Input page of the Toolkit tool, which also includes the signal range and gain and offset handles for signal calibration.

Menu Item	Function
1	EGT Summary Signal
2	Remote PT Speed Reference Setpoint
3	MW Load Signal
4	Compressor Inlet Temperature Signal
5	CDP Pressure Sensor #1
6	CDP Pressure Sensor #2
7	Gas Fuel Valve Position Feedback
8	Liquid Fuel Valve Position Feedback
9	Remote MW Setpoint
10	Speed Sync Bias Input
11	Inlet Supply Gas Pressure (P1)
12	NOX Water Supply Pressure
13	Analog Flame Detector #1
14	Remote GG Speed Reference Setpoint
15	Analog Flame Detector #2
16	NOX Valve Position Feedback
17	TBD
18	TBD
19	TBD
20	TBD

Table 3-1. Analog Input Functions Menu

To utilize Stall Detection protection via the CDP, the CDP must be configured to be wired into channel(s) Analog Input #5 and/or #6. The CDP signal must also be configured in psia units. (If desired the analog & Modbus outputs can be converted to Bar for display purposes.

Exhaust Gas Temperature (EGT)

The EGT section of this control includes the following sub-sections:

- EGT Sensing
- Temperature Reference
- Temperature Switch Output Relay Signals

EGT Sensing
Two methods of sensing EGT are available, one 4–20 mA summary EGT input or multiple thermocouples. When the summary method is selected, a single 4–20 mA input senses the EGT. The system feeds the temperature information from this signal to the three temperature level switches, overtemp switches, and the EGT control PID. When the multiple-thermocouple method is used, the EGT is sensed by a number of type K thermocouples (configurable from 1 to 11). Cold Junction compensation is done on the Atlas-II I/O module, but there is an option eliminate this compensation if T/C wiring is not run all the way to the Atlas-II. The temp spread monitor block calculates the average reading of the thermocouples. It excludes any that are outside of the allowed spread or those T/C that have failed. The temp spread monitor block and the subtract block calculate the difference between the highest and lowest readings of the thermocouples that are included in the average. Configurable alarms and shutdowns are available for each T/C, number of failed T/Cs, and excessive spread.

Temperature Reference
The EGT Reference is set by a tunable variable and can be configured to use an ambient temperature bias. There is an option to use the EGT control for starting the unit. The control has additional temperature setpoints that are used for this option.

Temperature Switches
In the software there are three temperature level switches for the EGT. These temp switches are configurable for any temperature setpoint and are used to drive relay outputs. The third switch can be used to trigger an alarm. These outputs can be used by other systems.

OverTemperature Switches
In the software there are two overtemperature switches for the EGT. These temp switches are configurable for any temperature setpoint and are used to trigger the start Overtemp and Overtemp shutdown events.

Speed References (GG and PT)

The speed reference produces the desired speed-setting signal and sends it to the speed controller. The sub-functions are:

- Speed Setting
- GG Ambient Bias
- Remote Speed Setting

Speed Setting
The GG and PT speed settings are raised or lowered by closing the associated contact and the rate at which the reference changes can also be selected. Each speed reference has both an upper and a lower limit position. The speed setting at each of these positions is a tunable value. Each speed reference also includes relay options to indicate when that speed reference is at the upper and lower limits.

GG Ambient Bias
There is an option to bias the GG speed or the GG reference input from an ambient temperature bias block. If the ambient temperature input fails, a fixed value (which is configurable) bias signal is used.

Remote Speed Setting
Both the PT speed setting can be controlled by a remote signal. The ENABLE contact enables remote PT speed setting. When enabled, the speed setting can be changed by varying a remote 4-to-20 mA signal. For the GG speed setting the unit is configure to allows use or not use a remote signal. The user can also configure that remote signal to pass through a deadband block to safely move the setpoint up and down, or to send it directly to the reference ramp.

Megawatt Sensor (MW)

The MW section of this control includes the following sub-section:
- MW Sensing

MW Sensing
The megawatt load (MW) is sensed by a 4-to-20 mA load transducer. There is a 4-to-20 mA MW load sensor input signal available for applications driving generators. This value is then used by the control for load control/droop feedback when running the unit against a utility grid.

Compressor Inlet (Ambient) Temperature Sensor

The control is designed to receive a compressor inlet temperature signal via a single 4–20 mA input, a thermocouple input, or via a single or redundant RTD input.

It is very common for the CIT temperature to be sensed by an AD590. There is an optional kit item that can be included with the GTC products to convert this signal. The AD590 microamp signal is converted to a milliamp signal through the Moore Industries device. This device has been programmed with a microamp to milliamp/temperature conversion chart that converts the value into a 4–20 mA signal.

The CIT temperature sensor signal is converted to a digital signal in the Atlas-II Digital Control System and can be configured to bias any of the following turbine parameters: GG Speed, GG reference, and/or the EGT reference. If the CIT temperature input signal fails, a fixed-value signal (tunable) is used as the bias signal. Ideally this signal is sensed at the inlet to the GG compressor, if this location is unavailable it is acceptable to use the ambient inlet temperature at the bellmouth for this input.

Compressor Discharge Pressure (CDP)

The CDP section of this control includes the following sub-sections:
- CDP Sensing
- CDP Derivative Calculation

CDP Sensing
The compressor discharge pressure (CDP) is sensed by a 4–20 mA pressure transducer. There are two 4–20 mA pressure signals available. The selection of the value that is used is the highest signal selected (HSS). This value is then used by the control for pressure control and fuel schedules.

CDP Derivative Calculation
The CDP sensor input blocks also generate a derivative of this signal, which gives the control a high frequency calculation of the rate of change of compressor discharge pressure over time. This signal is high signal selected and this value is used in certain turbine operation protection algorithms, such as Stall Detection.

IMPORTANT

The CDP signal can be setup in any units the user desires, as long as the schedules are created based upon the same units. If however, the optional Stall Detection algorithm is used, then the signal range must be setup for psia units, and the correct stall schedule block must be used.

Fuel/NOX Valve Position Feedbacks (Gas, Liquid and NOX)

The control can accept a 4–20 mA input relating to the fuel valve position feedback and use this signal to create an alarm or shutdown relating to an error between the demanded and the feedback positions.

Remote MW Setpoint

The control can accept a 4–20 mA input that will be used as the Load setpoint if MW/Load control or MW Limiting is configured to be used in the control.

Inlet Gas Supply Pressure

The control can accept a 4–20 mA input of the gas inlet pressure. No functions are currently programmed for this input other than sending this out on the Modbus communication link.

NOX Water Supply Pressure

The control can accept a 4–20 mA input of the NOX water supply pressure. This can be used to trigger a configurable permissive to enable NOX control.

Speed Sync Bias

The control can accept a 4–20 mA input that be used as a speed bias during synchronization of the turbine genset with the load bus or utility. This signal will an rpm value that will be added to the rated speed configured in the control. The range of this signal must be setup with 12 mA = 0 rpm (for example a range of –36 to 36 would allow the sync bias to move the reference 1% of rated speed on a 60 Hz unit).

Flame Established and Flameout Detection Logic (UV)

The Flameout section of this control includes the following sub-sections:
- UV Detector (discrete inputs) Sensing
- Analog Flame Sensors
- EGT Temperature Monitoring
- GG Speed Monitoring

Ultra-Violet Flame Sensor Detectors
If UV detectors are used, the control will monitor these signals to confirm that ignition exists in the combustor. Both single and redundant sensors are supported. Flame is recognized by the control by a True signal on the discrete contacts.

Analog Flame Sensor Detectors
If analog detectors are used, the control will monitor these signals to confirm that ignition exists in the combustor. Both single and redundant sensors are supported. Flame is recognized by the control by the user setting a analog flame signal threshold level (tunable).

EGT Temperature Monitoring
The control uses EGT temperature logic to monitor for a 'Lite-off' detection in the combustor. This setpoint for this software switch is set at 400 °F (204 °C). If during any valid turbine running sequence the EGT temperature drops below this level, the control will consider this a lost flame condition and initiate a shutdown. The control can be configured to use either one or both of these options.

GG Speed Monitoring
This method monitors the GG shaft for speed to be greater than a programmed setpoint. Once this speed is reached, the control monitors for the speed to drop 200 rpm below this speed to determine that the unit has flamed out.

Thermocouple Inputs

Eleven T/C inputs are available as direct inputs into the Atlas-II I/O. These 'high-speed' input signals are used to acquire temperature data from the turbine and direct the actions and functions of the fuel control. In System Configuration pages the user will indicate the number of T/C's that are to be brought into the control for EGT averaging (in addition to setting the type, min temp, max temp…). The toolkit tool will reveal a matching number of T/C inputs depending on this user setting. The T/C Input page of the Toolkit tool includes gain and offset handles for signal calibration.

Discrete Inputs

Twenty-four discrete inputs are available as direct inputs into the Atlas-II I/O. These 'high-speed' input signals are used to direct the actions and functions of the fuel control. Each of these inputs is configured from a menu.

Menu Item	Function
1	Emergency Shutdown
2	Start / RUN Command
3	Event Reset Command (ALM & SD)
4	Event Acknowledge Command (ALM & SD)
5	Lower GG Speed Reference Setpoint Command
6	Raise GG Speed Reference Setpoint Command
7	GG Speed Reference Select Fast Rate
8	GG Speed Reference Select Instant Rate
9	PT Speed Reference Lower Setpoint Command
10	PT Speed Reference Raise Setpoint Command
11	PT Speed Reference Select Fast Rate
12	GG Speed Signal Failed Override (for start sequence)
13	PT Speed Signal Failed Override
14	Fuel Selection / Transfer (TRUE = Liquid Fuel)
15	Enable Remote PT Speed Reference Setpoint
16	Enable External Synchronizer
17	Generarator Breaker Aux (52) CLOSED (=Droop)
18	Utility Breaker OPEN / Load Share Enable
19	DI Flame Detector 1
20	DI Flame Detector 2
21	Enable MW/Load Control
22	Enable Remote MW/Load Setpoint
23	Go to PT Rated Setpoint
24	Enable NOX Control
25	NOX Lower Reference Command
26	NOX Raise Reference Command
27	DI Start Permissive
28	Hold Valve at Position #2 Command
29	PT Speed Reference Select Instant Rate
30	Water Valve Driver Fault

Table 3-2. Discrete Input Functions Menu

DI Function Descriptions

Emergency Shutdown—Initiates a Fuel Chop command to the fuel metering valve.

Start / RUN Command—Initiates a FUEL ON command to the fuel control to position the fuel valve for lite-off & begin active control of the fuel valve once flame is established. When signal is removed it will be used as a FUEL OFF command with no Shutdown indication (intended for Normal Stop from sequencer).

Event Reset Command (ALM & SD)—Resets any alarm or shutdown condition, if condition is corrected. Configuration option for this command to provide an Acknowledge command if pulsed for less than 1.5 seconds.

Event Acknowledge Command (ALM & SD)—Acknowledge input silences the HORN output, does not attempt to Reset the fault condition.

Lower GG Speed Reference Setpoint Command—The commands the Gas Generator Speed reference ramp setpoint to lower from its current setting.

Raise GG Speed Reference Setpoint Command—The commands the Gas Generator Speed reference ramp setpoint to raise from its current setting.

GG Speed Reference Select Fast Rate—The commands the Gas Generator Speed reference ramp setpoint to move at the configured fast rate (rpm/sec) rather than the default rate.

GG Speed Reference Select Instant Rate—The commands the Gas Generator Speed reference ramp setpoint to move instantly to the selected setpoint.

PT Speed Reference Lower Setpoint Command—This commands the Power Turbine Speed reference ramp setpoint to lower from its current setting.

PT Speed Reference Raise Setpoint Command—This commands the Power Turbine Speed reference ramp setpoint to raise from its current setting.

PT Speed Reference Select Fast Rate—The commands the Gas Generator Speed reference ramp setpoint to move at the configured fast rate (rpm/sec) rather than the default rate.

GG Speed Signal Failed Override (for start sequence)—This input overrides the GG speed signal failed condition to allow the unit to start—the start sequence should remove this override once the starter has engaged and the GG shaft should have exceeded the minimum detectable speed ($1/50^{th}$ of maximum)

PT Speed Signal Failed Override—This input manually overrides the PT speed signal failed condition to allow the sequencer to control when this speed should be present. The user can configure an automatic override that performs this function until a desired GG speed is reached.

Fuel Selection / Transfer (TRUE = Liquid Fuel)—For dual fuel units this input is used to transfer from one fuel to another. In single fuel applications this input does not need to be used.

Enable Remote PT Speed Reference Setpoint—This command request that the fuel control follow the analog remote PT speed reference setpoint.

Enable External Synchronizer—This input enables the external analog speed bias signal to affect the rated speed setpoint so that an external synchronizer device can control the breaker closure.

Generator Breaker Aux (52) CLOSED (=Droop)—This is the status of the units Generator Breaker with TRUE meaning Breaker Closed.

Utility Breaker OPEN / Load Share Enable—This is the status of the units Utility Tie Breaker with TRUE meaning Breaker is Open. It is also a permissive to allow Load sharing between units (units with PowerSense only). It this is not used the control will assume that whenever the GEN breaker is closed that the unit is tied to the utility grid.

DI Flame Detector 1—This input is to support the use of a discrete input signal from a flame detector device.

DI Flame Detector 2—This input is to support the use of a discrete input signal from a flame detector device.

Enable MW/Load Control—This command enables the MW/Load control function. If while in MW Control a Lower PT Reference command is received it will disable the MW Control automatically.

Enable Remote MW/Load Setpoint—This command enables the MW/Load control setpoint to come from an analog input signal.

Go to PT Rated Setpoint—This input sets the PT reference setpoint to rated speed.

Enable NOX Control—This input enables the NOX control functionality to position the NOX Valve demand output to the correct percent.

NOX Lower Reference Command—This command causes the NOX reference ramp to move toward its lower limit (0.8) from its current setting. This ramp is a multiplier bias to the configured schedule.

NOX Raise Reference Command—This command causes the NOX reference ramp to move toward its upper limit (1.2) from its current setting. This ramp is a multiplier bias to the configured schedule.

DI Start Permissive—This command allows the user to inhibit the turbine startup from a device other than the sequencer. If used, this input must be True to accept a start command from the sequencer.

Hold Valve at Position #2 Command—This command allows the sequencer to hold the fuel valve at a set position after combustor lite-off (True). When this command is released (False) the start ramp will resume ramping open the fuel valve toward GG Speed control.

PT Speed Reference Select Instant Rate—The commands the Power Turbine Speed reference ramp setpoint to move instantly to the selected setpoint.

Water Valve Driver Fault—This input indicates a summary fault from the NOX valve or a remote NOX driver. It will disable the NOX control functions and can be activated as an alarm or shutdown.

Fuel Control Output Signals

Actuator Driver Outputs

This system includes two actuator drivers, one for the gaseous-fuel actuator and one for the liquid-fuel actuator. Each of the actuator drivers receives a fuel demand signal and sends a proportional drive current signal to its actuator. Each actuator, in turn, controls the flow of one type of fuel. The outputs are configurable as 4–20 mA or 0–200 mA. These outputs are proportional drivers only—if integrating drivers are required, inquire about the Woodward Servo Position Controller (SPC).

The control also includes a CAN interface that can be used to directly drive Woodward gas valves designed with on-board drivers.

Analog Outputs

The system includes ten analog outputs. These readout signals are 4–20 mA signals for driving readouts or sending to other plant system controls. Each of these analog outputs can be configured to be driven by one of the functions shown below. Each of these outputs is configured from a menu on the Analog Output page of the Toolkit tool, which also includes the signal range and gain and offset handles for signal calibration.

Menu Item	Function
1	Actual PT Speed Readout
2	PT Speed Reference Readout
3	EGT Average Temp Readout
4	Liquid Fuel Valve Demand Readout
5	MW Load Readout
6	Total Fuel Demand % Readout
7	Gas Fuel Valve Demand Readout
8	CDP - Compressor Discharge Pressure Readout
9	GG Speed Reference Readout
10	Actual GG Speed Readout
11	NOX Valve Demand Readout
12	VG Postiion Demand Readout
13	TBD
14	Output driven from Modbus
15	TBD
16	TBD
17	TBD
18	TBD
19	TBD
20	TBD

Table 3-3. Analog Output Functions Menu

AO Function Descriptions

Each of these outputs is self explanatory from the descriptions above, with the exception of menu selection 14.

Output Driven from Modbus—When this selection is used the analog output will send out a 4–20 mA signal proportional to the Modbus analog value sent from the sequencer to the fuel control via Modbus as per the following list.

- Analog Output #1 – AW Address 21
- Analog Output #2 – AW Address 22
- Analog Output #3 – AW Address 23
- Analog Output #4 – AW Address 24
- Analog Output #5 – AW Address 25
- Analog Output #6 – AW Address 26

Discrete Relay Driver Outputs

Twelve relay driver outputs are available from the Atlas-II I/O. These signals are used to indicate the function or status of the control or turbine. The first output for the SHUTDOWN relay is fixed. The SHUTDOWN output can be configured to be energized or de-energized when a shutdown is present. The other 11 signal outputs are configurable and are defaulted to energize when the condition shown is reached.

Menu Item	Function
1	SHUTDOWN Summary
2	ALARM Summary
3	EGT Temp Switch #1
4	EGT Temp Switch #2
5	EGT Temp Switch #3
6	PT Speed Switch #1
7	PT Speed Switch #2
8	PT Speed Switch #3
9	PT Speed Reference at Lower Limit
10	Utility Breaker is OPEN (Unit in ISOCH)
11	GEN Breaker is CLOSED (Unit in Droop)
12	Summary HORN Output
13	GG Speed in Control
14	PT Speed in Control
15	EGT Temp in Control
16	Start Ramp in Control
17	MW Load in Control
18	GG Speed Switch #1
19	GG Speed Switch #2
20	GG Speed Switch #3
21	Running on Liquid Fuel (100%)
22	Running on Gas Fuel (100%)
23	Transferring Fuels
24	Sent from Modbus Command
25	NOX Reduction Enabled
26	Reset Output to Fuel Drivers
27	OPEN GEN Breaker Command
28	TBD
29	TBD
30	TBD

Table 3-4. Discrete Relay Output Functions Menu

DO Function Descriptions

Shutdown Summary—Indicates the Fuel Control has a Shutdown present.

Alarm Summary—Indicates the Fuel Control has a Alarm present.

EGT Temp Switch #1—Energizes when EGT temp exceeds Switch #1 Setpoint.

EGT Temp Switch #2—Energizes when EGT temp exceeds Switch #2 Setpoint.

EGT Temp Switch #3—Energizes when EGT temp exceeds Switch #3 Setpoint.

PT Speed Switch #1—Energizes when PT speed exceeds Switch #1 Setpoint.

PT Speed Switch #2—Energizes when PT speed exceeds Switch #2 Setpoint.

PT Speed Switch #3—Energizes when PT speed exceeds Switch #3 Setpoint.

PT Speed Reference at Lower Limit—Energizes when PT speed reference setpoint is at the lower limit of the ramp (typically used as a start permissive for the sequencer.

Utility Breaker is OPEN (Unit in ISOCH)—Energizes when Utility grid breaker is Open – indicating unit is in Isochronous mode.

Generator Breaker is CLOSED (Unit in DROOP)—Energizes when Generator breaker is Closed – indicating unit is in Droop mode.

Summary Horn Output—Energizes whenever an alarm or shutdown event takes place. An acknowledge will clear this input – it will retrigger on each new event.

GG Speed in Control—Energizes when GG speed PID is controlling the fuel demand.

PT Speed in Control—Energizes when PT speed PID is controlling the fuel demand.

EGT Temp in Control—Energizes when EGT temperature PID is controlling/limiting the fuel demand.

Start Ramp in Control—Energizes when Start Ramp is controlling the fuel demand.

MW Load in Control—Energizes when MW Load control is active and controlling the fuel demand.

GG Speed Switch #1—Energizes when GG speed exceeds Switch #1 Setpoint.

GG Speed Switch #2—Energizes when GG speed exceeds Switch #2 Setpoint.

GG Speed Switch #3—Energizes when GG speed exceeds Switch #3 Setpoint.

Running on 100% Liquid Fuel—Energizes when turbine is running on Liquid Fuel.

Running on 100% Gas Fuel—Energizes when turbine is running on Gas Fuel.

Transferring Fuels—Energizes when control is performing a Fuel transfer.

Sent from Modbus Command—This output will energize on a command sent via Modbus by the user and thus can be used to send out a condition not on this menu list. Discrete output relay #2 is driven from BW 63, output #3 is driven from BW 64 and so on – up to output #12 which is driven by BW 73.

NOX Reduction Enabled—Energizes when NOX reduction function is enabled and active.

Reset Output to Fuel Drivers—Energizes whenever a Reset of a Shutdown condition is sent to the control. This is typically sent to remote fuel drivers, fuel valves or remote NOX or VG drivers.

Open GEN Breaker Command—Energizes when the control is attempting to Trip the Generator Breaker – the user can configure 'Soft' Shutdowns to either go to minimum load (default) or issue an Open Breaker command via this output option.

Software Interface Tools Setup

Apply Power to the GTC250A_FC

At power-up, the GTC250A_FC runs through its boot-up routine and performs a set of initial diagnostics to verify CPU, memory, I/O initialization, and bus health. This boot-up routine takes approximately a minute to execute. During this time, the control's green run and red status LEDs on the CPU and I/O modules should be on. When boot-up is complete, the application program code begins running, the control outputs will be enabled, and system control will begin—the control's red status LEDs will turn off and should remain off as long as the control is running.

Install Woodward Software Tools

- AppManager (2.7 or higher)
- ToolKit (2.3 or higher)
- Control Assistant (3.7 or higher)
- NetSim™ Control Executive Basic License (optional add-on)

Woodward's AppManager, Control Assistant and ToolKit programs may be downloaded at no cost from the Woodward website (**www.woodward.com/ic/software**). As an alternative, an Install version of these software tools are included on the System documentation CD that came with the control.

Connect PC to GTC250A_FC

The connection of a computer is required for calibration and setup of the GTC250A_FC. The computer and service interface software program are not required or necessary for normal operation of the control. You will need to connect a standard Ethernet cable between the Ethernet port # 1 of the Atlas-II A5200 CPU module on the GTC250A_FC and a user PC per the control wiring diagram (Appendix A - 9971-1307). For information on the cable or communication port settings, see the troubleshooting section of this manual.

AppManager (2.7 or higher)

Application Manager is a tool that allows users to do the following:

- Change the IP address of the control
- Connect the control time to a system network clock
- Transfer application or datalog files to or from the control
- Start or Stop the GAP application that the control is running
- Install Operating System Service Packs

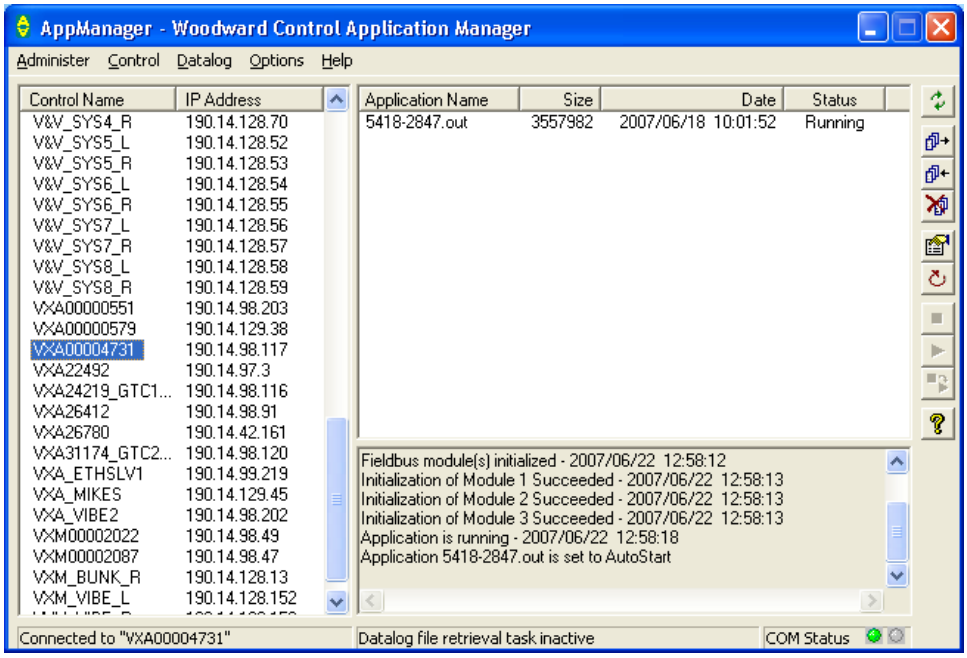


Figure 3-1. AppManager Tool

Initiating Ethernet Communications with the Control

Each GTC250A_FC ships from Woodward with a default IP address of **172.16.100.20.** This means that the user must initially connect directly to the control with a PC that has had its IP changed to an address that is on this same first three octets within the subnet mask (for example 172.16.100.21). Once the connecting PC is configured like this, the user will see the control on the left side of the AppManager window.

Changing the IP address of the Control

It is usually desirable to change the fixed IP to an address available on the user's plant network, thus placing the control on the plant LAN. This is done via the AppManager program (available from **www.woodward.com**). The user can change the control IP to any available IP on the plants local network. The GTC250A_FC can also be set up to receive an IP automatically from a DNS or DHCP.

IMPORTANT **This is done from AppManager via the "Change Network Settings" under the Control pull down menu in the menu bar.**

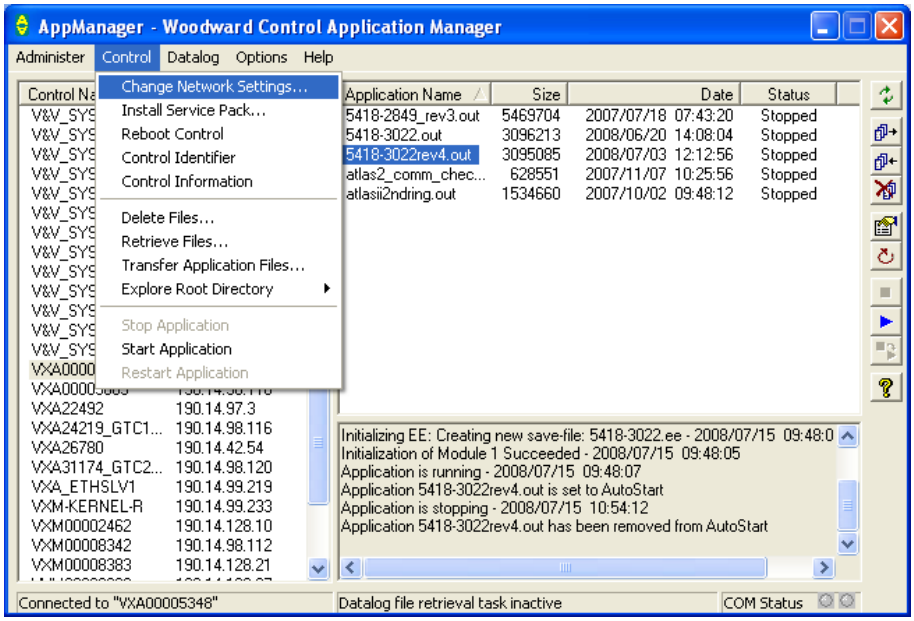


Figure 3-2. Change Network Settings

Synchronizing the Control Real Time Clock

If its desired to synchronize the fuel control clock with a network system clock, this can be done via AppManager as well. To do this:

1. Stop the current application running on the control
2. Go to the change network settings screen (see section above)\
3. Check the SNTP enable box and enter the IP address of the server to be used for synchronization.
4. Set the desire update (re-synch) rate
5. Control will need to reboot, when complete, restart the application.
6. In the control configuration – set the Time Zone Offset (relative to GMT)

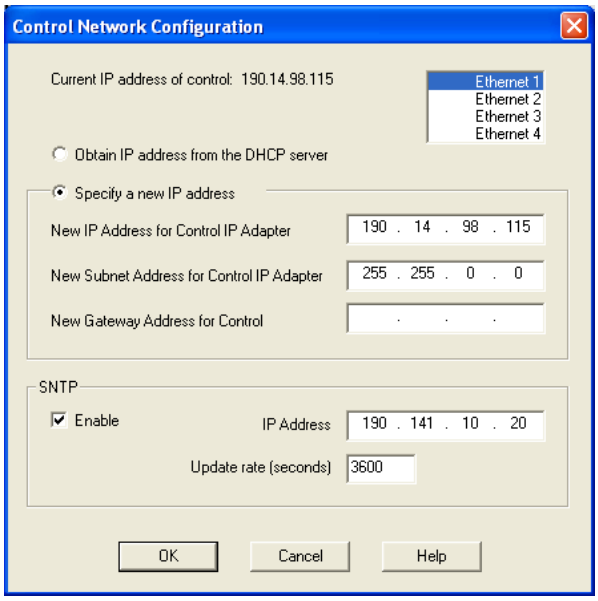


Figure 3-3. Synchronization with System clock

ToolKit (Woodward Service Program – version 2.3 or higher)

ToolKit is the primary service interface tool needed to configure the control. The software setup for the GTC250A_FC begins with the Software Configuration & Service Worksheet in Appendix E of this manual. When the worksheet is completed, the values are then entered into the control via the ToolKit graphical interface programming tool.

Details on installing and using this tool are highlighted in the next Chapter.

Control Assistant (3.7 or higher)

Control Assistant is a tool that allows users to do the following:

- View program / block values in the control
- Manage the tunable/configuration settings in the control (upload/download these values)
- View Datalog files (high speed data at 10 ms intervals)
- View and Setup live trend scripts of values in the control (License may be required)

The GTC250A_FC is programmed to interface with this tool via an Ethernet connection from port 1 of the control to a user PC via the Woodward ServLink to OPC Server (SOS) communication utility. SOS is included in the Control Assistant installation and will launch automatically when needed.

WinPanel (Tool within Control Assistant)

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

The WinPanel tool within Control Assistant permits you to talk to the GTC250A_FC via the Ethernet port on the CPU. You can use WinPanel to monitor values, read fault messages, or issue instructions to the GTC250A_FC System. The WinPanel tool runs on a laptop or desktop PC and utilizes standard Windows dialog boxes and Explorer windows to allow the user to create ‘Inspector’ files of any fields available in the application software.

Initial GTC250A_FC Communications
Before communications can begin between the WinPanel program and a control, a service interface definition file must be created. Once this network definition file is created and saved, it never has to be recreated, unless a new program is loaded into the control.

To create a service interface definition file:

1. Open the Control Assistant program and click on the WinPanel icon .
2. The following prompt will open – **enter the password 1112** and select OK.

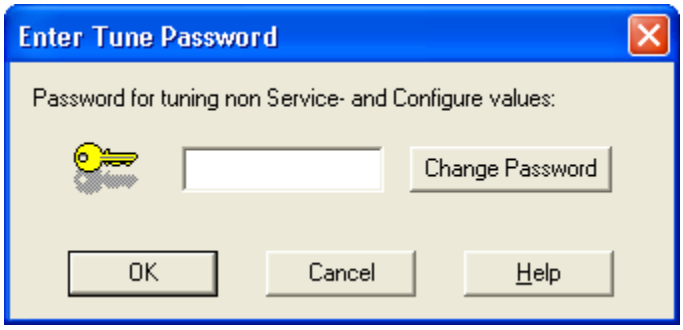


Figure 3-4. Initial WinPanel screen

At this point the tool will prompt you for the type of OPC connection you desire.

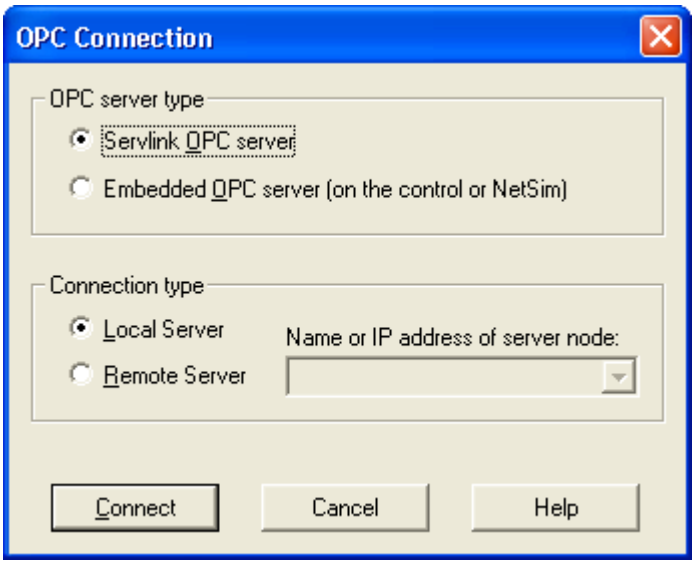


Figure 3-5. OPC Connection screen

Select ServLink OPC server and Local Server and select Connect.

IMPORTANT **If you are using the NetSim simulation package to pre-configure the control, then chose the Embedded OPC / Local Server options in this dialog box.**

At this point the SOS utility will launch. Initially it will not know where to connect to the control, so from the dialog box below select Session / New.

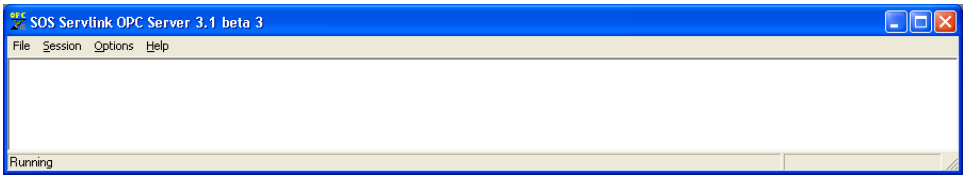


Figure 3-6. Initial SOS screen

and the following dialog box will open.

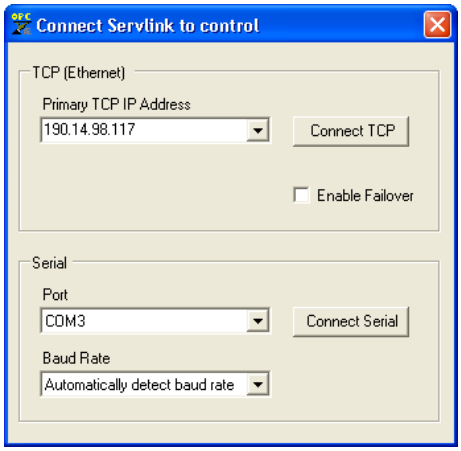


Figure 3-7. Ethernet Link IP address

Enter the correct TCP IP address of your control and click on Connect TCP and the OPC Server program will establish control communications, begin reading all control setting registers, and create a lookup table for these registers to expedite future control communications. Upon reading register location information from the control, the following Windows pop-up box will appear. (This step can take up to a minute to complete.)

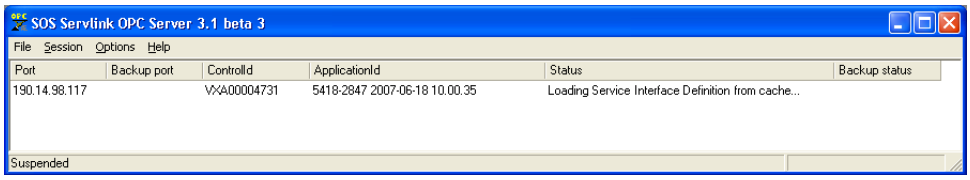


Figure 3-8. Reading Control Information

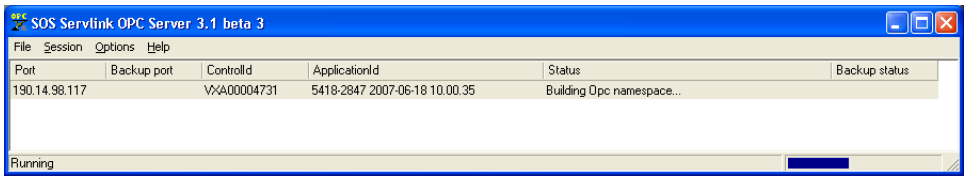


Figure 3-9. Building Control Information

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

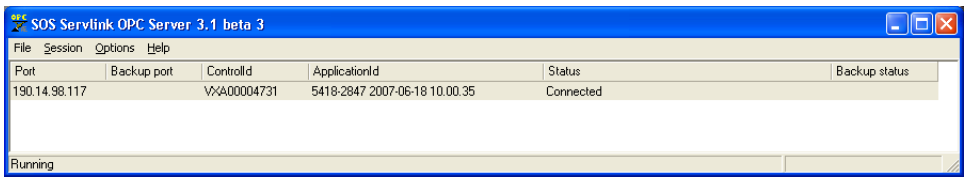


Figure 3-10. Connection to Control Established

Start WinPanel Software

At this point, the WinPanel software program will open its interface environment that looks like this:

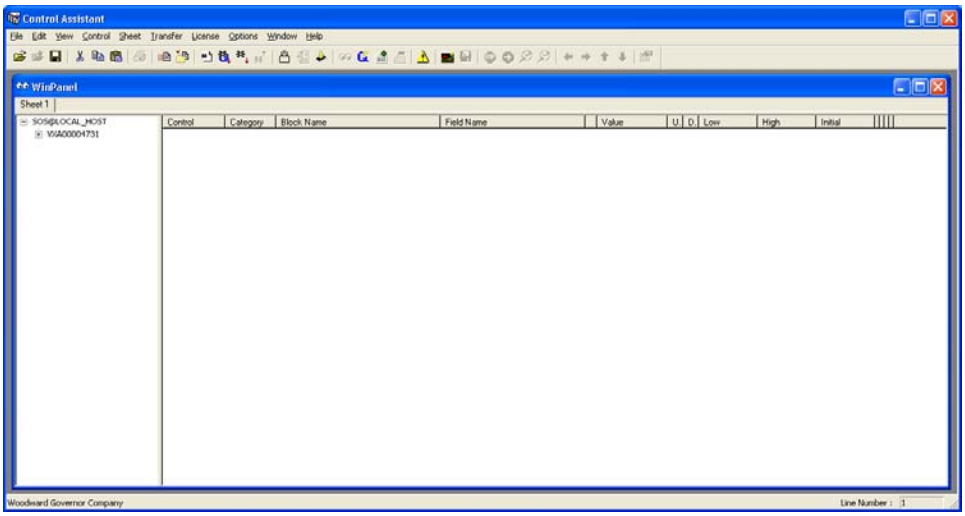


Figure 3-11. WinPanel Menu and Explorer

The WinPanel Menu bar, Explorer and Inspector will appear as shown above.

Once communications with the control is established, WinPanel performs many functions, not all of which will be explained here. The primary functions for the GTC250A_FC are discussed below.

Monitoring and Tuning of Control Variables

WinPanel presents variables in a tabular format. The user chooses the variables to view. Multiple pages of variables can be created, each with useful parameters for various troubleshooting or tuning procedures. The user can toggle between pages depending on the task being performed.

Tunable Upload/Download Function

The TUNABLE UPLOAD & DOWNLOAD functionality is used for downloading or uploading tunables into or out of the control. The tunables may be downloaded from the control to a PC anytime, however the turbine must be shutdown while using the TUNABLE UPLOAD FUNCTION mode.

Saving Control Tunables to a File (From control to PC)
From Control Assistant use the **Transfer** pull-down menu and select the **Receive Debug Tunable List** selection, or click on the  icon.

This will allow you to Save all settings to File.

Loading Control Tunables to the Control (From file on PC to the Control)
Loading tunables into the control will cause the unit to Lock the I/O and shutdown the turbine.

NOTICE

Entering into I/O Lock mode while the turbine is running will cause an automatic shutdown of the turbine with resulting process stoppage. Do not enter the I/O Lock to upload tunables into the control while the turbine is running.

From Control Assistant use the **Control** pull-down menu and select the **Lock IO** selection, or click on the  icon. You will be prompted with a warning that the control will enter a shutdown state, if OK select YES.

Use the **File** pull-down menu and select **Open** and open the tunable file that is to be loaded into the control.

Use the **Transfer** pull-down menu and select the **Send Tunable List** or click on the  icon. Once loaded you will be prompted to save tunables on control to non-volatile memory – select YES.

Close the tunable window or just select the WinPanel window to make it active – this will allow you to reset the control via either the **Control / Reset** pull down menu or by selecting the  icon. You will be shown a Reset Control dialog box to confirm you have read the warnings – check this box and select **RESET.**

The control will now have returned to Run condition.

A complete list of tunables can be found in Appendix B.

IMPORTANT

It is highly recommended that the user keep a current tunable list file available at site. This will make the configuration and setup of a spare unit very simple.

View a Datalog File Function

Any Datalog file that is captured on the control can be retrieved with AppManager and can then be interrogated using Control Assistant

Use the **File** pull-down menu and select **Open** and open the datalog file.

Live Trending or Viewing a Trend Buffer File Function

With WinPanel open the user can select the File / New Trend pull down or the  icon to select parameters in the control to graph on a live trend window. The user can also open pre-defined or saved Trend script files that will assist in commissioning (especially PID loop tuning) and troubleshooting the system. Check the system documentation CD for examples of these.

Other useful functions include:

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

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

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

 This icon open a view into the Annunciation of Events (AEView) window. This dialog box will display information generated by the Alarm & Shutdown Events logic showing the sequence of events, time stamping of the event occurrence, source of event (s/w trigger) and a descriptive text message of the event. (Category and Severity are not used in this application).

 Use this to save WinPanel inspector windows or Trend script files.

NetSim Control Executive (8.6 or higher)

This program is a simulation tool. A DEMO NetSim package comes with the control that allows the user to simulate the software tools that will interface to the control hardware. This enables the user to pre-configure the unit off-line or at an alternate location than the jobsite.

The purchasing of the optional NetSim Control Executive Basic package allows users to also do the following:

- Control the Time Clock – start/stop time as a debugging tool
- Force the I/O of the control and the turbine model

Chapter 4.
Configuration and Service Setup Procedures

Introduction

This chapter contains information on control configurations, setting adjustments, and the use of Woodward's ToolKit software tool. Because of the variety of installations, system and component tolerances, the GTC250A_FC 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 over speeding prime mover, read this entire procedure before starting the prime mover.

The worksheet in the Appendices of this manual should be used to select the values used in the tunable blocks of the GAP™ program for the GTC250A_FC application. On the lines provided, enter the values used for your control. Once the worksheet is completed, launch the ToolKit tool as described in the previous section and connect to the control or the NetSim simulation control. Using the worksheet, tune each field to the value you require for your application. Use a separate worksheet for each control when more than one control is used at each site.

IMPORTANT

It is strongly recommended to complete the Configuration Worksheet in Appendix D and use it along with this chapter in setting up the control via the ToolKit tool file.

This should be done at initial installation to establish the correct turbine package configuration details for correct operation of the fuel control. The turbine must be shut down (in a non-running state) during control set-up to tune or adjust any of the parameters on the Configuration sheets. This is not required to adjust or tune any parameters in the Service sheets.

ToolKit Layout

The initial page of the ToolKit is a Navigation page that is intended to guide the user through the correct sequence of configuration steps to setup the control.

The user may also use the Blue Page forward/back buttons  in the ToolKit toolbar or jump directly to a page using the pull-down list of page descriptions.

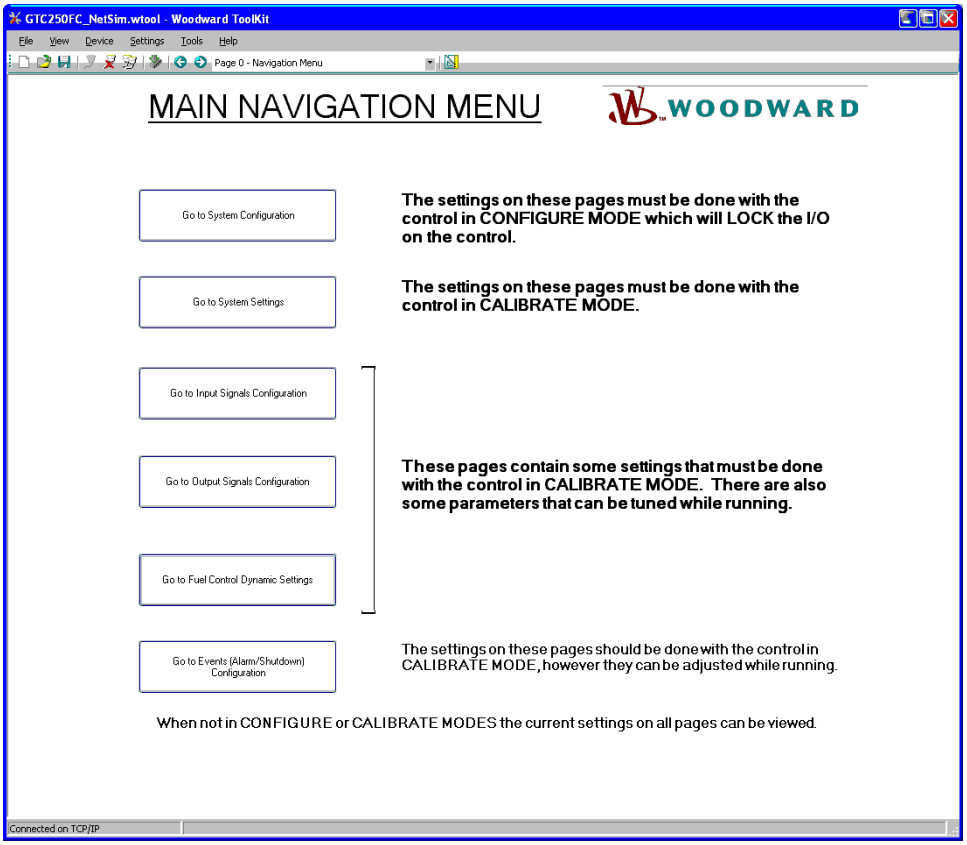


Figure 4-1. ToolKit Tool Navigation Menu page

IMPORTANT

As the configuration is completed, following pages will reveal more or less data depending on the choices made by the user. For example, if the unit is to be gas fuel only, then the liquid fuel options will be switched out or if 8 individual T/C's are to be used for EGT then only the first 8 T/C channels are revealed.

The ToolKit tool has approximately 40 pages of screens to guide the user through configuring the GTC250A_FC control. Generally the information needed to configure the control can be grouped into these descriptions and the page layout follows this order.

1. System Configuration
2. System Settings
3. Input Signal Configuration
4. Output Signal Configuration
5. Fuel Control Dynamic Settings
6. Events (Alarm/Shutdown) Configuration

System Configuration

These pages should be completed first as they define overall functionality definition and set parameters that some blocks only read on system initialization.

- **CALIBRATION Mode** – Permissible when a Hard Shutdown exists OR No Start/Run Command is Present. Enter this mode by using the check box. In this mode, most of the configuration selections can be made.
- **CONFIGURATION Mode** – Once in Calibration Mode, user can enter this mode by using the check box. This will LOCK the Control I/O

System Settings
These pages should be done next as this is where the desired options and functions are configured

Input Signal Configuration
These pages allow the user to configure the input channel assignments of all the signals required to perform the functions for which the control has been configured. For analog signals it includes range setting and calibration tunables of gain, offset and filtering (lag) of the input signal.

Output Signal Configuration
These pages allow the user to configure the output channel assignments of all the signals required to perform the functions for which the control has been configured. For analog signals it includes range setting and calibration tunables of gain and offset of the output signal.

Events (Alarm/Shutdown) Configuration
These pages allow the user to define which Alarm and Shutdown events are active in the control. It is the users responsibility to insure that careful review and consideration is given to the setting of all of these events. Critical items have been defaulted as Shutdowns and are recommended to not be changed.

Fuel Control Dynamic Settings
These pages are to be used once the other sections are completed. They allow the user to define specific settings for the control loops. Items such as ramp rates, PID dynamic settings, curve/schedule definitions, fuel transfer rates and NOX and VG operational settings.

Page Appearance

Many toolkit pages utilize switchable panels to allow parameter tuning only when the user is in the correct mode, for example unit running versus shutdown or Calibration mode. The view may also change based upon what options the user has selected.

For example the first System Configuration Page looks like this during run mode.

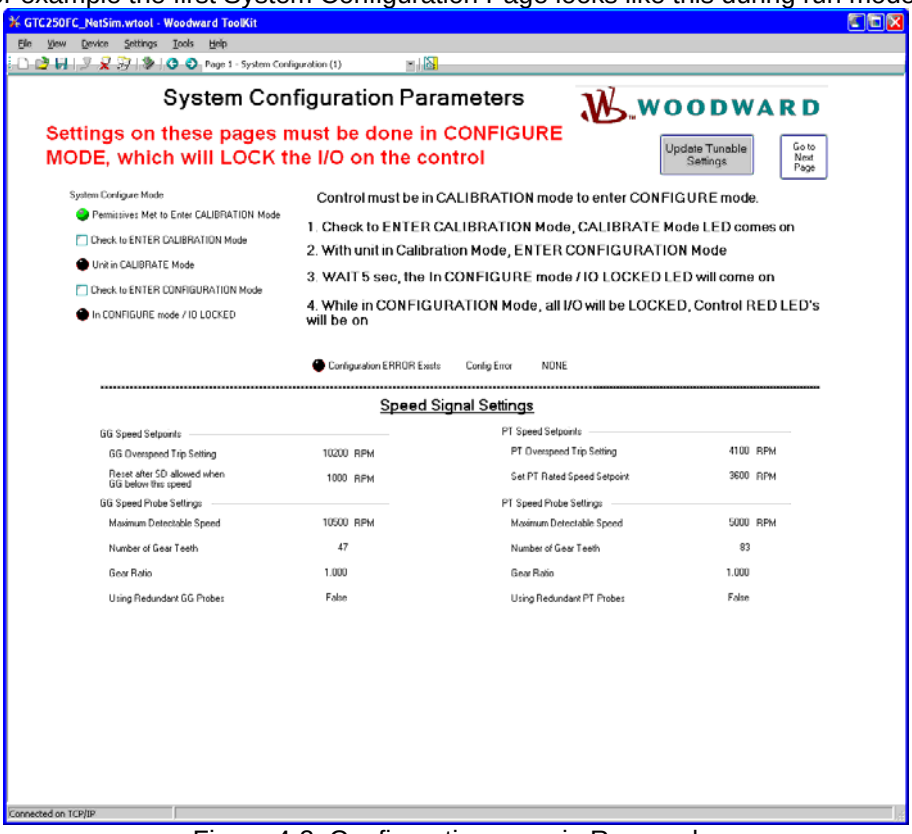


Figure 4-2. Configuration page in Run mode

Once the user enters Configuration Mode the page looks like this.

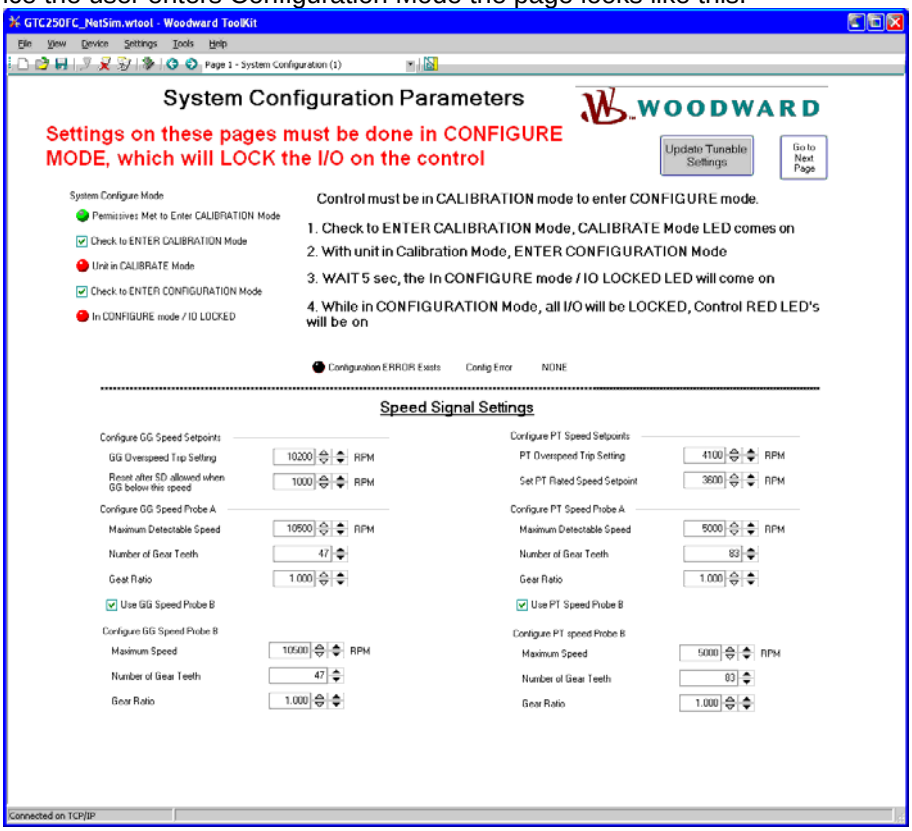


Figure 4-3. Configuration page in Configure mode

List of ToolKit Pages

Page 0	Navigation Menu Page
Page 1	System Configuration
Page 2	System Configuration
Page 3	System Configuration
Page 4	System Settings
Page 5	System Settings
Page 6	System Settings
Page 7	Discrete Inputs 1-16
Page 8	Discrete Inputs 17-24
Page 9	Analog Inputs 1-2
Page 10	Analog Inputs 3-4
Page 11	Analog Inputs 5-6
Page 12	Analog Inputs 7-8
Page 13	T/C Inputs 1-4
Page 14	T/C Inputs 5-8
Page 15	T/C Inputs 9-11
Page 16	RTD Inputs 1-2
Page 17	Gas Fuel Actuator
Page 18	Gas Fuel Actuator
Page 19	Discrete Output Relays 1-6
Page 20	Discrete Output Relays 7-12
Page 21	Analog Outputs 1-4
Page 22	Analog Outputs 5-6
Page 23	MODBUS Communications
Page 24	MODBUS Communications
Page 25	HW Summary - MAIN Board
Page 26	HW Summary - Analog Combo Board
Page 27	GG Speed Control
Page 28	PT Speed Control
Page 29	MW/Load Control
Page 30	CDP & EGT Topping Controls/Limiters
Page 31	Acceleration Control/Limiter
Page 32	Deceleration Control/Limiter
Page 33	Fuel Demand Logic
Page 34	Fuel Transfer Logic
Page 35	NOX Water Injection
Page 36	Variable Geometry Settings
Page 37	Event List (1-40)
Page 38	Event List (41-80)
Page 39	Event List (81-100)

IMPORTANT

For specific information as to the settings available on each of the above sheets the user should refer to Appendix D. Appendix D is intended to guide the user in configuring the control and should be completed first.

Fuel Control Functional Options

Start Modes

This control contains options for start control, which is the initial control mode for the fuel. These options are intended to provide a consistent acceleration of the turbine, from turbine 'lite-off' up to closed loop GG speed control. Once the fuel control has reached GG control, the start mode demand signal is ramped out of the way (to 100%). The default option is to have the unit transition from Start Ramp to up to GG Speed control at the GG Idle (Lower limit) setpoint. For more aggressive ramp-up times of the turbine the user can increase the start ramp rate or enable the GG Derivative Control (Accel schedule) during start. For less aggressive ramp-ups, the start ramp rate can be reduced, or the EGT Temp controlled start ramp option can be enabled.

Once the Start Ramp Enabled discrete input contact is closed (TRUE), the fuel control will initiate a start. This contact is NOT a latched input, meaning that it must be held TRUE to activate fuel (hold closed versus momentary). If this signal is lost or drops out, the fuel control chops fuel demand to the MIN Fuel Demand position. To achieve successful turbine 'lite-off', the unit must have been set up for either a Mechanical Lite-off or an Electrical Lite-off.

IMPORTANT **For information on setting correct Fuel Flow for lite-off, see the Troubleshooting section.**

Mechanical Lite-off = Minimum Valve position mechanically set to yield correct lite-off fuel flow. If this is used configure the MIN_FUEL position to Zero (0.0).

Electrical Lite-off = Minimum Valve position is set in software (MIN_FUEL) to yield correct valve demand position to yield lite-off fuel flow. If this is used then mechanically the valve should have the min stop set to zero degrees.

Start Ramp Control Start

The initial increase of fuel valve position is accomplished by a ramp of the Start Ramp from the initial MIN_FUEL position to a point at which a speed loop takes over control of the fuel valve demand. The ramp will increase at the default rate, which is configurable. The start ramp provides a user-defined increase in fuel valve demand and a corresponding acceleration of the turbine until another input of the LSS takes control. If the rate of increase of the ramp becomes too high, other active controls may take over control of fuel demand (GG Derivative control, EGT Start Temp or Accel/CDP curve) or the unit may hit a protective setting on over temperature.

Parameters to use this are found on the SYSTEM SETUP PARAMETERS page.

CDP/Fuel Flow Limiter Curve

The GTC250A_FC requires that the user configure a fuel limiter curve based on the compressor discharge pressure of the turbine. The CDP/Fuel Schedule biases on CDP (as the X value) as scaled by the user. The output of the curves block (Y value) limits the LSS bus in scale of 0-100% (that is, if output is 50 for a given input, then fuel flow will not be able to increase above 50%). There are separate curves for gas and liquid fuel—if the turbine is a single fuel, unit then the unused fuel curve should have all Y values set to 100%.

To calculate the correct X and Y values for this curve, one of the following methods should be used.

- Turbine OEMs typically define a curve of Compressor Discharge Pressure vs. Fuel (in BTU/hr) in the control or installation manuals for the turbine. The user should get the heating value of the fuel used at their installation site and translate this curve into a CDP vs. Fuel Flow curve. The user should then plot their fuel valve flow output (in pph) versus demanded position (%) and create an appropriate CDP vs Fuel Valve demand curve. Further information of the creation of this curve can be found in the Troubleshooting section.
- The user could record data from their unit while it is currently running and generate a CDP vs Fuel Valve demand curve. The Appendices of this manual contain a sheet to assist in this effort.

The CDP versus Fuel Flow curve limits the Accel PID from over-demanding fuel if the turbine does not accelerate. This mode is typically used jointly with the start ramp to provide control protection during the start ramp control period. If the turbine CDP fails to increase as the start ramp increases demand, this curve will limit the fuel demand and result in a stagnation or failed to start condition that the sequencer can annunciate to the operator.
This limiter utilizes a curve that allows the fuel valve demand to increase as the CDP pressure increases. Many older fuel systems used this type of start schedule performed mechanically within the fuel valve or fuel governor.

Parameters to use this are found on the ACCELERATION CONTROL page.

GG Derivative Control Start

This start mode is available to provide a closed loop start mode that controls the acceleration of the turbine from lite-off to GG speed control. This mode provides a PID control to raise the GG speed at a defined acceleration rate of the GG speed signal. The rate for acceleration is defined by the output of the GG speed derivative curve which starts at 75 rpm/s. This control loop steadily increases fuel demand until a point at which a speed loop takes over control. The advantage of this mode is that it is closed loop around a parameter, while the start ramp mode simply opens the fuel valve with no feedback on what is happening. The start ramp default rate (tunable) should be set to be high enough to just stay ahead (greater than) the demand from this PID. The CDP versus Fuel Flow curve limits the Accel PID from over-demanding fuel if the turbine does not accelerate.

Parameters to use this are found on the ACCELERATION CONTROL page.

EGT Temp Ramp Control Start

After the initial increase of fuel valve position is accomplished by the start ramp, the EGT PID can be used to bring the unit up to a point at which a speed loop takes over control of the fuel valve demand (usually GG Speed control). The temp ramp contains two user defined setpoints and a ramp rate (in °F/s). The temp ramp starts at the Lower temp setpoint until 'Lite-off' is detected. The ramp then ramps up to the High temp setpoint at the user defined rate. This option is useful if a unit is experiencing overtemps during start-ups or the user desires to avoid high temps at sub-idle conditions. If the rate of increase of the ramp becomes too high, other active controls may take over control of fuel demand.

Parameters to use this are found on the EGT TEMP CONTROL page.

Event Annunciation and Sequence Actions

The user should use Appendix A to configure the alarm and shutdown events that he wants to activate in his control. The most critical items that should be active to Trip/Shutdown the unit are defaulted to be active as Shutdowns. The user should carefully review each item on the list to identify which ones to activate and also identify the appropriate action sequence as defined below.

Each of these events is annunciated by sending the information about the specific cause of the alarm out through the Modbus block as a discrete trigger (per each event) or as a numeric alarm value that corresponds to the numbered alarms found in the Appendices of this manual. . The customer can also view the event cause by using Control Assistant and selecting the Annunciation of Events icon.

Alarm Sequence (Action = 2)

When the fuel control detects an alarm condition, it activates a summary alarm relay output and horn annunciation output. An acknowledge command will turn off the Horn output. A reset command will clear the alarm, if the condition that initiated it no longer exists.

Parameters for this are found on the EVENT LIST pages.

Soft Shutdown Sequence (Action = 3)

When a soft shutdown occurs, the control will ramp the load back (at the Unload rate programmed) to the minimum load setpoint and await for operator action. The fuel control can activate a summary soft shutdown relay output. An acknowledge command will turn off the Horn output. A reset will only clear the shutdown if the condition that initiated it no longer exists.

Parameters for this are found on the EVENT LIST pages.
(The Unload Rate is programmed on the MW LOAD CONTROL page)

Hard Shutdown Sequence (Action = 4)

When a hard shutdown occurs, either a fuel control initiated event or the discrete contact shutdown input, all of the actuator signals go to zero and the turbine shuts down. The fuel control will activate a summary shutdown relay output. An acknowledge command will turn off the Horn output. A reset will only clear the shutdown if the condition that initiated it no longer exists AND the GG speed has dropped below the user defined speed setpoint (defaulted to 1000 rpm).

Parameters for this are found on the EVENT LIST pages.

NO_X Water Injection Setup

The control has the capability to control the turbine emissions through the modulation of a NO_x control valve. This logic provides a 4–20 mA output that is designed to be the demand signal to a driver for positioning of a water injection valve. The algorithm for calculating the water demand signal is basically a ratio of fuel to water. A tunable curve schedule block that outputs the fuel flow (in pph) based on fuel valve demand position **must be set up first**. The output of this block yields the calculated fuel flow, and is used to determine the correct water flow demand. The output side (Y-values) of this curve block is all tunable values to be configured by the user. There are separate schedule curves for gas and liquid fuel. The NOX water demand will equal this curve output multiplied by the ratio value set by the user (default = 1.0). There are also raise and lower inputs into the final position demand ramp to adjust the entire NO_x demand from the base ratio schedule. It contains tunable ramp rates for adjusting how quickly water is ramped in or out once it is enabled/disabled (default = 0.0666 which yields a 15 second timeframe), and a default rate (default = 0.01) for the raise/lower bias commands. The bias commands have +/- 20% authority on the nominal ratio/curve schedule.

Parameters for this are found on the NOX WATER INJECTION page.

Variable Geometry Logic Setup

The control has the capability to control a turbine's variable geometry stage through the modulation of a VG control valve. This logic provides a 4–20 mA output that is designed to be the demand signal to a driver for positioning of an actuator that will modulate the VG valve(s). The demand output for the VG position is configured by entering the position % outputs of a curve that uses the corrected GG speed for the input forcing function of the curve. There are options for the user to configure either a 2-dimensional or a 3-dimensional curve to determine the correct VG demand output. The 3-D option is actual 2 series of X-Y curves that is biased by a third parameter (Compressor Inlet Temp). The curve is configured with the first set of values at the lower CIT limit and a second set of values for the upper CIT limit. The curve will calculate the output based on both the X and the Bias inputs.

Parameters for this are found on the VARIABLE GEOMETRY LOGIC page.

Chapter 5.
Troubleshooting & Configuration Examples

Example #1

Setting up the PT Speed Control Loop

On the System Configuration Parameters Page

Required Signals

PT Speed Sensor Input (**Set Max Speed, Gear Teeth & Gear Ratio)**

- On the Configuration Parameters pages – setup the Maximum Detectable Speed, Number of Gear Teeth and Gear Ratio for the speed sensor. This is also where the Overspeed Trip and PT Rated Speed Setpoints are configured.
- In addition to the Configuration page data there are PT Speed and PT Reference settings to be completed on the System Setup Parameters pages. For the sensor. these parameters include the low/high signal range, spread for Speed difference alarm, PT Overspeed alarm setpoint and options for Auto overriding the failed signal indications at sub-Idle speeds. This is also where the Upper and Lower limits of the PT reference ramp are set, as well as the default and fast ramp rates.
- Configure the correct action for Events relating to these (**Events 001 through Event 006 and Event 075**) on the Event List pages **(Recommendation if all options used: 002 and 004 = Hard Shutdown and 001, 003, 005, 006, 075 = Alarm)**

On the I/O Configuration Pages

Required Signals

- Lower PT Speed Reference Input (**DI – Menu Option #9)**
- Raise PT Speed Reference Input (**DI – Menu Option #10)**

Optional Signals

- Redundant PT Speed Sensor Input **(in System Configuration)**
- Remote PT Reference Setpoint (**AI – Menu Option #2**)
- PT Speed Reference Fast Rate (**DI – Menu Option #11)**
- Override PT Sensor Faults (**DI – Menu Option #13)**
- Enable Remote PT Setpoint (**DI- Menu Option #15 / Modbus BW_15**)
- Go to PT Rated Speed Setpoint (**DI – Menu Option #23)**
- PT Speed Reference Instant Rate (**DI – Menu Option #29)**

On the PT Speed Control Page

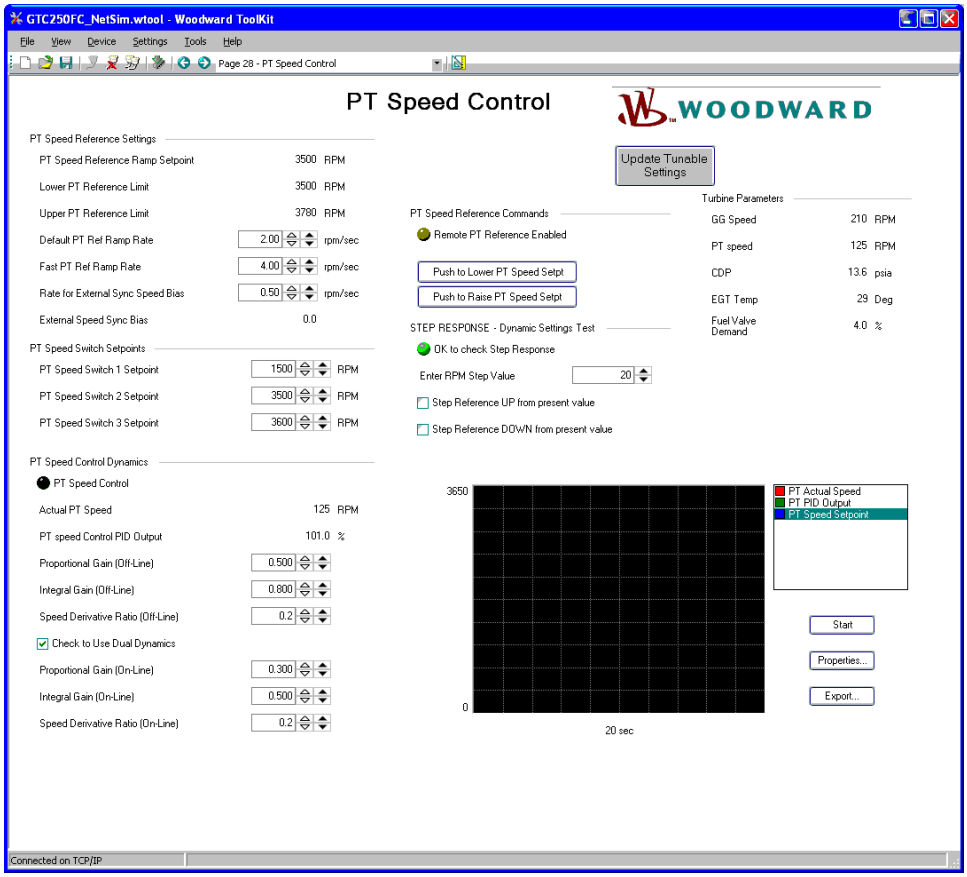


Figure 5-1. PT Control Page

Default PT Ref Ramp Rate - value
This allows the user to set the desired default rate (rpm/sec) at which the reference ramp will move when raise or lower commands are received. This default rate is used unless another rate is selected (Fast or Instant)

Fast PT Ref Ramp Rate - value
This allows the user to set the desired fast rate (rpm/sec) at which the reference ramp will move when raise or lower commands are received. To use this rate a discrete input signal to enable it must be triggered.

Rate for External Speed Sync Bias - value
This allows the user to set the adjustment rate of the analog speed sync bias signal that gets added to the rated speed setpoint to synchronize the generator.

PT Speed Switch 1 Setpoint - value
This allows the user to set the value of an analog software switch that will go TRUE when the PT Speed exceeds this value. The control does not need these for any control actions – they are optionally provided for the user to access as these can be configured to relay outputs.

PT Speed Switch 2 Setpoint - value
This allows the user to set the value of an analog software switch that will go TRUE when the PT Speed exceeds this value. The control does not need these for any control actions – they are optionally provided for the user to access as these can be configured to relay outputs

PT Speed Switch 3 Setpoint - value
This allows the user to set the value of an analog software switch that will go TRUE when the PT Speed exceeds this value. The control does not need these for any control actions – they are optionally provided for the user to access as these can be configured to relay outputs

For setting up of the PT Speed Control Dynamics – first be sure that the unit is in PT Speed control. Details of the procedure to tune the speed loop dynamics can be found later in this chapter.

Proportional Gain (Off-Line) - value
This is the adjustment of the proportional gain input to the PT Speed PID.

Integral Gain (Off-Line) - value
This is the adjustment of the integral gain input to the PT Speed PID.

Speed Derivative Ratio (Off-Line) - value
This is the adjustment of the derivative gain input to the PT Speed PID.

Check to use Dual Dynamics - checkbox
The control has the ability do use two different sets of dynamic adjustments so that response to disturbances can be handled differently dependent on the Generator breaker being open or closed (GEN applications only). The Off-Line Dynamics above will always be used initially (Off-Line = GEN Breaker OPEN). If this is selected, the On-Line dynamics will be used once the GEN breaker is closed.

Proportional Gain (On-Line) - value
This is the adjustment of the proportional gain input to the PT Speed PID.

Integral Gain (On-Line) - value
This is the adjustment of the integral gain input to the PT Speed PID.

Speed Derivative Ratio (On-Line) - value
This is the adjustment of the derivative gain input to the PT Speed PID.

PT Speed Reference Commands
These section indicates if the Remote reference is enabled or not, and allows the user to adjust the PT speed reference setpoint.

Remote PT Reference Enabled - display LED
This indicates to the user if the control is following a remote reference (AI) input – Yellow LED is ON, or if the unit is following the discrete input commands (LED is OFF)

Push to Lower PT Speed Setpt - Toggle button
This button allows the user to lower the setpoint. When pressed it indicates the reference is LOWERING. Select the button again to stop moving the reference. This function has a 10 sec limit after which it will cease to Lower the setpoint.

Push to Raise PT Speed Setpt - Toggle button
This button allows the user to raise the setpoint. When pressed it indicates the reference is RAISING. Select the button again to stop moving the reference. This function has a 10 sec limit after which it will cease to Raise the setpoint.

STEP RESPONSE – Dynamic Settings Test
To assist the user in the setup of the PT speed loop PID dynamic settings, a function to allow the user to step the reference instantly in small steps has been provided.

OK to check Step Response - display
The Step Ref function is available any time that the GEN Breaker is Open.
A GREEN LED indicates that this functionality is available.
A RED LED indicates the function is disabled.

Enter RPM to Step Value - value
This is the rpm step that the Reference setpoint will take when either the UP or DOWN box gets checked. Initial steps should be small (20 rpm or less) until acceptable control response is witnessed. The upper limit for this value is 200.

Step Reference UP from present value - checkbox
When this box is checked the setpoint will instantly step UP the # of RPMs entered in the field above. This box then should be unchecked, which will not create any action in the control, but will re-arm the function.

Step Reference DOWN from present value - checkbox
When this box is checked the setpoint will instantly step DOWN the # of RPMs entered in the field above. This box then should be unchecked, which will not create any action in the control, but will re-arm the function.

This page also contains a ToolKit Trend graph to monitor the Speed, Reference, and PID Output of the PT Control loop. To begin trending press the Start button. All three parameters will be shown and the scale on the left of the graph will be shown for whichever item is highlighted in the graph color key. It will only trend while Toolkit remains on this page.

IMPORTANT

The Control Assistant Tool offers much more enhanced trending capability and is recommended to be used for actual PID tuning. Some Trend Script files (*.ts) are included on the System Documentation CD to assist users in this – reference the "PT_Control_Loop" file.

Example #2

Setting up MW Control or MW Limiting

On the I/O Configuration Pages

Required Signals

- MW Sensor Input (**AI – Menu Option #3)**
- Enable MW/Load Control (**DI- Menu Option #21 and/or Modbus BW_21**)

Optional Signals

- Remote MW Setpoint (AI – Menu Option #9 or Modbus AW_16)
- Enable Remote MW Setpoint (DI- Menu Option #22 / Modbus BW_22)

- On the configuration pages for Discrete and Analog Inputs select the required signals above from the menu choices and select other options if desired, program the correct signal ranges for the analog inputs
- Configure the correct action for Events relating to these (**Event 076** and **Event 082**) on the Event List pages **(Recommendation: Alarm)**

On the MW Load Control Page

For MW as a Controller the page will look like this:

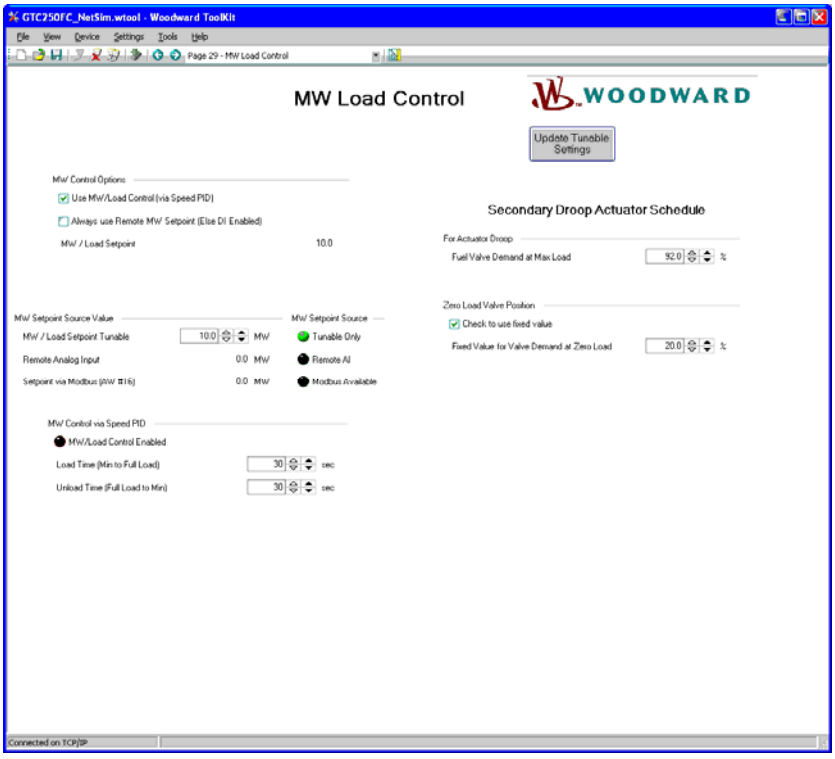


Figure 5-2. MW Load Control – Cascade controller

If MW is configured as a Topping Limiter PID then the page looks like this:

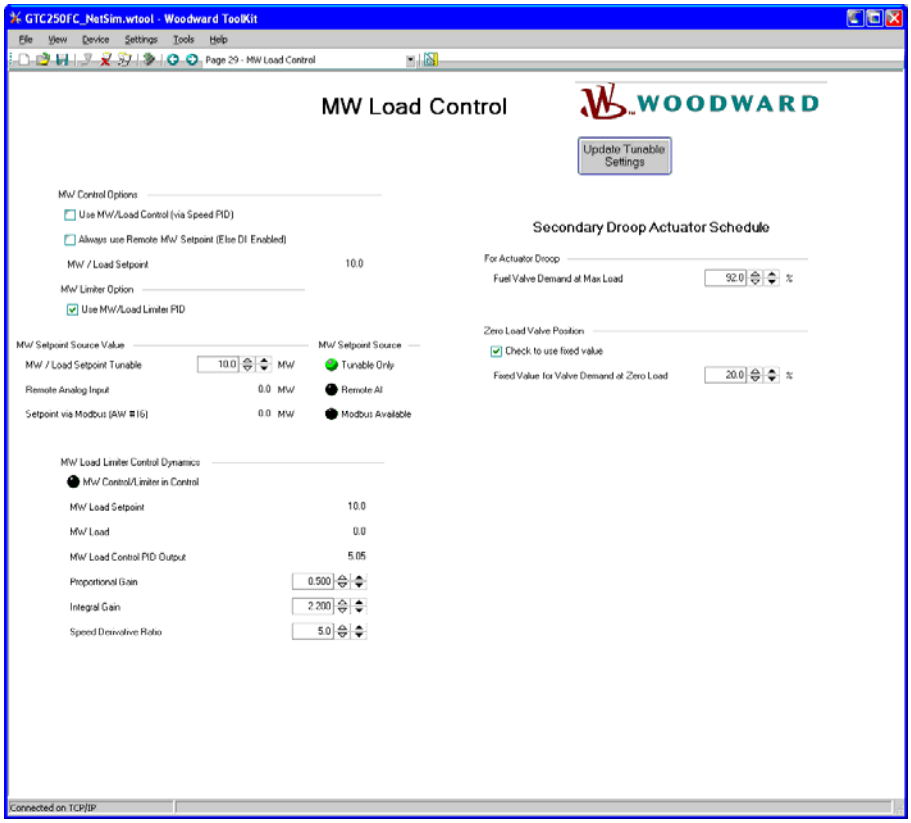


Figure 5-3. MW Load Control – PID Limiter

MW CONTROL OPTIONS

Use MW/Load Control (via Speed PID) – checkbox
Check this box if you want to actively control the MW to any setpoint value. No dynamic adjustments are needed since this setpoint is cascaded into the speed reference for the PT speed control regulator.
If selected:

- the control will respond to the Enable MW/Load Control command
- the MW Control via Speed PID box will appear.

If this is not checked then the MW Limiter Option box will be available.

Use MW/Load Limiter PID – checkbox
Check this box if you only want to limit the maximum output of the unit.
If selected:

- the limiter will be active, as long as the Enable MW/Load Control command is false. (**Recommendation: if only limiting desired do not configure a DI for Enable MW/Load Control)**
- the MW Load Limiter Control Dynamics box will appear.

Always use Remote MW Setpoint (Else DI Enabled) – checkbox
Check this box to always use the Remote MW Setpoint Analog input as the setpoint. If unchecked the control will use the fixed tunable setpoint until the remote MW setpoint is selected via the discrete input command

MW SETPOINT SOURCE VALUE

MW/Load Setpoint Tunable – value
Tune this valued to the desired MW setpoint value – this is value the setpoint will go to if the AI or Modbus value fails

Remote Analog Input - value
This displays the value of the AI programmed as the Remote MW setpoint

Setpoint via Modbus (AW #16) – value
This displays the value of the AI programmed as the Remote MW setpoint

MW CONTROL VIA SPEED PID (appears if Control Selected)

MW/Load Control Enabled – Indicator LED
LED is ON when MW Control is active (Controls fuel demand unless limited by other PIDs)

Load Time (Min to Full Load) – value (time in sec)
Set the desired loading time to ramp from minimum load to full load. This will determine the MW/Sec rate at which the MW Control will use to bring the unit up to the MW setpoint entered

Unload Time (Full Load to Min) – value (time in sec)
Set the desired loading time to ramp from full load to minimum load. This will determine the MW/Sec rate at which the MW Control will use to bring the unit down to the MW setpoint entered

MW LOAD LIMITER CONTROL DYNAMICS (appears if Limiter Selected)

MW Control/Limiter in Control – Indicator LED
LED is ON when this control is actively limiting the unit (the MW PID controls fuel demand)

MW Load Setpoint – value
Displays the active MW / Load setpoint value from the sources (above)

MW Load – value
Displays the present MW output of the unit

MW Load Control PID Output – value
Displays the present PID output of this PID

Proportional Gain – tunable value
Dynamic setting for Proportional error response of MW PID

Integral Gain – tunable value
Dynamic setting for Integral response of MW PID

Speed Derivative Ratio – tunable value
Dynamic setting for SDR response of MW PID

Dynamic Response Problems

PID Controller Tuning

The majority of problems associated with the control of the turbine can be attributed to poor tuning of the PID control loops. These problems include overspeeding, overtemping, and flaming out as well as many others. For example, if the turbine control is hunting, the loop that is currently controlling the fuel valve is most likely incorrectly tuned and could cause sufficient overshoot to overspeed or overtemp the turbine. Some general tuning guidelines are outlined below.

⚠WARNING

Tuning of PID loops should only be performed by qualified personnel that have a good understanding how the control should be performing. Improper tuning can result in overspeed or overtemp conditions, which could cause damage to the turbine or possible injury or death to personnel.

The quality of regulation obtained from an automatic control system depends upon the adjustments that are made to the various controller modes. Best results are obtained when the adjustment (tuning) is done systematically. Prior training and experience in controller tuning are desirable for effective application of this procedure.

This procedure will lead to controller settings, which, after a load change, will provide:

- Process control without sustained cycling
- Process recovery in a minimum time

Controller settings derived for given operating conditions are valid over a narrow range of load change. The settings made for one operating set of conditions may result in excessive cycling or highly damped response at some other operating condition. This procedure should be applied under the most difficult operating conditions to assure conservative settings over the normal operating range.

There are several methods of controller tuning in use. The following procedure presents one which will be easy to use, and at the same time minimize process upset. This method is one of systematic trial and error.

The method given is based upon the 1/4-ratio decay cycle. The peak of each cycle is 1/4 of the preceding one. The objective is to produce a trace as shown in Figure 5-1.

It is good practice to keep the average of the set point changes near the normal set point of the process to avoid excessive departure from normal operating level.

After each set point change, allow sufficient time to observe the effect of the last adjustment. It is wise to wait until approximately 90% of the change has been completed.

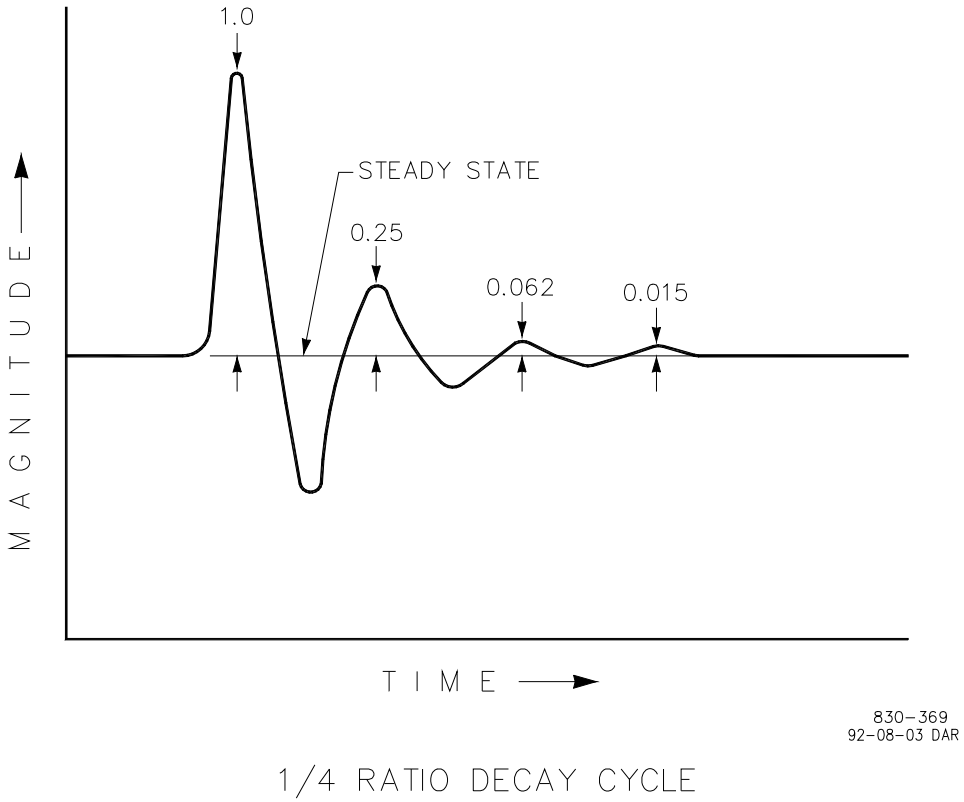


Figure 5-4. Ratio Decay Cycle

Controller Field Tuning Procedure

1. Have the process steady state on manual control at the normal set point. It is important that, for the duration of the controller tuning operation, no load changes take place. The occurrence of a load change may cause a misinterpretation of the recorder trace. Turn the integral adjustment to the position of low reset response, that is, place the reset adjustment at 0.02 repeats per minute (or 50 minutes per repeat). Adjust the Proportional Gain to a fairly low setting. (The actual value of the Proportional Gain will depend on the type of process variable being controlled.) Leave it this way until you are sure that the process has reached steady state.

2. Turn the Integral adjustment to minimum Reset effect; this will reduce or eliminate the Integral function. Check to see that Derivative adjustment is set for minimum Derivative, or in Woodward controllers at 100.

3. Switch to automatic control. Make a small change* in the set point and observe the response of the process to the Proportional Gain setting. If little or no cycling takes place, increase the Proportional Gain to 150% of its previous value and make another small change to the set point. After each set point change, increase the Proportional Gain to twice its previous value until an "Optimum Proportional" response curve (see below) is obtained. If a change in Proportional produces a "Proportional Too High" curve (see below), lower the Proportional Gain to its previous setting. The "Proportional Too Low" curve illustrates the condition in which the proportional is too low.

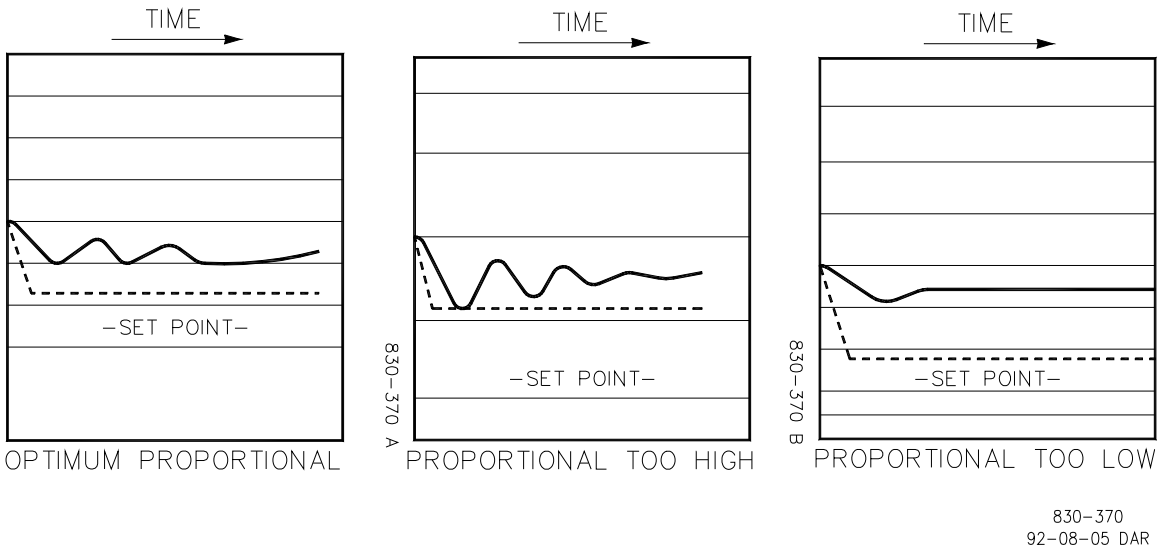


Figure 5-5. Proportional Gain Settings

*Set point changes can be made either up or down scale. The second change should return the set point to its original setting. Repeat this pattern through the tuning procedure.

4. With the Proportional Gain at the setting previously obtained in step 3, make a change in set point and observe the recovery cycle. If there is no excessive cycling, increase the Integral to 0.04 repeats per minute (or 25 minutes per repeat). Make another set point change and observe results. After each set point change, make a change in the Integral adjustment to increase the Integral by 50% of the previous Integral effect. Continue in this manner until an acceptable response curve is obtained.

Accel/Decel Curves Setup

The GTC250A_FC requires the user to configure an acceleration limiting curve and a deceleration limiting curve. The forcing function of this curve is the CDP signal. The output is a fuel valve position demand that equals the maximum fuel flow allowed for a given CDP. The information below will assist the user in programming these parameters. There are separate schedules for both gas and liquid fuels. For each curve, a maximum of five pairs (x,y) of data points can be defined. Any unused curve points should be at the end of the schedule and tuned out of the way (max CDP, 100).

Acceleration Control (Accel/CDP to Fuel Limit Curve)—The curve-defined acceleration rate limiter based on CDP. Outputs are scaled from 0 to 100% of valve travel. The purpose of this curve is to limit the rapid request for fuel during transient events and provide a CDP based fuel demand schedule for starting of the turbine.

Deceleration Control (Decel/CDP to Fuel Limit Curve)—The curve-defined deceleration rate limiter based on CDP. Outputs are scaled from 0 to 100% of valve travel. The purpose of this curve is to maintain minimum fuel flow to the combustor during transient response to prevent flameout. If no OEM data is available the curve is typically setup with) output up to a CDP value near rated speed where the output can be set as a straight line at about 10% less than the required valve position to hold rated speed at no load.

⚠WARNING

The purpose of Decel control is to keep the valve open when all other controls are pulling back on fuel. An improperly setup curve can cause the valve to remain open further than desired interfering with Speed control operation.

Note on completing Accel and Decel Schedules: Gas flow in pph or BTU/hr vs. actuator current data is required. Since gas flow is not proportional to actuator current or valve angle, the schedule breakpoints should be calculated based on fuel flow and then fuel flow converted to actuator current using valve test data. Also required are the turbine manufacturer's acceleration and deceleration specifications.

Plot a piece-wise linear approximation to the required accel and decel schedules with four slopes maximum for accel and decel. This plot determines the breakpoints in the schedules entered into the Atlas-II Digital Control System. Note that line slopes established by the schedule points do not change to zero at endpoints. If actuator current is to be held constant for varying CDP then a zero slope line segment must be created in the schedule.

1. Rescale the dependent variable (gas mass flow or heat consumption) to match the units used in the gas flow data.

2. Now plot the valve test data with the dependent variable scaled as above vs. actuator current. For greatest accuracy, a non-linear curve fit of the data should be used, however a piece-wise linear plot is generally acceptable.

3. Using the Y axis (gas flow) values of the endpoints and breakpoints from the plot of step 1, determine the corresponding actuator current values, which produce those flows in the plot of step 3.

4. Find the X axis (CDP) values of the endpoints and breakpoints from the plot of step 1.

5. Rescale the actuator current values of step 4 on a scale of 0 to 100 corresponding to min. to max. stops on the valve. If desired, plot this normalized actuator current as a function of CDP. This is the schedule to be entered in the Atlas-II Digital Control System.

   For example, see the linearized sample manufacturers specification, Figure 5-3, and the valve test data example Table 5-1.

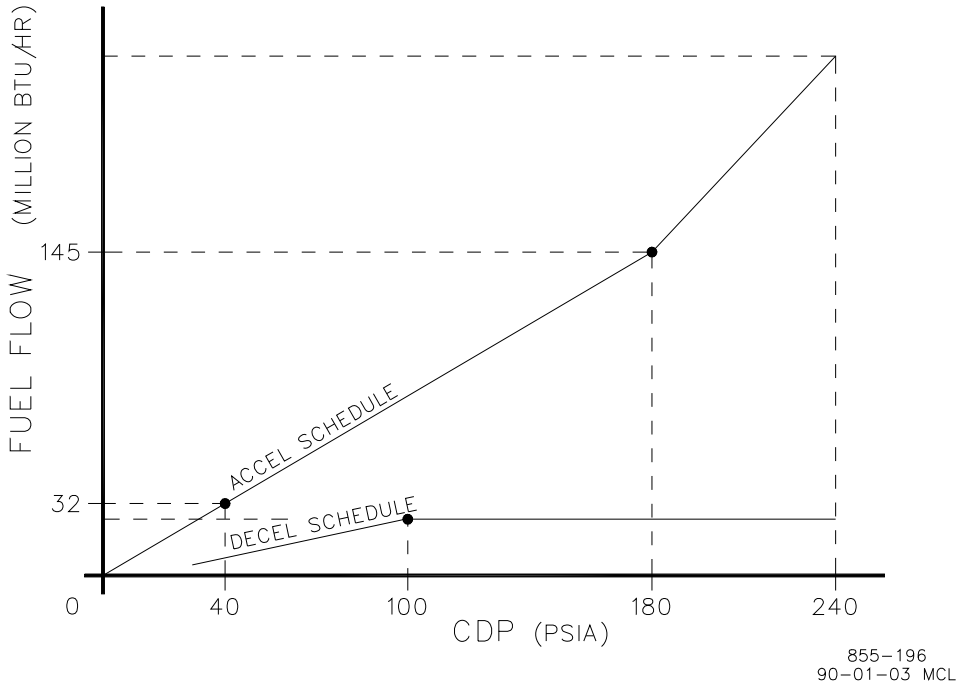


Figure 5-6. Linearized Flow Schedule

Valve Angle (deg)	Actuator Current (mA)	Gas Flow (pph)
9.0	32.8	435
9.8	35.0	515
16.5	54.7	1580
22.6	72.1	3060
28.0	86.3	4689
34.9	107.2	7059
41.8	127.7	9378
51.5	155.1	12488

Table 5-1. Valve Test Data

Given the gas lower heating value of 20 000 BTU/lbm, flow in million BTU/h can be rescaled for pph as in the valve test data. The accel schedule breakpoint is at 7250 pph (145 million BTU/h) fuel flow and 180 psia CDP. From the valve test data, this point corresponds to 108.9 mA of actuator current. For this example, a linear interpolation between valve test data points was used to find the actuator current (step 3 above). However, better accuracy would result using a non-linear curve fit. Two more points are required to establish the two-slope accel schedule. The first is (40 psia, 1600 pph) which corresponds to 54.9 mA. The second endpoint is (240 psia, 10500 pph) which corresponds to an actuator current of 137.6 mA. Now rescale actuator current for 0 to 100 for min. to max. travel of the valve. From the valve data, min. travel is at 35.0 mA and max travel is at 155.1 mA. This gives:

CDP (psia)	Act. Current (mA)	Act. Signal (0 to 100)
40	54.9	16.6
180	108.9	61.5
240	137.6	85.4

Where CDP is the Accel Schedule input value to be entered and ACT. SIGNAL is the output value to be entered. The same procedure is followed for the Decel Schedule.

DN/DT Accel Schedule is biased by GG speed derivative. When DN/DT PID control is used, the acceleration (or deceleration) schedule values must be in terms of GG speed (for inputs) and GG derivative (for outputs).

Poor Valve Response

What can often appear as a tuning problem is poor valve response. This can be due to a sticky actuator or inconsistent hydraulic pressure to the actuator. Changing hydraulic oil properties can also have an adverse affect to the control of the turbine.

The hydraulic supply to the actuator must be a consistent pressure over the entire operating range of the turbine.

The Atlas-II Digital Control System does have logic built in to account for a sticky valve/actuator assembly. If you are having problems with the control of the turbine and the loops have been tuned and hydraulics verified, contact Woodward for service.

Common SIO Port Configurations

The following is a guideline for configuring a serial port interface from the control to a communication device. Items highlighted are required.

	Control Assistant (Mimic/WinPanel)	Control Assistant (Tunables/Datalogs)	Modbus RTU	Eventlatch	ServLink and Watch Window
BAUD	10 (38400)	10 (38400)	10 (38400)	10 (38400)	10 (38400)
BITS	2 (8 data)	2 (8 data)	2 (RTU-8 bits)	2 (8 data)	2 (RTU-8 bits)
STOP	1 (1 stop)	1 (1 stop)	1 (1 stop)	1 (1 stop)	1 (1 stop)
PARITY	1 (none)	1 (none)	1 (none)	1 (none)	1 (none)
MODE	2 (char)	1 (line)	1 (line)	1 (line)	1 (line)
FLOW	1 (off)	1 (off)	1 (off)	2 (xon-xoff)	1 (off)
ECHO	1 (off)	1 (off)	1 (off)	1 (off)	1 (off)
ENDLINE	3 (crlf)	3 (crlf)	3 (crlf)	3 (crlf)	1 (lf)
IGNCR	2 (on)	2 (on)	1 (off)	1 (off)	1 (off)

Serial Null Modem Cable Reference

The following defines a standard null modem cable which can be purchase an any electronics store. This cable is useful for interfacing a Woodward control to a PC running either Control Assistant, ServLink, or Watch Window.

Pinout Diagram for a 9 pin to 9 pin null modem cable:
(1-4, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7)

RD2	----------\	/----------	2RD	(pin 2 is tied to pin 3)
TD3	----------/	\----------	3TD	(pin 3 is tied to pin 2)
DTR4	--------|	/|--------	4DTR	(pin 4 is tied to pin 1, then to 6
DCD1	--------| \	/ |--------	1DCD	on both sides)
DSR6	----------/	\----------	6DSR	(both are tied to pin 6)
SG5	----------		5SG	
RTS7	----------\	/----------	7RTS	(pin 7 is tied to pin 8)
CTS8	----------/	\----------	8CTS	(pin 8 is tied to pin 7)
RI9	-----|	|-----	9RI	(pins 9 and 9 are terminated)

Pin Definitions

CTS	Clear To Send. The CTS line is asserted by the PC (as DCE device) when it is ready to receive data.
DCD	Data Carrier Detect. The DCD line is asserted when the data link is established.
DCE	Data Communications Equipment. Refers to the modem in a computer to modem setup.
DSR	Data Set Ready. The DSR line is asserted by the DCE when it is ready to communicate with the DTE.
DTE	Data Terminal Equipment. Refers to the computer in a computer to modem setup.
DTR	Data Terminal Ready. The DTR line is asserted by the DTE when it is ready to communicate with the DCE.
FG	Field Ground. A protective line used to ground the DCE.
RD	Receive Data. The RD line is used by the DCE to send data to the DTE.
RI	Ring Indicator. The RI line is asserted by the DCE when a ring is detected.
RTS	Request To Send. The RTS line is asserted by the DTE when it wants to transmit data to the DCE.
SG	Signal Ground. The common return (and voltage baseline) for the various signal lines.
TD	Transmit Data. The TD line is used by the DTE to send data to the DCE.

Chapter 6.
Service Options

Product Service Options

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

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

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

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

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

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

www.woodward.com/directory

Woodward Factory Servicing Options

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

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

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

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

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

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

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

Returning Equipment for Repair

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

When shipping the item(s), attach a tag with the following information:

- return authorization number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

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

NOTICE

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

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

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

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

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

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

How to Contact Woodward

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

Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

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

www.woodward.com/directory

Technical Assistance

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

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #2	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #3	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	

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

Appendix A.
System Input/Output Signal Layout

Control Wiring Diagram, 10 sheets (9971-1307)

IMPORTANT **An electronic copy of this information is available on the System Documentation CD (BCD85244).**


Control Wiring Diagram
GTC250FC
(ATLAS II BASED)
8262-1036 - FUEL CONTROL (FC) ONLY
WOODWARD
DIAGRAM -
CONTROL WIRING GTC FUEL CONTROL
-ATLASII PLATFORM
9971-1307
AUTOCAD

SHEET NUMBER	DESIGNATION	DESCRIPTION	Applies to GTC P/N
SHEET 1	COVER	COVER SHEET	All
SHEET 2	INDEX	SHEET INDEX SHEET	All
SHEET 3	CHASSIS LAYOUT	ATLAS-II CHASSIS	All
SHEET 4	PS BOARD	POWER & DISCRETE OUTPUTS	All
SHEET 5	A02 A5200CPU1	DISCRETE INPUTS	All
SHEET 6	A02 A5200CPU2	ANALOG INPUTS & SPEED INPUTS	All
SHEET 7	A02 A5200CPU3	ANALOG OUTPUTS AND ACTUATOR OUTPUTS	All
SHEET 8	A02 A5200CPU4	COMMUNICATION PORTS	All
SHEET 9	A03 ANALOGCOMBO1	ANALOG INPUTS - T/C Channels 1-11	All
SHEET 10	A03 ANALOGCOMBO2	ANALOG INPUTS/OUTPUTS & SPEED SIGNAL INPUTS	All

NOTES;

1) Descriptions in * **BOLD** are fixed I/O points that are required by the GTC250A.
2) All other I/O points are configurable to be used as shown or reprogrammed via customer programming.
3) The Analog Combo board is configured in the following manner:
   - Channels 1-11 Thermocouple Input
   - Channels 12-13 RTD Input (100 or 200 Ohm only)
   - Channels 14-15 Analog 4-20 mA Input

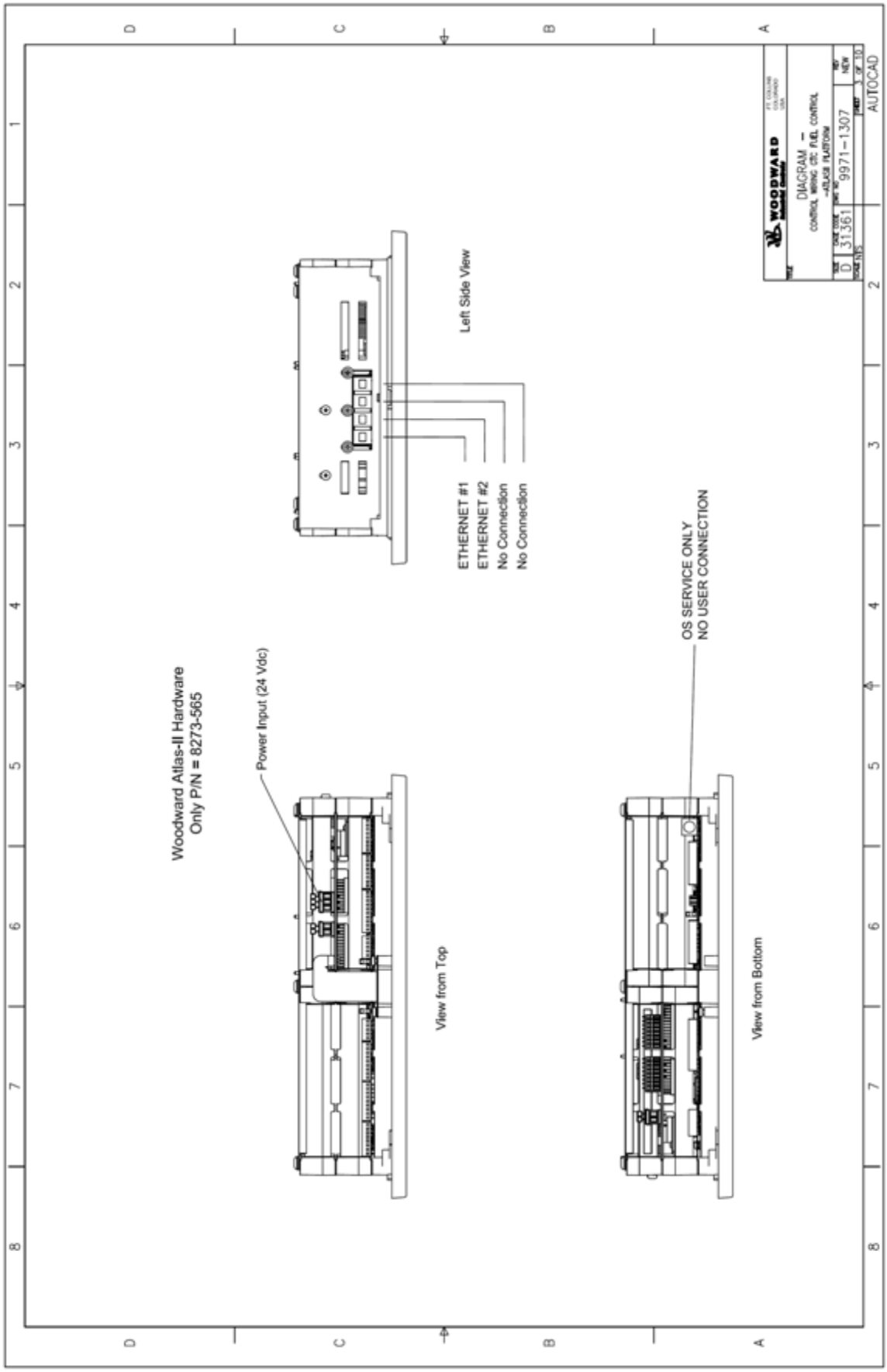
WOODWARD — FT. COLLINS, COLORADO, USA

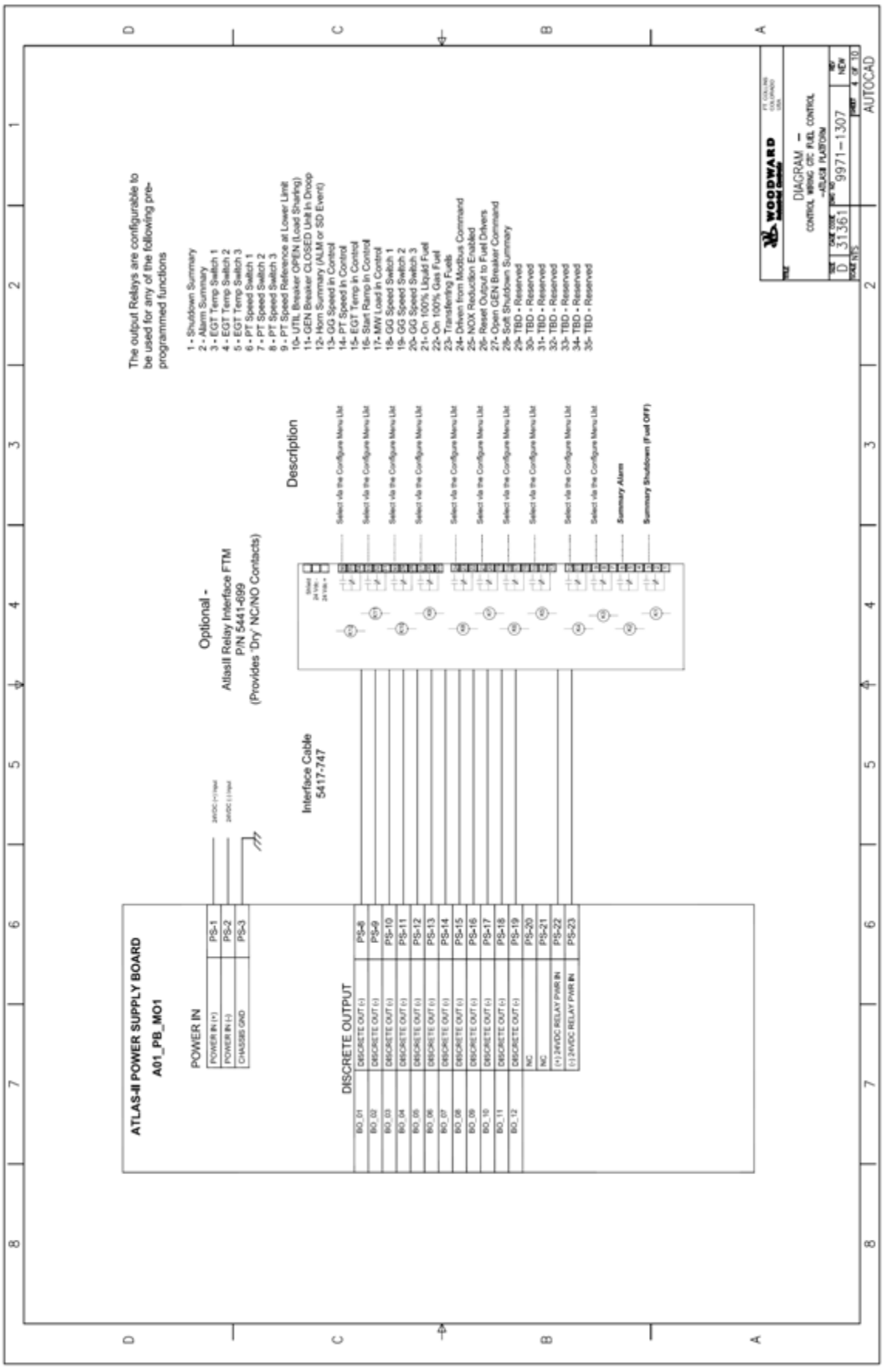
DIAGRAM –
CONTROL WIRING GTC FUEL CONTROL
–ATLAS® PLATFORM

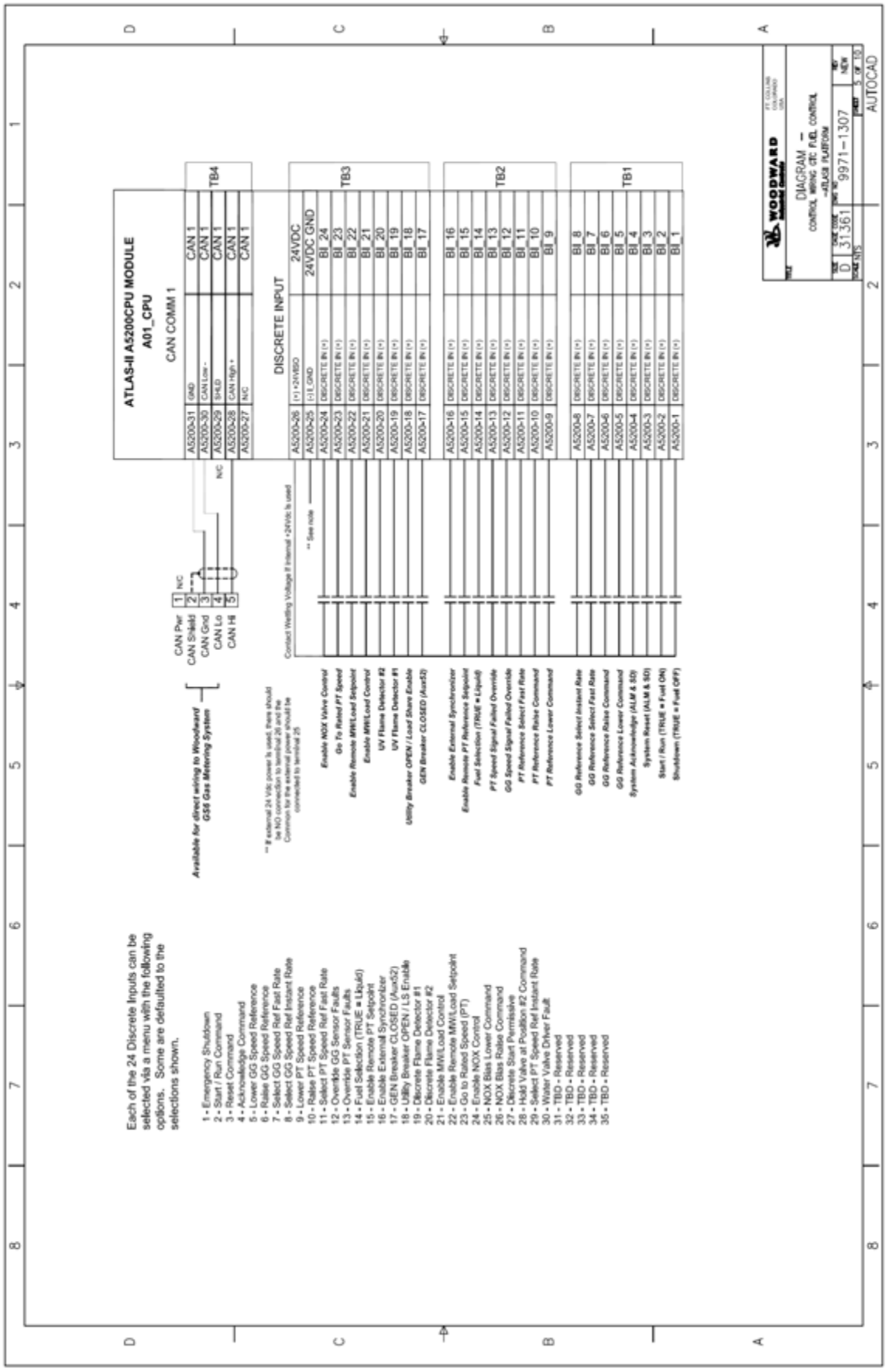
SIZE	CAGE CODE	DWG NO	REV
D	31361	9971–1307	NEW

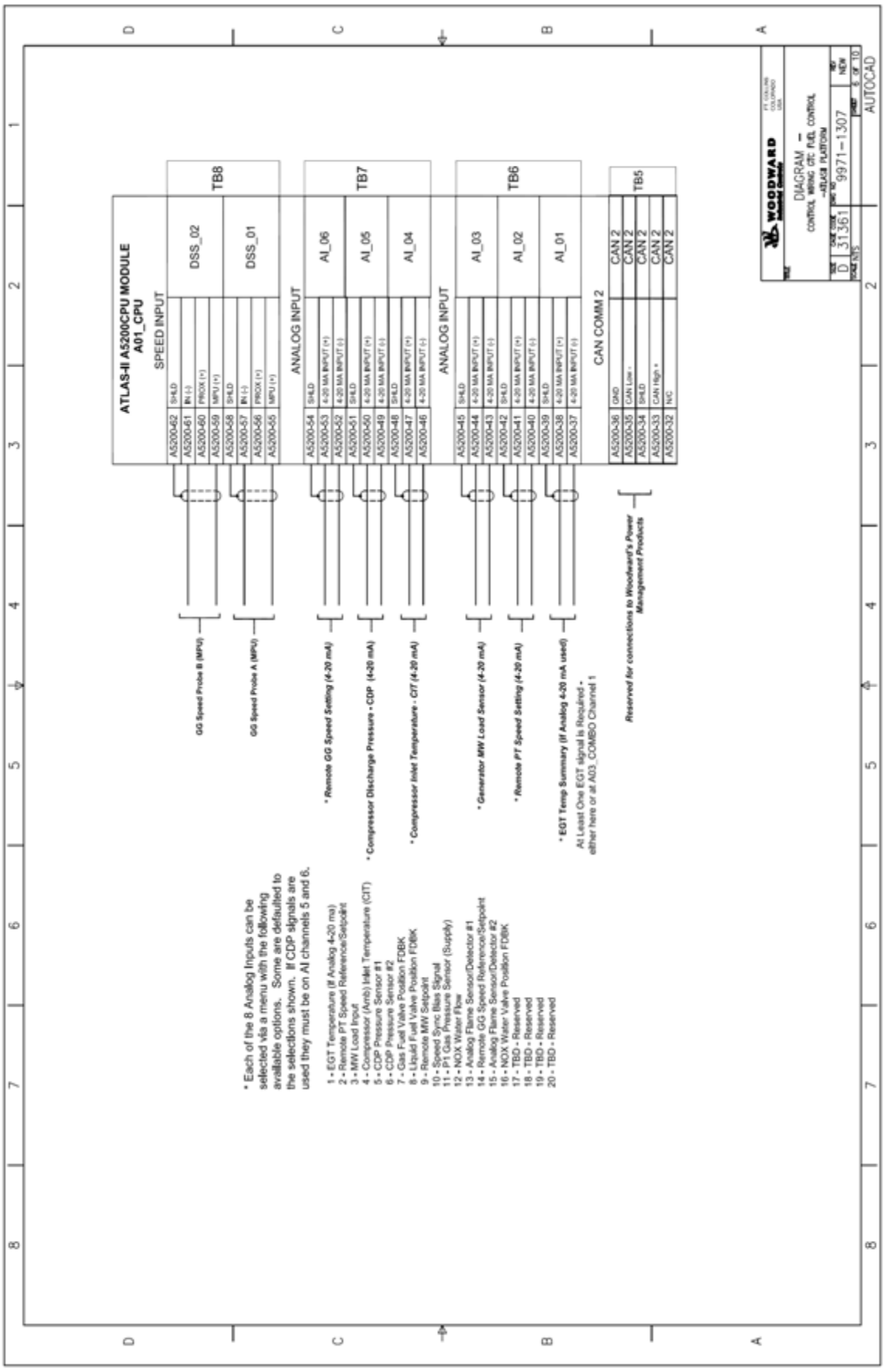
SCALE NTS SHEET 2 OF 10

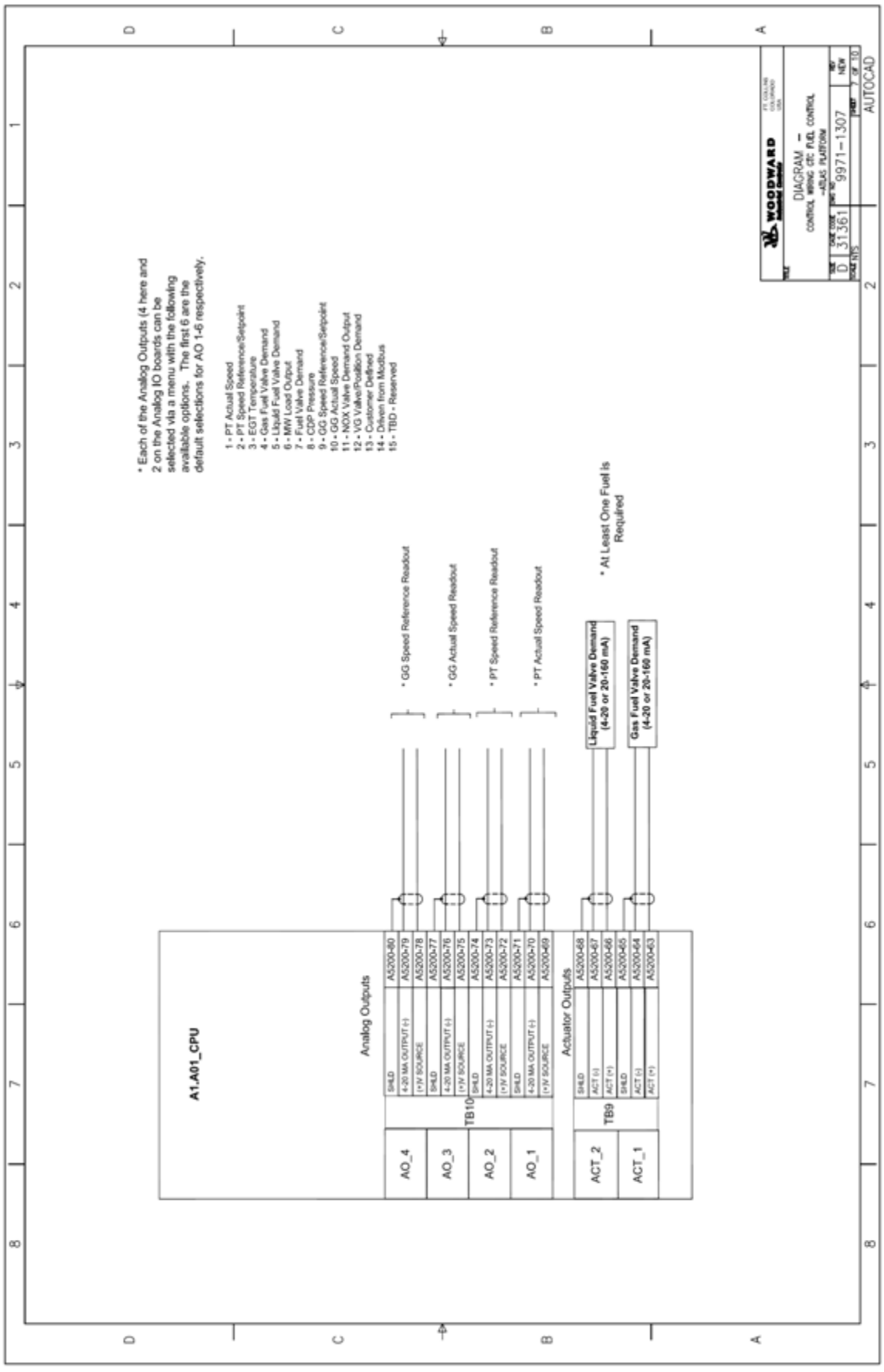
AUTOCAD

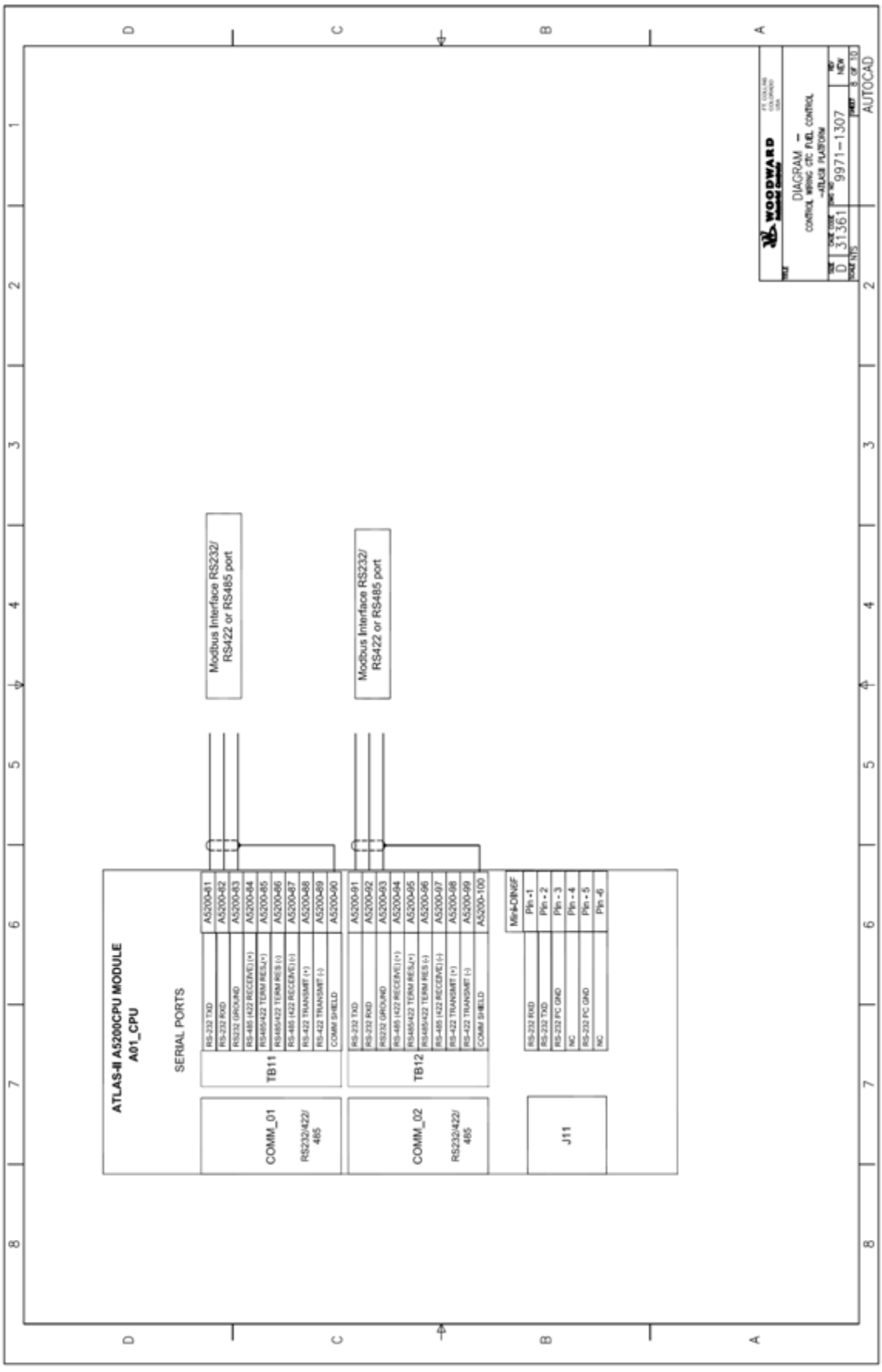

Left Side View
ETHERNET #1
ETHERNET #2
No Connection
No Connection
OS SERVICE ONLY
NO USER CONNECTION
Woodward Atlas-II Hardware
Only P/N = 8273-565
Power Input (24 Vdc)
View from Top
View from Bottom
WOODWARD
DIAGRAM -
CONTROL WIRING GTC FUEL CONTROL
-ATLAS II PLATFORM
D
31361
9971-1307
NEW
SHEET 1 OF 10
AUTOCAD

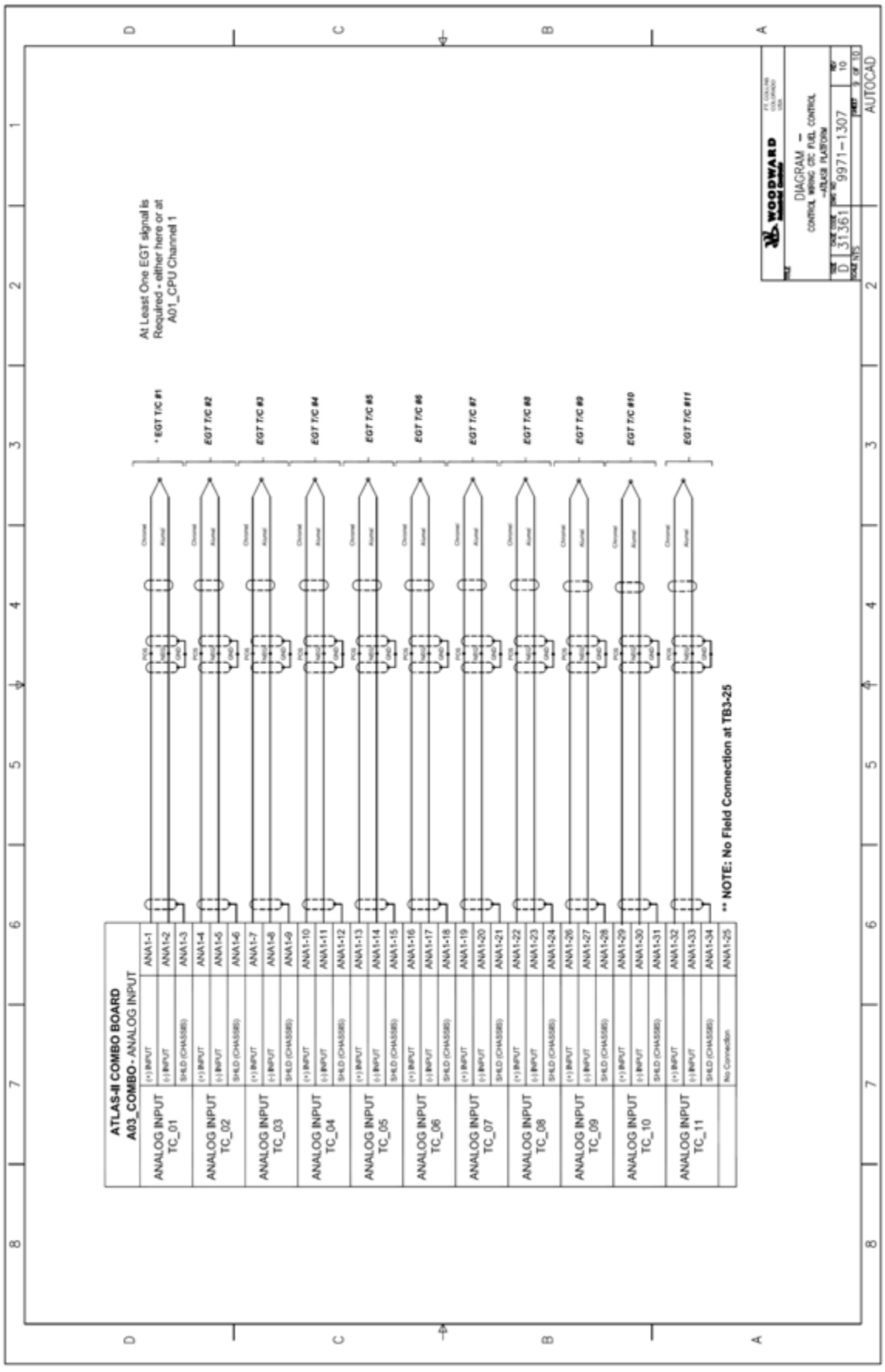

ATLAS-II POWER SUPPLY BOARD
A01_PB_MO1
POWER IN
POWER IN (+)
POWER IN (-)
CHASSIS GRD
PS-1
PS-2
PS-3
DISCRETE OUTPUT
BO_01
BO_02
BO_03
BO_04
BO_05
BO_06
BO_07
BO_08
BO_09
BO_10
BO_11
BO_12
DISCRETE OUT (+)
NC
(+) 24VDC RELAY PWR IN
(-) 24VDC RELAY PWR IN
PS-4
PS-5
PS-10
PS-11
PS-12
PS-13
PS-14
PS-15
PS-16
PS-17
PS-18
PS-19
PS-20
PS-21
PS-22
PS-23
Interface Cable
5417-747
Optional -
Atlas II Relay Interface FTM
P/N 5441-699
(Provides 'Dry' NC/NO Contacts)
Description
The output Relays are configurable to be used for any of the following pre-programmed functions
1 - Shutdown Summary
2 - Alarm Summary
3 - EGT Temp Switch 1
4 - EGT Temp Switch 2
5 - EGT Temp Switch 3
6 - PT Speed Switch 1
7 - PT Speed Switch 2
8 - PT Speed Switch 3
9 - PT Speed Reference at Lower Limit
10- UTIL Breaker OPEN (Load Sharing)
11- GEN Breaker CLOSED Unit In Droop
12- Horn Summary (ALM or SD Event)
13- GG Speed in Control
14- PT Speed in Control
15- EGT Temp in Control
16- Start Ramp in Control
17- MW Load in Control
18- GG Speed Switch 1
19- GG Speed Switch 2
20- GG Speed Switch 3
21- On 100% Liquid Fuel
22- On 100% Gas Fuel
23- Transferring Fuels
24- Driven from Modbus Command
25- NOX Reduction Enabled
26- Reset Output to Fuel Drivers
27- Open GEN Breaker Command
28- Soft Shutdown Summary
29- TBD - Reserved
30- TBD - Reserved
31- TBD - Reserved
32- TBD - Reserved
33- TBD - Reserved
34- TBD - Reserved
35- TBD - Reserved
Select via the Configure Menu List
Summary Alarm
Summary Shutdown (Fuel OFF)
WOODWARD
DIAGRAM -
CONTROL WIRING CFC FUEL CONTROL
-ATLAS II PLATFORM
9971-1307
31361
AUTOCAD

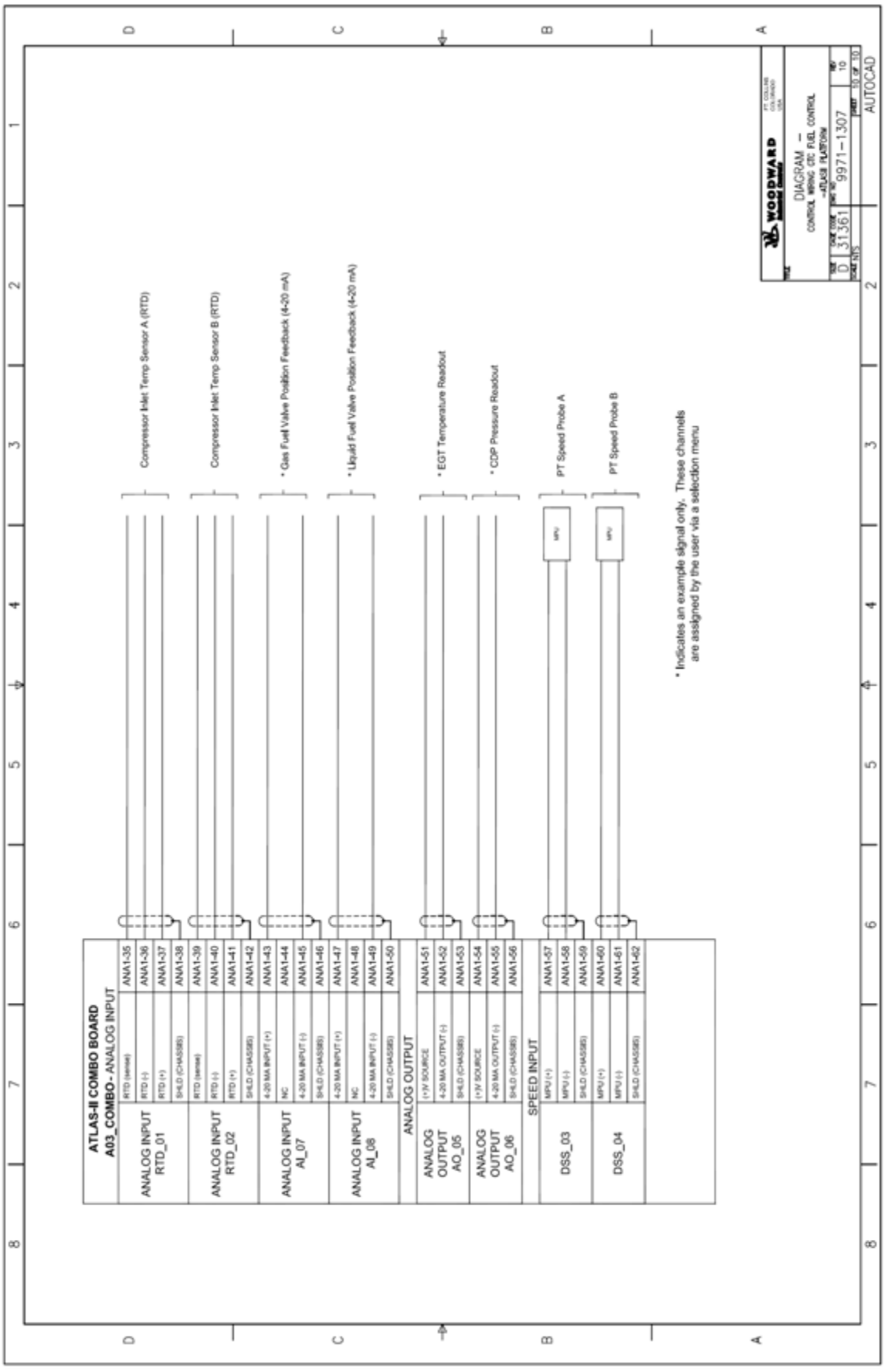

ATLAS-II A5200CPU MODULE
A01_CPU
CAN COMM 1
A5200-31 GND CAN 1
A5200-30 CAN Low - CAN 1
A5200-29 SHLD CAN 1
A5200-28 CAN High + CAN 1
A5200-27 N/C CAN 1
TB4
N/C
CAN Pwr
CAN Shield
CAN Grid
CAN Lo
CAN Hi
DISCRETE INPUT
Contact Wetting Voltage If Internal +24Vdc Is used
** See note
A5200-26 (+) +24VBD 24VDC
A5200-25 (-) E.GND 24VDC GND
A5200-24 DISCRETE IN (+) BI_24
A5200-23 DISCRETE IN (+) BI_23
A5200-22 DISCRETE IN (+) BI_22
A5200-21 DISCRETE IN (+) BI_21
A5200-20 DISCRETE IN (+) BI_20
A5200-19 DISCRETE IN (+) BI_19
A5200-18 DISCRETE IN (+) BI_18
A5200-17 DISCRETE IN (+) BI_17
TB3
A5200-16 DISCRETE IN (+) BI_16
A5200-15 DISCRETE IN (+) BI_15
A5200-14 DISCRETE IN (+) BI_14
A5200-13 DISCRETE IN (+) BI_13
A5200-12 DISCRETE IN (+) BI_12
A5200-11 DISCRETE IN (+) BI_11
A5200-10 DISCRETE IN (+) BI_10
A5200-9 DISCRETE IN (+) BI_9
TB2
A5200-8 DISCRETE IN (+) BI_8
A5200-7 DISCRETE IN (+) BI_7
A5200-6 DISCRETE IN (+) BI_6
A5200-5 DISCRETE IN (+) BI_5
A5200-4 DISCRETE IN (+) BI_4
A5200-3 DISCRETE IN (+) BI_3
A5200-2 DISCRETE IN (+) BI_2
A5200-1 DISCRETE IN (+) BI_1
TB1
Available for direct wiring to Woodward GS8 Gas Metering System
Enable NOX Valve Control
Go To Rated PT Speed
Enable Remote MW/Load Setpoint
Enable MW/Load Control
UV Flame Detector #2
UV Flame Detector #1
Utility Breaker OPEN / Load Share Enable
GEN Breaker CLOSED (Aux52)
Enable External Synchronizer
Enable Remote PT Reference Setpoint
Fuel Selection (TRUE = Liquid)
PT Speed Signal Failed Override
GG Speed Signal Failed Override
PT Reference Select Fast Rate
PT Reference Raise Command
PT Reference Lower Command
GG Reference Select Instant Rate
GG Reference Select Fast Rate
GG Reference Raise Command
GG Reference Lower Command
System Acknowledge (ALM & SD)
System Reset (ALM & SD)
Start / Run (TRUE = Fuel ON)
Shutdown (TRUE = Fuel OFF)
** If external 24 Vdc power is used, there should be NO connection to terminal 26 and the Common for the external power should be connected to terminal 25
Each of the 24 Discrete Inputs can be selected via a menu with the following options. Some are defaulted to the selections shown.
1 - Emergency Shutdown
2 - Start / Run Command
3 - Reset Command
4 - Acknowledge Command
5 - Lower GG Speed Reference
6 - Raise GG Speed Reference
7 - Select GG Speed Ref Fast Rate
8 - Select GG Speed Ref Instant Rate
9 - Lower PT Speed Reference
10 - Raise PT Speed Reference
11 - Select PT Speed Ref Fast Rate
12 - Override GG Sensor Faults
13 - Override PT Sensor Faults
14 - Fuel Selection (TRUE = Liquid)
15 - Enable Remote PT Setpoint
16 - Enable External Synchronizer
17 - GEN Breaker CLOSED (Aux52)
18 - Utility Breaker OPEN / LS Enable
19 - Discrete Flame Detector #1
20 - Discrete Flame Detector #2
21 - Enable MW/Load Control
22 - Enable Remote MW/Load Setpoint
23 - Go to Rated Speed (PT)
24 - Enable NOX Control
25 - NOX Bias Lower Command
26 - NOX Bias Raise Command
27 - Discrete Start Permissive
28 - Hold Valve at Position #2 Command
29 - Select PT Speed Ref Instant Rate
30 - Water Valve Driver Fault
31 - TBD - Reserved
32 - TBD - Reserved
33 - TBD - Reserved
34 - TBD - Reserved
35 - TBD - Reserved
WOODWARD
DIAGRAM -
CONTROL WIRING GTC FUEL CONTROL
-ATLAS-II PLATFORM
D 31361 9971-1307
SCALE: NTS
SHEET 5 OF 10
AUTOCAD


ATLAS-II A5200CPU MODULE
A01_CPU
SPEED INPUT
DSS_02
TB8
DSS_01
ANALOG INPUT
AI_06
TB7
AI_05
AI_04
AI_03
TB6
AI_02
AI_01
CAN COMM 2
TB5
CAN 2
GG Speed Probe B (MPU)
GG Speed Probe A (MPU)
* Remote GG Speed Setting (4-20 mA)
* Compressor Discharge Pressure - CDP (4-20 mA)
* Compressor Inlet Temperature - CIT (4-20 mA)
* Generator MW Load Sensor (4-20 mA)
* Remote PT Speed Setting (4-20 mA)
* EGT Temp Summary (If Analog 4-20 mA used)
At Least One EGT signal is Required - either here or at A03_COMBO Channel 1
Reserved for connections to Woodward's Power Management Products
* Each of the 8 Analog Inputs can be selected via a menu with the following available options. Some are defaulted to the selections shown. If CDP signals are used they must be on AI channels 5 and 6.
1 - EGT Temperature (If Analog 4-20 ma)
2 - Remote PT Speed Reference/Setpoint
3 - MW Load Input
4 - Compressor (Amb) Inlet Temperature (CIT)
5 - CDP Pressure Sensor #1
6 - CDP Pressure Sensor #2
7 - Gas Fuel Valve Position FDBK
8 - Liquid Fuel Valve Position FDBK
9 - Remote MW Setpoint
10 - Speed Sync Bias Signal
11 - P1 Gas Pressure Sensor (Supply)
12 - NOX Water Flow
13 - Analog Flame Sensor/Detector #1
14 - Remote GG Speed Reference/Setpoint
15 - Analog Flame Sensor/Detector #2
16 - NOX Water Valve Position FDBK
17 - TBD - Reserved
18 - TBD - Reserved
19 - TBD - Reserved
20 - TBD - Reserved
WOODWARD
DIAGRAM -
CONTROL WIRING GTC FUEL CONTROL
-ATLAS-II PLATFORM
9971-1307
AUTOCAD


* Each of the Analog Outputs (4 here and 2 on the Analog IO boards can be selected via a menu with the following available options. The first 6 are the default selections for AO 1-6 respectively.
1 - PT Actual Speed
2 - PT Speed Reference/Setpoint
3 - EGT Temperature
4 - Gas Fuel Valve Demand
5 - Liquid Fuel Valve Demand
6 - MW Load Output
7 - Fuel Valve Demand
8 - CDP Pressure
9 - GG Speed Reference/Setpoint
10 - GG Actual Speed
11 - NOX Valve Demand Output
12 - VG Valve/Position Demand
13 - Customer Defined
14 - Driven from Modbus
15 - TBD - Reserved
A1.A01_CPU
Analog Outputs
Actuator Outputs
AO_4
AO_3
AO_2
AO_1
ACT_2
ACT_1
TB10
TB9
SHLD
4-20 MA OUTPUT (+)
(+)V SOURCE
ACT (+)
ACT (-)
A5200-80
A5200-79
A5200-78
A5200-77
A5200-76
A5200-75
A5200-74
A5200-73
A5200-72
A5200-71
A5200-70
A5200-69
A5200-68
A5200-67
A5200-66
A5200-65
A5200-64
A5200-63
* GG Speed Reference Readout
* GG Actual Speed Readout
* PT Speed Reference Readout
* PT Actual Speed Readout
Liquid Fuel Valve Demand (4-20 or 20-160 mA)
Gas Fuel Valve Demand (4-20 or 20-160 mA)
* At Least One Fuel is Required
WOODWARD
DIAGRAM -
CONTROL WIRING GTC FUEL CONTROL
-ATLAS PLATFORM
D
31361
9971-1307
NEW
SHEET 7 OF 10
SCALE NTS
AUTOCAD


ATLAS-II A5200CPU MODULE
A01_CPU
SERIAL PORTS
COMM_01
RS232/422/485
TB11
RS-232 TXD
RS-232 RXD
RS232 GROUND
RS-485 (422 RECEIVE) (+)
RS485/422 TERM RES(+)
RS485/422 TERM RES (-)
RS-485 (422 RECEIVE) (-)
RS-422 TRANSMIT (+)
RS-422 TRANSMIT (-)
COMM SHIELD
A5200-81
A5200-82
A5200-83
A5200-84
A5200-85
A5200-86
A5200-87
A5200-88
A5200-89
A5200-90
Modbus Interface RS232/ RS422 or RS485 port
COMM_02
RS232/422/485
TB12
RS-232 TXD
RS-232 RXD
RS232 GROUND
RS-485 (422 RECEIVE) (+)
RS485/422 TERM RES(+)
RS485/422 TERM RES (-)
RS-485 (422 RECEIVE) (-)
RS-422 TRANSMIT (+)
RS-422 TRANSMIT (-)
COMM SHIELD
A5200-91
A5200-92
A5200-93
A5200-94
A5200-95
A5200-96
A5200-97
A5200-98
A5200-99
A5200-100
Modbus Interface RS232/ RS422 or RS485 port
J11
MiniDIN6F
RS-232 RXD
RS-232 TXD
RS-232 PC GND
NC
RS-232 PC GND
NC
Pin -1
Pin - 2
Pin - 3
Pin - 4
Pin - 5
Pin -6
WOODWARD
DIAGRAM -
CONTROL WIRING GTC FUEL CONTROL
-ATLAS II PLATFORM
D
31361
9971-1307
AUTOCAD


At Least One EGT signal is Required - either here or at A01_CPU Channel 1
* EGT T/C #1
EGT T/C #2
EGT T/C #3
EGT T/C #4
EGT T/C #5
EGT T/C #6
EGT T/C #7
EGT T/C #8
EGT T/C #9
EGT T/C #10
EGT T/C #11
ATLAS-II COMBO BOARD
A03_COMBO - ANALOG INPUT
ANALOG INPUT TC_01
ANALOG INPUT TC_02
ANALOG INPUT TC_03
ANALOG INPUT TC_04
ANALOG INPUT TC_05
ANALOG INPUT TC_06
ANALOG INPUT TC_07
ANALOG INPUT TC_08
ANALOG INPUT TC_09
ANALOG INPUT TC_10
ANALOG INPUT TC_11
(+) INPUT
(-) INPUT
SHLD (CHASSIS)
No Connection
** NOTE: No Field Connection at TB3-25
WOODWARD
DIAGRAM -
CONTROL WIRING GTC FUEL CONTROL
-ATLAS-II PLATFORM
D
31361
9971-1307
10
AUTOCAD


ATLAS-II COMBO BOARD
A03_COMBO - ANALOG INPUT
ANALOG INPUT RTD_01
ANALOG INPUT RTD_02
ANALOG INPUT AI_07
ANALOG INPUT AI_08
ANALOG OUTPUT
ANALOG OUTPUT AO_05
ANALOG OUTPUT AO_06
SPEED INPUT
DSS_03
DSS_04
Compressor Inlet Temp Sensor A (RTD)
Compressor Inlet Temp Sensor B (RTD)
* Gas Fuel Valve Position Feedback (4-20 mA)
* Liquid Fuel Valve Position Feedback (4-20 mA)
* EGT Temperature Readout
* CDP Pressure Readout
PT Speed Probe A
PT Speed Probe B
* Indicates an example signal only. These channels are assigned by the user via a selection menu
WOODWARD
DIAGRAM - CONTROL WIRING CEC FUEL CONTROL
9971-1307
AUTOCAD

Appendix B.
Modbus List

The following is the Modbus List generated from the Application software. This information is sent out from the control on serial port COM1 and COM2, on Ethernet UDP Ports 5001 and 5002, and Ethernet TCP on the CPU module.

WOODWARD GOVERNOR COMPANY
INDUSTRIAL CONTROLS DIVISION
FORT COLLINS, COLORADO, U.S.A.

Woodward MODBUS Slave Address Information
File created on 07/29/08
FileName: 5418-3022.gap
Project: 92871
P/N: 5418-3022
Rev: NEW
GTC250 MASTER GAP FILE
STAND-ALONE
CORE FUEL CONTROL
GAP 2.18B / CODER 4.04

MODBUS_S Block Name : MODBUS.OI_LOC

Boolean Writes (RPTbw)

Addr	Input	Description
0:0001		SHUTDOWN
0:0002		START
0:0003		RESET
0:0004		ACKNOWLEDGE
0:0005		GG SPEED LOWER
0:0006		GG SPEED RAISE
0:0007		GG FAST RATE SELECT
0:0008		GG INSTANT RATE SELECT
0:0009		PT SPEED LOWER
0:0010		PT SPEED RAISE
0:0011		PT FAST RATE SELECT
0:0012		GG AND EGT OVERRIDE
0:0013		PT SPEED SIGNAL OVERRIDE
0:0014		FUEL TRANSFER (TRUE = LIQ)
0:0015		ENABLE REMOTE SPEED SETPOINT
0:0016		Enable External Synchronizer
0:0017		GEN Breaker Closed / DROOP Selected
0:0018		UTIL Breaker OPEN / LS Enable
0:0019		FLAME DETECTOR A
0:0020		FLAME DETECTOR B
0:0021		Enable MW/Load Control

0:0022	Enable Remote MW/Load Setpoint
0:0023	Go To PT Rated Setpoint
0:0024	Enable NOX Control
0:0025	NOX Bias Lower Cmd
0:0026	NOX Bias Raise Cmd
0:0027	DI Start Permissive
0:0028	HOLD Fuel Valve at Position 2
0:0029	Select PT Speed Ref Instant Rate
0:0030	Water Valve Driver Fault
0:0031	
0:0032	
0:0033	
0:0034	
0:0035	
0:0036	
0:0037	Enable Output Forcing Mode
0:0038	Initiate Normal Stop
0:0039	
0:0040	ENABLE CALIBRATE MODE
0:0041	EXIT CALIBRATE MODE
0:0042	Force-Energize Output #1 Relay
0:0043	Force-Energize Output #2 Relay
0:0044	Force-Energize Output #3 Relay
0:0045	Force-Energize Output #4 Relay
0:0046	Force-Energize Output #5 Relay
0:0047	Force-Energize Output #6 Relay
0:0048	Force-Energize Output #7 Relay
0:0049	Force-Energize Output #8 Relay
0:0050	Force-Energize Output #9 Relay
0:0051	Force-Energize Output #10 Relay
0:0052	Force-Energize Output #11 Relay
0:0053	Force-Energize Output #12 Relay
0:0054	NOX LOWER
0:0055	NOX RAISE
0:0056	NOX SHUTDOWN COMMAND
0:0057	NOX VALVE STROKE ENABLE
0:0058	
0:0059	NOX WATER PRESSURE PERMISSIVE
0:0060	FUEL TRANSFER HOLD
0:0061	SELECT PEAK MODE
0:0062	Go to Min Load (Soft SD)
0:0063	Modbus Drive Output #02 Relay
0:0064	Modbus Drive Output #03 Relay
0:0065	Modbus Drive Output #04 Relay
0:0066	Modbus Drive Output #05 Relay
0:0067	Modbus Drive Output #06 Relay
0:0068	Modbus Drive Output #07 Relay
0:0069	Modbus Drive Output #08 Relay
0:0070	Modbus Drive Output #09 Relay
0:0071	Modbus Drive Output #10 Relay
0:0072	Modbus Drive Output #11 Relay
0:0073	Modbus Drive Output #12 Relay
0:0074	Start Datalogging

0:0075	Stop Datalogging
0:0076	
0:0077	
0:0078	
0:0079	
0:0080	
0:0081	
0:0082	
0:0083	
0:0084	
0:0085	
0:0086	
0:0087	
0:0088	
0:0089	
0:0090	
0:0091	
0:0092	
0:0093	
0:0094	
0:0095	
0:0096	
0:0097	
0:0098	
0:0099	
0.06944	

Boolean Reads (RPTbr)

Addr	Input	Description
1:0001	A01_CPU.BI_01.BI_ATL	SHUTDOWN (CHOP FUEL)
1:0002	A01_CPU.BI_02.BI_ATL	START/RUN
1:0003	A01_CPU.BI_03.BI_ATL	SYSTEM ACKNOWLEDGE (ALM & SD)
1:0004	A01_CPU.BI_04.BI_ATL	SYSTEM RESET (ALM & SD)
1:0005	A01_CPU.BI_05.BI_ATL	Customer Configurable DI
1:0006	A01_CPU.BI_06.BI_ATL	Customer Configurable DI
1:0007	A01_CPU.BI_07.BI_ATL	Customer Configurable DI
1:0008	A01_CPU.BI_08.BI_ATL	Customer Configurable DI
1:0009	A01_CPU.BI_09.BI_ATL	Customer Configurable DI
1:0010	A01_CPU.BI_10.BI_ATL	Customer Configurable DI
1:0011	A01_CPU.BI_11.BI_ATL	Customer Configurable DI
1:0012	A01_CPU.BI_12.BI_ATL	Customer Configurable DI
1:0013	A01_CPU.BI_13.BI_ATL	Customer Configurable DI
1:0014	A01_CPU.BI_14.BI_ATL	Customer Configurable DI
1:0015	A01_CPU.BI_15.BI_ATL	Customer Configurable DI
1:0016	A01_CPU.BI_16.BI_ATL	Customer Configurable DI
1:0017	A01_CPU.BI_17.BI_ATL	Customer Configurable DI
1:0018	A01_CPU.BI_18.BI_ATL	Customer Configurable DI
1:0019	A01_CPU.BI_19.BI_ATL	Customer Configurable DI
1:0020	A01_CPU.BI_20.BI_ATL	Customer Configurable DI
1:0021	A01_CPU.BI_21.BI_ATL	Customer Configurable DI
1:0022	A01_CPU.BI_22.BI_ATL	Customer Configurable DI
1:0023	A01_CPU.BI_23.BI_ATL	Customer Configurable DI

1:0024	A01_CPU.BI_24.BI_ATL	Customer Configurable DI
1:0025	FALSE	
1:0026	A02_PB_MO1.BO_01.DISPLAY	
1:0027	A02_PB_MO1.BO_02.DISPLAY	
1:0028	A02_PB_MO1.BO_03.DISPLAY	
1:0029	A02_PB_MO1.BO_04.DISPLAY	
1:0030	A02_PB_MO1.BO_05.DISPLAY	
1:0031	A02_PB_MO1.BO_06.DISPLAY	
1:0032	A02_PB_MO1.BO_07.DISPLAY	
1:0033	A02_PB_MO1.BO_08.DISPLAY	
1:0034	A02_PB_MO1.BO_09.DISPLAY	
1:0035	A02_PB_MO1.BO_10.DISPLAY	
1:0036	A02_PB_MO1.BO_11.DISPLAY	
1:0037	A02_PB_MO1.BO_12.DISPLAY	
1:0038		
1:0039		** CORE Status Indicators at 41 ****
1:0040	CNTRL.GGCTRL.B_NAME	GG Speed Control
1:0041	CNTRL.PTCTRL.B_NAME	PT Speed Control
1:0042	CNTRL.EGTCTRL.B_NAME	EGT Temp Control
1:0043	CNTRL.ACCELCTRL.B_NAME	Accel Control
1:0044	CNTRL.STRTCTRL.B_NAME	Start Mode Control
1:0045	CNTRL.CDP_CTRL.B_NAME	CDP Control
1:0046	CNTRL.MWLIMCTRL.B_NAME	MW Limit Control
1:0047	CNTRL.MAXFL_CTRL.B_NAME	Max CDP vs Fuel Curve Limit
1:0048	CNTRL.DEC_CTRL.B_NAME	Decel Control
1:0049	CNTRL.FUELOFCTRL.B_NAME	Unit Shutdown
1:0050	DRIVER.GAS_100.B_NAME	Running Gas Fuel 100%
1:0051	DRIVER.LIQ_100.B_NAME	Running Liquid Fuel 100%
1:0052	DI_CMDS.SD_FUEL.OR	External SD to Fuel Control CORE
1:0053	DI_CMDS.START_RUN.OR	Start/Run to Fuel Control CORE
1:0054	DI_CMDS.RESET.OR	Reset to Fuel Control CORE
1:0055	DI_CMDS.ACKN.OR	Acknowledge to Fuel Control CORE
1:0056	DI_CMDS.GG_LOWER.OR	GG Ref Lower to Fuel Control CORE
1:0057	DI_CMDS.GG_RAISE.OR	GG Ref Raise to Fuel Control CORE
1:0058	DI_CMDS.GG_FSTRATE.OR	GG Ref Fast Rate to Fuel Control CORE
1:0059	DI_CMDS.GG_INSTRTE.OR	GG Instant Rate to Fuel Control CORE
1:0060	DI_CMDS.PT_LOWER.OR	PT Ref Lower to Fuel Control CORE
1:0061	DI_CMDS.PT_RAISE.OR	PT Ref Raise to Fuel Control CORE
1:0062	DI_CMDS.PT_FSTRATE.OR	PT Ref Fast Rate to Fuel Control CORE
1:0063	DI_CMDS.GG_EGT_OVR.OR	GG/EGT Failed Signal Override to CORE
1:0064	DI_CMDS.PT_OVRD.OR	PT Failed Overide to Fuel Control CORE
1:0065	DI_CMDS.FUEL_XFER.OR	Fuel Select to Fuel Control CORE
1:0066	DI_CMDS.ENBL_RMT.OR	Enable Remote PT setpoint to CORE
1:0067	DI_CMDS.ENA_SYNC.OR	Enable Ext Sync Speed Bias
1:0068	DI_CMDS.GENBRKCLOS.OR	Go to Isoch to Fuel Control CORE
1:0069	DI_CMDS.UTILB_OPEN.OR	PWR AUG Steam Enable to CORE
1:0070	DI_CMDS.FLAME_DET1.OR	Flame Detect #1 to Fuel Control CORE
1:0071	DI_CMDS.FLAME_DET2.OR	Flame Detect #2 to Fuel Control CORE
1:0072	DI_CMDS.ENA_MWCTL.OR	Enable MW/Load Control
1:0073	DI_CMDS.ENA_REMMW.OR	Enable Remote MW/Load Setpoint
1:0074	DI_CMDS.GOTO_RATED.OR	Go to PT Rated Command
1:0075	DI_CMDS.ENA_NOX.OR	Enable NOX Control
1:0076	DI_CMDS.NOX_LWR.OR	NOX Lower Cmd to Fuel Control CORE

1:0077	DI_CMDS.NOX_RAZ.OR	NOX Raise Cmd to Fuel Control CORE
1:0078	IFACE_SERV.NOXSHUTDN.B_NAME	NOX Shutdown Cmd to Fuel Control CORE
1:0079	IFACE_SERV.NOXSTRKEN.B_NAME	NOX Valve Stroke Enabled to CORE
1:0080	IFACE_SERV.WTRPRS_PRM.B_NAME	NOX Water Pressure Permissive to CORE
1:0081	CALMODE.CALPERM.B_NAME	Permissives Met for Calibration Mode
1:0082	CALMODE.CALMODE.B_NAME	Unit in Calibration Mode
1:0083	CALMODE.FORCE.AND	Output Forcing Enabled
1:0084	SEQ.GL_X_HOLD.OR	Hold Fuel Transfer to Fuel Control COR
1:0085	NOX_WATER.WATERACTIV.B_NAME	NOX Water system active
1:0086	NOX_WATER.WATER_SD.OR	NOX Water Shutdown
1:0087		
1:0088		
1:0089		
1:0090		
1:0091		
1:0092		
1:0093		
1:0094		
1:0095		
1:0096		
1:0097	EVENTS.SD_SOFT.B_NAME	CORE SUMMARY SOFT SD
1:0098	EVENTS.SD_HARD.B_NAME	CORE SUMMARY HARD SD
1:0099		** ALARMS START AT ADDRESS 100 **
1:0100	EVENTS.ALM_OUT.B_NAME	CORE SUMMARY ALARM
1:0101	ALM_MASTER.EVENT001.B_ALARM	PT Shaft Overspeed Alarm
1:0102	ALM_MASTER.EVENT002.B_ALARM	PT Shaft Overspeed Shutdown
1:0103	ALM_MASTER.EVENT003.B_ALARM	PT Speed Probe Difference Alarm
1:0104	ALM_MASTER.EVENT004.B_ALARM	All PT MPU Speed Signals Failed
1:0105	ALM_MASTER.EVENT005.B_ALARM	PT Speed Sensor A Failed
1:0106	ALM_MASTER.EVENT006.B_ALARM	PT Speed Sensor B Failed
1:0107	ALM_MASTER.EVENT007.B_ALARM	GG Shaft Overspeed Alarm
1:0108	ALM_MASTER.EVENT008.B_ALARM	GG Shaft Overspeed Shutdown
1:0109	ALM_MASTER.EVENT009.B_ALARM	GG Speed Probe Difference Alarm
1:0110	ALM_MASTER.EVENT010.B_ALARM	All GG MPU Signals Failed
1:0111	ALM_MASTER.EVENT011.B_ALARM	GG Speed Sensor A Failed
1:0112	ALM_MASTER.EVENT012.B_ALARM	GG Speed Sensor B Failed
1:0113	ALM_MASTER.EVENT013.B_ALARM	CDP Overpressure
1:0114	ALM_MASTER.EVENT014.B_ALARM	EGT Signal via AI Failed
1:0115	ALM_MASTER.EVENT015.B_ALARM	Single T/C Input for EGT Failed
1:0116	ALM_MASTER.EVENT016.B_ALARM	T/C 01 Difference ALM
1:0117	ALM_MASTER.EVENT017.B_ALARM	T/C 02 Difference ALM
1:0118	ALM_MASTER.EVENT018.B_ALARM	T/C 03 Difference ALM
1:0119	ALM_MASTER.EVENT019.B_ALARM	T/C 04 Difference ALM
1:0120	ALM_MASTER.EVENT020.B_ALARM	T/C 05 Difference ALM
1:0121	ALM_MASTER.EVENT021.B_ALARM	T/C 06 Difference ALM
1:0122	ALM_MASTER.EVENT022.B_ALARM	T/C 07 Difference ALM
1:0123	ALM_MASTER.EVENT023.B_ALARM	T/C 08 Difference ALM
1:0124	ALM_MASTER.EVENT024.B_ALARM	T/C 09 Difference ALM
1:0125	ALM_MASTER.EVENT025.B_ALARM	T/C 10 Difference ALM
1:0126	ALM_MASTER.EVENT026.B_ALARM	T/C 11 Difference ALM
1:0127	ALM_MASTER.EVENT027.B_ALARM	EGT Temp Signal LOW
1:0128	ALM_MASTER.EVENT028.B_ALARM	EGT Overtemp (Starting)

1:0129	ALM_MASTER.EVENT029.B_ALARM	EGT Overtemp (Running)
1:0130	ALM_MASTER.EVENT030.B_ALARM	Failure of 3 Adjacent T/C's
1:0131	ALM_MASTER.EVENT031.B_ALARM	EGT Spread Alarm
1:0132	ALM_MASTER.EVENT032.B_ALARM	EGT Spread Shutdown
1:0133	ALM_MASTER.EVENT033.B_ALARM	Excessive # of T/C Failed ALM
1:0134	ALM_MASTER.EVENT034.B_ALARM	Excessive # of T/C Failed SD
1:0135	ALM_MASTER.EVENT035.B_ALARM	DI Flame Detector Fault (Running)
1:0136	ALM_MASTER.EVENT036.B_ALARM	AI Flame Detector Fault (Running)
1:0137	ALM_MASTER.EVENT037.B_ALARM	External Shutdown Input
1:0138	ALM_MASTER.EVENT038.B_ALARM	Failed to Reach Rated Speed
1:0139	ALM_MASTER.EVENT039.B_ALARM	Starter Engaged - No Speed Detected
1:0140	ALM_MASTER.EVENT040.B_ALARM	Turbine Failed to Lite-Off
1:0141	ALM_MASTER.EVENT041.B_ALARM	Loss of Flame in Combustor
1:0142	ALM_MASTER.EVENT042.B_ALARM	Failed to Reach Idle Speed
1:0143	ALM_MASTER.EVENT043.B_ALARM	Loss of Load Feedback Signal
1:0144	ALM_MASTER.EVENT044.B_ALARM	Optional Stall Detection SD
1:0145	ALM_MASTER.EVENT045.B_ALARM	EGT Overtemp SW #3 setting
1:0146	ALM_MASTER.EVENT046.B_ALARM	All CDP Sensors Failed
1:0147	ALM_MASTER.EVENT047.B_ALARM	Amb Inlet Temp Snsr A Failed
1:0148	ALM_MASTER.EVENT048.B_ALARM	Amb Inlet Temp Snsr B Failed
1:0149	ALM_MASTER.EVENT049.B_ALARM	All Amb Inlet Temps Failed
1:0150	ALM_MASTER.EVENT050.B_ALARM	Unit in CALIBRATION Mode
1:0151	ALM_MASTER.EVENT051.B_ALARM	Atlas HW/OpSys Summary Fault
1:0152	ALM_MASTER.EVENT052.B_ALARM	Power Supply Low Fault
1:0153	ALM_MASTER.EVENT053.B_ALARM	Chassis High Temp ALM
1:0154	ALM_MASTER.EVENT054.B_ALARM	Configuration Error
1:0155	ALM_MASTER.EVENT055.B_ALARM	T/C #01 Failed
1:0156	ALM_MASTER.EVENT056.B_ALARM	T/C #02 Failed
1:0157	ALM_MASTER.EVENT057.B_ALARM	T/C #03 Failed
1:0158	ALM_MASTER.EVENT058.B_ALARM	T/C #04 Failed
1:0159	ALM_MASTER.EVENT059.B_ALARM	T/C #05 Failed
1:0160	ALM_MASTER.EVENT060.B_ALARM	T/C #06 Failed
1:0161	ALM_MASTER.EVENT061.B_ALARM	T/C #07 Failed
1:0162	ALM_MASTER.EVENT062.B_ALARM	T/C #08 Failed
1:0163	ALM_MASTER.EVENT063.B_ALARM	T/C #09 Failed
1:0164	ALM_MASTER.EVENT064.B_ALARM	T/C #10 Failed
1:0165	ALM_MASTER.EVENT065.B_ALARM	T/C #11 Failed
1:0166	ALM_MASTER.EVENT066.B_ALARM	Cold Junction Signal Fault
1:0167	ALM_MASTER.EVENT067.B_ALARM	GAS Fuel Valve Position Error
1:0168	ALM_MASTER.EVENT068.B_ALARM	LIQ Fuel Valve Position Error
1:0169	ALM_MASTER.EVENT069.B_ALARM	Configuration NOT Complete
1:0170	ALM_MASTER.EVENT070.B_ALARM	GAS Fuel Fault (Running on Liq)
1:0171	ALM_MASTER.EVENT071.B_ALARM	GAS Fuel Actuator Fault
1:0172	ALM_MASTER.EVENT072.B_ALARM	LIQ Fuel Fault (Running on Gas)
1:0173	ALM_MASTER.EVENT073.B_ALARM	LIQ Fuel Actuator Fault
1:0174	ALM_MASTER.EVENT074.B_ALARM	Modbus COMM Error
1:0175	ALM_MASTER.EVENT075.B_ALARM	Remote PT Setpoint Failed
1:0176	ALM_MASTER.EVENT076.B_ALARM	MW Load Input Failed
1:0177	ALM_MASTER.EVENT077.B_ALARM	Amb Turb Inlet Temp AI Failed
1:0178	ALM_MASTER.EVENT078.B_ALARM	CDP Pressure #1 Signal Failed
1:0179	ALM_MASTER.EVENT079.B_ALARM	CDP Pressure #2 Signal Failed
1:0180	ALM_MASTER.EVENT080.B_ALARM	GAS Fuel Act Pos FBDK Failed
1:0181	ALM_MASTER.EVENT081.B_ALARM	LIQ Fuel Act Pos FBDK Failed

1:0182	ALM_MASTER.EVENT082.B_ALARM	Remote MW Setpoint Failed
1:0183	ALM_MASTER.EVENT083.B_ALARM	Speed Bias Sig Failed
1:0184	ALM_MASTER.EVENT084.B_ALARM	P1 Gas Press Sig Failed
1:0185	ALM_MASTER.EVENT085.B_ALARM	NOX Water Supply Pressure Sig Failed
1:0186	ALM_MASTER.EVENT086.B_ALARM	Analog Flame Detect #1 Failed
1:0187	ALM_MASTER.EVENT087.B_ALARM	Remote GG Setpoint Failed
1:0188	ALM_MASTER.EVENT088.B_ALARM	Analog Flame Detect #2 Failed
1:0189	ALM_MASTER.EVENT089.B_ALARM	NOX Valve Feedback Sig Failed
1:0190	ALM_MASTER.EVENT090.B_ALARM	AI Menu #17 Sig Failed
1:0191	ALM_MASTER.EVENT091.B_ALARM	AI Menu #18 Sig Failed
1:0192	ALM_MASTER.EVENT092.B_ALARM	AI Menu #19 Sig Failed
1:0193	ALM_MASTER.EVENT093.B_ALARM	AI Menu #20 Sig Failed
1:0194	ALM_MASTER.EVENT094.B_ALARM	NOX Water Valve Position Error
1:0195	ALM_MASTER.EVENT095.B_ALARM	Analog Output #1 Readback Fault
1:0196	ALM_MASTER.EVENT096.B_ALARM	Analog Output #2 Readback Fault
1:0197	ALM_MASTER.EVENT097.B_ALARM	Analog Output #3 Readback Fault
1:0198	ALM_MASTER.EVENT098.B_ALARM	Analog Output #4 Readback Fault
1:0199	ALM_MASTER.EVENT099.B_ALARM	Spare
1:0200	ALM_MASTER.EVENT100.B_ALARM	Spare
1:0201	ALM_MASTER.EVENT101.B_ALARM	Direct AI #01 Signal Fault
1:0202	ALM_MASTER.EVENT102.B_ALARM	Direct AI #02 Signal Fault
1:0203	ALM_MASTER.EVENT103.B_ALARM	Direct AI #03 Signal Fault
1:0204	ALM_MASTER.EVENT104.B_ALARM	Direct AI #04 Signal Fault
1:0205	ALM_MASTER.EVENT105.B_ALARM	Direct AI #05 Signal Fault
1:0206	ALM_MASTER.EVENT106.B_ALARM	Direct AI #06 Signal Fault
1:0207	ALM_MASTER.EVENT107.B_ALARM	Direct AI #07 Signal Fault
1:0208	ALM_MASTER.EVENT108.B_ALARM	Direct AI #08 Signal Fault
1:0209	ALM_MASTER.EVENT109.B_ALARM	Direct T/C #01 Signal Fault
1:0210	ALM_MASTER.EVENT110.B_ALARM	Direct T/C #02 Signal Fault
1:0211	ALM_MASTER.EVENT111.B_ALARM	Direct T/C #03 Signal Fault
1:0212	ALM_MASTER.EVENT112.B_ALARM	Direct T/C #04 Signal Fault
1:0213	ALM_MASTER.EVENT113.B_ALARM	Direct T/C #05 Signal Fault
1:0214	ALM_MASTER.EVENT114.B_ALARM	Direct T/C #06 Signal Fault
1:0215	ALM_MASTER.EVENT115.B_ALARM	Direct T/C #07 Signal Fault
1:0216	ALM_MASTER.EVENT116.B_ALARM	Direct T/C #08 Signal Fault
1:0217	ALM_MASTER.EVENT117.B_ALARM	Direct T/C #09 Signal Fault
1:0218	ALM_MASTER.EVENT118.B_ALARM	Direct T/C #10 Signal Fault
1:0219	ALM_MASTER.EVENT119.B_ALARM	Direct T/C #11 Signal Fault
1:0220	ALM_MASTER.EVENT120.B_ALARM	Direct RTD #01 Signal Fault
1:0221	ALM_MASTER.EVENT121.B_ALARM	Direct RTD #02 Signal Fault
1:0222	ALM_MASTER.EVENT122.B_ALARM	
1:0223	ALM_MASTER.EVENT123.B_ALARM	
1:0224	ALM_MASTER.EVENT124.B_ALARM	
1:0225	ALM_MASTER.EVENT125.B_ALARM	
1:0226	ALM_MASTER.EVENT126.B_ALARM	
1:0227	ALM_MASTER.EVENT127.B_ALARM	
1:0228	ALM_MASTER.EVENT128.B_ALARM	
1:0229	ALM_MASTER.EVENT129.B_ALARM	
1:0230	ALM_MASTER.EVENT130.B_ALARM	
1:0231	ALM_MASTER.EVENT131.B_ALARM	
1:0232	ALM_MASTER.EVENT132.B_ALARM	
1:0233	ALM_MASTER.EVENT133.B_ALARM	
1:0234	ALM_MASTER.EVENT134.B_ALARM	

1:0235 ALM_MASTER.EVENT135.B_ALARM
1:0236 ALM_MASTER.EVENT136.B_ALARM
1:0237 ALM_MASTER.EVENT137.B_ALARM
1:0238 ALM_MASTER.EVENT138.B_ALARM
1:0239 ALM_MASTER.EVENT139.B_ALARM
1:0240 ALM_MASTER.EVENT140.B_ALARM
1:0241 ALM_MASTER.EVENT141.B_ALARM
1:0242 ALM_MASTER.EVENT142.B_ALARM
1:0243 ALM_MASTER.EVENT143.B_ALARM
1:0244 ALM_MASTER.EVENT144.B_ALARM
1:0245 ALM_MASTER.EVENT145.B_ALARM
1:0246 ALM_MASTER.EVENT146.B_ALARM
1:0247 ALM_MASTER.EVENT147.B_ALARM
1:0248 ALM_MASTER.EVENT148.B_ALARM
1:0249 ALM_MASTER.EVENT149.B_ALARM
1:0250 ALM_MASTER.EVENT150.B_ALARM
1:0251 ALM_MASTER.EVENT151.B_ALARM
1:0252 ALM_MASTER.EVENT152.B_ALARM
1:0253 ALM_MASTER.EVENT153.B_ALARM
1:0254 ALM_MASTER.EVENT154.B_ALARM
1:0255 ALM_MASTER.EVENT155.B_ALARM
1:0256 ALM_MASTER.EVENT156.B_ALARM
1:0257 ALM_MASTER.EVENT157.B_ALARM
1:0258 ALM_MASTER.EVENT158.B_ALARM
1:0259 ALM_MASTER.EVENT159.B_ALARM
1:0260 ALM_MASTER.EVENT160.B_ALARM
1:0261 ALM_MASTER.EVENT161.B_ALARM
1:0262 ALM_MASTER.EVENT162.B_ALARM
1:0263 ALM_MASTER.EVENT163.B_ALARM
1:0264 ALM_MASTER.EVENT164.B_ALARM
1:0265 ALM_MASTER.EVENT165.B_ALARM
1:0266 ALM_MASTER.EVENT166.B_ALARM
1:0267 ALM_MASTER.EVENT167.B_ALARM
1:0268 ALM_MASTER.EVENT168.B_ALARM
1:0269 ALM_MASTER.EVENT169.B_ALARM
1:0270 ALM_MASTER.EVENT170.B_ALARM
1:0271 ALM_MASTER.EVENT171.B_ALARM
1:0272 ALM_MASTER.EVENT172.B_ALARM
1:0273 ALM_MASTER.EVENT173.B_ALARM
1:0274 ALM_MASTER.EVENT174.B_ALARM
1:0275 ALM_MASTER.EVENT175.B_ALARM
1:0276 ALM_MASTER.EVENT176.B_ALARM
1:0277 ALM_MASTER.EVENT177.B_ALARM
1:0278 ALM_MASTER.EVENT178.B_ALARM
1:0279 ALM_MASTER.EVENT179.B_ALARM
1:0280 ALM_MASTER.EVENT180.B_ALARM
1:0281 ALM_MASTER.EVENT181.B_ALARM
1:0282 ALM_MASTER.EVENT182.B_ALARM
1:0283 ALM_MASTER.EVENT183.B_ALARM
1:0284 ALM_MASTER.EVENT184.B_ALARM
1:0285 ALM_MASTER.EVENT185.B_ALARM
1:0286 ALM_MASTER.EVENT186.B_ALARM
1:0287 ALM_MASTER.EVENT187.B_ALARM

1:0288	ALM_MASTER.EVENT188.B_ALARM
1:0289	ALM_MASTER.EVENT189.B_ALARM
1:0290	ALM_MASTER.EVENT190.B_ALARM
1:0291	ALM_MASTER.EVENT191.B_ALARM
1:0292	ALM_MASTER.EVENT192.B_ALARM
1:0293	ALM_MASTER.EVENT193.B_ALARM
1:0294	ALM_MASTER.EVENT194.B_ALARM
1:0295	ALM_MASTER.EVENT195.B_ALARM
1:0296	ALM_MASTER.EVENT196.B_ALARM
1:0297	ALM_MASTER.EVENT197.B_ALARM
1:0298	ALM_MASTER.EVENT198.B_ALARM
1:0299	ALM_MASTER.EVENT199.B_ALARM
1:0300	ALM_MASTER.EVENT200.B_ALARM

Analog Reads (RPTar)

Addr	Input	Description
3:0001	ACCEL_DEC.ACCEL_OUT.A_NAME	ACCEL CONTROL
3:0002	ACCEL_DEC.DECEL_OUT.A_NAME	DECEL CONTROL
3:0003	START_MODE.START_CTRL.A_NAME	START RAMP CONTROL
3:0004	DISPLAY.CDPHSS.A_SW	CDP HIGH SIGNAL SELECT
3:0005	DRIVER.GAS_DMD.A_NAME	GAS VALVE DEMAND
3:0006	DRIVER.LIQ_DMD.A_NAME	LIQUID VALVE DEMAND
3:0007	DRIVER.VLV_DMND.A_NAME	VALVE DEMAND
3:0008	DISPLAY.EGT_AVG.A_SW	EGT AVERAGE
3:0009	EGT.EGT_PID.A_NAME	EGT CONTROL
3:0010	DISPLAY.EGT_SPRD.A_SW	EGT SPREAD
3:0011	MAX_LIM.CDPCURVLIM.A_NAME	CDP vs FUEL MAX LIMIT
3:0012	CDP.CDP_PID.A_NAME	CDP TOPPING CONTROL
3:0013	GG_CNTRL.GG_SPD.A_NAME	GG SPEED HIGH SIGNAL SELECT
3:0014	GG_CNTRL.GG_PID.A_NAME	GG SPEED CONTROL
3:0015	GG_REF.GG_REF.A_NAME	GG SPEED REFERENCE
3:0016	LOAD_LIM.RATE_CHANG.RATE_LIMIT	MAX MW Control Limit Setpoint
3:0017	DROOP.MW_MINVAL.A_MAX	Load Output
3:0018	VG_CNTRL.VG_DMD.A_NAME	Variable Geometry Demand
3:0019	NOX_WATER.WTR_RATIO.A_MUX_N_1	NOX WATER RATIO
3:0020	NOX_WATER.WATERBIAS.A_NAME	NOX WATER BIAS
3:0021	NOX_WATER.WTRDMD.A_NAME	NOX WATER DEMAND
3:0022	PT_CNTRL.PT_SPD.A_NAME	PT SPEED HIGH SIGNAL SELECT
3:0023	PT_CNTRL.PT_PID.A_NAME	PT SPEED CONTROL
3:0024	PT_REF.PTREF.RAMP	PT SPEED REFERENCE
3:0025		
3:0026		
3:0027	EVENTS.AL_FRSTOUT.A_NAME	First Alarm to set Latch (#)
3:0028	EVENTS.OB_FRSTOUT.A_NAME	First Soft Shutdown to Latch (#)
3:0029	EVENTS.SD_FRSTOUT.A_NAME	First Hard Shutdown to Latch (#)
3:0030	DISPLAY.EGT_REF.A_SW	EGT REFERENCE
3:0031	DRIVER.LSS_1.LSS_BUS	Fuel Demand LSS Bus 1
3:0032	DRIVER.HSS.HSS_BUS	Fuel Demand HSS Bus
3:0033	DRIVER.LSS_2.LSS_BUS	Fuel Demand LSS Bus 2
3:0034	DISPLAY.AMBTEMPANY.A_SW	Ambient Inlet Temp (Any type)
3:0035	DROOP.MW_VAL.A_NAME	Turbine MW Load (Snsr or Calc)
3:0036	ACCEL_DEC.DERIV_GG.LAG_2	Derivative of GG Speed

3:0037	ACCEL_DEC.DRY_STM_SW.A_SW	GG Accel Reference Setpoint
3:0038	ACCEL_DEC.DECELSCHED.CURVES_2	GG Decel Reference Setpoint
3:0039	ACCEL_DEC.FUEL_DCURV.A_SW	Fuel Decel Limit Curve (vs CDP)
3:0040	COND_MON.STRT_ATTMT.A_NAME	Turbine Start Attempts
3:0041	COND_MON.FIRE_STRTS.A_NAME	Turbine Number of Fired Starts
3:0042	COND_MON.TRUNHRS.A_NAME	Turbine Run Hours (accumulated)
3:0043	COND_MON.SD_NUM.A_NAME	Turbine CORE Shutdowns (accumulated)
3:0044	A01_CPU.TO_MODBUS.OUT_1	Real Time Clock - Year
3:0045	A01_CPU.TO_MODBUS.OUT_2	Real Time Clock - Month
3:0046	A01_CPU.TO_MODBUS.OUT_3	Real Time Clock - Day
3:0047	A01_CPU.TO_MODBUS.OUT_4	Real Time Clock - Hours
3:0048	A01_CPU.TO_MODBUS.OUT_5	Real Time Clock - Minutes
3:0049	A01_CPU.TO_MODBUS.OUT_6	Real Time Clock - Seconds
3:0050		*** Atlas H/W Analog Signals ***
3:0051	A01_CPU.GG_A.TSS_ATL	GG SPEED PROBE A
3:0052	A01_CPU.GG_B.TSS_ATL	GG SPEED PROBE B
3:0053	A01_CPU.AI_01.AI_420_ATL	Main Channel AI 1 (x10 Mult)
3:0054	A01_CPU.AI_02.AI_420_ATL	Main Channel AI 2 (x10 Mult)
3:0055	A01_CPU.AI_03.AI_420_ATL	Main Channel AI 3 (x10 Mult)
3:0056	A01_CPU.AI_04.AI_420_ATL	Main Channel AI 4 (x10 Mult)
3:0057	A01_CPU.AI_05.AI_420_ATL	Main Channel AI 5 (x10 Mult)
3:0058	A01_CPU.AI_06.AI_420_ATL	Main Channel AI 6 (x10 Mult)
3:0059	A01_CPU.AO_01.DISPLAY	Main Chan AO 1 (x10 Mult)
3:0060	A01_CPU.AO_02.DISPLAY	Main Chan AO 2 (x10 Mult)
3:0061	A01_CPU.AO_03.DISPLAY	Main Chan AO 3 (x10 Mult)
3:0062	A01_CPU.AO_04.DISPLAY	Main Chan AO 4 (x10 Mult)
3:0063	A01_CPU.ACT_01.ACT_ATL	GAS FUEL VALVE DEMAND (x10 Mult)
3:0064	A01_CPU.ACT_02.ACT_ATL	LIQUID FUEL VALVE DEMAND (x10 Mult)
3:0065		
3:0066		
3:0067	A03_COMBO.PT_A.TSS_ATL	PT SPEED PROBE A
3:0068	A03_COMBO.PT_B.TSS_ATL	PT SPEED PROBE B
3:0069	DISPLAY.TC01.A_SW	EGT T/C #1
3:0070	DISPLAY.TC02.A_SW	EGT T/C #2
3:0071	DISPLAY.TC03.A_SW	EGT T/C #3
3:0072	DISPLAY.TC04.A_SW	EGT T/C #4
3:0073	DISPLAY.TC05.A_SW	EGT T/C #5
3:0074	DISPLAY.TC06.A_SW	EGT T/C #6
3:0075	DISPLAY.TC07.A_SW	EGT T/C #7
3:0076	DISPLAY.TC08.A_SW	EGT T/C #8
3:0077	DISPLAY.TC09.A_SW	EGT T/C #9
3:0078	DISPLAY.TC10.A_SW	EGT T/C #10
3:0079	DISPLAY.TC11.A_SW	EGT T/C #11
3:0080	DISPLAY.RTD01.A_SW	AMBIENT TURB INLET TEMP A (RTD)
3:0081	DISPLAY.RTD02.A_SW	AMBIENT TURB INLET TEMP B (RTD)
3:0082		CUSTOMER CONFIGURABLE RTD
3:0083		
3:0084	DISPLAY.CJ01.A_SW	T/C COLD JUNCTION SENSOR
3:0085	A03_COMBO.AO_05.DISPLAY	CONFIGURABLE READOUT AO 5
3:0086	A03_COMBO.AO_06.DISPLAY	CONFIGURABLE READOUT AO 6
3:0087		
3:0088		

3:0089		
3:0090		
3:0091		
3:0092		
3:0093		
3:0094		
3:0095		
3:0096		
3:0097		
3:0098		
3:0099		
3:0100		
3:0101	AI_MUX.MUX_AI.OUT_1	AI Menu Item 01
3:0102	AI_MUX.MUX_AI.OUT_2	AI Menu Item 02
3:0103	AI_MUX.MUX_AI.OUT_3	AI Menu Item 03
3:0104	AI_MUX.MUX_AI.OUT_4	AI Menu Item 04
3:0105	AI_MUX.MUX_AI.OUT_5	AI Menu Item 05
3:0106	AI_MUX.MUX_AI.OUT_6	AI Menu Item 06
3:0107	AI_MUX.MUX_AI.OUT_7	AI Menu Item 06
3:0108	AI_MUX.MUX_AI.OUT_8	AI Menu Item 08
3:0109	AI_MUX.MUX_AI.OUT_9	AI Menu Item 09
3:0110	AI_MUX.MUX_AI.OUT_10	AI Menu Item 10
3:0111	AI_MUX.MUX_AI.OUT_11	AI Menu Item 11
3:0112	AI_MUX.MUX_AI.OUT_12	AI Menu Item 12
3:0113	AI_MUX.MUX_AI.OUT_13	AI Menu Item 13
3:0114	AI_MUX.MUX_AI.OUT_14	AI Menu Item 14
3:0115	AI_MUX.MUX_AI.OUT_15	AI Menu Item 15
3:0116	AI_MUX.MUX_AI.OUT_16	AI Menu Item 16
3:0117	AI_MUX.MUX_AI.OUT_17	AI Menu Item 17
3:0118	AI_MUX.MUX_AI.OUT_18	AI Menu Item 18
3:0119	AI_MUX.MUX_AI.OUT_19	AI Menu Item 19
3:0120	AI_MUX.MUX_AI.OUT_20	AI Menu Item 20

Analog Writes (RPTaw)

Addr	Description
4:0001	Analog Out #1 Force
4:0002	Analog Out #2 Force
4:0003	Analog Out #3 Force
4:0004	Analog Out #4 Force
4:0005	Analog Out #5 Force
4:0006	Analog Out #6 Force
4:0007	Analog Out #7 Force
4:0008	Analog Out #8 Force
4:0009	Analog Out #9 Force
4:0010	Analog Out #10 Force
4:0011	Analog Out #11 Force
4:0012	Analog Out #12 Force
4:0013	Actuator Out #1 Force
4:0014	Actuator Out #2 Force
4:0015	Fuel Valve Manual Stroke
4:0016	MW Setpoint
4:0017	

4:0018	
4:0019	
4:0020	
4:0021	Customer Defined Demand to AO 01
4:0022	Customer Defined Demand to AO 02
4:0023	Customer Defined Demand to AO 03
4:0024	Customer Defined Demand to AO 04
4:0025	Customer Defined Demand to AO 05
4:0026	Customer Defined Demand to AO 06
4:0027	
4:0028	
4:0029	
4:0030	

Appendix C.
Event List

When an alarm occurs, relay driver output turns on. The RESET will turn the alarm off if the alarm condition has been removed.

EVENT Number	DESCRIPTION	DEFAULT	SITE SETTING
AL_001	PT Shaft Overspeed Alarm		
AL_002	PT Shaft Overspeed Shutdown	SD	
AL_003	PT Speed Probe Difference Alarm		
AL_004	All PT MPU Speed Signals Failed	SD	
AL_005	PT Speed Sensor A Failed		
AL_006	PT Speed Sensor B Failed		
AL_007	GG Shaft Overspeed Alarm		
AL_008	GG Shaft Overspeed Shutdown	SD	
AL_009	GG Speed Probe Difference Alarm		
AL_010	All GG MPU Signals Failed	SD	
AL_011	GG Speed Sensor A Failed		
AL_012	GG Speed Sensor B Failed		
AL_013	CDP Overpressure	SD	
AL_014	EGT Signal via AI Failed	SD	
AL_015	Single T/C Input for EGT Failed	SD	
AL_016	T/C 01 Difference ALM		
AL_017	T/C 02 Difference ALM		
AL_018	T/C 03 Difference ALM		
AL_019	T/C 04 Difference ALM		
AL_020	T/C 05 Difference ALM		
AL_021	T/C 06 Difference ALM		
AL_022	T/C 07 Difference ALM		
AL_023	T/C 08 Difference ALM		
AL_024	T/C 09 Difference ALM		
AL_025	T/C 10 Difference ALM		
AL_026	T/C 11 Difference ALM		
AL_027	EGT Temp Signal LOW		
AL_028	EGT Overtemp (Starting)		
AL_029	EGT Overtemp (Running)	SD	
AL_030	Failure of 3 Adjacent T/C's		
AL_031	EGT Spread Alarm		
AL_032	EGT Spread Shutdown		
AL_033	Excessive # of T/C Failed ALM		
AL_034	Excessive # of T/C Failed SD	SD	
AL_035	DI Flame Detector Fault (Running)		
AL_036	AI Flame Detector Fault (Running)		
AL_037	External Shutdown Input	SD	
AL_038	Failed to Reach Rated Speed	SD	
AL_039	Starter Engaged - No Speed Detected	SD	
AL_040	Turbine Failed to Lite-Off	SD	
AL_041	Loss of Flame in Combustor	SD	
AL_042	Failed to Reach Idle Speed	SD	
AL_043	Loss of Load Feedback Signal		
AL_044	Optional Stall Detection SD	SD	
AL_045	EGT Overtemp SW #3 setting		
AL_046	All CDP Sensors Failed	SD	

AL_047	Amb Inlet Temp Snsr A Failed		
AL_048	Amb Inlet Temp Snsr B Failed		
AL_049	All Amb Inlet Temps Failed		
AL_050	Unit in Calibration Mode		
AL_051	Atlas HW/OpSys Summary Fault	SD	
AL_052	Power Supply Low Fault		
AL_053	Chassis High Temp ALM		
AL_054	Configuration Error	SD	
AL_055	T/C #01 Failed		
AL_056	T/C #02 Failed		
AL_057	T/C #03 Failed		
AL_058	T/C #04 Failed		
AL_059	T/C #05 Failed		
AL_060	T/C #06 Failed		
AL_061	T/C #07 Failed		
AL_062	T/C #08 Failed		
AL_063	T/C #09 Failed		
AL_064	T/C #10 Failed		
AL_065	T/C #11 Failed		
AL_066	Cold Junction Signal Fault		
AL_067	GAS Fuel Valve Position Error		
AL_068	LIQ Fuel Valve Position Error		
AL_069	Configuration NOT Complete	SD	
AL_070	GAS Fuel Fault (Running on Liq)		
AL_071	GAS Fuel Actuator Fault	SD	
AL_072	LIQ Fuel Fault (Running on Gas)		
AL_073	LIQ Fuel Actuator Fault	SD	
AL_074	Modbus Communication Error		
AL_075	Remote PT Setpoint Failed		
AL_076	MW Load Input Failed		
AL_077	Amb Turb Inlet Temp AI Failed		
AL_078	CDP Pressure #1 Signal Failed		
AL_079	CDP Pressure #2 Signal Failed		
AL_080	GAS Fuel Act Pos FBDK Failed		
AL_081	LIQ Fuel Act Pos FBDK Failed		
AL_082	Remote MW Setpoint Failed		
AL_083	Speed Bias Sig Failed		
AL_084	P1 Gas Press Sig Failed		
AL_085	NOX Water Supply Pressure Sig Failed		
AL_086	Analog Flame Detect #1 Failed		
AL_087	Remote GG Setpoint Failed		
AL_088	Analog Flame Detect #2 Failed		
AL_089	NOX Valve Feedback Sig Failed		
AL_090	AI Menu #17 Sig Failed		
AL_091	AI Menu #18 Sig Failed		
AL_092	AI Menu #19 Sig Failed		
AL_093	AI Menu #20 Sig Failed		
AL_094	NOX Water Valve Position Error		
AL_095	Analog Output #1 Readback Fault		
AL_096	Analog Output #2 Readback Fault		
AL_097	Analog Output #3 Readback Fault		
AL_098	Analog Output #4 Readback Fault		
AL_099	Remote NOX Valve/Driver Fault		
AL_100	Spare		
AL_101	Direct AI #01 Signal Fault		
AL_102	Direct AI #02 Signal Fault		
AL_103	Direct AI #03 Signal Fault		

AL_104	Direct AI #04 Signal Fault		
AL_105	Direct AI #05 Signal Fault		
AL_106	Direct AI #06 Signal Fault		
AL_107	Direct AI #07 Signal Fault		
AL_108	Direct AI #08 Signal Fault		
AL_109	Direct T/C #01 Signal Fault		
AL_110	Direct T/C #02 Signal Fault		
AL_111	Direct T/C #03 Signal Fault		
AL_112	Direct T/C #04 Signal Fault		
AL_113	Direct T/C #05 Signal Fault		
AL_114	Direct T/C #06 Signal Fault		
AL_115	Direct T/C #07 Signal Fault		
AL_116	Direct T/C #08 Signal Fault		
AL_117	Direct T/C #09 Signal Fault		
AL_118	Direct T/C #10 Signal Fault		
AL_119	Direct T/C #11 Signal Fault		
AL_120	Direct RTD #01 Signal Fault		
AL_121	Direct RTD #02 Signal Fault		
AL_122	Spare		
AL_123	Spare		
AL_124	Spare		
AL_125	Spare		
AL_126	Spare		
AL_127	Spare		
AL_128	Spare		
AL_129	Spare		
AL_130	Spare		
AL_131	Spare		
AL_132	Spare		
AL_133	Spare		
AL_134	Spare		
AL_135	Spare		
AL_136	Spare		
AL_137	Spare		
AL_138	Spare		
AL_139	Spare		
AL_140	Spare		
AL_141	Spare		
AL_142	Spare		
AL_143	Spare		
AL_144	Spare		
AL_145	Spare		
AL_146	Spare		
AL_147	Spare		
AL_148	Spare		
AL_149	Spare		
AL_150	Spare		

Appendix D.
Configuration and Service Tunables Worksheet

Control Part Number _____

Control Serial Number _____

I/O CONFIGURATION NOTES

MPUs:
GG MPUs: Maximum frequency sensing = 25000 Hz
PT MPUs: Maximum frequency sensing = 25000 Hz

CONFIGURE WORKSHEETS
The following section outlines optional configurations that can be adjusted in this standard control. These should be checked at the site to be sure they are correct for the turbine being controlled. The default value and range are shown for each tunable.

System Configuration Parameters

	Units	Default	Site Value
GG Speed Setpoints			
GG Overspeed Trip Setting	RPM	10200	
SD Reset allowed when GG Speed less than	RPM	1000	
GG Speed Probe Settings			
Maximum Detectable Speed	RPM	10500	
Number of Gear Teeth		47	
Gear Ratio		1.00	
Use GG Speed Probe B ?		Yes	
Maximum Detectable Speed	RPM	10500	
Number of Gear Teeth	RPM	47	
Gear Ratio		1.00	
PT Speed Setpoints			
PT Overspeed Trip Setting	RPM	4100	
PT Rated Speed	RPM	3600	
PT Speed Probe Settings			
Maximum Detectable Speed	RPM	5000	
Number of Gear Teeth		83	
Gear Ratio		1.00	
Use PT Speed Probe B ?		Yes	
Maximum Detectable Speed	RPM	5000	
Number of Gear Teeth	RPM	83	
Gear Ratio		1.00	
Configure EGT Settings			
Select Type of EGT Signal			
Analog 4–20 mA			
Single T/C Harness			
Individual T/C		X	
Number of T/C EGT Inputs		8	
T/C Type		K	
Temp Units (F or C)	Deg	F	
Action on Open Wire (Fail Hi/Fail Lo)		Fail Hi	
Set Min Temp Value	Deg	-100	
Set Max Temp Value	Deg	2000	
EGT Overtemp Setpoint	Deg	1600	

System Configuration Parameters

	Units	Default	Site Value
System Functions			
Fuel Type Gas/Liquid/Dual		Dual	
Type of NOX Control		None	
Use Modbus Input Commands		Yes	
Set PT Rated Speed Setpoint	RPM	3600	
Display Temps in Deg C		No	
Shutdown Relay Output indicates SD		Yes	
Enable Stall Detection based on CDP Deriv		Yes	
Turbine Stall Detection Schedule (if Used)		LM2500	

System Setup Parameters

	Units	Default	Site Value
Primary Droop is MW Load Droop			
Enter Droop Percentage	%	5.00	
Secondary Droop - CDP Curve or Actuator		CDP	
Unit Load Settings			
Enter MAX Rated MW of Unit	MW	25.00	

Minimum MW Load Setpoint	MW	1.00	
Unit is Generator or Compressor		GEN	
Action at GEN Breaker Closure			
Step to Min Load		X	
Ramp to Base Load			
Select Flame Detection Method			
EGT > 400 Deg F		X	
Discrete Input Flame Sensors			
Analog Input Flame Sensors			
if so set Signal threshold for Flame	mA	7.00	
Use GG Speed Switch			
if so set GG Speed Switch Setpoint	RPM	3200	
GG Speed Settings			
Auto Override of GG Faults until FUEL ON		Yes	
GG Speed Signal Failed Lower Limit	RPM	500	
GG Speed Signal Failed Upper Limit	RPM	10400	
Spread Setpoint for Speed Difference Alarm	RPM	1000	
Overspeed Alarm Setpoint	RPM	10100	
Reset of SD allowed w/ GG Speed less than	RPM	1000	view only
GG Speed Reference Settings			
GG Idle (Lower Limit of GG Reference)	RPM	6000	
Upper GG Reference Limit	RPM	10000	
Default GG Ref Ramp Rate	rpm/sec	20	
Fast GG Ref Ramp Rate	rpm/sec	50	
Upper Limit for Corrected GG Reference	RPM	10100	
Use Remote GG Reference Setpoint		No	
Use Remote GG Ref Directly (Not thru DB)		No	

System Setup Parameters

	Units	Default	Site Value
PT Speed Settings			
Auto Override of PT Speed Faults		Yes	
PT Speed Signal Failed Lower Limit	RPM	275	
PT Speed Signal Failed Upper Limit	RPM	4200	
Spread Setpoint for Speed Difference Alarm	RPM	1000	
PT Overspeed Alarm Setpoint	RPM	3960	
Override PT Sensors until GG Speed =	RPM	6000	
PT Speed Reference Settings			
Lower PT Reference Limit	RPM	3500	
Upper PT Reference Limit	RPM	3780	
Default PT Ref Ramp Rate	rpm/sec	2.00	
Fast PT Ref Ramp Rate	rpm/sec	4.00	
Start Ramp Setup			
Use Electric Valve Liteoff Position		Yes	
Start Ramp Rate	%/sec	0.30	
Set Start Ramp Position 2 for Gas	%	2.00	
Set Start Ramp Position 2 for Liquid	%	2.00	
Fuel Settings for Lite-Off			
Minimum Liquid Fuel Demand (Position 1)	%	3.00	
Minimum Gas Fuel Demand (Position 1)	%	4.00	
Time to wait for Flame Detect on Liquid	sec	15.00	
Time to wait for Flame Detect on Gas	sec	10.00	

System Setup Parameters

	Units	Default	Site Value
EGT Options and Temp Settings			

Number of TC Used (from Configuration)			
Use 3 Adjacent T/C's Failed SD Logic		No	
T/C Sensor Failed Low Setpoint	Deg		
T/C Sensor Failed High Setpoint	Deg		
Max Number of TC's Failed Alarm			
Max Number of TC's Failed Shutdown			
Hi Delta - Discard T/C over average by this	Deg		
LO Delta - Discard T/C below average by this	Deg		
Disable all Spread Events		No	
Spread Alarm Setpoint (Highest-Lowest)	Deg	120	
Spread Shutdown Setpoint (Highest-Lowest)	Deg	140	
Analog 4–20 EGT Sensor Failed low setpoint	Deg	100	
EGT Start Overtemp Alarm Setpoint	Deg	1580	
EGT Overtemp Setpoint (Set in Configure)		display	
EGT Temp Switch 1 Setpoint	Deg	400	
EGT Temp Switch 2 Setpoint	Deg	1000	
EGT Temp Switch 3 Setpoint	Deg	1500	
Use Remote CJ Compensation on T/C		No	

Ambient Inlet Temperature Signal Setup

Select Type of Ambient Temp Signal		1	
Type Selected		display	
Default Amb Temp Value (if signal failed)	Deg	80	

Configuration of Discrete Inputs

Each Discrete Input can be assigned via a menu selection of the following choices:
0 = Unused Channel
1 = Emergency Shutdown
2 = Start/Run Command
3 = Reset Command
4 = Acknowledge Command
5 = Lower GG Speed Reference
6 = Raise GG Speed Reference
7 = GG Speed Reference Fast Rate
8 = GG Speed Reference Instant Rate
9 = Lower PT Speed Reference
10 = Raise PT Speed Reference
11 = PT Speed Reference Fast Rate
12 = Override GG Sensor Faults
13 = Override PT Sensor Faults
14 = Fuel Selection (True = Liquid)
15 = Enable Remote PT Speed Setpoint
16 = Enable External Synchronizer
17 = GEN Breaker Closed (Aux 52)
18 = Utility Breaker OPEN / LS Enable
19 = Discrete Flame Detector #1
20 = Discrete Flame Detector #2
21 = Enable MW/Load Control
22 = Enable Remote MW/Load Setpoint
23 = Go to Rated Speed
24 = Enable NOX Control
25 = NOX Bias Lower Command
26 = NOX Bias Raise Command
27 = Discrete Start Permissive
28 = Hold Fuel Valve at Position #2
29 = PT Speed Reference at Instant Rate

Input	Default	Site Value
DI 01	1	
DI 02	2	
DI 03	3	
DI 04	4	
DI 05	5	
DI 06	6	
DI 07	7	
DI 08	8	
DI 09	9	
DI 10	10	
DI 11	11	
DI 12	12	
DI 13	13	
DI 14	14	
DI 15	15	
DI 16	16	
DI 17	17	
DI 18	18	
DI 19	19	
DI 20	20	
DI 21	21	
DI 22	22	
DI 23	23	
DI 24	24	

30 = Water Valve Driver Fault

Configuration of Analog 4–20 mA Inputs

Each Analog Input can be assigned via a menu selection of the following choices:
0 = Unused Channel
1 = EGT Summary Signal
2 = Remote PT Speed Reference Setpoint
3 = MW Load Signal
4 = Ambient Inlet Temp
5 = CDP Pressure Sensor #1
6 = CDP Pressure Sensor #2
7 = Gas Fuel Valve Position Feedback
8 = Liquid Fuel Valve Position Feedback
9 = Remote MW Setpoint
10 = Speed Sync Bias Input
11 = Inlet Supply Gas Pressure (P1)
12 = NOX Water Supply Pressure
13 = Analog Flame Detector #1
14 = Remote GG Speed Ref Setpoint
15 = Analog Flame Detector #2
16 = NOX Water Valve Position Feedback
17 = TBD
18 = TBD
19 = TBD
20 = TBD

	Input	Default	Site Value
AI 01		0	
AI 02		0	
AI 03		3	
AI 04		0	
AI 05		5	
AI 06		0	
AI 07		7	
AI 08		8	

Configure Analog Input #1

Function Selection for AI 01		0	
Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configure Analog Input #2

Function Selection for AI 02		0	
Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configuration of Analog 4–20 mA Inputs

Configure Analog Input #3

	Input	Default	Site Value
Function Selection for AI 03		3	
Value at 4 mA		0.00	
Value at 20 mA		50.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configure Analog Input #4

Function Selection for AI 04		0	
Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configure Analog Input #5

Function Selection for AI 05		5	
Value at 4 mA		0.00	
Value at 20 mA		300.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configure Analog Input #6

Function Selection for AI 06		0	
Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configure Analog Input #7

Function Selection for AI 07		0	
Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configuration of Analog 4–20 mA Inputs

	Input	Default	Site Value

Configure Analog Input #8

Function Selection for AI 08		0	
Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Lag Tau delay Value (sec)		0.00	
Signal Offset		0.00	
Signal Gain		1.00	

Calibration of Thermocouple Inputs

	Units	Default	Site Value

EGT TC Input #1

Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	

EGT TC Input #2

Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	

EGT TC Input #3

Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	

EGT TC Input #4

Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	

EGT TC Input #5

Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	

Calibration of Thermocouple Inputs

	Input	Default	Site

			Value
EGT TC Input #6			
Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	
EGT TC Input #7			
Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	
EGT TC Input #8			
Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	
EGT TC Input #9			
Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	
EGT TC Input #10			
Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	
EGT TC Input #11			
Gain		1.00	
Offset		0.00	
Delay on Signal Fault	ms	500.00	

Calibration of RTD Inputs

	Units	Default	Site Value
RTD Input #1			
Select RTD Type (100 or 200 ohm)		100	
Select Temp units (F or C)		F	
Select RTD Curve (A or E)		E	
RTD #1 Low Value Fault	Deg	-40	
RTD #1 High Value Fault	Deg	1000	
Latch delay on signal failed	ms	500.00	
Lag Tau input filter (sec)		1.00	
Offset		0.00	
Gain		1.00	
RTD Input #2			
Select RTD Type (100 or 200 ohm)		100	
Select Temp units (F or C)		F	
Select RTD Curve (A or E)		E	
RTD #2 Low Value Fault	Deg	-40	
RTD #2 High Value Fault	Deg	1000	
Latch delay on signal failed	ms	500.00	
Lag Tau input filter (sec)		1.00	
Offset		0.00	
Gain		1.00	

Gas Fuel Actuator/Valve

	Units	Default	Site Value
Select Gas Fuel Actuator/Valve Type			
Actuator #1 Main Board		X	
CAN Device #1 VPC to GS6/GS16			
CAN Device #2 Link to DVP Driver			
Actuator #1 Gas Fuel			
Select range 0-20 or 0-200 mA		0-20 mA	

Actuator #1 mA at 0% Demand	mA	4.00	
Actuator #1 mA at 100% Demand	mA	20.00	
Actuator #1 Gain		1.00	
Actuator #1 Offset		0.00	
Actuator #1 Dither	mA	0.00	

CAN Link to GS6 or GS16 Gas Fuel Valve

Use CAN Communication to GS Valve		No	
Max Resolver FDBK difference SD	Deg	1	

CAN Link to DVP Driver

Use CAN Communication to DVP Driver		No	

Liquid Fuel Actuator/Valve

	Units	Default	Site Value
Actuator #2 Gas Fuel			
Select range 0-20 or 0-200 mA		0-20 mA	
Actuator #2 mA at 0% Demand	mA	4.00	
Actuator #2 mA at 100% Demand	mA	20.00	
Actuator #2 Gain		1.00	
Actuator #2 Offset		0.00	
Actuator #2 Dither	mA	0.00	

Configuration of Discrete Relay Outputs

Each Output Relay can be assigned via a menu selection of the following choices:
1 = Unit is Shutdown (Hard SD)
2 = Alarm Summary
3 = EGT Temp Switch #1
4 = EGT Temp Switch #2
5 = EGT Temp Switch #3
6 = PT Speed Switch #1
7 = PT Speed Switch #2
8 = PT Speed Switch #3
9 = PT Reference at Lower Limit
10 = Utility Breaker Open Indication
11 = Unit is in Droop
12 = Horn (Triggered by any new event)
13 = GG Speed in Control
14 = PT Speed in Control
15 = EGT Temp in Control
16 = Start Ramp in Control
17 = MW/Load Limiter in Control
18 = GG Speed Switch #1
19 = GG Speed Switch #2
20 = GG Speed Switch #3
21 = Running on Liquid Fuel
22 = Running on Gas Fuel
23 = Transferring Fuels
24 = Controlled via Modbus
25 = NOX Water System Active
26 = Shutdown Reset Pulse Output
27 = Open Breaker Command
28 = Soft Shutdown Summary Output
29 = TBD
30 = TBD
31 = TBD
32 = TBD
33 = TBD

Input	Default	Site Value
DO 01	1	
DO 02	2	
DO 03	12	
DO 04	40	
DO 05	40	
DO 06	40	
DO 07	23	
DO 08	11	
DO 09	36	
DO 10	37	
DO 11	38	
DO 12	39	

34 = TBD
35 = TBD
36 = * Starter Motor ON Command * Demo/Simulation Only
37 = * Ignitors ON Command * Demo/Simulation Only
38 = * Open Gas Shutoff Valves Command * Demo/Simulation Only
39 = * Open Liquid Shutoff Valves Command * Demo/Simulation Only
40 = TBD

Configuration of Analog 4–20 mA Outputs

Each Analog Input can be assigned via a menu selection of the following choices:
0 = Unused Channel
1 = PT Speed
2 = PT Speed Reference Setpoint
3 = EGT - Exhaust Gas Temperature
4 = Gas Fuel Demand Readout
5 = Liquid Fuel Demand Readout
6 = MW Load Output
7 = Fuel Valve Demand Readout
8 = CDP - Compressor Discharge Pressure
9 = GG Speed Reference Setpoint
10 = GG Speed
11 = NOX Valve Demand Output
12 = VG Demand Output
13 = TBD
14 = Controlled via Modbus
15 = TBD
16 = TBD
17 = TBD
18 = TBD
19 = TBD
20 = TBD

	Input	Default	Site Value
AO 01		1	
AO 02		2	
AO 03		3	
AO 04		4	
AO 05		5	
AO 06		10	

	Input	Default	Site Value
Configure Analog Output #1			
Function Selection for AO 01		1	
Value at 4 mA		0.00	
Value at 20 mA		5000.00	
Signal Offset		0.00	
Signal Gain		1.00	
Configure Analog Output #2			
Function Selection for AO 02		1	
Value at 4 mA		0.00	
Value at 20 mA		5000.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configuration of Analog 4–20 mA Outputs

	Input	Default	Site Value
Configure Analog Output #3			
Function Selection for AO 03		1	
Value at 4 mA		0.00	
Value at 20 mA		2000.00	
Signal Offset		0.00	
Signal Gain		1.00	
Configure Analog Output #4			
Function Selection for AO 04		1	

Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configure Analog Output #5

Function Selection for AO 05		1	
Value at 4 mA		0.00	
Value at 20 mA		100.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configure Analog Output #6

Function Selection for AO 06		1	
Value at 4 mA		0.00	
Value at 20 mA		50.00	
Signal Offset		0.00	
Signal Gain		1.00	

Configuration of MODBUS Communications

	Units	Default	Site Value
Select MODBUS Comm. Links Used			
Use Link #1 - Ethernet UDP Port 5001		No	
Use Link #2 - Ethernet UDP Port 5002		No	
Use Link #3 - Serial Port COM 1		No	
Use Link #4 - Serial Port COM 2		No	
Use Link #5 - Ethernet TCP 1		No	
Use Link #6 - Ethernet TCP 2		No	
Settings for Link #1			
Enable Analog Writes (AW)		Yes	
Enable Boolean Writes (BW)		Yes	
Comm. Time Out	sec	3.00	
Select 1=Ascii or 2=RTU Mode		2	
Slave Address		1	
Settings for Link #2			
Enable Analog Writes (AW)		Yes	
Enable Boolean Writes (BW)		Yes	
Comm. Time Out	sec	3.00	
Select 1=Ascii or 2=RTU Mode		2	
Slave Address		1	

Settings for Link #3 thru Link #6 appear if used and are same as above

Settings for Serial COMM Ports	Default	Site Value PORT 1	PORT 2
BAUD Rate (1=110, 2=300, 3=600, 4=1200, 5=1800, 6=2400, 7=4800, 8=9600, 9=19200, 10=38400, 11=57600, 12=115200)	10		
DATA BITS (1=7, 2=8)	2		
STOP BITS (1=1, 2=2, 3=1.5)	1		
PARITY (1=Off, 2=Odd, 3=Even)	1		
MODE (1=Line, 2-Character)	1		
FLOW Control (1=Off, 2=XON/XOFF, 3=CTS-RTS)	1		
ECHO (1=Off, 2=On)	1		
ENDLINE (1=LF, 2=CR, 3=CRLF)	3		
IGNCR Ignore CR (1=Off, 2=On)	2		
Driver Type (1=RS232, 2=RS422, 3=RS485)	1		

Fuel Control Dynamic Settings

	Units	Default	Site

			Value
GG Speed Control			
Default GG Reference Ramp Rate	rpm/sec	20	
Fast GG Reference Ramp Rate	rpm/sec	50	
GG Speed Switch 1 Setpoint	RPM	2000	
GG Speed Switch 2 Setpoint	RPM	5000	
GG Speed Switch 3 Setpoint	RPM	7000	
GG PID Proportional GAIN		0.08	
GG PID Integral GAIN		0.26	
GG PID Speed Derivative Ratio		100.00	
PT Speed Control			
Default PT Reference Ramp Rate	rpm/sec	2.00	
Fast PT Reference Ramp Rate	rpm/sec	4.00	
Rate for External Sync Speed Bias	rpm/sec	0.50	
PT Speed Switch 1 Setpoint	RPM	1500	
PT Speed Switch 2 Setpoint	RPM	3500	
PT Speed Switch 3 Setpoint	RPM	3600	
PT PID Proportional GAIN (Off-Line)		0.50	
PT PID Integral GAIN (Off-Line)		0.80	
PT PID Speed Derivative Ratio (Off-Line)		0.20	
Check to use Dual Dynamic Settings		Yes	
PT PID Proportional GAIN (On-Line)		0.30	
PT PID Integral GAIN (On-Line)		0.50	
PT PID Speed Derivative Ratio (On-Line)		0.20	
MW Load Control			
Use MW/Load Control ?		No	
if NO - Use MW/Load Limiter PID		No	
Always use Remote MW Setpoint ?		No	
MW Load Setpoint Tunable	MW	10.00	
Desired Load Time (Min to Full Load)	sec	30	
Desired Unload Time (Full to Min Load)	sec	30	
If using MW/Load Limiter PID then			
MW Load PID Proportional GAIN		0.50	
MW Load PID Integral GAIN		2.20	
MW Load PID Speed Derivative Ratio		5.00	

Fuel Control Dynamic Settings

MW Load Control	Default	Site Value	Default	Site Value
If secondary Droop Parameter is CDP	X		Y	
X Input 1 / Y Output 1	10.00		0.00	
X Input 2 / Y Output 2	50.00		0.00	
X Input 3 / Y Output 3	100.00		0.00	
X Input 4 / Y Output 4	200.00		0.00	
X Input 5 / Y Output 5	300.00		0.00	

x= CDP and y= MW

	Units	Default	Site Value
If secondary Droop Parameter is Actuator			
Fuel Valve Demand at Maximum Load	%	92.00	
Check to use fixed value for zero load position - *if not checked Zero load will equal valve demand percent at GEN Breaker Closure*		No	
Fixed Value for Valve Demand at Zero Load	%	20.00	
EGT Temp Control			
EGT PID Proportional GAIN		0.30	
EGT PID Integral GAIN		0.80	
EGT PID Speed Derivative Ratio		100.00	

Base Temperature Setpoint	Deg	1575	
Check to use Peak Temp Setpoint		No	
Base Temperature Setpoint	Deg	1585	
Check to use EGT Temp PID during Start		No	
EGT Start - Lower Temp Setpoint		1575	
EGT Start - Upper Temp Setpoint		1575	
EGT Start Ramp Rise Rate	Deg/sec	10	

CDP Pressure Control

CDP PID Proportional GAIN		0.60	
CDP PID Integral GAIN		7.80	
CDP PID Speed Derivative Ratio		100.00	
CDP Control Limit Setpoint	psia	285	
CDP Overpressure Setpoint	psia	290	
Check to use Corrected CDP Setpoint		No	

Fuel Control Dynamic Settings

Acceleration Control	Units	Default	Site Value
Check to Enable Accel PID		No	
Check to Enable Accel Curve Limiter		No	

For Accel PID this curve determines setpoint	Default	Site Value	Default	Site Value
GG Speed Derivative Setpoint Curve	X		Y	
X Input 1 / Y Output 1	0		75	
X Input 2 / Y Output 2	5900		75	
X Input 3 / Y Output 3	6800		200	
X Input 4 / Y Output 4	8130		1545	
X Input 5 / Y Output 5	9530		725	
X Input 6 / Y Output 6	10200		725	

x= GG Corr Speed and y= Setpoint in rpm/sec

Acceleration (of GG) Control	Units	Default	Site Value
Accel PID Proportional GAIN		0.05	
Accel PID Integral GAIN		20.00	
Accel PID Threshold		4000	
Accel PID Speed Derivative Ratio		100.00	

Accel/CDP Curve for Gas Fuel	Default	Site Value	Default	Site Value
x=CDP and y=Gas Fuel Demand %	X		Y	
X Input 1 / Y Output 1	2		0.00	
X Input 2 / Y Output 2	10		11.50	
X Input 3 / Y Output 3	165		64.80	
X Input 4 / Y Output 4	225		90.00	
X Input 5 / Y Output 5	250		100.00	

Accel/CDP Curve for Liquid Fuel	Default	Site Value	Default	Site Value
x=CDP and y=Liquid Fuel Demand %	X		Y	
X Input 1 / Y Output 1	2		0.00	
X Input 2 / Y Output 2	10		11.50	
X Input 3 / Y Output 3	165		64.80	
X Input 4 / Y Output 4	225		90.00	
X Input 5 / Y Output 5	250		100.00	

Fuel Control Dynamic Settings

Deceleration Control	Units	Default	Site Value
Check to Use Decel PID		No	

Else the CDP Limiter curves will be used

For Decel PID this curve determines setpoint	Default	Site	Default	Site

GG Speed Derivative Setpoint Curve	X	Value	Y	Value
X Input 1 / Y Output 1	0		-100	
X Input 2 / Y Output 2	7200		-100	
X Input 3 / Y Output 3	7763		-750	
X Input 4 / Y Output 4	7930		-2400	
X Input 5 / Y Output 5	8353		-4200	
X Input 6 / Y Output 6	10050		-4200	

x= GG Corr Speed and y= Setpoint in rpm/sec

Deceleration (of GG) Control	Units	Default	Site Value
Decel PID Proportional GAIN		0.008	
Decel PID Integral GAIN		20.00	
Decel PID Threshold		4000	
Decel PID Speed Derivative Ratio		100.00	

Decel/CDP Curve for Gas Fuel	Default	Site Value	Default	Site Value
x=CDP and y=Gas Fuel Demand %	X		Y	
X Input 1 / Y Output 1	0		0.00	
X Input 2 / Y Output 2	35		0.00	
X Input 3 / Y Output 3	75		10.00	
X Input 4 / Y Output 4	250		20.00	
X Input 5 / Y Output 5	300		30.00	

Decel/CDP Curve for Liquid Fuel	Default	Site Value	Default	Site Value
x=CDP and y=Liquid Fuel Demand %	X		Y	
X Input 1 / Y Output 1	0		0.00	
X Input 2 / Y Output 2	35		0.00	
X Input 3 / Y Output 3	75		10.00	
X Input 4 / Y Output 4	250		20.00	
X Input 5 / Y Output 5	300		30.00	

Fuel Control Dynamic Settings

Fuel Transfer Logic (Dual Fuel Systems)	Units	Default	Site Value
XFER Time from Liquid to Gas Fuel	sec	60	
XFER Time from Gas to Liquid Fuel	sec	60	

Gas Fuel Valve Linearization Curve	FIXED	Default	Site Value
	X	Y	
X Input 1 / Y Output 1	0	0	0
X Input 2 / Y Output 2	10	10	
X Input 3 / Y Output 3	25	25	
X Input 4 / Y Output 4	50	50	
X Input 5 / Y Output 5	75	75	
X Input 6 / Y Output 6	100	100	

X= LSS Fuel Demand and Y= Gas Valve Demand %

Liquid Fuel Valve Linearization Curve	FIXED	Default	Site Value
	X	Y	
X Input 1 / Y Output 1	0	0	0
X Input 2 / Y Output 2	10	10	
X Input 3 / Y Output 3	25	25	
X Input 4 / Y Output 4	50	50	
X Input 5 / Y Output 5	75	75	
X Input 6 / Y Output 6	100	100	

X= LSS Fuel Demand and Y= Liquid Valve Demand %

NOX Water Injection Logic	Units	Default	Site

			Value
Injection NOX System below this GG Speed	sec	60	
Check to Enable Min Water Pressure Permissive		No	
Set Minimum Water Pressure		400	
Max NOX Water Flow Rate	PPH	100	
Initial Water to Gas Fuel Ratio (Flow)		1.00	
Initial Water to Liquid Fuel Ratio (Flow)		1.00	
NOX Valve Position Error Event 094 Active		FALSE	
Demand versus Position FDBK Tolerance	%	5.00	
Position Error Delay	sec	5.00	

Fuel Control Dynamic Settings

NOX Water Injection Logic

NOX Water Curve for Gas Fuel	FIXED	Default	Site Value
	X	Y	
X Input 1 / Y Output 1	0	0	
X Input 2 / Y Output 2	10	0	
X Input 3 / Y Output 3	20	0	
X Input 4 / Y Output 4	30	0	
X Input 5 / Y Output 5	40	0	
X Input 6 / Y Output 6	50	0	
X Input 7 / Y Output 7	60	0	
X Input 8 / Y Output 8	70	0	
X Input 9 / Y Output 9	80	0	
X Input 10 / Y Output 10	90	0	
X Input 11 / Y Output 11	100	0	
X Input 12 / Y Output 12	101	0	

X= Gas Fuel Demand (%) and Y= Water Demand (PPH)

NOX Water Curve for Liquid Fuel	FIXED	Default	Site Value
	X	Y	
X Input 1 / Y Output 1	0	0	
X Input 2 / Y Output 2	10	0	
X Input 3 / Y Output 3	20	0	
X Input 4 / Y Output 4	30	0	
X Input 5 / Y Output 5	40	0	
X Input 6 / Y Output 6	50	0	
X Input 7 / Y Output 7	60	0	
X Input 8 / Y Output 8	70	0	
X Input 9 / Y Output 9	80	0	
X Input 10 / Y Output 10	90	0	
X Input 11 / Y Output 11	100	0	
X Input 12 / Y Output 12	101	0	

X= Liquid Fuel Demand (%) and Y= Water Demand (PPH)

Fuel Control Dynamic Settings

Variable Geometry Logic	Units	Default	Site Value
Select Type of Schedule (2D or 3D)		2D Curve	
Check to Step Demand on Shutdown		Yes	
Upon SD - Step to this Demand		0.00	

VG Curve - Simple 2D	Default	Site Value	Default	Site Value
	X		Y	
X Input 1 / Y Output 1	0		0	
X Input 2 / Y Output 2	7373		0	

X Input 3 / Y Output 3	7676		31	
X Input 4 / Y Output 4	8383		31	
X Input 5 / Y Output 5	10100		100	
X Input 6 / Y Output 6	10100		100	

X= GG Corr Speed and Y= VG Demand %

Bias for 3D Curve (CIT Temp)	Units	Default	Site Value
CIT Bias Point 1 (First Curve Table)		-40	
CIT Bias Point 2 (First Curve Table)		150	

VG Curve - 3D at Bias Point 1	Default	Site Value	Default	Site Value
	X		Y	
X Input 1 / Y Output 1	0		0	
X Input 2 / Y Output 2	7373		0	
X Input 3 / Y Output 3	7676		31	
X Input 4 / Y Output 4	8383		31	
X Input 5 / Y Output 5	10100		100	
X Input 6 / Y Output 6	10100		100	

X= GG Corr Speed and Y= VG Demand %

VG Curve - 3D at Bias Point 2	Default	Site Value	Default	Site Value
	X		Y	
X Input 1 / Y Output 1	0		0	
X Input 2 / Y Output 2	7373		0	
X Input 3 / Y Output 3	7676		31	
X Input 4 / Y Output 4	8383		31	
X Input 5 / Y Output 5	10100		100	
X Input 6 / Y Output 6	10100		100	

X= GG Corr Speed and Y= VG Demand %

Event Action Configuration

If using Synchronized Network Clock	Units	Default	Site Value
Time Zone Offset Relative to GMT	hrs	-7	

Configuration of all Events should be completed in Appendix C.

Appendix E.
Pre-Installation Control Information Checklist

Detail an I/O list (interfaces to GTC Fuel Control)

- Analog Inputs & Outputs – (ranges, units, alarm & shutdown points)
- Discrete Inputs – Active High or Low
- Relay outputs – NO or NC, contact load ratings
- MPU Speed sensor specifications (# of teeth, gear ratio, hi/lo fail speeds)
- Fuel Actuator/Valve drivers – mA range (need SPC?), pph flow vs. Valve Pos.
- Communication Links – signal type, protocols
- Termination wiring details (existing & upgrades)

Control Limits

- EGT topping temperature limit
- CDP topping pressure limit
- GG Speed – upper limit (Alm & SD), Ref limits (high & low)
- PT Speed – upper limit (Alm & SD), Ref limits (high & low)
- Identify transient response performance requirements (Accel/Decel options)
- Review all Event List options & identify job specific requirements

Start-up Information

- Electrical or Mechanical liteoff, valve degrees, start ramp percent
- Fuel Info – Type, supply pressure, LHV, SG
- Manifold pressure at liteoff
- Any EGT Start overtemp limit
- Time from Liteoff to GG Control (typically GG Lower Ref limit)
- Time from GG Idle to PT Rated speed
- Review/select the start mode option for specific job

Running Information

- Gathering the following info will greatly simplify GTC control configuration

Data Point	CDP (psia)	EGT (deg F)	GG Speed (rpm)	Fuel Valve (%)	NOX Valve (%)
@ GG Idle			----		
@ PT Rated					
@ 10% Load					
@ 25% Load					
@ 50% Load					
@ 75% Load					
@ 100% Load					

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