WOODWARD

Product Manual 26262
(Revision B)
Original Instructions

GTC200 Gas Turbine Control for Generator or Compressor Applications

8262-1002 (no PowerSense Board)
8262-1022 (w/ PowerSense Board)

Installation and Operation Manual

General Precautions	**Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.** **Practice all plant and safety instructions and precautions.** **Failure to follow instructions can cause personal injury and/or property damage.**

Revisions	**This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:** **www.woodward.com/publications** **The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.**

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

Translated Publications	**If the cover of this publication states "Translation of the Original Instructions" please note:** **The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.**

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

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⚠ 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 GTC200 Digital Control System designed to control two-shaft gas turbines for compressor or generator applications. The manual should be used along with the standard AtlasSC™ hardware manual (26179), and therefore the scope of this document is only to describe details of the GTC200 application software functionality and assist the customer in configuration and start-up of the control. Refer to manual 26179 for information on hardware specifications, mounting information, and wiring details.

Scope of Supply

Item #	Description
8262-1002	GTC200—AtlasSC (Standard Gas Turbine Fuel Control)
8262-1022	GTC200—AtlasSC (same as above w/ PowerSense Functionality)
BCD85210	CD—System Documentation & Software Tools

Optional Add-ons

Item #	Description
[Inquire]	Operator Interface
1784-505	Moore Industries AD590 Ambient Temperature Signal Converter
8900-067	Ambient Air Temperature Sensor (AD590)
5441-699	Relay Interface (12) FTM
5417-747	Relay FTM Interface Cable
8200-224	Servo Position Controller (SPC)

General Description

The Woodward GTC200 AtlasSC Digital Control System is a configurable control system for gas turbines that produces a fuel demand output to control speed, load, pressure, and temperature. It contains optional start/stop sequence control and Modbus® * communication links to an optional HMI or a user defined operator interface. In addition to this, the control allows the packager or user to utilize pre-programmed options by the way in which they configure the unit. 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.

*—Modbus is a trademark of Schneider Automation Inc.

Hardware

The GTC200 AtlasSC Digital Control is designed to be bulkhead mounted in a control panel. The complete unit contains a 'SmartCore' CPU module, an Analog Combo module and a Power Supply board. In addition, the system can also include an optional relay Field Termination Module (FTM). 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 AtlasSC Digital Control System requires an 18-32 Vdc input supply voltage.

Physical Description
For further details on the physical hardware, refer to the AtlasSC product manual 26179.

Central Processor Unit (CPU) Module

The SmartCore CPU runs a proprietary Woodward real time operating system and follows the instructions of the application program, which controls all of the input and output circuits of the GTC200 AtlasSC Control.

The SmartCore module has the following Communications Ports:

Serial COM 1
The COM 1 Serial Port is configured for use as a Modbus interface on this control.

Serial COM 2
The COM 2 Serial Port is configured for use as a Modbus interface on this control.

Serial COM 3
This port is RS-232 only and is a dedicated as a ServLink Port that interfaces to the Woodward software interface tools.

I/O Modules

Each module has a FAULT LED that is controlled by the CPU. During every initialization of the system, the CPU turns these LEDs 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.
If the FAULT LEDs come on at any other time one of 3 things has occurred:

1. The module has faulted
2. The CPU / Operating System has detected a fault and shutdown the module
3. The unit has been placed in IO Lock by the Watch Window service tool (which happens when the unit is placed in Configure mode).

For further details on the specific hardware modules installed in this system refer to the AtlasSC product manual 26179.

AtlasSC I/O—The standard I/O (input/output) for this product is:

Type of Input	# of Inputs	Options/Details
DC Power Input		
Low Voltage dc input	1	18–32 Vdc, protected from reverse polarity
Analog Inputs		
Function Configurable Inputs	9	Current 4-20 mA dc (1-6 can be 0-5 Vdc)
MPU Speed Sensor	4	100–20 000 Hz
Thermocouple Inputs	10	Type E,J,K,N,R,S,T – First 8 used for EGT
RTD Inputs	2	100 or 200 Ohm
Bus PT Input	1	3-phase ac input
Generator PT Input	1	3-phase ac input
Bus CT Input	1	3-phase ac input
Generator CT Input	1	3-phase ac input
Analog Outputs		
Speed Bias	1	±3 Vdc, 1–5 Vdc, 500 Hz, PWM, 4–20 mA
Voltage Bias	1	±1 Vdc, ±3 Vdc, ±9 Vdc, 4–20 mA
Function Configurable outputs	8	Current
Actuator outputs	2	Current 0-20 mA or 0-200mA range
Discrete Inputs		
Configurable Switch or Contact inputs	24	Switch to + to activate, Isolated from input power
Discrete Outputs		
Relay Driver Outputs	12	Low side drivers
Communication Ports		
Serial Ports	3	(1)—RS-232, (2)—RS-232/422/485

Table 1-1. Summary Input/Output List

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 GTC200 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 GTC200 control, as delivered from Woodward, also contains software options to provide turbine start/stop sequencing logic. It contains configurable start permissives and can control the turbine motor starter, ignitors, and positive fuel shutoff valves (block valves) in addition to the fuel-metering valve for both Gas and Liquid fuels. The application also allows the user to take some of the GTC programmed I/O signals and reallocate them for a site specific use for some off-turbine package sub-system indication, or plant process requirements. Specifics on the options available for customer signals are in the fuel control Input / Output signal section.

⚠WARNING

A separate and independent overspeed trip device is always required to be installed to prevent possible serious injury from an over speeding prime mover.

Chapter 2.
Description of Operation

Introduction

This chapter describes the operation and features included in the GTC200 system for control of a gas turbine driving a generator or a compressor. The purpose of the chapter is to provide a clear understanding of the functions and features that are available in this Woodward GTC product.

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 functions of this AtlasSC™ Digital Control System include:

- Start Sequence Options
- Control Loop Functions
- Synchronization Logic
- Load Control Options
- Generator Protection

Start Sequence Options

The sections below will provide insight as to the options programmed into the GTC for starting the gas turbine. The functional block diagram Figure 2.1 will provide an overview of the startup sequence, the specific details of setting up the start options for each sequence step is found in Chapter 6.

- Configurable Start/Stop Sequencing Logic
- Turbine Lite-Off and Flameout Detection
- Start Ramp and Start Control Logic
- Optional EGT start temp limiter

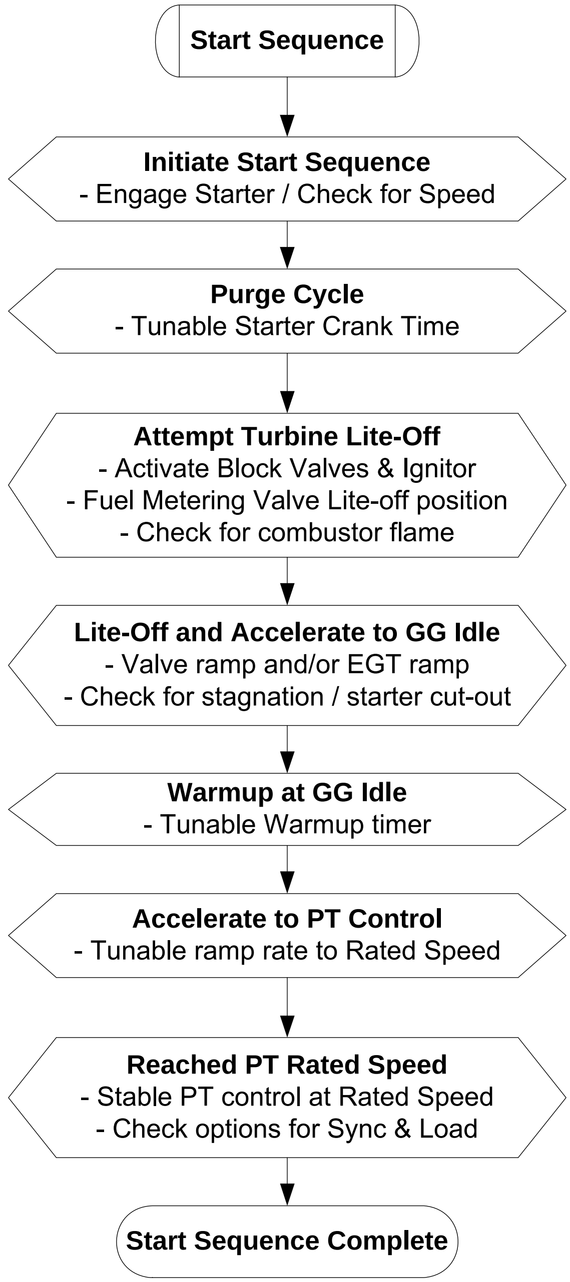


Figure 2-1. GTC200 Start Sequence Logic Flow Diagram

The following sections will explain the sequence logic and identify some of the items that are configurable by the user in each step.

Initiate Start Sequence

After receiving a start command the control will check all of the start permissives, which is a logical AND of the following:

- No Shutdowns present
- Unit not in Calibrate mode
- Not in a Manual Starter Crank Cycle
- EGT temp is less than 400 °F (204 °C)
- Fuel Shutoff Valves are Closed
- Fuel Metering Valve at minimum position
- GG reference set point at minimum value
- PT reference set point at minimum value
- Any of the customer Start Permissive inputs (DI's 5-8, 18-24)

If these are all TRUE then the control will energize the Motor Starter relay output and wait to detect that the GG speed probes are reading a speed above the minimum starter crank speed, if no speed is detected after 30 seconds then an alarm is issued. The Start sequence can take the unit to GG Idle or to PT Rated (Sync) speed. Once speed is detected the Sequence move into the Purge Cycle step.

Configuration Items:

Minimum Crank Speed (rpm)	*1000 (100, 2000)
Delay time to wait for Speed Detection	*15.0 (0,120)
Start/Lite-off Gas Fuel Valve Min Demand	*0.0 (0, 100)
Start/Lite-off Liquid Fuel Valve Min Demand	*0.0 (0, 100)

Purge Cycle Sequence

The control will allow the turbine to crank on the starter motor for the amount of time that the user configures for the purge time. This allows for any required purge of a downstream boiler system, if none is present then this time can be minimized. Once this timer is complete the control will move to the Attempt Lite-off step

Configuration Items:

Purge Cycle Time (sec)	*20 (5, 3000)

Attempt Lite-off Sequence

At this step the control will issue relay commands open the fuel shutoff valves for the selected fuel type and turn on the ignitors. The control will wait for the configured time to see that a flame has been established in the combustor (via one of the selected options for flame detections). If the control does not get this indication then a shutdown command is issued and annunciated as a Failed to achieve Lite-off. Once Lite-off is achieved the sequence proceeds to the Lite-off and Accel step.

Configuration Items:

Time to wait for Lite-off on Gas Fuel (sec)	*10 (2, 30)
Time to wait for Lite-off on Liquid Fuel (sec)	*15 (2, 30)

*Note—be sure the time is correct for the chosen fuel.

Lite-off and Start Accel Sequence

At this step the control begins to ramp open the fuel start ramp and will continue on this control, or one of the other start mode options, up to the minimum GG speed set point. During this acceleration the GG speed will pass through the Starter cutout speed, which is when the Motor Starter relay will drop out. The control has a configurable timer during which it must reach the minimum GG speed set point (GG Idle). If it does not reach GG idle within this time frame a shutdown command is issued and annunciated as a GG Failed to Accel. Once GG Idle is reached then the sequence proceeds to the Warm-up step.

Configuration Items:

Time to Accel to GG Idle (sec)	*60 (5, 600)
Motor Starter Cut-out Speed (GG rpm)	*3500 (100, 5000)
Ignitors Off Speed (GG rpm)	*5400 (100, 10000)
GG Idle Speed = GG Min Ref	*6000 (100, 10000)

GG Idle Warm-up Cycle Sequence

At this step the control will hold the unit at the GG Idle speed for the amount of time configured by the user. At the end of this cycle the unit will issue a pulse to set the PT reference to the rated set point. At this point the sequence proceeds to the GG Accel to PT step.

Configuration Items:

Time to Warm-up at GG Idle (sec)	*20 (5, 600)	
Raise GG Ref at Fast Rate	(F=Default Rate)	*False
GG Reference Default Rate (rpm/sec)	*20 (0, 1000)	
GG Reference Fast Rate (rpm/sec)	*50 (0, 1000)	

GG Accel to PT Rated Sequence

At this step the control will begin to raise the GG reference at the default or fast ramp rate, as determined by the user. At some point during this ramp the PT shaft should break away and begin to accelerate up to the PT Sync set point. The control will accelerate the turbine on GG speed control up to the point at which the PT speed loop comes into control. If PT control at rated speed is not achieved in the configured time allowance then a Shutdown command is issued and annunciated as PT Failed to Accel. It is important to set this timer to a calculated amount of time in which the PT should reach rated speed. If desired, the user could calculate a maximum GG speed to be reached by using the GG ramp starting point and the configured ramp rate. Once the unit achieves control at PT Sync the sequence proceeds to the Reached PT rated speed step.

Configuration Items:

Time to Accel to PT Sync (sec)	*60 (5, 600)
PT Reference Rated Speed Set point	*3600 (100, 20000)

Accelerate to PT Control

At this step the control transitions from GG speed control into PT speed control. The GG reference will continue to ramp up to maximum and the PT reference will ramp up from idle to rated speed.

Reached PT Rated Sequence

At this step the control looks to determine that the turbine is in PT speed control at rated PT speed. Once this is confirmed the control will step the GG reference to the maximum reference set point to move the GG speed loop out of the way and the Start Sequence is completed.

Control Loop Functions

The sections below will provide insight as to how the control application software implements the functions shown in the functional block diagram of Figure 2.2.

- Ambient Temperature Sensing
- Single Shaft Speed Sensing (w/ Redundant probes)
- Turbine Inlet Temperature Sensing
- Compressor Discharge Pressure (CDP) Sensing
- Exhaust Gas Temperature (EGT) Sensing
- GG Speed Reference Logic
- PT Speed Reference Logic

- Remote Speed Reference Logic
- Speed Control of Gas Generator Shaft (GG)
- Speed Control of Power Turbine Shaft (PT)
- Load Control of Power Turbine
- CDP Limiting Control
- EGT Limiting Control
- Kilowatt Limiting Control
- Acceleration and Deceleration Control
- Fuel Actuator Demand and Fuel Transfer Logic

Functional Block Diagram

The following diagram shows a general outline of the functionality of the GTC200 control.

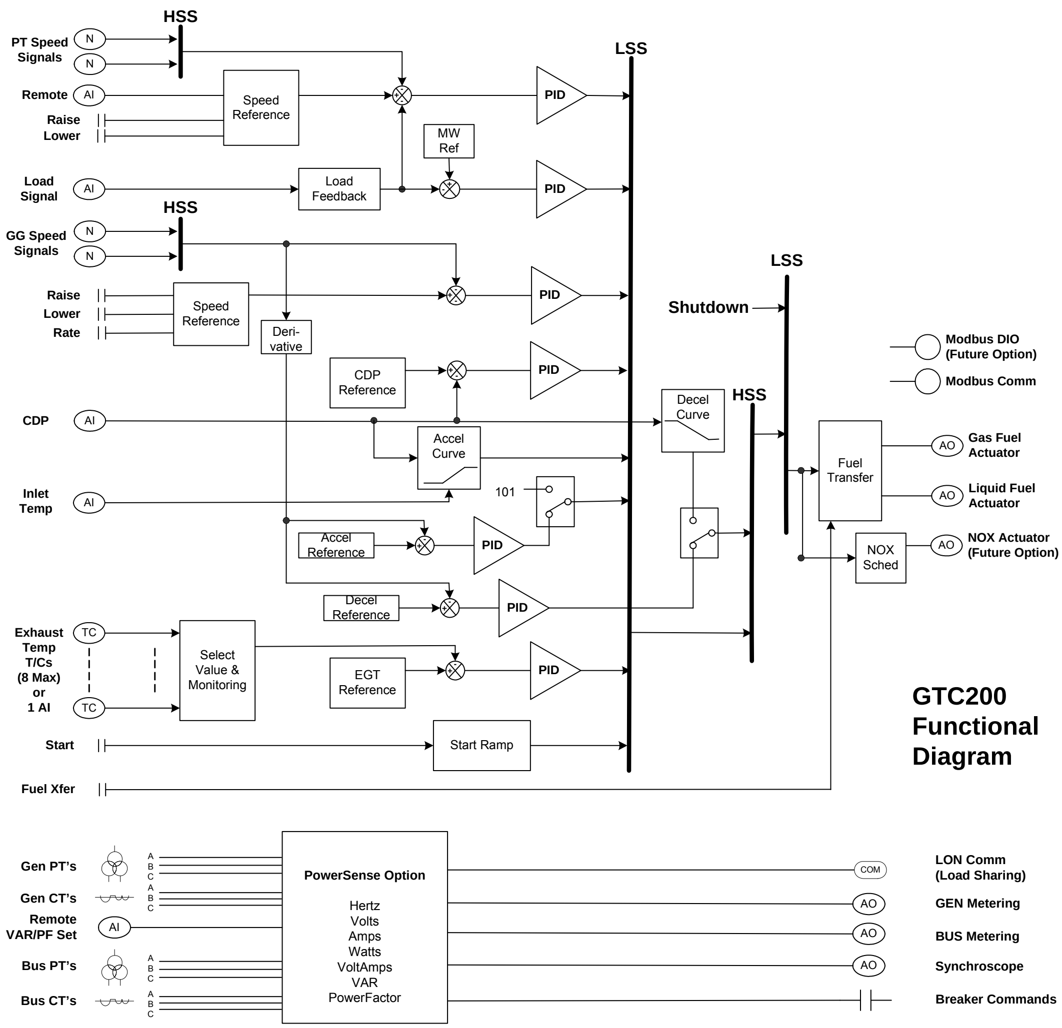


Figure 2-2. GTC200 Functional Block Diagram

Start Ramp/Start Control (Default rate 0.3 % per sec)

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. Once speed control is reached this ramp is taken to 100%.

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. After PT control is obtained the GG Reference is typically ramped to maximum and the controller continues to be active as a maximum shaft speed limiter. 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 and load 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

ACCEL Control (Curve Schedule)

The acceleration schedule determines the maximum amount of fuel allowed, during acceleration. The configuration of this function is required to protect the turbine from over fueling. This demand is driven by a configurable curve based on CDP. The CDP versus Fuel Demand accel limit curve will determine the maximum amount of fuel allowed for the current CDP. This fuel demand limiter feeds into the LSS bus. If this value is the lowest on the LSS, then its schedule controls the LSS output.

Temperature Limiting Control (EGT) PID

The intent of this controller is to limit the maximum Exhaust Gas Temperature of the turbine. 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. It will limit the fuel demand to the turbine once the EGT temperature reaches the EGT reference set point. The EGT Control PID has three inputs:

- Thermocouple (from 1 to 8 max) or Analog Input signal of EGT
- EGT temperature reference set point
- Feedback from the LSS

Kilowatt Limiting Control (KW_LIM) PID

The intent of this optional controller is to limit the maximum KW output of the turbine/generator. The KW PID block compares the actual KW signal (or calculated KW load based on turbine CDP) with the reference KW signal and generates an appropriate output response signal. The KW 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 KW output reaches the KW reference set point. On the controls with the PowerSense board the KW load signal is calculated from the PT and CT inputs.

The KW Control PID has three inputs:

- Actual or calculated KW load input
- KW limiter reference set point
- Feedback from the LSS

Pressure Limiting Control (CDP) PID

The intent of this controller is to limit the maximum Compressor Discharge Pressure (which equates to load) of the turbine. 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 set point. The CDP Control PID has three inputs:

- CDP input signal
- CDP reference set point
- Feedback from the LSS

LSS Bus

The low signal select (LSS) bus selects the lowest of the PT PID, EGT PID, CDP PID, KW 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.

DECEL Control (Curve Schedule)

The deceleration schedule determines the minimum amount of fuel allowed during deceleration. The configuration of this function is required to protect the turbine from lean-blowout (loss of flame) during load transients. This demand is driven by a configurable curve based on CDP. The CDP versus Fuel Demand decel limit curve will determine the minimum amount of fuel allowed for the current CDP. The correct setup of the Decel control curve will result in the turbine recovering to synchronous speed after a load drop (as in a breaker open event). Without decel control the speed control will typically pull the fuel demand back to zero percent when the speed rises at the initialization of the load drop event, which usually results in a flameout Shutdown of the turbine.

Both of these control parameters feed into the HSS bus. If the value is the highest on the HSS, then its schedule controls the HSS.

⚠WARNING	**Improper setup of the Decel Control options can result in this control loop opening (or limiting closure of) the fuel valve while all other control loops are requesting minimum fuel demand.**

HSS Bus

The HSS bus receives the output of the LSS bus and the decel schedule as inputs. 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. All signals of the PIDs up to the LSS_2 logic are 0 to 1.

Actuator Driver

The actuator driver output converts the 0-to-100% software control signal into 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.

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.

Flameout Detection Logic (UV)

The Flameout section of this control includes the following options:

- EGT Temperature Monitoring (Option 1)
- UV Detector (discrete inputs) Sensing (Option 2)
- Uses EGT Temp OR UV Detection to indicate flame (Option 3)
- Speed Monitoring (Option 4)

EGT Temperature Monitoring

The control uses EGT temperature logic to monitor for a ‘Lite-off’ detection in the combustor. This set point 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.

Flame Detectors Sensor

If a Ultra-Violet (UV) or other type of flame detector is used, the control will monitor this signal to confirm that ignition exists in the combustor. Flame is recognized by the control by a True signal on the discrete input contacts.

Speed Monitoring

This method monitors the PT shaft for speed to be greater than a programmed set point. 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.

Synchronization Logic

The GTC200 control uses digital signal processing techniques to derive both true RMS voltages and relative phase of the fundamental frequencies of the bus and generator voltage wave forms. Digital signal processing techniques offer significantly improved measurement accuracy in the presence of waveform distortions, particularly since the phase measurement does not depend on zero crossings of the waveforms.

Either phase matching or slip frequency synchronizing may be selected. Phase matching method controls the turbine speed to give zero speed error and minimal phase error between the generator and bus; this provides rapid synchronizing for critical standby power applications. Slip frequency synchronizing guarantees a fixed speed difference between generator and bus. This insures the generator to be faster than the bus and initial power flow is out of the machine for larger generators. For both synchronizing methods, the GTC200 control uses actual slip frequency and breaker delay values to anticipate a minimum phase difference between bus and generator at actual breaker closure.

The synchronizer can sense a dead local bus and close the generator circuit breaker automatically when safe to do so. The network communication between GTC200 controls assures that multiple generators cannot close simultaneously onto a dead bus.

There are four synchronizer modes of operation: Run, Check, Permissive, Off. The mode can be selected through Watch Window or Modbus. The last mode selected by any of these interface methods will be the mode of operation.

Additional synchronizer features include: voltage matching, time delayed automatic multi-shot reclosing, and a synchronizer timeout alarm. Raise and lower inputs can be used to manually adjust speed for manual synchronizing. Voltage raise and lower inputs can be used to manually adjust voltage for manual voltage matching. Each of these features may be enabled or disabled during setup.

Load Control Options

The GTC200 control includes several different load control options:

- Simple load droop operation provides safe operation in parallel bus applications in the event of a circuit breaker aux contact failure
- Isochronous operation when the bus is isolated
- Isochronous Load Sharing with other units connected to the bus
- Process Control
- VAR/Power Factor Control

When the generator circuit breaker is closed, the GTC200 can be in simple droop mode or in Isochronous Load Share mode. In the system configuration menu the user can determine the initial mode the unit will go into based upon the Generator breaker closure. The unit can go to a minimum load set point (manual loading) or go to a 'Base' Load set point programmed by the user (auto loading). Both of these are Droop mode load control loops. The user may also select that the unit stay in Isochronous mode which will allow it to immediately load share with any other units on the local bus. It will do this via the LON communication port, which interfaces to the other units. If this unit is the only one on the bus it will pick up all of the load.

Load and unload ramps provide smooth transition between autoloading, manual loading, Isochronous Load sharing and process control any time the operating mode is changed.

Process Control

A cascade process controller is provided for controlling load based on a customer input signal. A typical example of this is to use the process control for import/export control of generated power. An adjustable bandwidth input filter, flexible controller adjustments, an adjustable deadband, and direct or indirect control action, allow the process control to be used in a wide variety of applications.

A 4–20 mA (or 1–5 Vdc) process transmitter provides the process signal to the GTC200 control. The control includes an internal digital process reference set point controlled by raise and lower switch contacts or by a Modbus or ServLink communication interface. The output of the process control provides the cascade load reference to the Load control.

Adjustable ramps allow smooth entry to or exit from the process control mode. When the process control mode is selected, an adjustable ramp moves the load reference in a direction to reduce the process control error. When the error is minimized, or the reference first reaches either the specified high or low load pick-up limits, the process controller is activated. When unloading from the process control, an adjustable unload ramp provides time controlled unloading to the unload trip level. When load reaches the unload trip level, the GTC200 control automatically issues a breaker open command to remove the generator set from the system. The ramp pause switch input allows holding of the load ramp for cool-down or warm-up purposes.

When multiple gensets and GTC200 controls are connected to a bus in process control mode one unit is automatically assigned as the “Process Master”. Its process control loop then dictates through the LON network the load levels of other gensets on the bus.

VAR/PF Control

The VAR/PF functions control the reactive power component of the generator in parallel systems. The reactive load mode can be configured for VAR or Power Factor control. The controller compares the reactive load on the generator with an adjustable internal reference and makes corrections to the set point of the Automatic Voltage Regulator (AVR) until the desired reactive power is obtained. The reactive power level can be maintained while also controlling real load through the generator breaker. The analog voltage bias output can be directly connected to compatible voltage regulators. The control also has raise and lower contact outputs to activate a voltage regulator MOP when an analog input is not provided on the AVR. The GTC200 control has a selectable voltage range alarm that is activated if the analog output to the voltage regulator reaches high or low saturation. The GTC200 control also has selectable and adjustable high and low voltage limit switches and alarm outputs.

The GTC200 control provides switch inputs to allow raising or lowering the generator voltage reference. The control also provides a 4–20 mA (or 1–5 Vdc) analog input for kVAR/PF set point control, if desired. The kVAR/PF reference can also be set through a Modbus or ServLink DDE communication interface.

While the GTC200 is controlling unit load to accomplish real load (kW) sharing, the voltage of the generators in parallel will be controlled to accomplish equal Power Factor levels of each generator.

Generator Protection

The GTC200 control with the PowerSense Module includes the following features as selection options for the user.

Power and Energy Metering

The digital signal processing techniques are used to provide significantly improved accuracy and speed of response over conventional analog measurement techniques. Accuracy is improved using rapid sampling of the voltage and current signal waveforms and developing a true RMS measurement. Measuring true RMS power allows optimal accuracy, even in the presence of power line distortions.

The PowerSense board receives the PT and CT inputs for both the generator and bus for calculation of parameters for the GTC200 to use in system control. The algorithms used are based on IEEE 1459-2000. For the generator and bus the following parameters are provided: Hz, Vac, Amps, W, VA, VAR, PF, Phase, Voltage harmonics, Current harmonics, Negative Phase Sequence Voltage, Negative Phase Sequence Current.

Available for selection at the 4-20 mA analog outputs: Synchroscope, Generator metering, Mains metering

Protective Relaying

Alarms and Trips can be configured for generator protective relay functions. Time delays for the alarm and trip thresholds can be set. The GTC200 contains programming logic to annunciate the following generator events:

- Over and Under Voltage
- Over and Under Current
- Over and Under Frequency
- Over and Under VARs
- Negative Phase Current and Voltage
- Phase Over Current
- Phase Differential Current
- Reverse Power and Over Power protection

Each of the events has an initial Warning level and an Alarm level condition that can trigger the desired action (Alarm, Open Breaker Trip, Shutdown unit Trip). Current based protections are implemented using the ANSI/IEEE C37.112 Very Inverse curve.

Special Features of the GTC

The GTC200 also contains a few special features that the user may be interested in using. These tools may require the user to have a deeper level of understanding of the Woodward control and software products than is required to just configure and run the unit. However, anyone capable of commissioning a unit should be able to utilize these features, and instruct others on how & when to use them.

Debug Tunables—There are additional tunables in the control application that are not available in the service and configure headers. These are intended to be used only if needed by experienced personnel.

Non-Volatile Memory—The application has logic that will keep an incremental count of the following:

Number of Starts Attempted
Number of Fired Starts (Start & Temp seen)
Number of Shutdowns (Hard shutdowns only)
Total Turbine Run Hours (Fuel On & Temperature seen)

The control will save these values periodically to a non-volatile memory location so that these values will not be lost upon a power cycle to the control. These accumulated values are sent to the Modbus list. There are tunable handles in the application to preset these accumulators to any desired value when the control is being initially installed or when the control is replaced.

Data logging—The GTC has a high-speed datalog block included in the application that allows the control to trend a pre-programmed number of parameters at a rate of 10 ms increments. These values are stored in an accumulation buffer that will retain approximately 2 minutes of run time. These block is setup to automatically start once the turbine is achieved a successful start and will automatically stop the log anytime a shutdown event occurs. It will retain the data in the buffer until it is either downloaded to a serial port or a new start command is issued to the datalog block. It is important to realize that this file must be retrieved before attempting a restart or the file will be lost.

This file can be downloaded and viewed with the Control Assistant tool. This file can be very valuable in troubleshooting dynamic control issues or intermittent shutdowns.

Chapter 3. Installation and Wiring Guidelines

For general information on unpacking the unit, mounting the unit, shielding and grounding signals refer to the AtlasSC digital control manual (26179). This chapter is intended to guide the user in specific control wiring of the I/O signals used in the GTC200 application.

Electrical Connections

For noise suppression, it is recommend that all low-current wires be separated from all high-current wire.

Most inputs and outputs to the GTC200 are made through “CageClamp” terminal blocks. The GTC200 is shipped with mating connectors for all terminals. Most of the GTC200 control’s terminal blocks are designed for removal by hand. After GTC200 input power is disconnected, the pluggable terminal blocks can be removed one at a time by pulling them straight out. Be careful not to pull the plug out at an angle, as this will fracture the end terminal.

Each Terminal block has a label (PS, PSEN, SCM) to indicate which board it is used with, and terminal numbering to indicate which terminal block on that board to plug into. The board assemblies also are marked with a label to match with terminal block labels.

The pluggable terminal blocks are screwless CageClamp-style blocks. The spring clamp can be opened with a standard 2.5 mm (3/32 inch) flat bladed screwdriver (see Figure 2-2). The GTC200 pluggable terminal blocks accept wire 28 to 18 AWG (0.08 to 0.8 mm²). One 18 AWG (0.8 mm²) wire, or two 20 AWG (0.5 mm²) wires, or three 22 AWG (0.3 mm²) wires can be easily installed in each terminal. Wires for the pluggable I/O terminals should be stripped 8 mm (0.3 inch).

The GTC200 fixed terminal blocks used for the power supply input accept wires from 28 to 18 AWG (0.08 to 0.8 mm²). One 18 AWG (0.8 mm²) wire, or two 20 AWG (0.5 mm²) wires, or three 22 AWG (0.3 mm²) wires can be easily installed in each terminal. Wires for the fixed mounted power terminals should be stripped 5 mm (0.2 inch).

IMPORTANT	**Do not tin (solder) the wires that terminate at the GTC200 terminal blocks. The spring-loaded CageClamp terminal blocks are designed to flatten stranded wire, and if those strands are tinned together, the connection loses surface area and is degraded.**

All ac wiring for voltages and currents is done with fixed screw barrier blocks rather than pluggable terminal blocks. The fixed screw barrier blocks accept wires terminated into terminal lugs for #6 screws.

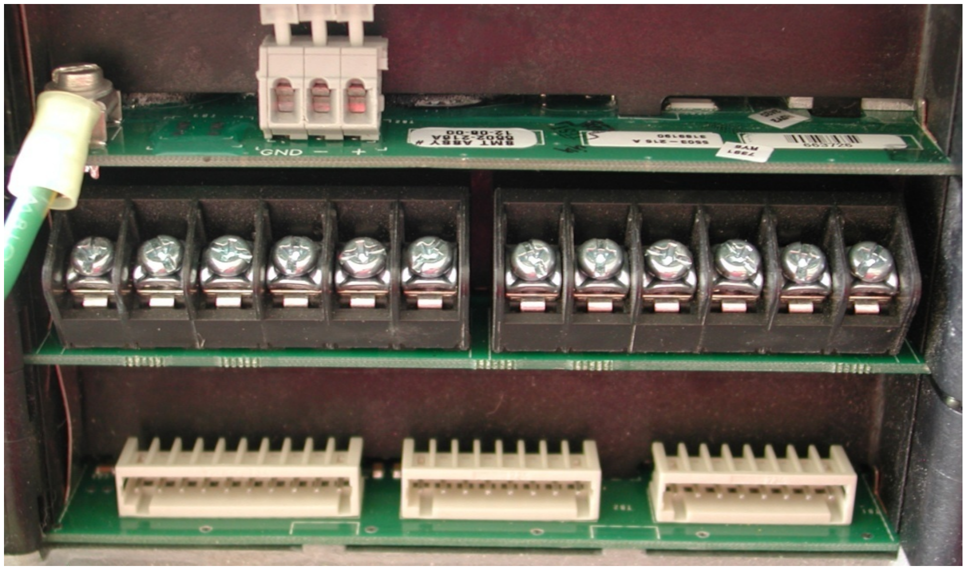


Figure 3-1. Fixed Ring Terminals

Grounding for Protection Against Electrical Shock

Protective Earth (PE) must be connected to the termination point on the backside of the unit next to the label with the symbol ⏚ (or 1 of 3 other like termination points without label) to reduce the risk of electric shock. This connection will be made using a thread-forming screw (M4 x 6 mm). The conductor providing the connection must have a properly sized ring lug and wire larger than or equal to 3.3 mm² (12 AWG).

Recommended Grounding Practices

Providing the proper ground for the GTC200 is important. Improper connection of the GTC200 chassis to the ground plane may lead to stray currents between the reference point for the ac signal sources (current and voltage transformers), and the reference point for the sensing inputs on the GTC200. Differences in potential between these two points results in equalizing current flow which then produces unacceptably high common mode voltages. Common mode voltages may result in improper readings for the sensed ac inputs, or even damage to the GTC200 in extreme cases. To minimize this problem, it is necessary to provide a low resistance path between the ac signal reference point, and the chassis of the GTC200. Typically this point is the designated ground for the generator set and related instrument transformers.

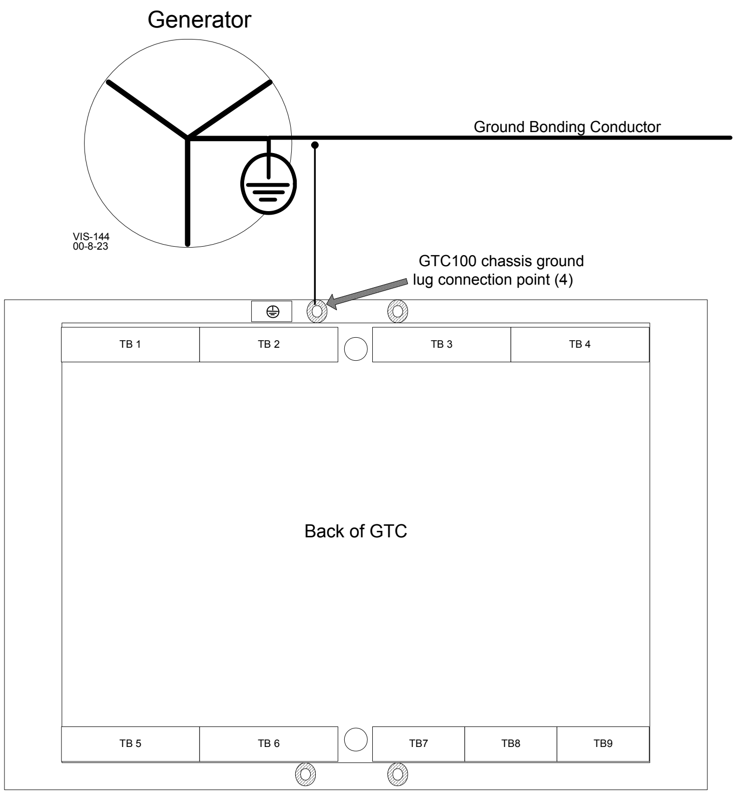


Figure 3-2. Recommended Single Point Grounding Scheme

Isolation

Figure 3-3 shows how the I/O is isolated with regard the main system power supply and other I/O types. Each input wiring diagram also shows how an input type is isolated in more detail.

Figure 3-3 uses numerals to indicate isolation grouping. Power and Ground isolation groups are indicated with a P# and G#. Every instance of the same P# and G# indicates that the item is part of the same group and not isolated from the other members of the same group. For example, all analog inputs, analog outputs, and CPUs use P9 for power and G9 for ground.

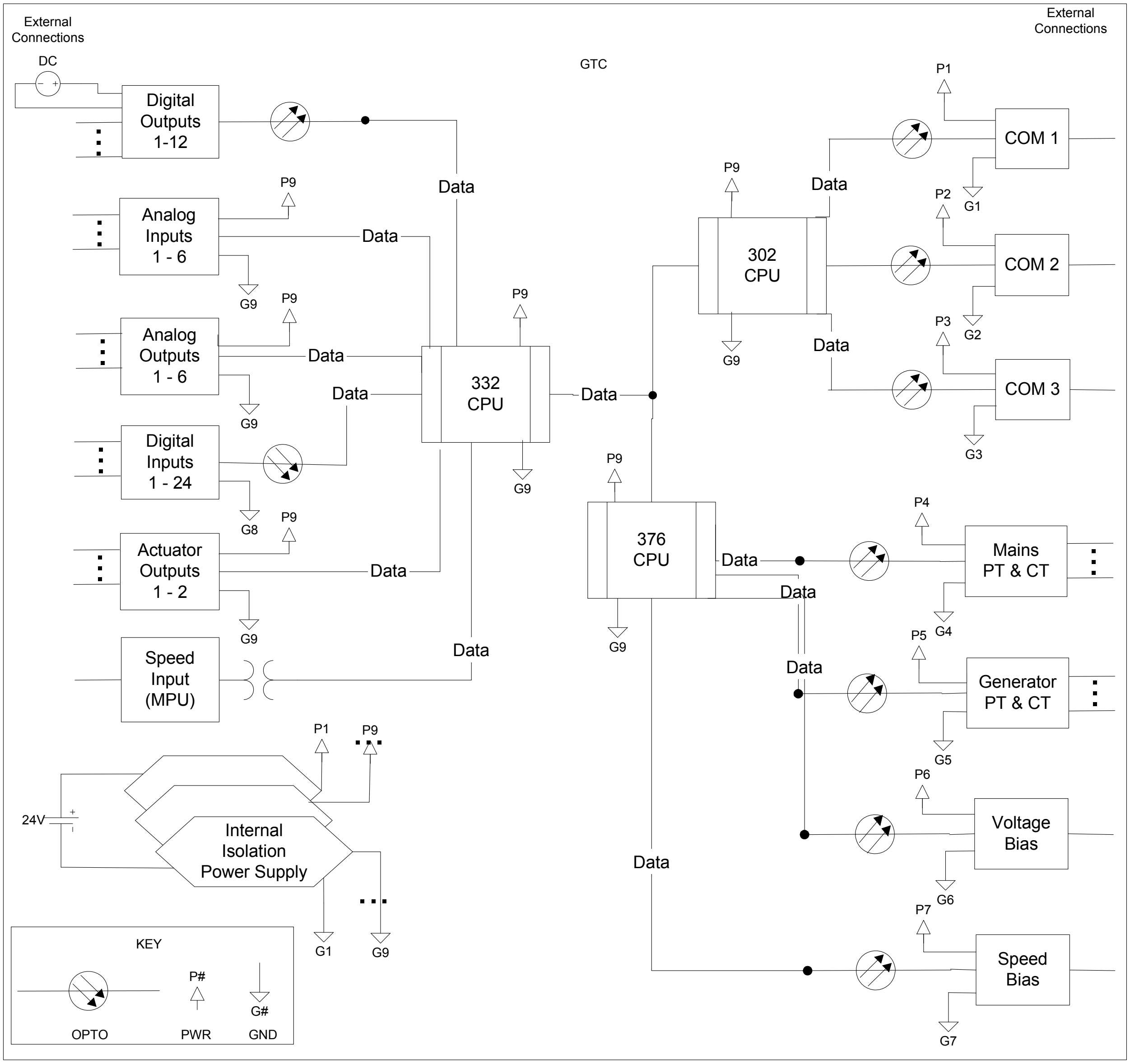
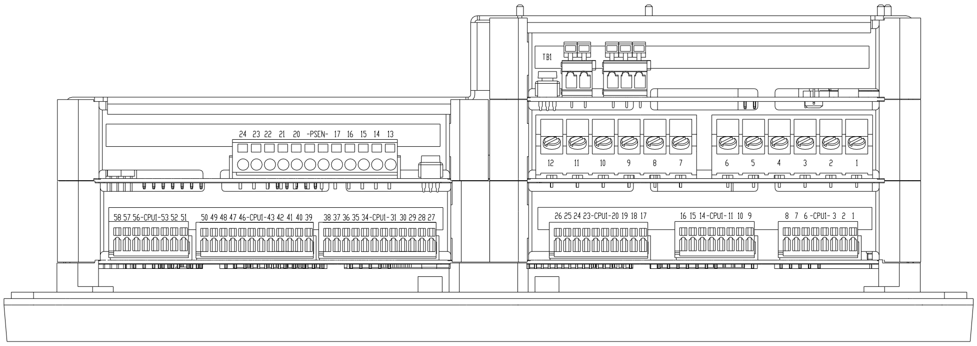


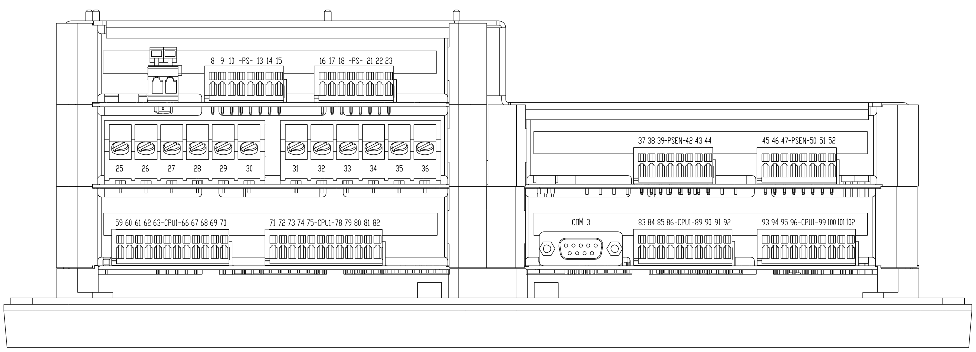
Figure 3-3. I/O Isolation

Terminal Locations

All terminals are located on the top and bottom of the GTC200. All but the PT and CT use either a cage clamp or a pluggable terminal strip for ease of connection. Figure 3-4 shows top and bottom views of the GTC200 to help orient each of the three board positions within the control. Each boards Wiring Diagram is shown immediately following the top and bottom terminal views.



(Top View)



(Bottom View)

Figure 3-4. GTC200 Terminal Strip Location View

Input Power

⚠WARNING

The GTC200 power supply board must have the input power removed before installing or removing any connectors or wiring.

This equipment is suitable for use in Class 1, Division 2, Groups A, B, C, and D, or non-hazardous locations only.

The GTC200 is suitable for use in European Zone 2, Group IIC environments per DEMKO certification.

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

Do not connect more than one main power supply to any one fuse or circuit breaker.

The power supply and ground connections are located on the top of the GTC200 on the power supply board. The input to the Power supply must be of a low impedance type for proper operation of the control. DO NOT power a control from a high voltage source containing dropping resistors and zener diodes. If batteries are used for operating power, an alternator or other battery-charging device is necessary to maintain a stable supply voltage.

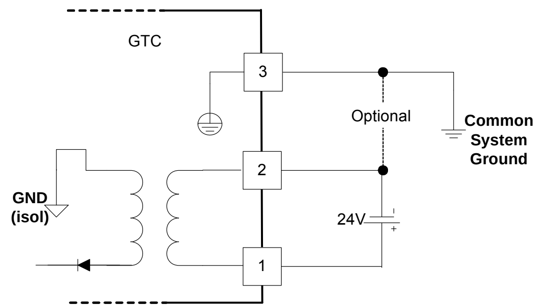


Figure 3-5. Input Power Wiring Diagram

Input Power Ratings

Voltage Range	18–32 Vdc
Maximum Voltage	40 Vdc
Minimum Voltage	9 Vdc (engine cranking only)
Input Current	0.9 A @ 24 Vdc 1.1 A @ 18 Vdc
Maximum Input Power	22 W
Typical Input Power	20 W @ 24 Vdc
Interrupt Time Holdup	8 ms @ >= 24 Vdc input voltage
Efficiency	70% minimum over operating input voltage range
Reverse Polarity Protection	100 Vdc
Input Wiring Constraints	The GTC200 must be wired such that no other device receives power from the wiring between the unit and the power supply source.
Input Wire Size	12 AWG (2.5 mm²)
Input Fuse Rating	3 A (time delay with melting I2t □100A2 sec)

Significant inrush currents are possible when current is applied to the GTC200 control. The magnitude of the inrush current depends on the power source impedance, so Woodward cannot specify the maximum inrush current. Time-delay fuses or circuit breakers must be used to avoid nuisance trips.

Power Supply Monitoring Circuit

Maximum voltage measured	35 Vdc
Resolution in volts	0.15 Vdc
Maximum error due to temperature change	1.0 Vdc
Maximum error due to load change	1.0 Vdc
Total maximum error at 25 °C	1.2 Vdc

Input Power Wiring

Protective earth ground (PE) must be connected to the chassis at the ⏚ labeled termination point on the back of the display. The power supply grounding terminals should also be connected to earth to ensure grounding of the power supply printed circuit boards. The grounding conductor must be the same size as the main supply conductors or the PT wires, whichever is larger.

Note that the control's power supplies are not equipped with input power switches. For this reason, some means of disconnecting input power to each main power supply must be provided for installation and servicing.

It is expected that the installation of this equipment will include overcurrent protection between the power source and the GTC200. This overcurrent protection may be accomplished by series connection of properly rated fuses or circuit breakers. Branch circuit protection of no more than 250% of the maximum GTC200 power supply input current rating must be provided. Maximum fuse rating must meet the 250% UL listing requirements. The use of properly sized UL class CC, J, T, G, RK1, or RK5 fuses meet the requirements for branch circuit protection. Do not connect more than one GTC200 to any one fuse. Use only the wire size specified above, or equivalent, that meets local code requirements. Time delay fuses should be used to prevent nuisance trips.

The power supply holdup time specification is the time the supply will continue to operate within specification after its input power is interrupted. This information may be useful in specifying uninterruptible power supply (UPS) systems.

IMPORTANT

2.5 mm² (12 AWG) is the largest wire gauge size that can be connected to the control power input terminal blocks.

The minimum continuous input voltage allowed is 18 V at the power input of the control. The length, size of wire, and load current will determine the minimum supply output voltage. The minimum supply voltage measured at the source should always be greater than 18 V. Example: two (source and return) 20 foot (6 m) lengths of 14 AWG (2.5 mm²) wire carrying 1.2 A (maximum rated current) will result in a voltage drop from source output to control power input of approx. 0.16 volts. The resulting supply voltage from the example must be greater than 18.16 volts.

The GTC200 will remain in operation when an electrical starter is engaged, if input power drops to no less than 9.0 V.

Chapter 4.
PowerSense Signal Wiring

PowerSense Board Wiring Pinout

The PowerSense board (**PSEN**) is mounted between the Power Supply and the SmartCore board. The PowerSense Board inputs are the Mains and Generator power monitoring. Each PowerSense board contains the circuitry for two sets of three phase ac voltage (PT) and ac current (CT) inputs, as well as a speed bias output, a voltage bias output, and a LON communications port.

Features

- On-board processor for automatic calibration of the I/O channels
- PT and CT inputs provide fundamental as well as harmonic information
- PT and CT inputs are updated after 3 cycles, which is 50 ms at 60 Hz
- PT and CT inputs and bias outputs have 12 bit resolution
- PT inputs are software configurable for 70 V, 120 V, or 240 V ranges
- Each set of PT and CT inputs is isolated from the rest of the board and chassis
- Speed bias output is software configurable for 4–20 mA, 0–5 V, PWM, or ±3 V output
- Voltage Bias output is software configurable for 4–20 mA, ±1 V, ±3 V, and ±9 V
- Speed Bias and Voltage bias outputs are isolated from the rest of the board
- LON communication port

Potential Transformer (PT) Inputs

The Generator and Mains ac voltage inputs can accept voltages up to 300 Vac RMS maximum between the positive and negative terminals of each input. The inputs may be connected line-to-line or line-to-neutral. For example, if the inputs are connected line-to-neutral, each input A-N, B-N, and C-N may have up to 300 Vac. Therefore, a 480 Vac generator may be wired to the GTC200 using line-to-neutral connections resulting in 277 Vac at the inputs.

Input Voltage Range Selections	70, 120, 240 Vac RMS
Max. Input Voltage	300 Vac
Input Current	3 mA maximum
Input Frequency	40–70 Hz
Common Mode Rejection Voltage	±450 Vdc minimum
Common Mode Rejection Ratio	-63 dB minimum

The GTC200 must be configured for a voltage range relative to the input (Potential Transformer secondary) provided. For example, if a phase (+) to phase (–) input to the GTC200 is to be a nominal of 70 Vac, set the range to the 70 volt range. No change in wiring is necessary. This configuration setting maximizes the accuracy for the voltage level being sensed. There is also a voltage floor below which a voltage cannot be detected so setting the correct range is important for more than just accuracy. See the table below for the voltage floor at each range.

Voltage Range	Dead bus Voltage Detected	Maximum Voltage Detected
70	27 Vac	100 Vac
120	40 Vac	150 Vac
240	80 Vac	300 Vac

Table 4-1. Voltage Ranges Available

If potential transformers are used, be careful to select an accurate transformer. The largest source of inaccuracy in the system will be the transformer, since even the most accurate transformer is less accurate than the ac voltage inputs to the GTC200. The calibration menu contains turns ratio compensation factors for each PT input. Follow the calibration procedure to negate much of the transformer error.

When the PT input to the control is conditioned with a transformer the generator and mains transformer ratio is entered into the GTC200. This is described in the Configuration section of the Operation Manual. The GTC200 will use the PT ratio and the entered configured Range to calculate the actual system voltage(s).

EXAMPLE:

Hwd range = 120
PT ratio = 4
Measured PT secondary (input at terminals) = 112.5 Vac

The GTC200 will display 450 Vac for this input voltage.

Hazardous Live

The following circuits are classified as Hazardous Live because they carry potential shock hazardous voltages during normal operation or under single fault conditions:

- Potential transformer (PT) inputs
- Current transformer (CT) inputs
- Voltage bias outputs

WARNING **HIGH VOLTAGE—Do not touch or make contact with the above inputs and outputs during system operation when such circuits are live. Possible serious personal injury or death could result.**

These inputs and outputs are provided with 500 V of dielectric isolation from chassis ground. In addition, these inputs/outputs are isolated from safety extra-low voltage (SELV) circuits (such as serial communication, PC/104 circuits) by optoisolators or transformers provided with double insulation and 3 000 Vac of dielectric isolation.

PT—3∅ Wye, L-N, No Transformers

No transformers are necessary if the voltage input to the GTC200 is less than 300 Vac at a given phase input. This diagram shows a system where both the generator and bus are less than 300 Vac measured line-to-neutral. Each is connected to the GTC200 in a L-N mode without transformers (PT Ratio = 1:1). It is not required that both the mains and the generator inputs be connected in the same manner. One could be L-L and the other L-N if preferred. Also, one could use transformers and the other not. The diagram shown is simply an example of a typical system.

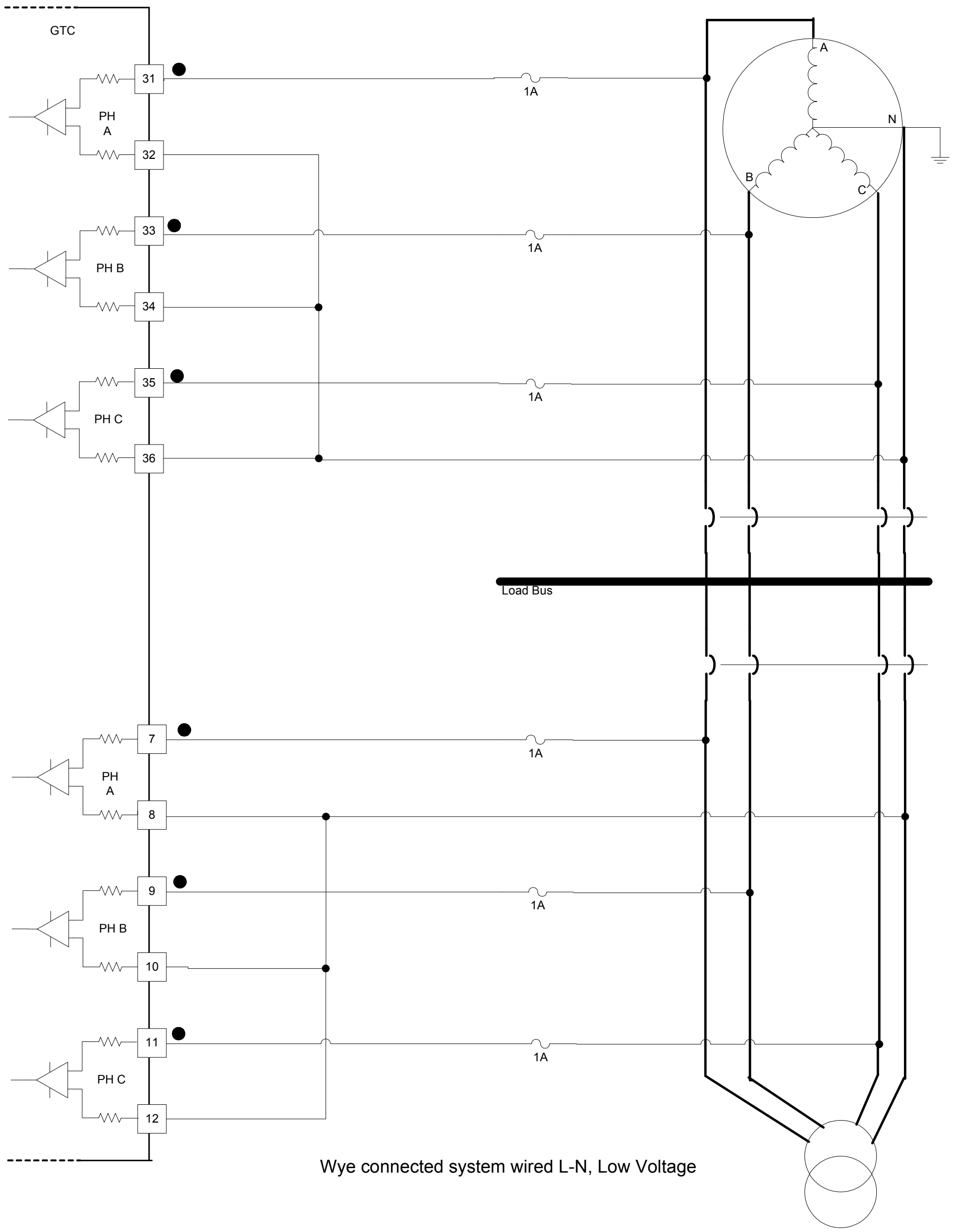
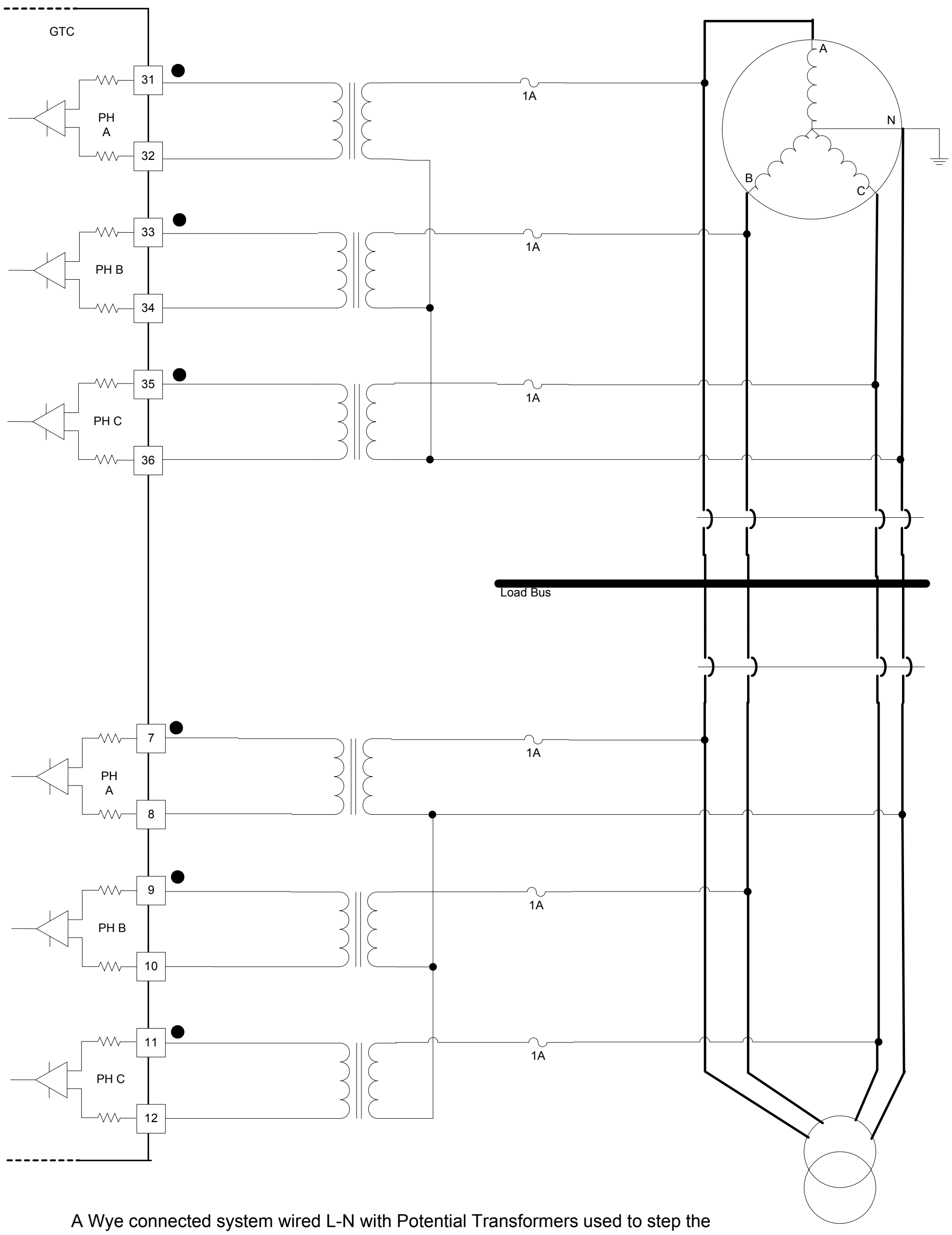


Figure 4-1. PT Wiring—3Ø Wye, L-N, without Transformer

PT—3∅ Wye, L-N, with Transformers

Transformers are necessary if the voltage input to the GTC200 is greater than 300 Vac at a given phase input or a customer preference. This diagram shows a system where both the generator and bus utilize potential transformers. Each is connected to the GTC200 in a L-N mode. It is not required that both the mains and the generator inputs be connected in the same manner. One could be L-L and the other L-N if preferred. Also, one could use transformers and the other not. The diagram shown is simply an example of a typical system.



A Wye connected system wired L-N with Potential Transformers used to step the voltage down.

Figure 4-2. PT Wiring—3Ø, Wye, L-N, with Transformer

PT—3∅ Wye, L-L, with Transformers

Transformers are necessary if the voltage input to the GTC200 is greater than 300 Vac at a given phase input or a customer preference. This diagram shows a system where both the generator and bus utilize potential transformers. Each is connected to the GTC200 in a L-L mode utilizing open delta wired transformers. It is not required that both the mains and the generator inputs be connected in the same manner. One could be L-L and the other L-N if preferred. Also, one could use transformers and the other not. The diagram shown is simply an example of a typical system. Notice for this configuration that the generator is a wye, but the potential transformers are connected in a L-L fashion, so the GTC200 should be configured as a delta L-L.

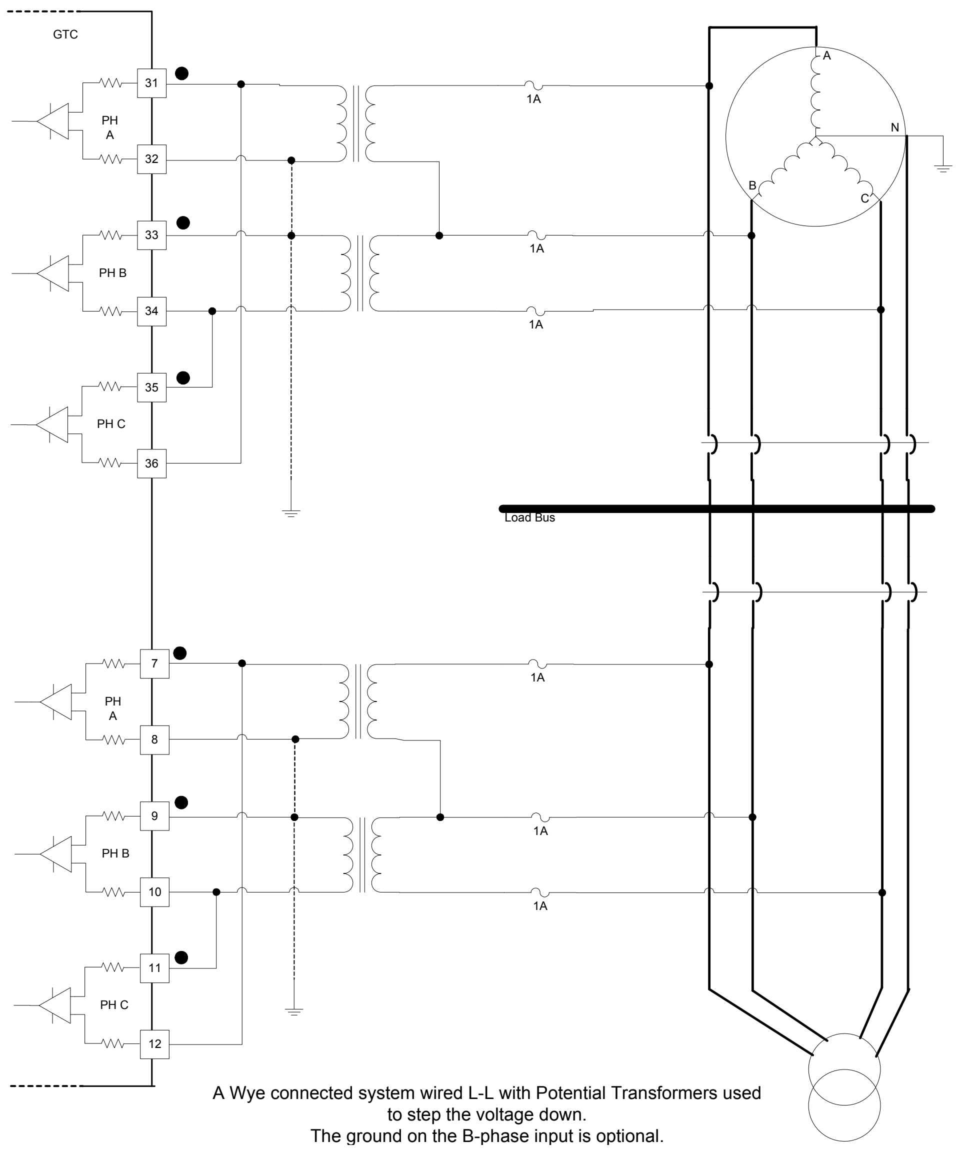


Figure 4-3. PT Wiring—3∅ Wye, L-L, with Transformers

PT—3∅ & 1∅ Inputs, Wye, L-L with Transformers

Transformers are necessary if the voltage input to the GTC200 is greater than 300 Vac at a given phase input or a customer preference. A single phase monitoring system may be wired either L-L or L-N. The B and C phase inputs will be ignored and do not need to be wired. Single phase mode must then be selected in the software configuration.

The generator and mains do not have to be configured identically. One can use single phase and the other can use three phase if preferred. The below wiring diagram example shows the generator wired 3∅ with open delta transformers from a wye system. It also shows the mains wired 1∅ with a step down transformer wired L-L.

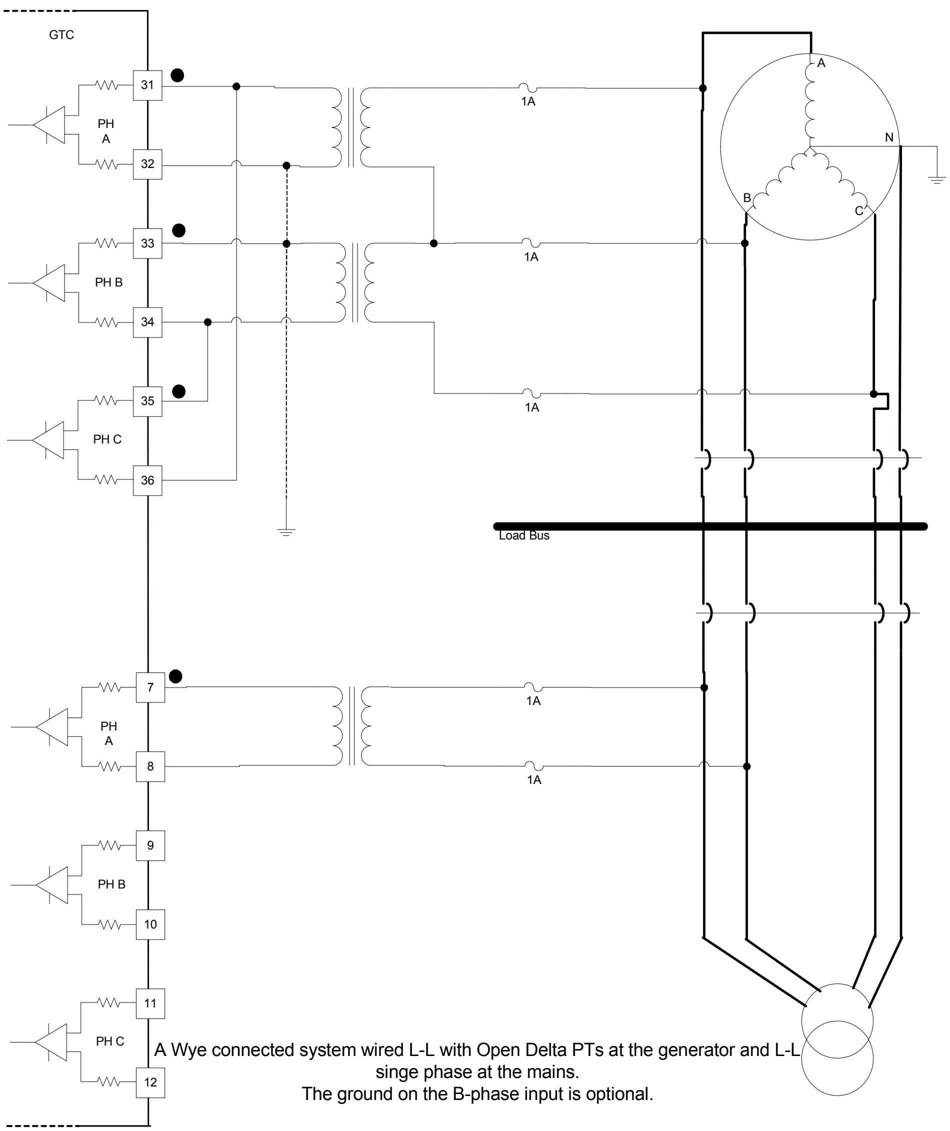


Figure 4-4. PT Wiring—3∅ Wye, & 1∅ Wye, L-L, with Transformers

PT—3∅ Input, Delta, L-L Connection with Transformers

Transformers are necessary if the voltage input to the GTC200 is greater than 300 Vac at a given phase input or transformers may be used per customer preference. This diagram shows a system where both the generator and bus utilize potential transformers. Each is connected to the GTCP100 in a L-L mode utilizing open delta wired transformers. It is not required that both the mains and the generator inputs be connected in the same manner. One could use transformers and the other not. The diagram shown is simply an example of a typical system.

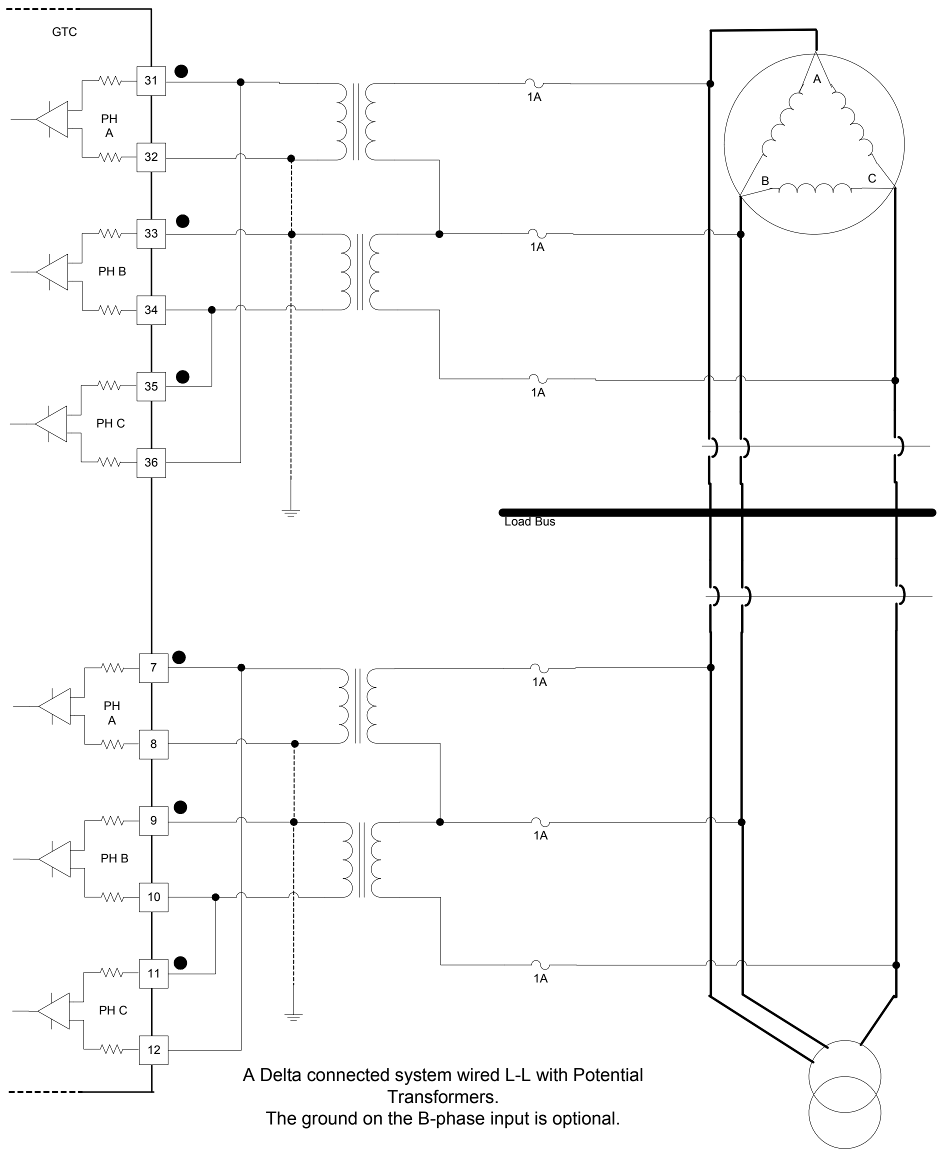


Figure 4-5. PT Wiring—3∅ Delta, L-L, with Transformers

PT—3∅ Input, Delta, L-L Connection without Transformers

Transformers are necessary if the voltage input to the GTC200 is greater than 300 Vac at a given phase input or a customer preference. This diagram shows a system where the generator and the bus do not utilize potential transformers. Each is connected to the GTC200 in a L-L mode. It is not required that both the mains and the generator inputs be connected in the same manner. One could use transformers and the other not. The diagram shown is simply an example of a typical system.

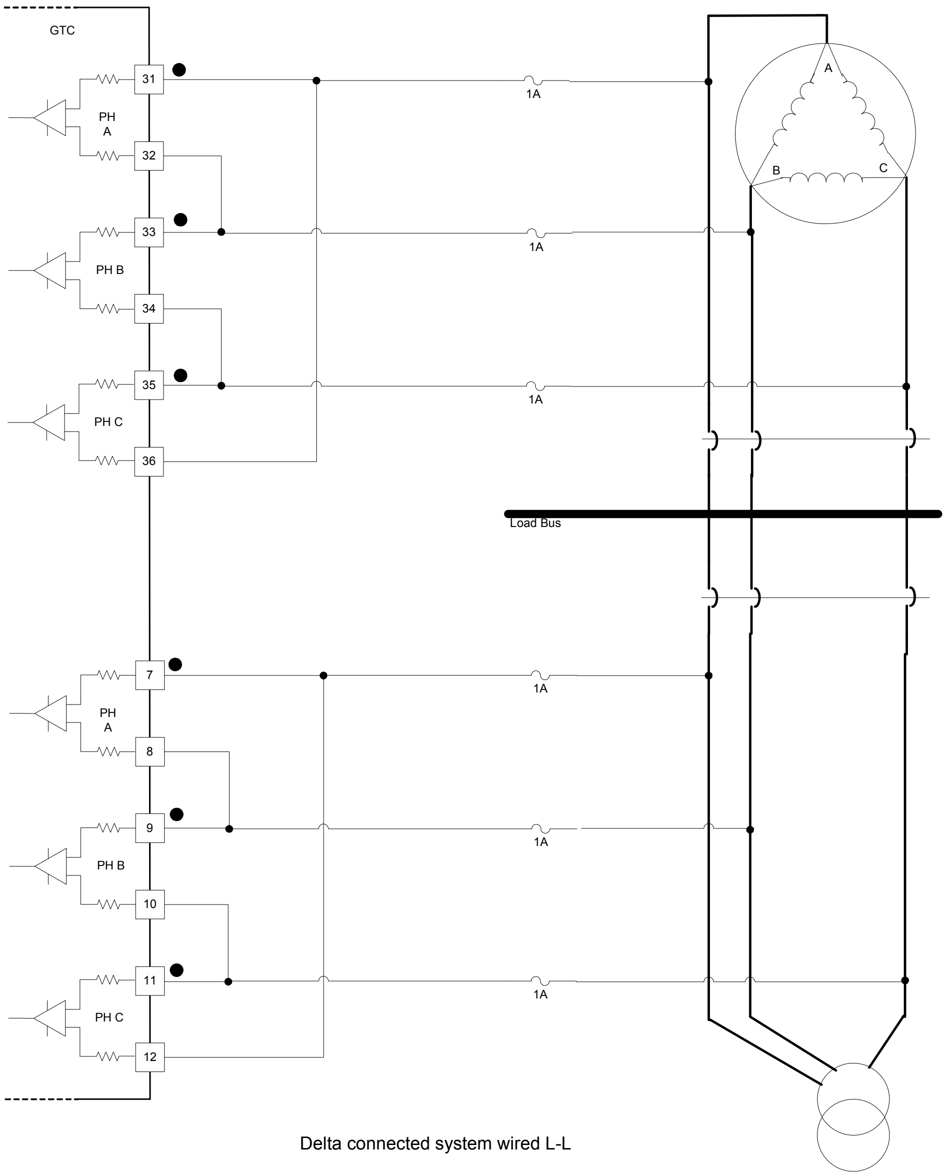


Figure 4-6. PT Wiring—3∅ Delta, L-L, without Transformers

Current Transformer (CT) Inputs

The Generator and Mains ac current inputs can accept currents up to 7 A ac RMS maximum between the positive and negative terminals of each input. The CT inputs are rated at 5 A ac RMS nominal and function down to 50 mA. For optimum accuracy in the usable range, it is recommended to use 5 A secondary CTs (Do not use 1 A secondary CTs).

Input Current	5 A RMS full scale
Max. Transient Input Current	7.07 A RMS
Input Frequency	40–70 Hz
Common Mode Voltage	±250 Vdc minimum
Common Mode Rejection Ratio	–63 dB minimum

Be careful to select an accurate current transformer. The largest source of inaccuracy in the system will be the transformer since even the most accurate transformer is less accurate than the AC current inputs to the GTC200. The calibration menu contains turns ratio compensation factors for each CT input. Follow the calibration procedure to negate much of the transformer linear error.

The GTC200 does not require three phases for current calculations. The user can configure the GTC200 for single phase, and all functionality will be modified accordingly. The phase input that must be provided is the A phase.

The generator and mains Current Transformer ratio is entered into the GTC200. This is described in the Configuration section of the Operators Manual (26137). The GTC200 will use the CT ratio to calculate the actual system current(s).

EXAMPLE:

CT ratio = 500

Measured CT secondary (input at terminals) = 3.9 A

The GTC200 will display 1950 A ac for this input current.

For a full wiring connection, combine the Current Transformer (CT) wiring below with the Potential Transformer (PT) section above.

CT—3∅ Wye

This diagram shows the generator and mains in a wye configuration. The current transformers are placed on the leads connecting to the load. The diagram shown is simply an example of a typical system.

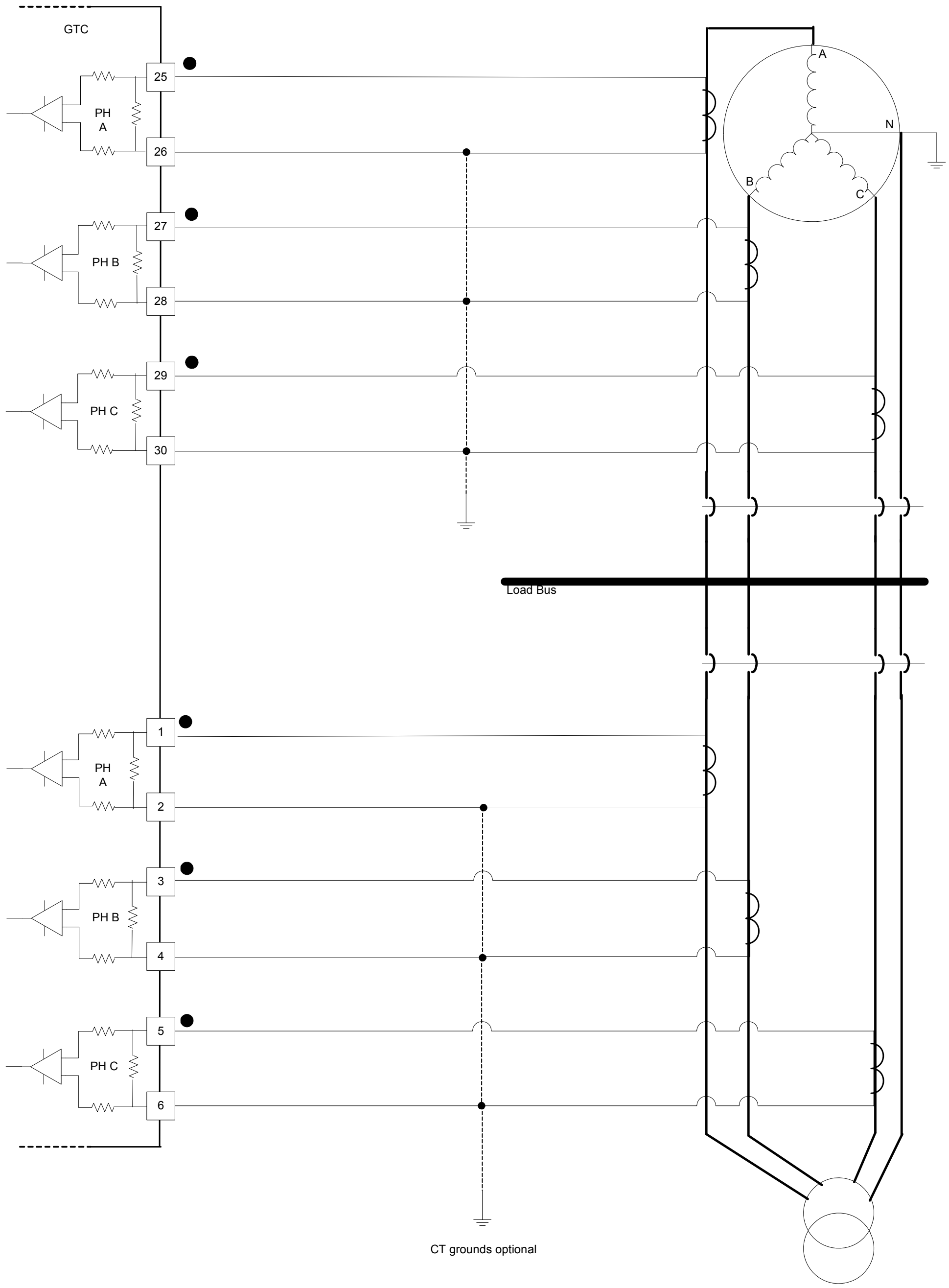


Figure 4-7. CT Wiring—3∅ Wye

CT—3∅ Delta

This diagram shows the generator and mains in a delta configuration. The current transformers are placed on the leads connecting to the load. The diagram shown is simply an example of a typical system.

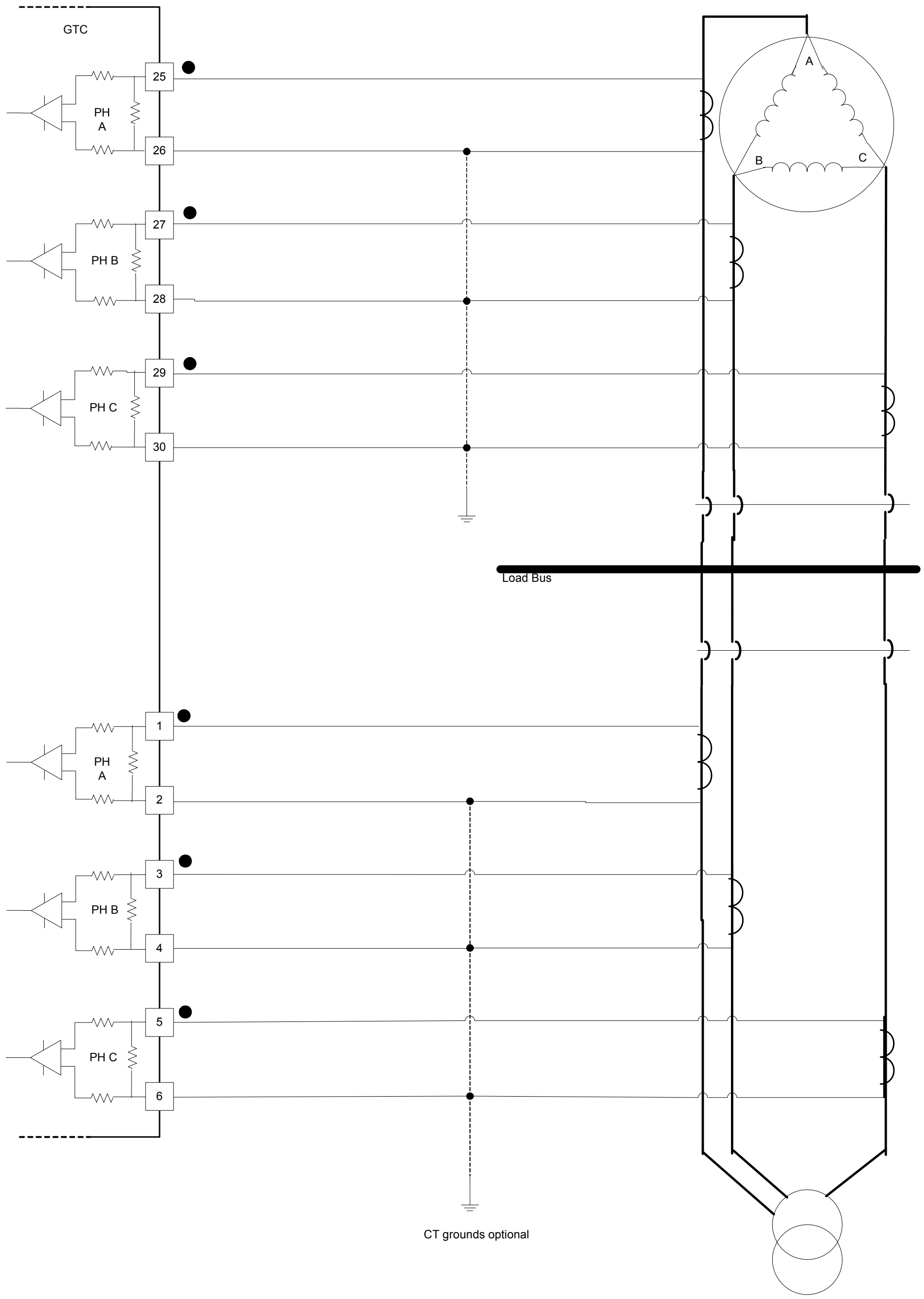


Figure 4-8. CT Wiring—3Ø Delta

Single Phase Monitoring

In a single phase monitoring system, the GTC200 will only use the A phase CT input. Anything connected to the B and C phase inputs will be ignored. The current transformer is placed on the A phase leads connecting to the load. See the appropriate diagram above and ignore the B and C phase inputs. For a single phase input, the PT and CT must be monitoring the same phase. During control Configuration the software must be selected to use Single Phase. The single phase monitoring is applied to 3 phase machines, it is not intended for single phase machines.

IMPORTANT

The GTC200 power calculations are based on a per-phase calculation. When a single phase input is used the displayed values will be 1/3 of the total devise levels. Therefore the entered CT ratio or the total power level(s) for the mains or generator will have to be adjusted to display actual 3∅ devise power levels.

Speed Bias Output

The Speed Bias output is not used on the GTC200.

Voltage Bias Output

The Voltage Bias allows the GTC200 to vary the generator voltage level to control the reactive load on the generator. The Voltage Bias can be configured one of four types of outputs: 4–20 mA, ±1 V, ±3 V, ±9 V. The output mode selected should be determined based on the voltage regulator specifications. Minimum to maximum voltage bias output change from the GTC200 should be approximately ±10% change in rated generator voltage. Both the configuration and the wiring must be changed to switch between current and voltage outputs. Only the configuration must be changed to switch between the differing voltage outputs.

PWM frequency	3 kHz for current and voltage outputs
Current output	4–20 mA selected by software switch and wiring
Voltage output	±1, ±3, ±9 Vdc selectable by software switch and wiring
Max current output	
4–20 mA output	25 mA ±5%
Max voltage output	
±1, ±3, ±9 Vdc	±9 V limit ±5%
Isolation	See HAZARDOUS LIVE isolation requirement
Max load resistance	
4–20 mA	300 Α at 24 mA
±1, ±3, ±9 Vdc	No maximum
Min load resistance	
4–20 mA	0 Ω
±1, ±3, ±9 Vdc output	7 kΩ
Resolution	
4–20 mA	12 bits
±1 V output	>7 bits
±3 V output	>9 bits
±9 V output	12 bits
Accuracy	Better than ±0.1% of full scale @ 25 °C
4–20 mA	±0.025 mA
±1 V, ±3 V, ±9 V output	±0.018 V
Temperature Drift	
Voltage outputs	330 ppm/°C, maximum
4–20 mA output	140 ppm/°C, maximum

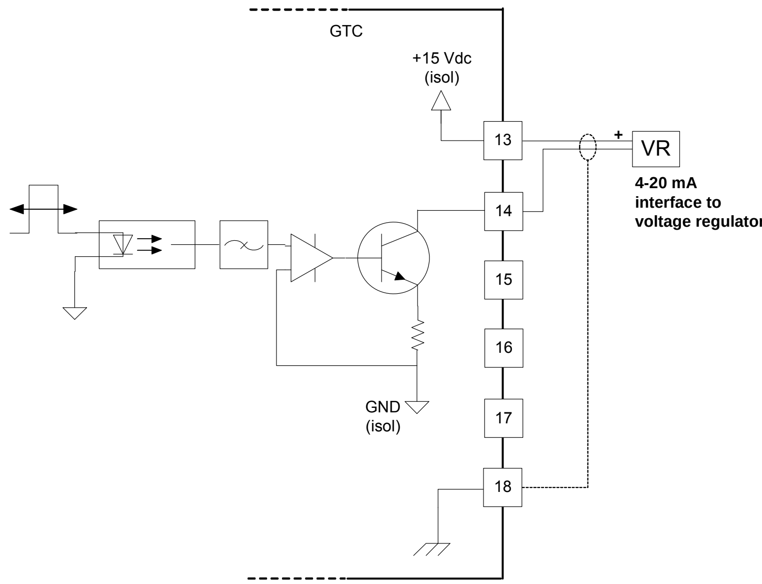


Figure 4-9. Voltage Bias Wiring Diagram, 4–20 mA Output

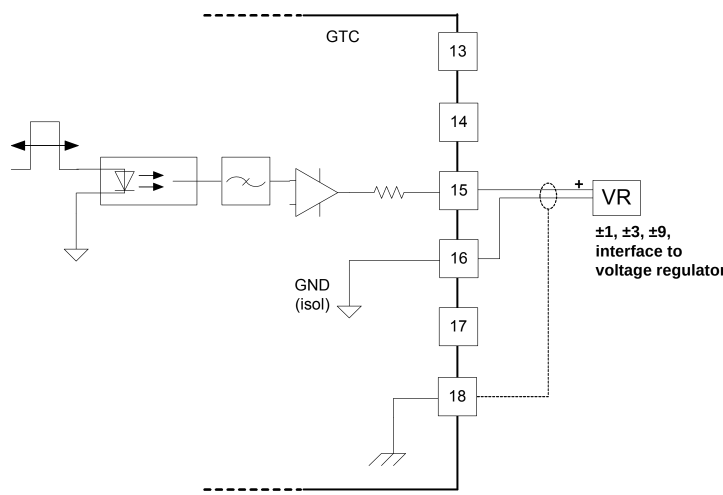


Figure 4-10. Voltage Bias Wiring Diagram, Bi-polar Voltage Output

LON Communication Port

The LON port is used to communicate with up to 16 other GTC200 devices. The LON allows controls to share breaker status and load share information between generator sets. The LON communication is also compatible with Digital Synchronizer and Load Control (DSLC) devices. When an GTC200 is the last device of the LON string, the termination jumper at 48 and 49 should be installed.

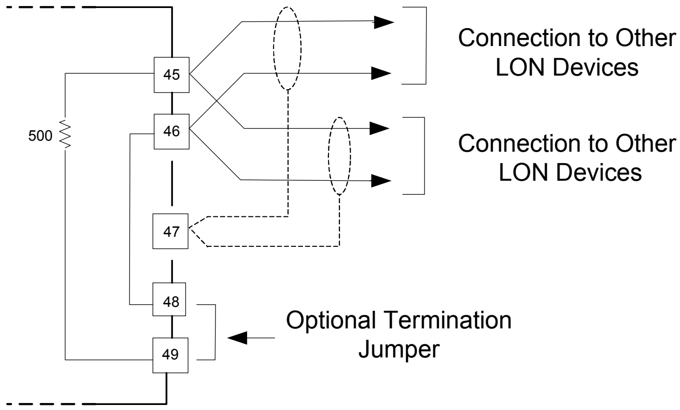


Figure 4-11. LON Connections

Use only recommended shielded cabling for LON network. Correct cable is available from Woodward, Belden, or other suppliers providing an equivalent cable.

Woodward part number 2008-349

Belden
PO Box 1980
Richmond IN 47375
Telephone (317) 983-5200

Belden Part Number	Description
9207	PVC 20 AWG shielded. NEC Type CL2, CSA Cert. PCC FT 1.
89207	Teflon 20 AWG shielded, Plenum version. NEC Type CMP, CSA Cert. FT 4.
YR28867	PVC 22 AWG shielded.
YQ28863	Plenum 22 AWG shielded.

Recommended cable length and stub length of LON network wiring.

System Ambient Temperature Range:	0 to 55 °C	–20 to +55 °C	–40 to +55 °C
Maximum Network Cable Length	150 m	150 m	50 m
Maximum Stub Length	300 mm	300 mm	300 mm

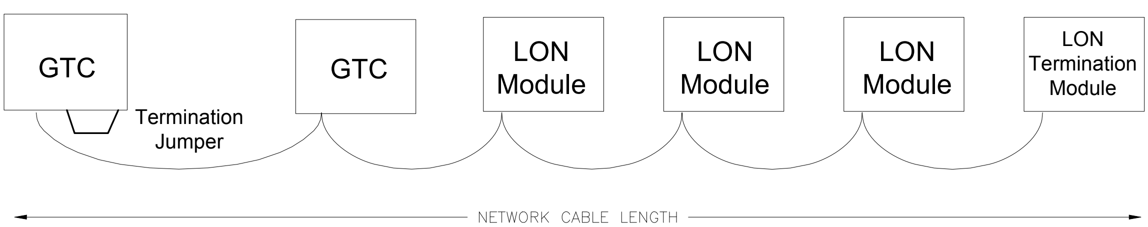


Figure 4-12. Direct Wired LON Network

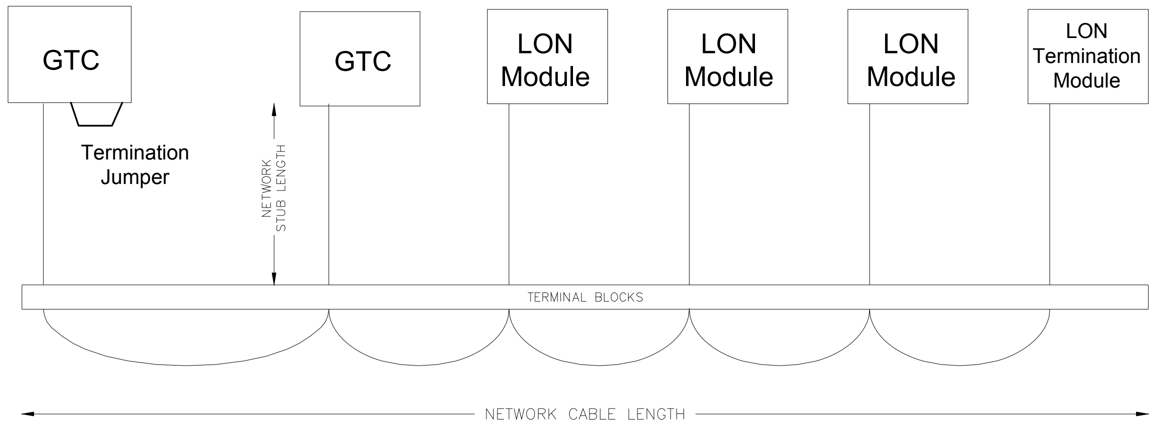


Figure 4-13. Stub Wired LON Network

It should be noted that in some installations there may be a combination of systems that may or may not be able to communicate via the Woodward product LON network. In those cases the user can opt to use a Woodward Load Sharing Interface Module (LSIM – p/n 8239-082). This device provides an analog to LON communication gateway which allows analog load sharing units to join a LON type of load sharing network. This device is self-configuring and self-binding but does have some limitations in that it only supports load sharing between the units. It does not support VAR/PF control through the LON.

Chapter 5. Control Signal Wiring

Fuel Control Input/Output Signals

A detailed list of the AtlasSC™ I/O signal layout including channel allocation, wiring terminations, descriptions, and range information is found in Appendix A. This chapter describes details of the signals that the GTC200 is programmed to handle. The control wiring diagrams in Appendix A also identify which signals are required and which are optional. The details below show the '**Programmed Default**' functions of the GTC200 input/output channels. This section should be used in conjunction with Appendix D which lists the information that the user will see on the Service and Configure screens when using Watch Window to configure the control. Appendix D will guide the user in the specific detailed configuration options of the control for each turbine. Most of the I/O channels in the GTC200 have been programmed with 3 options:

- GTC Used—as per default allocation below and in Appendix A
- Customer Use—custom signals for pre-programmed options
- Not Used

MPU (Speed) Inputs

The GTC200 accepts passive magnetic pickup (MPU) inputs for speed sensing. It is not recommended that gears mounted on an auxiliary shaft be used to sense speed. Auxiliary shafts tend to turn more slowly than the rotor or crankshaft (reducing speed sensing resolution) and have coupling gear backlash, resulting in less than optimum speed detection. For safety purposes, it is also not recommended that the speed sensing device sense speed from a gear coupled to a generator or mechanical drive side of a system.

Input frequency	100–24 950 Hz
Input amplitude	1–25 Vrms
Input impedance	2 k Ω
Isolation voltage	500 Vac minimum, each channel is isolated from all other channels
Resolution	Dependent on frequency, 13 bit minimum at maximum speed
Accuracy	Better than ±0.08% full scale from –40 to +85 °C internal temperature

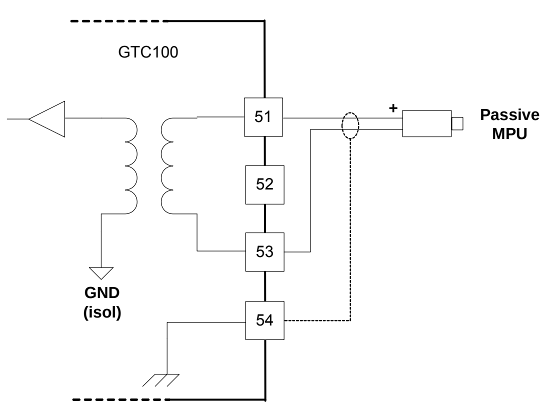


Figure 5-1. MPU Wiring Diagram

Speed Sensing (DSS_01 thru DSS_04)

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 can be 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

The Analog Inputs may be current or voltage type. If a current input is used, a jumper is installed at the terminal block, and the software must be selected for current. This allows the GTC100 to use the applicable hardware calibration values. If a voltage input is needed, the jumper must be removed, and the software must be selected for voltage.

When the GTC100 inputs are configured (see Operator Manual), the engineering unit values are entered for the sensor at minimum (1 v or 4 mA) and at maximum (5 V or 20 mA).

The Analog Inputs may be used with a two-wire ungrounded (loop powered) transducer or isolated (self-powered) transducer. See transducer wiring below for typical wiring. If interfacing to a non-isolated device that may have the potential of reaching over 10 Vdc with respect to the control's common, the use of a loop isolator is recommended to break any return current paths, which could produce erroneous readings. Loop power must be provided from an external source.

Input type	4–20 mA or 1–5 V
Max. Input current	25 mA ±5% if configured for 4–20 mA
Max. Input voltage	5.0 V ±5% if configured for 1–5 V
Common mode rejection	80 dB minimum
Input common mode range	±11 V minimum
Safe input common mode volt	±40 V minimum
Input impedance	200 Ω (±1%) if configured for 4–20 mA >260 kΩ if configured for 1–5 V
Anti-aliasing filter	2 poles at 10 ms
Resolution	14 bits
Accuracy @ 25 °C	Better than ±0.1% of full scale, 0.025 mA
Temp Drift	171 ppm/°C, maximum (1.1% of full scale, 0.275 mA) 30 ppm/°C, typical (0.20% of full scale, 0.05 mA)

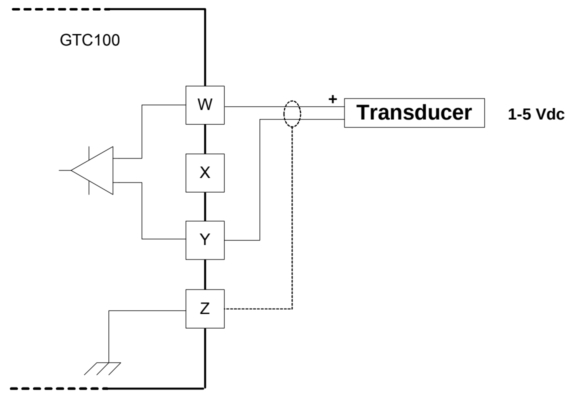
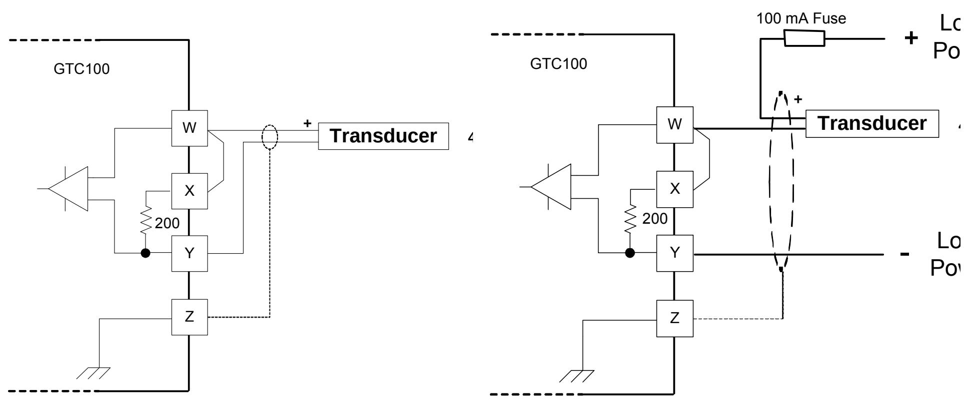


Figure 5-2. Analog Input Wiring Diagram, 1–5 V



Self powered

Loop Powered

Figure 5-3. Analog Input Wiring Diagram; 4–20 mA

The analog input signal on the GTC200 are allocated in the following way:

- 10 Thermocouple Inputs (8 of which are allocated to be EGT signals)
- 9 Analog 4-20 mA inputs (the first 6 of which can be 0-5 Vdc)
- 4 Speed Sensor Inputs
- 2 RTD Inputs

The first 6 analog inputs are configured via a selection menu of pre-programmed functions. Analog inputs 7, 8, and 9 can be used for the assigned GTC function or they can be configured to handle customer-defined inputs. The first 8 T/C inputs are available for EGT inputs, using and number of signals from 1 to 8. The T/C's 9 and 10 and the 2 RTD signals are available for customer-defined signals. Each of the inputs into the control has built in options for:

- Annunciation of a failed signal as an Alarm or a Shutdown
- The setting of a signal level that triggers an 'event' (ALM or SD)
- Monitoring of the signal and output of the value via Modbus

Analog Input Selection Menu:

1 Process Control Input Signal
2 Remote Process Control Set point
3 Ambient Inlet Air Temperature Sensor
4 Remote KW Reference Set point
5 Remote VAR/PF Reference Signal
6 Remote CJ Comp for T/C Signals
7 Gas Fuel Valve Position Feedback
8 Liquid Fuel Valve Position Feedback
9 Customer Defined Signal
10 Reserved – Not Used

Optional Analog Input Signals Programmed

Process Control Input Sensor – (Option #1)

The process input signal is available for applications that plan to use the turbine load capability to control a plant determined parameter. The control can be setup to control this value to a programmed set point. The GTC will then use its output to determine the turbine load set point.

Remote Process Reference Set point - (Option #2)

A remote Process reference set point can be brought back into the control via a 4-to-20 mA signal. This value is used as the set point for the Process controller.

Ambient Temperature Sensor - (Option #3)

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

It is very common for this ambient 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 ambient temperature sensor signal is converted to a digital signal in the AtlasSC Digital Control System and can be configured to bias the EGT temperature reference and the Acceleration limiter curve. If the ambient temperature input signal fails, a fixed-value signal (tunable) is used as the bias signal.

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 KW Reference - (Option #4)

A remote KW reference set point can be brought back into the control via a 4–20 mA signal. This value is used as the set point for the KW Load controller.

Remote VAR/PF Reference - (Option #5)

For units that include the PowerSense module, a remote VAR or PF reference set point can be brought back into the control via a 4-to-20 mA signal. This value is used as the set point for the Reactive Load controller.

Remote Cold Junction Compensation for T/C’s - (Option #6)

If T/C wiring is not routed all the way to the GTC unit, then a remote CJ Comp signal can be brought in to correctly compensate the thermocouple wiring circuit for the remote wiring material change.

Gas Fuel Valve Position Feedback - (Option #7)

The gas fuel valve position feedback can be brought back into the control via a 4-to-20 mA signal from the valve driver or the valve itself. This value is sent to the Modbus communication link for display purposes.

Liquid Fuel Valve Position Feedback - (Option #8)

The liquid fuel valve position feedback can be brought back into the control via a 4-to-20 mA signal from the valve driver or the valve itself. This value is sent to the Modbus communication link for display purposes.

Customer Defined Signal - (Option #9)

The customer can bring in a 4-20 mA signal for any site specific parameter that they desire. The GTC application is designed to allow a configurable switch to be activated by this input value. This event action can be configured as an Alarm or a Shutdown. The user can configure the loss of this input signal to trigger either an Alarm or a Shutdown.

Compressor Discharge Pressure–CDP (AI_07)

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-to-20 mA pressure transducer. This value is then used by the control for pressure control and fuel schedules.

CDP Derivative Calculation

The CDP sensor input block also generates 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 used in certain turbine operation protection algorithms.

Exhaust Gas Temperature – EGT (if used = AI_08)

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 analog input 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 switches, the overtemp switch, and the EGT control PID. When the thermocouple input method is used, the EGT is sensed by a number of type K thermocouples (configurable from 1 to 8). Cold Junction compensation is done directly on the AtlasSC I/O module, but there is an option to bring in a CJ sensor from a remote location if the appropriate T/C wiring is not run all the way to the AtlasSC. 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. The average is sent to the three temperature switches, the overtemp switch, and the EGT control PID. 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 set points that are used for this option.

Temperature Switches
In the software there are three temperature switches for the EGT. These temp switches are configurable for any temperature set point and can used to drive relay outputs. These outputs can be used by other systems.

Remote PT Speed Reference (if used = AI_09)
The speed reference produces the desired speed-setting signal and sends it to the speed controller. The sub-functions are:
- Speed Setting
- Remote Speed Setting (PT only)

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

Remote Speed Setting
The PT speed setting can be controlled by a remote signal. The ENABLE contact enables remote speed setting, as long as the speed is above rated speed. When enabled, the speed setting can be changed by varying a remote 4-to-20 mA signal. At this time all PT associated switch contacts (RAISE, LOWER, FAST, and INSTANT) will be disabled.

Actuator Driver Outputs (ACT_01 and ACT_02)
This system includes two actuator drivers, one for the gaseous-fuel actuator (ACT_01) and one for the liquid-fuel actuator (ACT_02). 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).

Number of channels	2
Actuator Type	Proportional, non-isolated
Output type	4–20 or 20-160 mA outputs, software selectable
Common Mode Voltage	15 Vdc ±10%
Max current output	25 mA ±5% (4-20 mA scale) 200 mA ±5% (20-160 mA scale)
Min. load resistance	0 Ω
Max load resistance	300 Ω at 22 mA (4-20 mA scale) 45 Ω at 200 mA (20-160 mA scale)
Resolution	12 bits
Accuracy @ 25 °C	Better than ±0.1% of full scale 0.026mA (4-20 mA scale) 0.2mA (20-160 mA scale)
Readback Accuracy @ 25 °C	0.5%
Temperature Drift	140 ppm/°C, 0.24 mA maximum (4-20 mA scale) 1.82 mA maximum (20-160 mA scale) 70 ppm/°C, typical (0.45% of full scale, 0.11375 mA) 0.12 mA maximum (4-20 mA scale) 0.91 mA maximum (20-160 mA scale)
Readbacks	Actuator source and return currents
Dither Current	25 Hz, fixed duty cycle, software variable amplitude

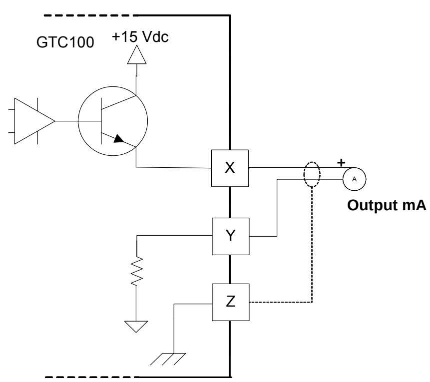


Figure 5-4. Actuator Output Wiring Diagram

Gas Fuel Valve Position Demand (ACT_01)

The gas fuel valve position demand is output from the control via this actuator output channel. It can be a 4-20 mA or 20-160 mA signal from the control to the valve driver or to the valve itself.

Liquid Fuel Valve Position Demand (ACT_02)

The liquid fuel valve position demand is output from the control via this actuator output channel. It can be a 4-20 mA or 20-160 mA signal from the control to the valve driver or to the valve itself.

Analog Outputs

There are six analog outputs that may be assigned to a number of functions. Each output is a 4–20 mA current source. The Analog Outputs may be used with a two-wire ungrounded device or isolated device. If interfacing to a non-isolated device, the use of a loop isolator is required. The chart below give the parameters that may be configured for analog output, The scale or range of each parameter can also be changed, i.e. a frequency read out may be set for 57 to 63 Hz, or 30 to 65 Hz.

Number of channels	6, PWM outputs
Output type	4–20 mA outputs, non-isolated
PWM frequency	1.5 kHz
Common Mode Voltage	15 Vdc ±10%
Current output	4–20 mA
Max current output	25 mA ±5%
Min. load resistance	0 Ω
Max load resistance	300 Ω at 22 mA
Resolution	12 bits
Accuracy @ 25 °C	Better than ±0.1% of full scale, 0.025 mA
Temperature Drift	140 ppm/°C, 0.23 mA maximum 70 ppm/°C, typical (0.45% of full scale, 0.11375 mA)

Each analog output has identical circuitry. There is no isolation between outputs and no isolation to the digital circuitry of the GTC200. Wiring for each is shown below but only the terminal numbers change for each output.

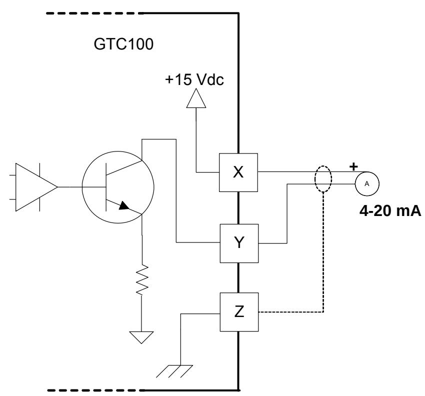


Figure 5-5. Analog Output Wiring Diagram

Analog Outputs (AO_01 thru AO_08)

The system includes eight analog outputs. These readout signals are 4–20 mA signals for driving meters or sending readouts to other plant system controls. Each of these signals is configurable in the application program. The default status for each one is to be driven by the fuel control with the functions shown below in selection numbers 1-8 respectively.

1 GG Actual Speed
2 GG Reference Speed
3 PT Actual Speed Readout
4 PT Reference Speed Readout
5 Exhaust Gas Temperature (EGT) Readout
6 Compressor Discharge Pressure (CDP) Readout
7 Fuel Valve Demand Readout
8 Generator KW Readout
9 Generator KVAR Readout
10 Generator KVA Readout
11 Generator Power Factor Readout
12 Generator Current Readout
13 Generator Voltage Readout
14 Utility Bus KW Readout (Export)
15 Utility Bus KVAR Readout
16 Utility Bus KVA Readout
17 Utility Bus Power Factor Readout
18 Utility Bus Current Readout
19 Utility Bus Voltage Readout
20 Synchroscope

21 Customer Configurable Analog Output (from Modbus AW_11)
22 Customer Configurable Analog Output (from Modbus AW_12)
23 Customer Configurable Analog Output (from Modbus AW_13)

*Via the S/W service tool it is possible to select the output of the power monitoring elements to be displayed as a phase value, or total/average of the phases. The default is to output the total/average.

Discrete Inputs

Discrete Inputs (BI_01 thru BI_24)

Twenty-four discrete inputs are available as direct inputs into the AtlasSC I/O. These 'high-speed' input signals are used to direct the actions and functions of the fuel control. The first 3 inputs are fixed and can only be used for the function shown. If they are configured for customer use it will disable the GTC function of that input. The signal status of each input will be sent through the Modbus communication link as indications. Discrete inputs 4-24 have been pre-programmed with the following optional functionality:

- A Start Permissive Input
- An Alarm Condition Input
- An Shutdown Condition Input

****** Each of these inputs is Boolean "OR" ed with a Modbus BW value that can be sent through the Modbus link. These writes can be used or disabled. It is important to note that if the Communication Link is lost – ONLY the Shutdown, Start/Run and Fuel Selection/Transfer inputs will retain the last state sent. All other will go to the False state.
******The default function and active state of each of these signals is shown, these can be altered in the configuration of the control. **(Active High or Low)**

	Active State
1. Shutdown (Fuel Off)	* TRUE = No external Shutdowns
2. Start/Run	* TRUE=Start /Fuel ON FALSE=Normal Stop
3. System Reset (ALM & SD)	* TRUE = Reset Alarm/Shutdown
4. System Acknowledge (ALM & SD)	TRUE = Acknowledge Alarm/Shutdown
5. PT Reference Lower	TRUE = Lower PT Speed Set point
6. PT Reference Raise	TRUE = Raises PT Speed Set point
7. Gas Fuel Valve Status Input	TRUE = Gas Fuel Valve Healthy
8. Liquid Fuel Valve Status Input	TRUE = Liquid Fuel Valve Healthy
9. Go to Rated Speed / Go to Baseload	TRUE = Holds PT Reference to Rated if GEN Breaker Closed then Go to Baseload
10. Combustor Flame Detector	TRUE = Flame Detected in Combustor
11. Fuel Selection/Transfer	TRUE = Liquid Fuel (False = Gas Fuel)
12. Enable Remote PT Reference Set Point	TRUE = Actively follow remote PT set point
13. Inhibit Synchronizer	TRUE = Disable Synchronization
14. GEN Breaker (Aux 52) CLOSED	TRUE = Generator Breaker is CLOSED
15. UTIL Breaker OPEN	TRUE = Utility Breaker OPEN (Enables LS)
16. Enable Reactive Load Control	TRUE = Enables Reactive Load Control
17. VAR/PF/Voltage Lower Command	TRUE= Lowers VAR/PFset point/voltage bias
18. VAR/PF/Voltage Raise Command	TRUE= Raises VAR/PFset point/voltage bias
19. Enable Process Control	TRUE = Enables Process Control
20. Process Set point Lower Command	TRUE = Lowers Process Set Point
21. Process Set point Raise Command	TRUE = Raises Process Set Point
22. GG Reference Lower	TRUE = Lower GG Speed Set Point
23. GG Reference Raise	TRUE = Raises GG Speed Set Point
24. Customer Input 24	TRUE = Event Action

Discrete Outputs

There are 12 discrete output relay drivers, which are individually optically isolated, available from the AtlasSC I/O. However, all twelve share a common power supply and return circuit. Each output uses a thermally protected MOSFET that will pulse the circuit if the current limit is exceeded. An over-current condition on one output will not affect the other outputs. The output will be pulsed continuously until the current requirement is reduced, allowing the output to operate normally again.

Number of channels	12
Output type	Low-side driver with short circuit and over voltage protection
Current drive rating	<200 mA
Discrete Output supply voltage	9-32 Vdc
Isolation voltage	500 Vac, all channels are isolated from the other I/O

An external 9–32 Vdc power source must be provided to source the circuit voltage switched by the GTC200. Due to circuit isolation, the external power supply common must be connected to the GTC200 terminal 23 as shown in the wiring diagrams in Appendix A.

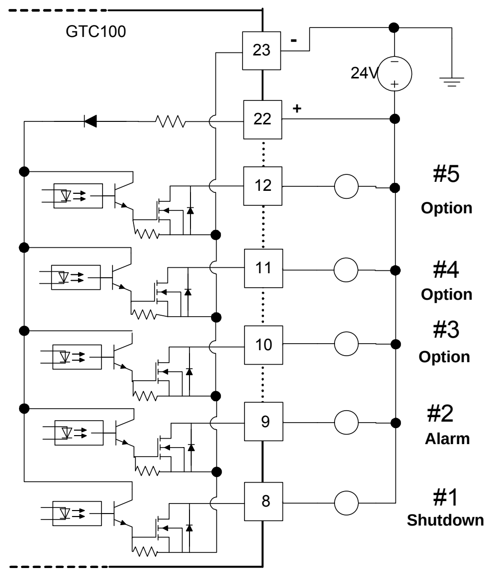


Figure 5-6. Discrete Output Wiring Diagram

Relay Driver Outputs

Twelve relay driver outputs are available from the GTC200 application. These signals are used to indicate the function or status of the control or turbine. The first two relay outputs are for SHUTDOWN and ALARM and fixed outputs. The SHUTDOWN signal (1) is normally energized to reflect a healthy GTC200 with no shutdowns present. The ALARM signal (2) along with all of the others is normally de-energized, and the control energizes this output on one of 2 configurable conditions: 1) Alarm summary – meaning that the output is true when any alarm is present or 2) Alarm Horn indication – meaning that when an Alarm event comes in, the output is True until an Acknowledge input is received, then the output goes False until another alarm condition happens. The other ten signal outputs are configurable via a menu (as per the list below) for each relay output to be driven from a pre-programmed function in the fuel control, or to be driven via a Modbus command.

IMPORTANT

When configuring these output drivers, use the first 6 for the most critical (time dependent) signals, such as fuel shutoff valve commands. The channels are programmed at the following rate groups:
Outputs 1-6 =10 ms Outputs 7-9 = 40 ms Outputs 10-12 =160 ms

1 SHUTDOWN
2 CLOSE GEN Breaker Command
3 OPEN GEN Breaker Command
4 Open Gas Fuel Shutoff Valves
5 Open Liquid Fuel Shutoff Valves
6 Ignitors Energized (ON)
7 Motor Starter Engaged
8 ALARM
9 GG Speed Switch 1
10 GG Speed Switch 2
11 Run / Shutdown / Reset Signal to Fuel Valve
12 GG Speed Reference at Lower Limit
13 PT Speed Reference at Lower Limit
14 GTC Health Indication (Fuel Control ON)
15 Running on Liquid Fuel (off = On Gas Fuel)
16 Raise Voltage Command to AVR
17 Lower Voltage Command to AVR
18 Speed in Control (GG or PT)
19 EGT in Control
20 CDP in Control
21 Process Control Enabled
22 Remote PT Speed Reference Enabled
23 Load Sharing Enabled
24 Max Turbine Output Load Reached
25 EGT Speed Switch 1
26 EGT Speed Switch 2
27 EGT Speed Switch 3
28 PT Speed Switch 1
29 PT Speed Switch 2
30 PT Speed Switch 3
31 Customer Command from Modbus BW 21
32 Customer Command from Modbus BW 22
33 Customer Command from Modbus BW 23
34 Customer Command from Modbus BW 24

Chapter 6.
Configuration and Service Setup Procedures

Introduction

This chapter contains information on control configurations, setting adjustments, and the use of Woodward's Control Assistant software tool. Because of the variety of installations, system and component tolerances, the GTC200 must be tuned and configured for each system to obtain safe operation and 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 GTC200 application. On the lines provided, enter the values used for your control. Once the worksheet is completed, connect the control with the Control Assistant service tool as described in the previous section. Launch WinPanel and click on the Q in the tool bar to execute a routine that will automatically generate an inspector file for all of the configuration and service fields **(*you will want to resize the Block, Field, and Value columns in the inspector file to see the complete prompts that exist for each row*)**. 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. Note that as a user gets more familiar with the system, you can modify/customize your own inspector files to best fit your needs.

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 shutdown (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.

Software Interface Tools Setup

An "inspector" provides a window for real-time monitoring and editing of all control Configuration and Service Menu parameters and values. Control Assistant can have a license added that will allow the user utilize trending capability and will also allow the creation of custom "inspectors" can easily be created and saved. Each window can display up to 28 lines of monitoring and tuning parameters without scrolling. The number with scrolling is unlimited. Two windows can be open simultaneously to display up to 56 parameters without scrolling. Tunable values can be adjusted at the inspector window.

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.

WinPanel performs these primary functions:

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

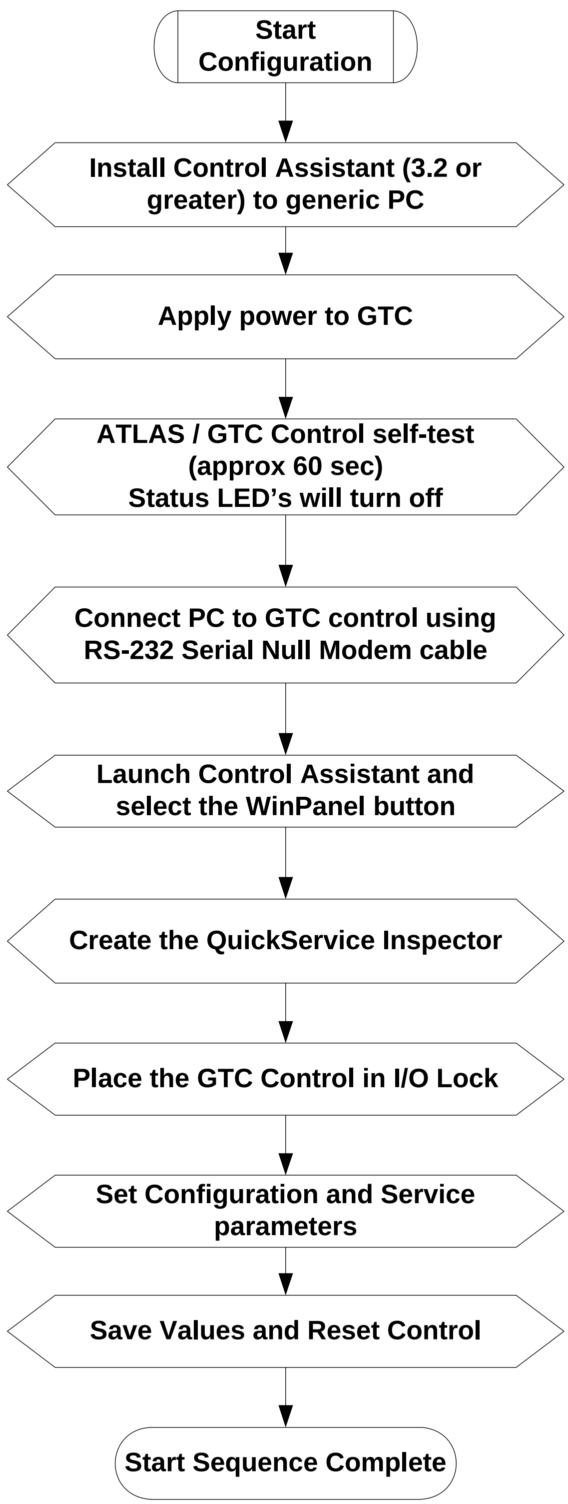


Figure 6-1. Basic Configuration Procedures

Apply Power to the GTC200

At power-up, the GTC200 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 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.

Prior to installing Control Assistant, you must install the Microsoft .net framework program supplied on the CD. This will install some operating system library files that are used by Control Assistant.

Setup Control Assistant version 3.2 or greater (CA3.2)–

- Installing Control Assistant
- Connecting a PC/Laptop to the Control (AtlasSC)
- Generating the Service & Configuration Worksheet
- Maintaining Control Tunables (Download/Upload)

A) Installing Control Assistant

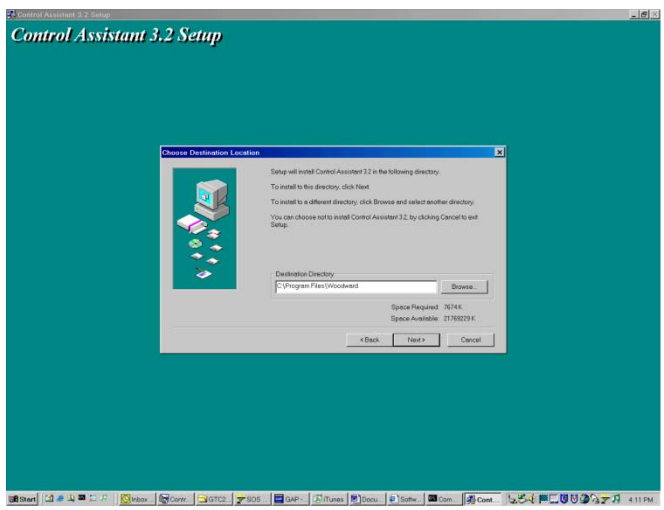


Figure 6-2. Control Assistant Install Window

Define the desired directory to save Control Assistant and press ‘Next’. It is preferable to use the default, as it will keep all Woodward Software in a common folder. If the program folder field is blank, type in “Woodward” and the install will create a program folder named Woodward.

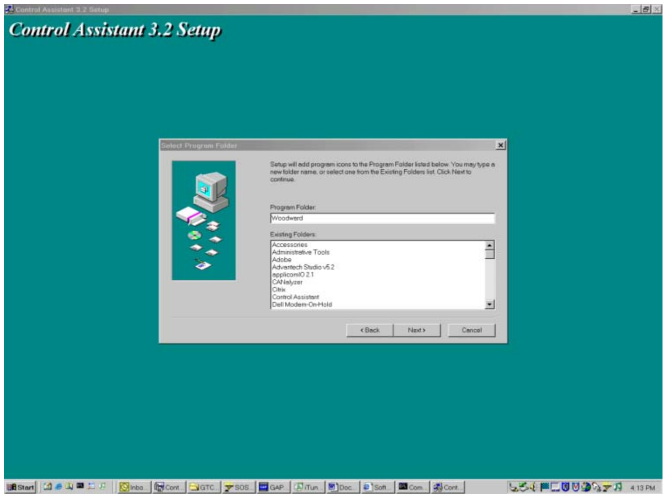


Figure 6-3. Control Assistant Folder Selection

Choose the desired folder in the ‘Start Menu’ to save the shortcuts.

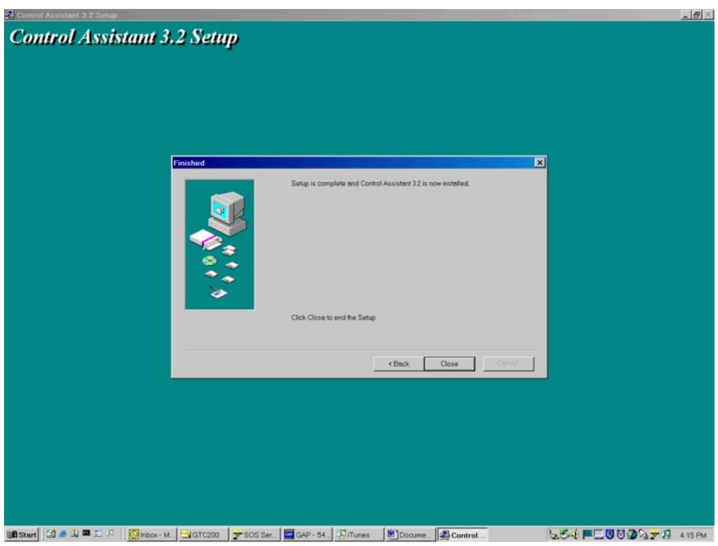


Figure 6-4. Control Assistant Install Complete

After Control assistant is installed press ‘Close’.

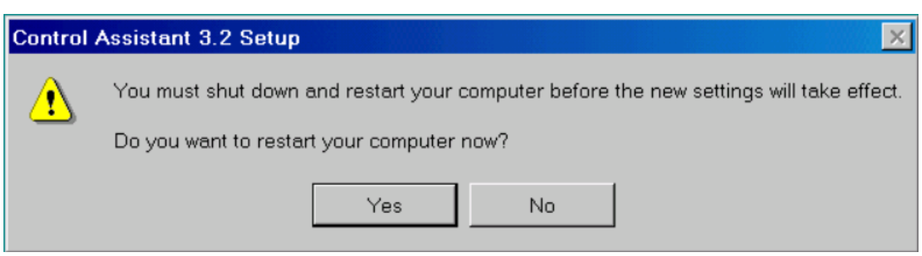


Figure 6-5. Control Assistant Restart Window

Press 'Yes' to restart your computer now, or press 'No' to restart your computer later. Control Assistant will NOT function properly until the PC is restarted.

B) Connecting a PC/Laptop to the Control (AtlasSC)
The connection of a computer is only required for calibration and setup of the GTC200. The computer and CA3.2 software program are not required or necessary for normal operation of the control. You will need to connect a standard 9-pin Null Modem cable between the communication port # 3 (COM 3) of the AtlasSC Main (SmartCore) module on the GTC200 and a user PC. This port has a 9-pin sub-D connector and is located on the bottom layer of the PC104 bus stack of the control modules. This port's protocol settings are defaulted to the correct settings to communicate with the Woodward ServLink service tools (Baud = 115200, Data Bits = 8, Stop Bits = 1, Parity = None). For information on the cable or communication port settings, see the troubleshooting section of this manual.

Connect from the PC to the COM 3 serial port (9 pin- sub-D connector on Main board) on the control using a Null Modem serial cable.

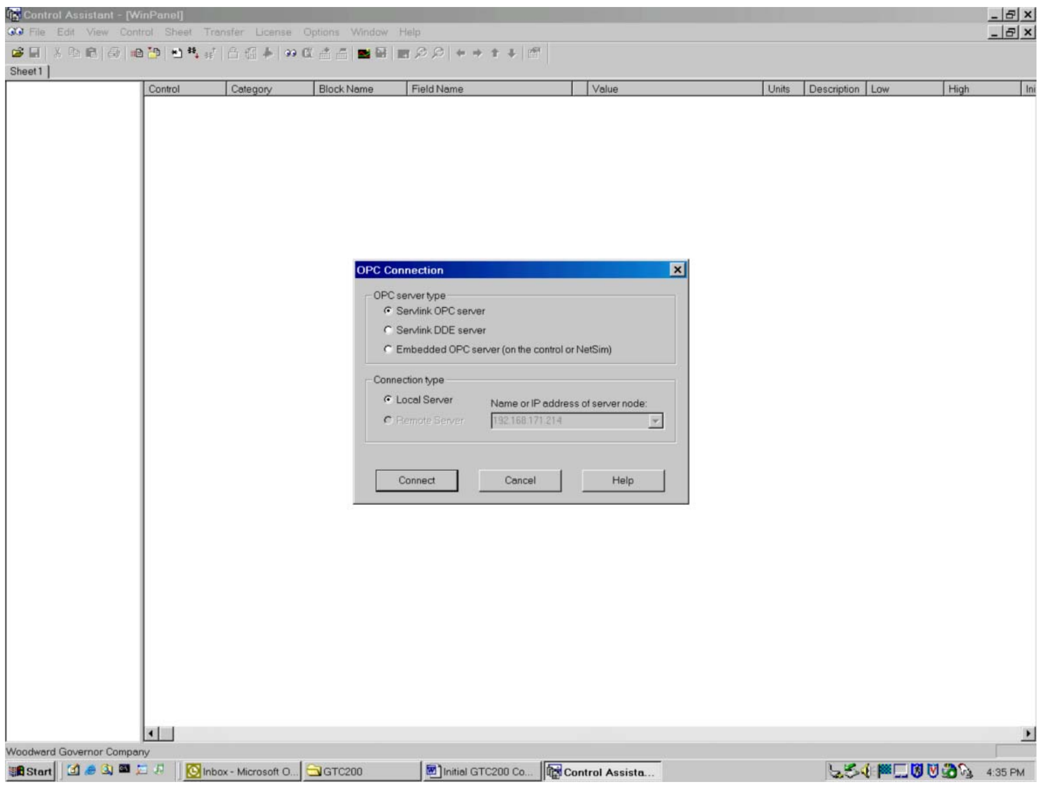


Figure 6-6. Control Assistant – WinPanel Communication Choice

Start Control Assistant from the 'Start Menu' or desktop shortcut. Press the WinPanel button  on the toolbar. CA3.2 will open a dialog to allow the user to select the type of communication connection desired. Select 'ServLink OPC server' and 'Local Server' then press 'Connect'. CA3.2 will then launch the ServLink to OPC Server (SOS).

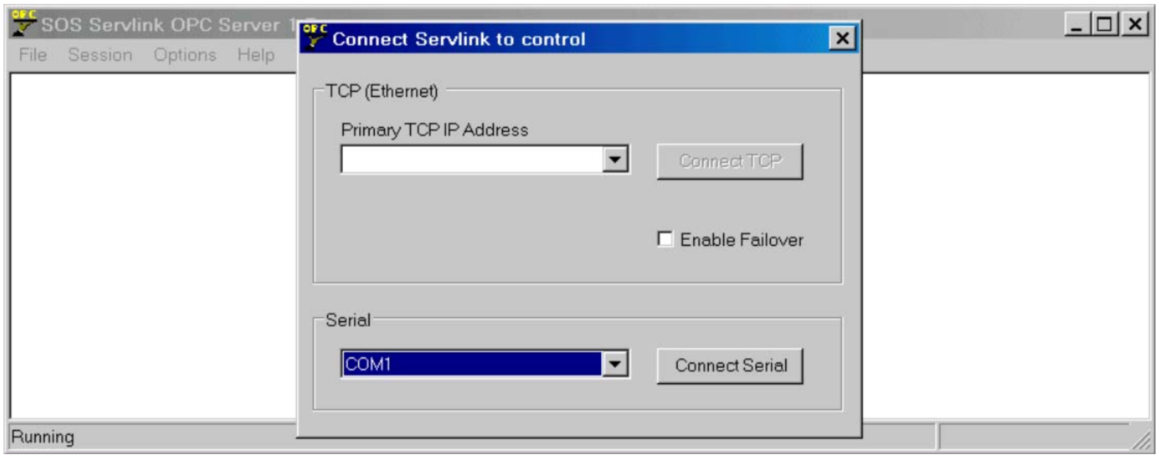


Figure 6-7. Control Assistant – SOS Connection Choice

SOS ServLink OPC Server will start automatically and ask to 'Connect ServLink to control'. Choose the Serial communications and select the Comm. Port you want to use on your PC. Press 'Connect Serial'. The SOS program will auto-negotiate the correct communications settings (Baud/Date Bits/Stop Bits/Parity) for the ServLink connection.

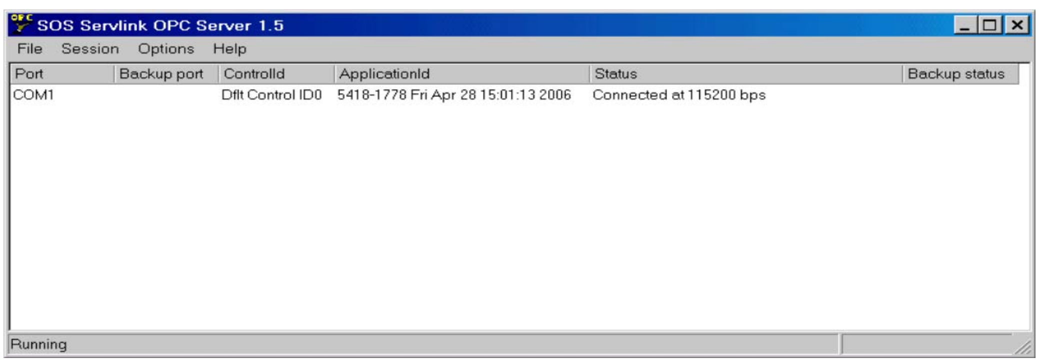


Figure 6-8. SOS Connection Window

When Control Assistant is connected to the control, your connection should look like the connection shown above.

C) Generating the Service & Configuration Worksheet

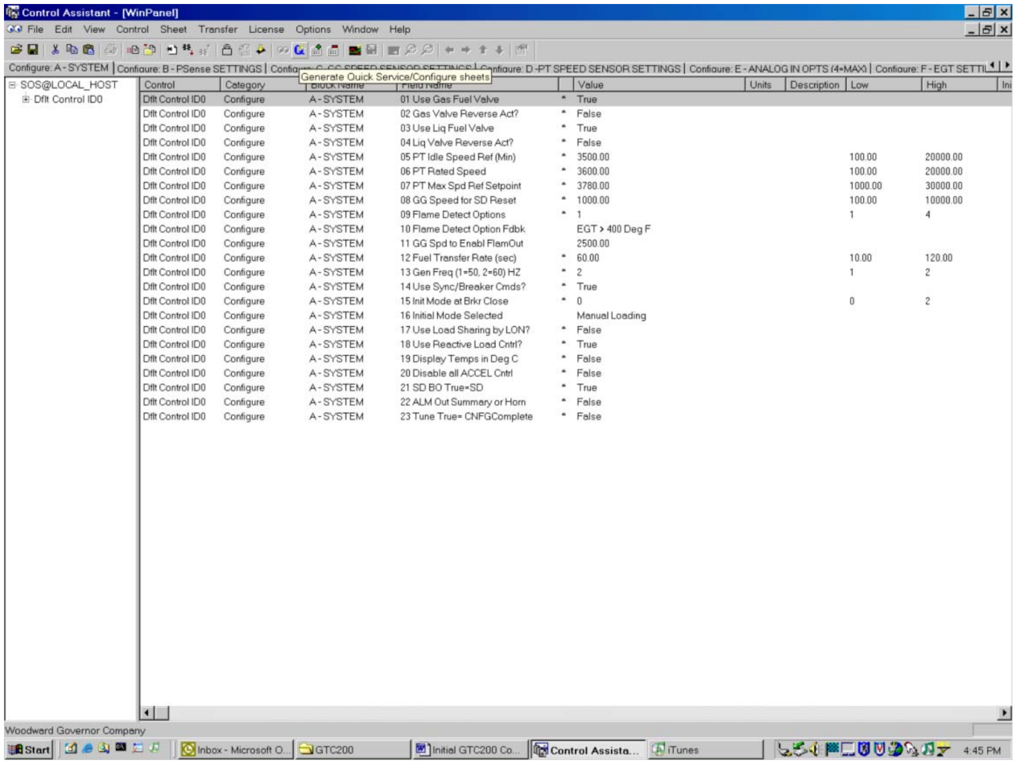


Figure 6-9. Control Assistant – WinPanel QuickService Window

Press the  Quick Inspector icon on the toolbar and a multiple sheet WinPanel inspector file will be generated automatically. This interface can now be used to adjust the Configure and Service settings of the control. The tab sheets labeled as “Configure” are settings that must be tuned while the prime mover is shutdown and the control is in I/O Lock. The tab sheets labeled as “Service” are available to be tuned at any time, but caution should be used whenever tuning the control with the prime mover in operation. The initial settings of these Service sheets should be done with the prime mover shutdown.

After configuration and calibration are complete save these settings in the control by using the  icon – “Save tunable values on control”. This should be done any time that tunable adjustments are made to the control. If this is not done the unit will return to the last saved value, which initially will be the default value in the application (shown on the appendix worksheet).

D) Maintaining Control Tunables (Download/Upload)

Once the control is configured and the signals are calibrated, it is recommended that the user create a file containing this information. This is useful for setting up a spare unit, as a replacement or for initially configuring other units of the same type.

1) Tunable format setup—

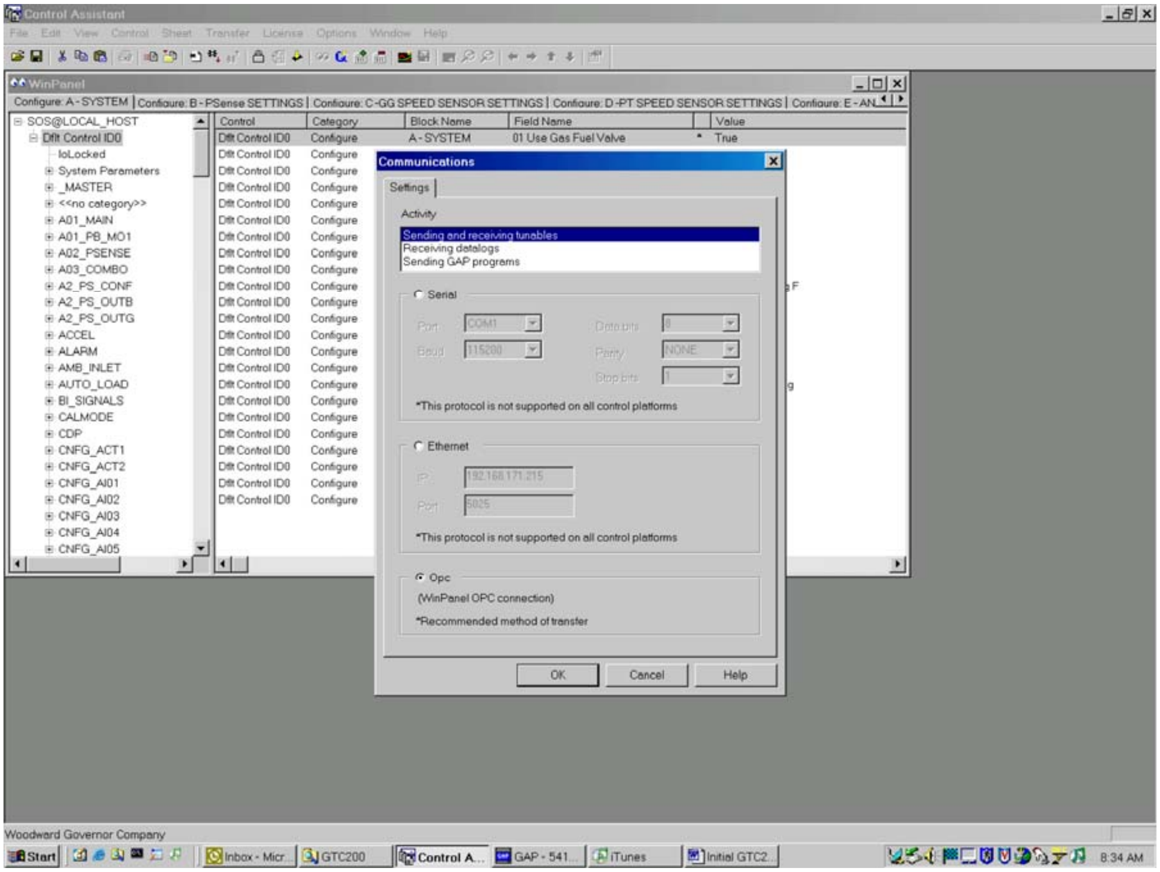


Figure 6-10. Control Assistant – Tunable Connection Choice

WinPanel must be open to send or receive tunables. Setup 'Send and Receive Tunables' for OPC (WinPanel OPC connection). Under 'Options'→' Communications'

2) Receiving (Downloading) Tunables from the control—

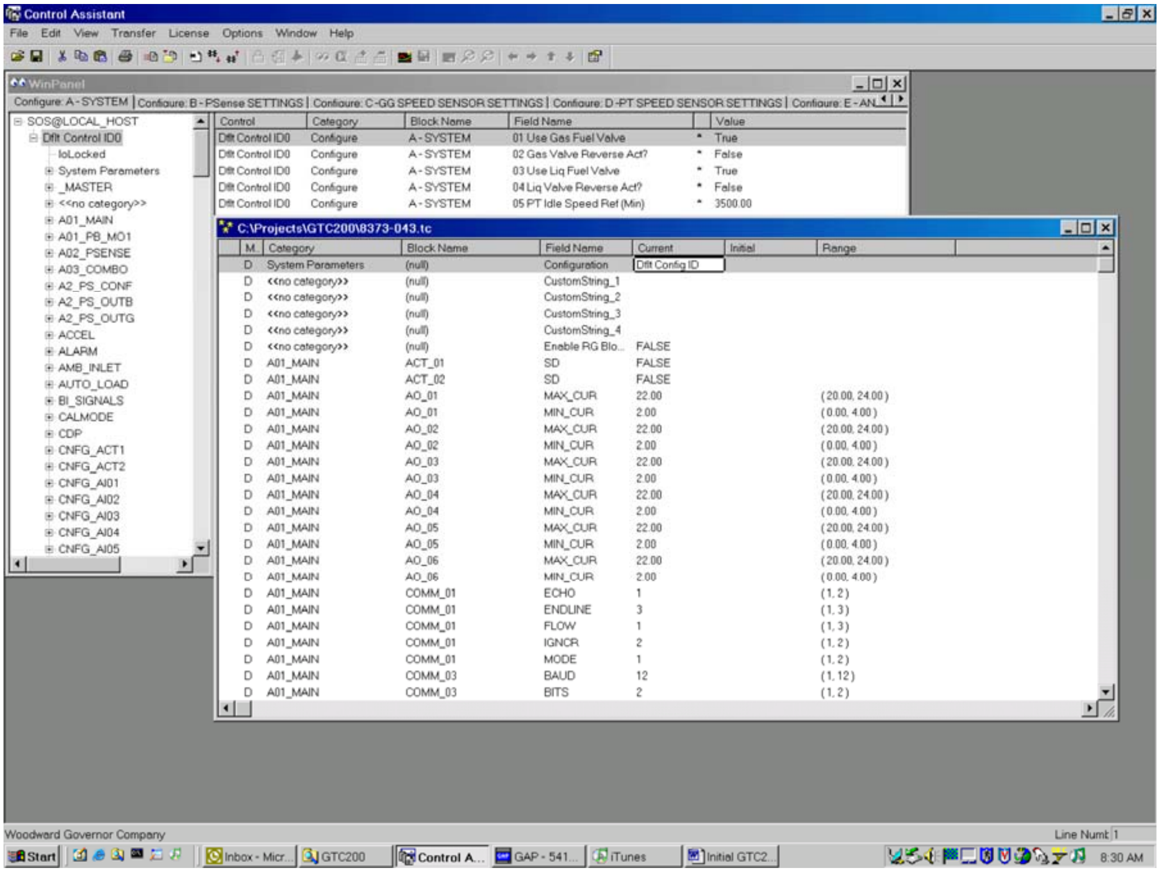
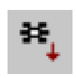


Figure 6-11. Control Assistant – Open Tunable File

Press the 'Receive Tunables'  icon on the toolbar. Save the file with an appropriate filename such as 'Unit_1_Settings.tc'. Archive this file to a safe storage area, to be used for initial setup of other controls and for troubleshooting assistance from Woodward.

3) Sending (Uploading) Tunables to the control—

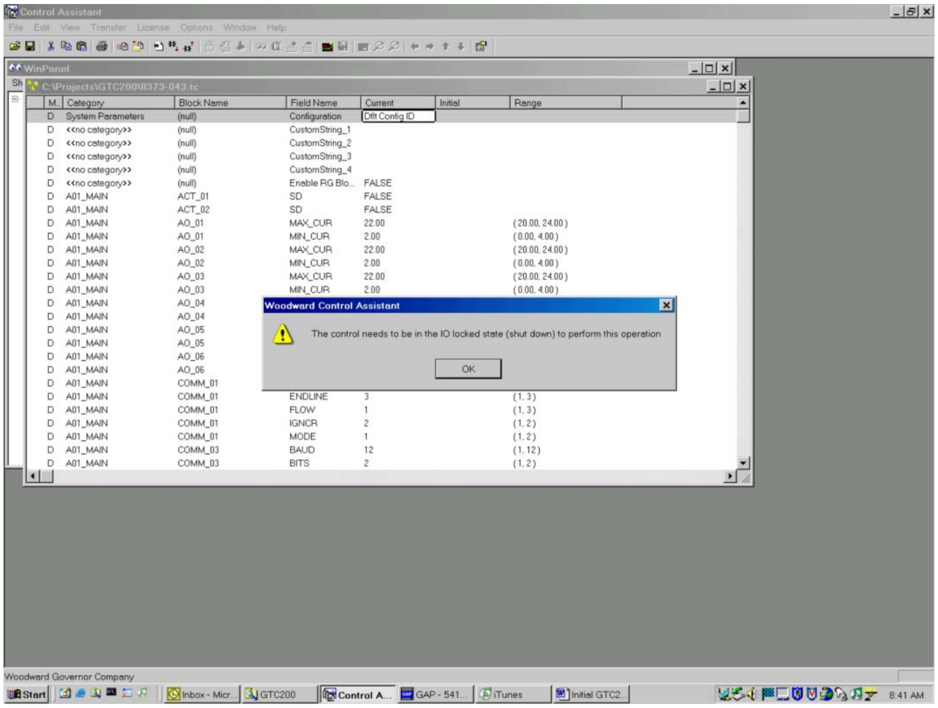
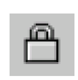


Figure 6-12. Control Assistant – Tunable to Send

WinPanel must be open and the desired control must be high lighted and the desired tunable list must be open to 'Send Tunables'. The control must also be in I/O lock to be able to 'Send Tunables' to the control. If you press the 'Send Tunables'  icon before the control is in I/O lock the control will display the warning shown above. Press 'O.K.'. This does NOT put the control in I/O lock. To put the control into I/O Lock –

BE SURE THE PRIME MOVER IS SHUT DOWN.

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.**

Go to the WinPanel display and press the 'Lock I/O'  icon on the toolbar.

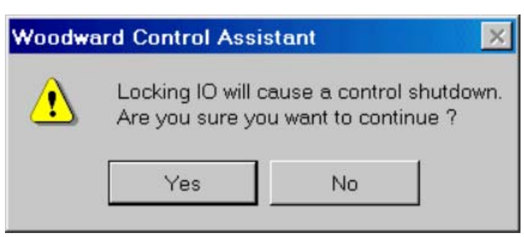


Figure 6-13. I/O Lock Confirmation

The control will display warning box shown above. Make sure the prime mover is NOT running before pressing the ‘Yes’ button.

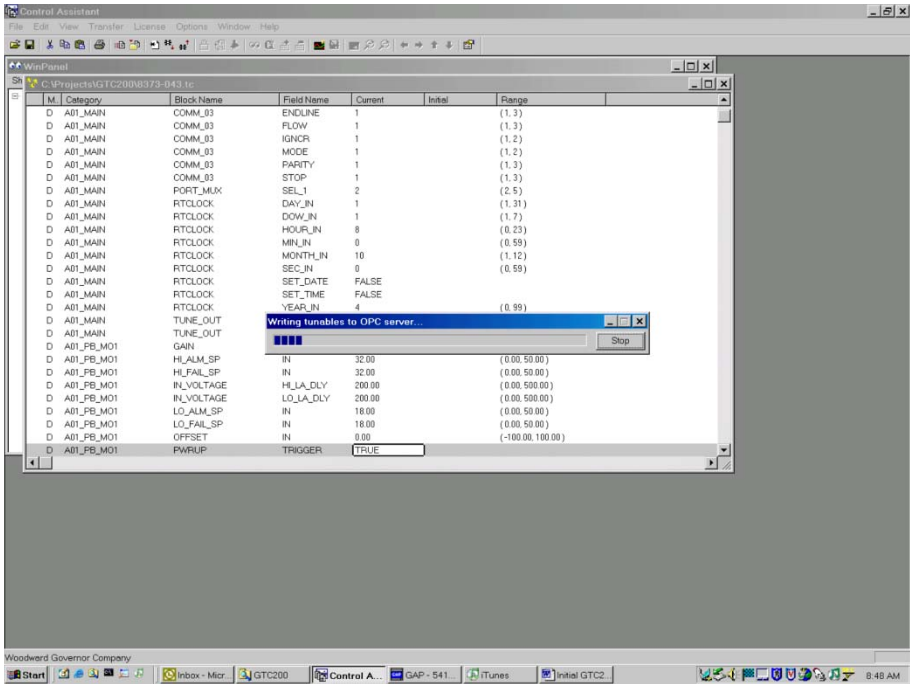


Figure 6-14. Control Assistant – Tunable sending progress bar

After putting the control in I/O lock. Press the ‘Send Tunables’  icon on the toolbar.

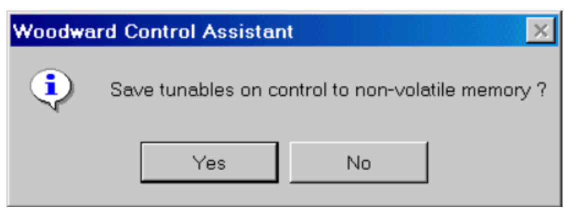


Figure 6-15. Control Assistant – Save to control dialog box

After the tunable download to control is complete save the tunables to non-volatile memory, Press ‘Yes’.

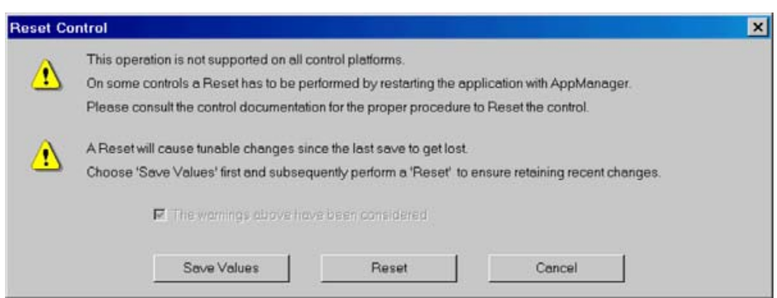


Figure 6-16. Control Assistant – Save Confirmation

To put the control back in operating mode, press the ‘Reset’  icon on the toolbar. The check box must be checked before the reset is issued.

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 and assist in troubleshooting system problems.**

Start Mode Options

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%). It is important to point out that the fuel control will not ramp the fuel valve open, on any option, until the control recognizes that the turbine has achieved 'lite-off'. The default start option is to have the control raise the fuel demand via a start ramp at the user-defined rate until the unit reaches GG Speed control at the minimum GG reference value. This allows for the most aggressive ramp-up times of the turbine. 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 / Run discrete input contact is closed (TRUE), the fuel control will initiate a start. If the GTC Start Sequence option is selected, then this input will initiate this sequence and the fuel valve demand will rise at the appropriate time. If this option is not selected, then this input will indicate to the control that a lite-off is being attempted. 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 (Default rate 0.3 % per sec)

The initial increase of fuel valve position is accomplished by a ramp up 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, the GG Derivative control or EGT Temp limiter control will take over control of fuel demand.

GG Derivative Control Start

This optional start mode can be programmed for accelerating the turbine from lite-off to speed control. This mode provides a PID control to raise the GG speed at a defined acceleration rate of the GG speed signal. The default rate for this is 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.

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 set points and a ramp rate (in °F/s). The temp ramp starts at the Lower temp set point until 'Lite-off' is detected. The ramp then ramps up to the High temp set point 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, the GG Derivative control takes over control of fuel demand.

Initiate a Normal Stop Sequence

The user can elect to initiate a normal stop sequence that will bring the unit down from any operating point at PT Rated or above. The sequence is initiated by removing the Start/Run command signal. The control will ramp down the GG reference which will slowly lower the load on the unit down to the minimum load point and then open the utility/generator breaker. After gaining PT speed control at rated speed, the control will continue to ramp down the GG reference from the maximum to the minimum set point (GG Idle). Once this is achieved the control will hold the unit at this speed until the configured cool down timer has expired. At this point the control will shutoff fuel (both the metering valve and the shutoff valves). When the EGT temperature falls below 400 degrees F then the unit is considered to be shutdown and the normal stop sequence is complete.
Configuration Items:

Time to Cool down at GG Idle (sec)	*30 (5, 600)
PT Reference Min Load Set point	*3605 (3000, 3700)

Alarm / Shutdown Event List

When an event occurs, the application sets a numbered Alarm flag (latch) as per the list below. The complete list of 175 Events is in Appendix C. The action to be taken is determined by the configuration option that the user selects for each event. The Quick Service inspector file has a user tunable value for the configuration number as per the chart below. The programmed default actions for these events are shown in the list below. The ACKNOWLEDGE input will turn off the Horn output. The RESET will clear the event latch, if the event condition no longer exists. Event options are as follows:

Configuration Number	Description
1	Disabled (No action taken)
2	Alarm (Audible & Visual annunciation of event)
3	Soft Shutdown (same as Alarm w/ Open Gen Breaker Command
4	Hard Shutdown (same as Soft w/ Fuel Shut-off)
5	Reserved (Not currently used)

Alarm Sequence

When the fuel control detects an alarm condition, it activates a summary alarm and horn output that can be tied to relay outputs. It also sends information about the specific cause of the alarm out through the Modbus block. The customer can also go into Service mode and view a numeric alarm value that corresponds to the numbered alarms found in Appendix C of this manual. An acknowledge signal will clear the horn annunciation of the event. A reset will clear the alarm if the condition that initiated it no longer exists.

Shutdown Sequence

When a shutdown occurs, either a fuel control initiated event or the discrete contact shutdown input, all of the actuator signals go to zero and the fuel shutoff valve outputs (if used) go False, which will cause the turbine to shutdown. The fuel control will activate a summary shutdown relay output and also send information as to the specific cause of the shutdown out through the Modbus block. The customer can also go into Service mode and view a numeric shutdown value that corresponds to the numbered shutdowns found in Appendix C of this manual. An acknowledge signal will clear the horn annunciation of the event. 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 set point. This is done to insure that there is no attempt to re-light the turbine while it is in a shutdown mode.

Setup of GG Speed Control

The GTC200 requires that the user setup reference parameters and dynamic gain values in order to control the GG (High Pressure) Shaft speed of the turbine. The control will create a ramp function based on the upper and lower reference limits defined by the user. This ramp will move at one of 3 rates—Default, Fast and Instant. The user defines the first 2 of these rates in units of rpm/sec. There are 3 optional speed switches that are connected to relay outputs. These signals can be use to assist any sequencing or auxiliary logic that may be performed by another external device. The speeds for each of theses switches can be defined by the user.

There are also a few other GG speed options available for the user.

- Limiting the upper GG Reference speed set point as a function of Ambient Inlet Temp (as defined by some OEM turbine specifications)
- Ability to enable an GG Overspeed test—which will allow the user to adjust the Overspeed Set point in the control while operating (THIS DOES NOT BIAS THE PHYSICAL SPEED IN ANY WAY)
- Option to automatically override the failed GG speed probe signals when in a non-running condition (typically used)

These parameters must be defined before the control is used to run the turbine. If the PID gain values are not known, then the control dynamics may be adjusted for desired performance, once the turbine is running, by following the procedure detailed in the Troubleshooting section below.

Setup of PT Speed Control

The GTC200 requires that the user setup reference parameters and dynamic gain values in order to control the PT (Low Pressure) Shaft speed of the turbine. The control will create a ramp function based on the upper and lower reference limits defined by the user. This ramp will move at one of 3 rates—Default, Fast and Instant. The user defines the first 2 of these rates in units of rpm/sec. There are 3 optional speed switches that are connected to relay outputs. These signals can be use to assist any sequencing or auxiliary logic that may be performed by another external device. The speeds for each of theses switches can be defined by the user.

There are also a few other PT speed options available for the user.

- Option of implementing dual dynamics, such that one set of speed PID gain values are used in one operating mode (such as Isoch mode) and a second set of dynamics can be used while in a different operating condition (such as Droop mode)
- Ability to enable an PT Overspeed test—which will allow the user to adjust the Overspeed Set point in the control while operating (THIS DOES NOT BIAS THE PHYSICAL SPEED IN ANY WAY)
- Option to automatically override the failed PT speed probe signals until the turbine reaches a defined GG speed set point (typically used)

These parameters must be defined before the control is used to run the turbine. If the PID gain values are not known, then the control dynamics may be adjusted for desired performance, once the turbine is running, by following the procedure detailed in the Troubleshooting section below.

Setup of the CDP/Fuel Limiter Curve

The GTC200 requires that the user configure a fuel limiter curve based on the compressor discharge pressure of the turbine. The purpose of this curve is to protect the turbine from over fueling (acceleration limiter) by limiting the maximum fuel valve position as a function of the turbine compressor discharge pressure. 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% valve demand). 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. This method should contain a full range of data points (sub-rated PT speed & under load conditions). The Appendices of this manual contain a sheet to assist in this effort.

Setup of the Accel PID Control

The acceleration schedule determines the maximum amount of fuel allowed, during acceleration. The configuration of this function is required to protect the turbine from over fueling. If optimum dynamic performance is desired during load transient events, then the Accel PID can be used. With this the set point of the Accel PID is determined by a GG speed vs. GG speed derivative curve. The process input to the Accel PID is the calculated GG speed derivative. This optional control loop can be used in addition to the CDP/Fuel Limiter curve and can provide improved dynamic response during load transients. The PID set point curve is defined with a maximum of 6 breakpoints and should be tuned in sequence from X-Y values 1 through 6, with any unused points at the end tuned high (out of the way).

Setup of the Decel Curve Setup

The GTC200 requires that the user chose either a curve or a PID (only one) to protect the turbine from under fueling (flame out) conditions. If the curve option is chosen, the user will configure a minimum fuel limiter curve based on the compressor discharge pressure of the turbine. The Decel curve uses 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 the output is 10 for a given input, then fuel flow will not be able to decrease below 10% valve demand). 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%. The curve is defined with a maximum of 5 breakpoints and should be tuned in sequence from X-Y values 1 through 5, with any unused points at the end tuned low (out of the way).

Setup of the Decel PID Control

If the Decel PID option is selected then the deceleration PID determines the minimum amount of fuel allowed, during deceleration. If optimum dynamic performance is desired during load transient events, then the Decel PID can be used. With this the set point of the Decel PID is determined by a GG speed vs. GG speed derivative curve. The process input to the Decel PID is the calculated GG speed derivative. The PID set point curve is defined with a maximum of 6 breakpoints and should be tuned in sequence from X-Y values 1 through 6, with any unused points at the end tuned high (out of the way).

Setup of CDP Pressure Control

The GTC200 allows the user to setup a CDP control loop to limit the maximum CDP pressure of the compressor within the turbine. The user can adjust the CDP set point and dynamic gain values of the PID. This function is typically used as a turbine protection / topping limiter and can also be used to limit the overall horsepower output of the turbine.

Setup of EGT Temperature Control

The GTC200 allows the user to setup an EGT control loop to limit the maximum EGT temperature of the exhaust gas output of the turbine. The user can adjust the EGT set point and dynamic gain values of the PID. This function is typically used as a turbine protection / topping limiter. This control loop also has an option to allow the user to include EGT limiting during the initial starting of the turbine. The user can enable this function and setup low temp and high temp set points that will define a ramp which will be used during initial start to limit the fuel valve position through this range. The user must also define a rate at which the control will ramp up the temp set point (from low to high), so that the turbine can continue to accelerate up to GG control. This function helps to eliminate potential overtemp shutdowns on initial startup by providing closed loop control at sub-GG Idle conditions. The EGT control automatically resumes to being a topping control once the turbine has reached GG speed control.

Setup of Generator Settings

The GTC200 allows the user to setup a MW control loop to limit the maximum MW output of the turbine. The user can adjust the MW set point and dynamic gain values of the PID. This function is typically used as a turbine protection / topping limiter and can also be used to limit the overall MW or horsepower output of the turbine. The user can also setup the Droop percentage and define a curve (CDP versus MW) that can be used for load feedback if the MW sensor fails. In the case of a compressor unit, the user can decide to use CDP as load feedback.

Chapter 7.
Generator Protection Functions

Protective Relay Descriptions

The table below gives some summary information about each type of protective relay function provided. Details for each follow the table. Note that the Alarm and Pre-Alarm Time Delays are used for both high and low conditions.

Name	Functionality	Type
Generator Under/Over Voltage (27,59)	Alarm and Pre-Alarm capability	Definite Time
Generator Over/Under Frequency (81O, 81U)	Alarm and Pre-Alarm capability	Definite Time
Generator Over/Under Power	Alarm and Pre-Alarm capability	Definite Time
Generator Directional Power Relay (32)	Alarm and Pre-Alarm capability	Inverse Time
Generator Negative Phase Sequence Over Voltage (47)	Alarm and Pre-Alarm capability	Definite Time
Generator Negative Phase Sequence Over Current (46)	Alarm and Pre-Alarm capability	Definite Time
Generator Phase Over Current (51)	Alarm and Pre-Alarm capability	Inverse Time
Generator Directional VAR Relay	Alarm and Pre-Alarm capability	Definite Time
Generator Phase Current Differential Imbalance relay (87)	Alarm and Pre-Alarm capability	Inverse Time
Sync Check (25)	True / False (no alarm)	Definite Time
Voltage (VAR/PF) Adjust Limits Reached	High and Low Alarms	Definite Time
Speed / Frequency Mismatch	Alarm only	Definite Time

Table 7-1 Generator Protection Alarms

Over and Under Voltage

The Over and Under Voltage protective relay is definite time. It operates by comparing the actual voltage to the level set points for this relay. The highest voltage of the 3 phase inputs is always used for the Over Voltage protective relay. Likewise, the lowest voltage of the 3 phase inputs is always used for the Under Voltage protective relay. Once an alarm is issued, it is latched until the GTC is reset. The generator Under Voltage relay is automatically disabled anytime the generator breaker is open. The Bus Under Voltage relay, Generator and Bus Over Voltage relays are not inhibited by breaker position.

The action to be taken for an Over Voltage Pre-Alarm, Over Voltage Alarm, Under Voltage Pre-Alarm, and Under Voltage Alarm are all independently configurable. There are separate Delay times for Pre-Alarm and Alarm. The delay times for Over Voltage and Under Voltage are identical but Generator and Bus are independently configured.

The Alarm and Pre-Alarm trigger levels for an Over Voltage Pre-Alarm, Over Voltage Alarm, Under Voltage Pre-Alarm, and Under Voltage Alarm are all independently configurable. The worst case phase voltage must exceed the configured level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram below shows how the Pre-Alarm and final Alarm events are envisioned to operate. Note that the delay times are identical between Over and Under Voltage event examples but the trigger levels are all separately configurable.

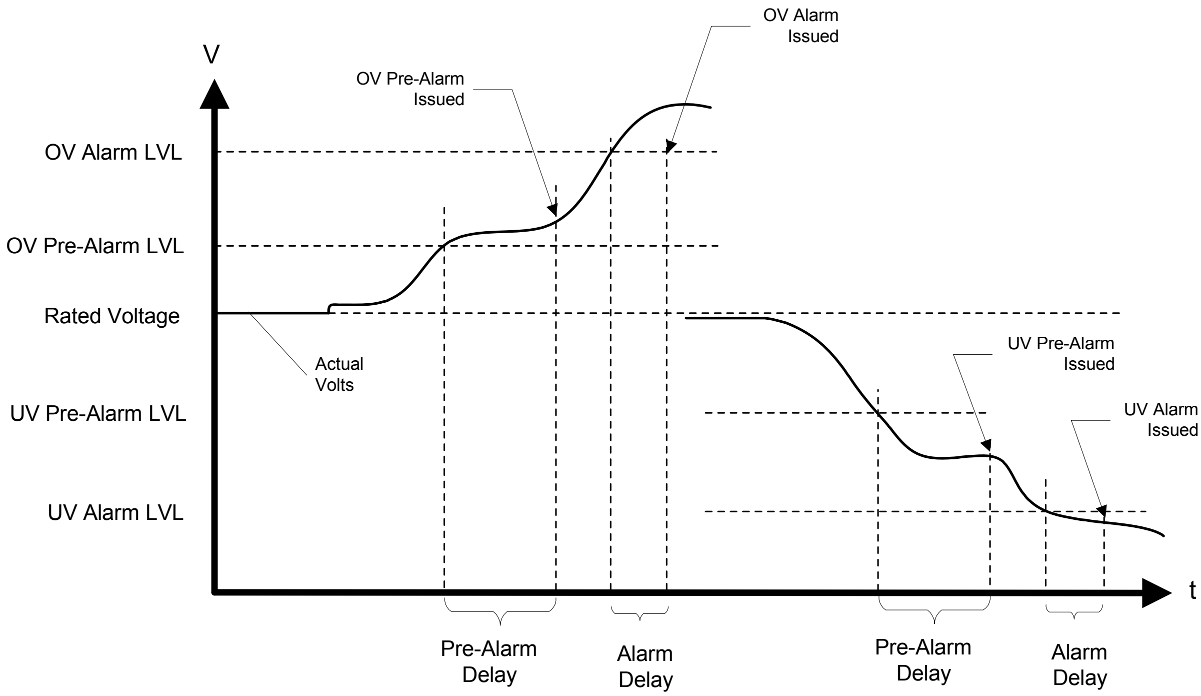


Figure 7-1. Over Voltage/Under Voltage Alarm

Over and Under Frequency

The Over and Under Frequency protective relay is definite time. It operates by comparing the actual frequency to the level set points for this relay. Once an alarm is issued, it is latched until the GTC is reset. The generator Under Frequency relay is automatically disabled anytime the generator breaker is open. The Bus Under Frequency relay, Generator and Bus Over Frequency relays are not inhibited by breaker position.

The action to be taken for an Over Frequency Pre-Alarm, Over Frequency Alarm, Under Frequency Pre-Alarm, and Under Frequency Alarm are all independently configurable. There are separate Delay times for Pre-Alarm and final Alarm. The delay times for Over Frequency and Under Frequency are identical but Generator and Bus are independently configured.

The Alarm and Pre-Alarm trigger levels for an Over Frequency Pre-Alarm, Over Frequency Alarm, Under Frequency Pre-Alarm, and Under Frequency Alarm are all independently configurable. The frequency must exceed the level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and final Alarm events are envisioned to operate. The Over and Under Frequency protective relay function operates in the same manner as the Over and Under Voltage protective relay function.

Directional Power

The Over and Reverse Power protective relays are inverse time. They operate by comparing the actual real power to the level set point for this relay. Only real power is of interest for this protection. Over power for the generator is power flowing out of the generator (produced by the generator). Over power for the Bus is defined as power flowing into the Bus (same relationship as generator). Over power for the Bus is denoted as Export Power and Reverse Power for the Bus is denoted as Import Power.

A configurable time delay setting is provided to shift the inverse time curve along the time axis. This movement allows adjustment of the minimum trip time at the configured level. The same shifted curve is used for Pre-Alarms and Alarms so a time shift done for one will affect the other as well. The same shift is also applied to both the Over Power and the Reverse Power protective relays.

The power level must exceed the level continuously for the calculated delay time before the Alarm or Pre-Alarm action is taken. The delay time is recalculated each time the power level changes. Once an alarm is issued, it is latched until the GTC is reset. The Directional Power relays are continuously enabled.

The below graph shows how the Pre-Alarm (warning) and final Alarm settings relate to actual and rated power levels. Notice the delay time for the over power pre alarm is longer than the delay time for the over power alarm. This time difference results from the difference in the actual power compared to the pre-alarm and alarm set points. A long time delay is seen when the actual power is only slightly higher than the pre-alarm level. When the actual power goes above the alarm level it goes noticeably higher so the time delay is shorter. In order to determine the calculated delay and to see how the curve shift is used, refer to the second graph below.

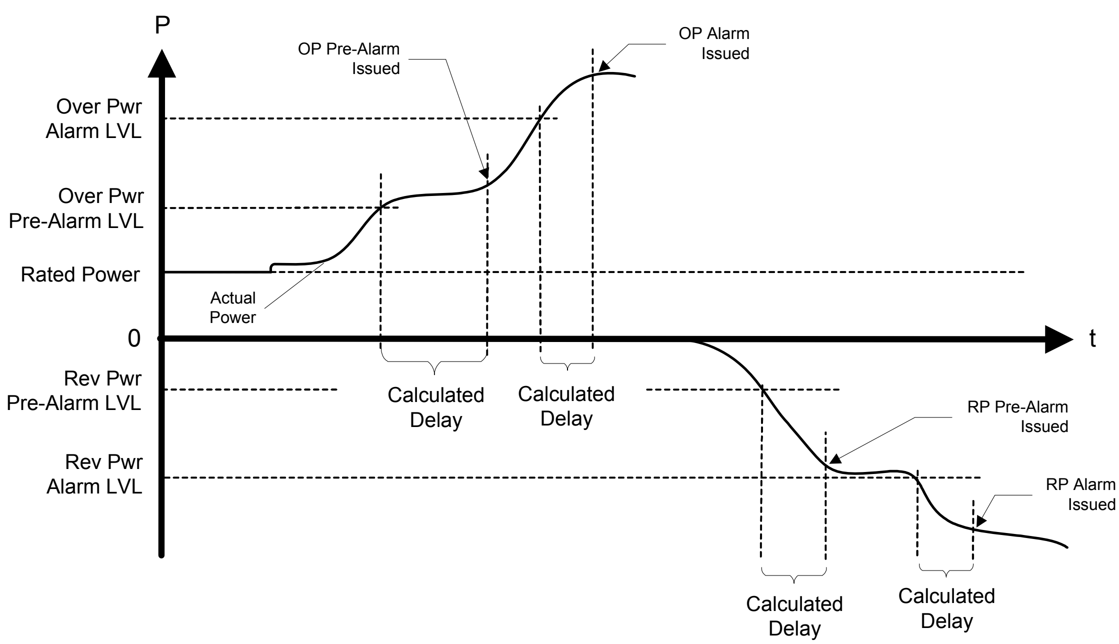


Figure 7-2. Over Power/Reverse Power

The graph below shows how the inverse time curve is applied to the directional power protective relay. Note the same curve shift applies to both Over and Reverse Power. Likewise, for the Bus, the same curve shift would apply to both Import and Export Power but is different than the curve shift used for the generator directional power protective relay.

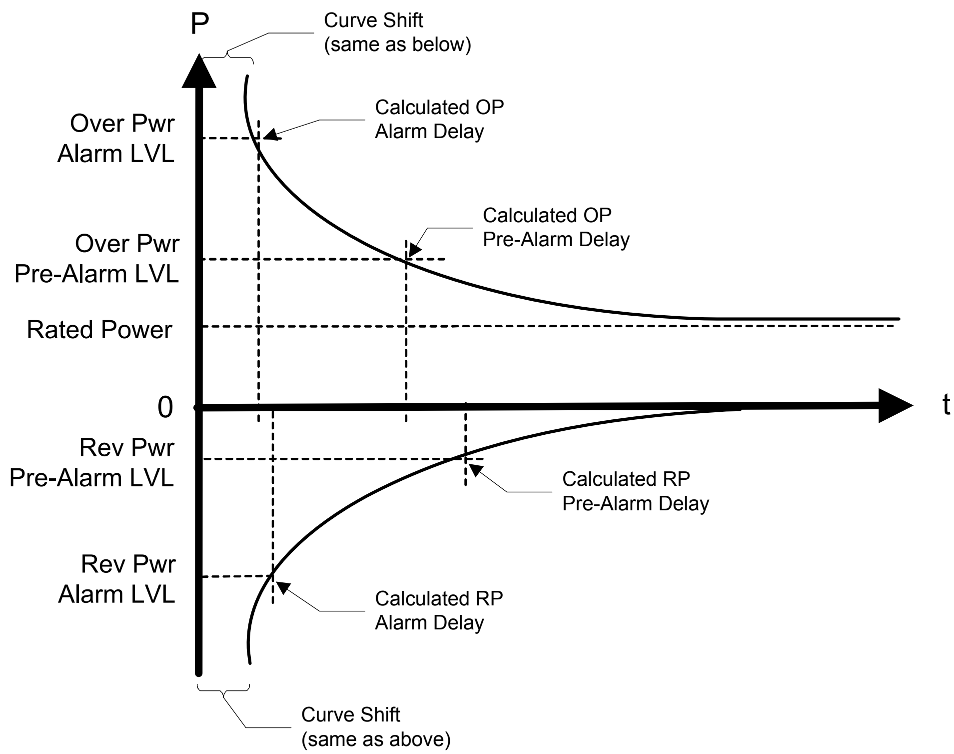


Figure 7-3. Over Power/Reverse Power Time Delay

Negative Phase Sequence Over Voltage

Negative Phase Sequence Voltage (NPS) is a measure of the imbalance in a three phase system. Any imbalance due to unequal voltage amplitude of the three phases or a phase angle error between phases creates NPS voltage. A completely balanced system with positive phase sequence generates 0% NPS voltage. Complete loss of one phase results in 50% NPS voltage, a 100% NPS voltage would result from a balanced system with reversed phase sequence. The NPS protection function must know the correct (expected) phase rotation in order to function properly.

Typical causes of voltage unbalance are large unbalanced loads (single phase loads in the system) and unbalances in the supply due to transformer designs or other customer loads in the power system. The most common effect of voltage unbalance (detected by NPS voltage) is rotor overheating on 3-phase motors.

For installations where significant regenerated EMF may occur (lifts, cranes, or similar), a sensitivity of 5%-7% is recommended above what is necessary for the system unbalance. To avoid tripping on system transient disturbances, this relay should be configured with a timeout from 2 to 4 seconds.

This Negative Phase Sequence Over Voltage protective relay is a definite time relay. As the name implies, it tracks levels ABOVE a configured setting. It operates by comparing the actual Negative Phase Sequence Voltage with the level set point for this relay. Once an alarm is issued, it is latched until the GTC is reset. The Negative Phase Sequence Over Voltage relays are continuously enabled.

The actions to be taken for a Negative Phase Sequence Over Voltage Pre-Alarm or a Negative Phase Sequence Over Voltage Alarm are both independently configurable. The Negative Phase Sequence Over Voltage trigger levels are also independently configurable for the Pre-Alarm and Alarm. There are separate Delay times for Pre-Alarm and Alarm. The Negative Phase Sequence Voltage must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and final Alarm events are envisioned to operate. Only the Over Voltage portion of the diagram is used. The Negative Phase Sequence Over Voltage protective relay function operates in the same manner as the Over Voltage protective relay function.

Negative Phase Sequence Over Current

This Negative Phase Sequence Over Current protective relay is a definite time relay. The negative phase sequence over current is derived the same as the voltage above. Once an alarm is issued, it is latched until the GTC is reset. The Negative Phase Sequence Over Current relays are continuously enabled.

The actions to be taken for a Negative Phase Sequence Over Current Pre-Alarm or a Negative Phase Sequence Over Current Alarm are both independently configurable. The Negative Phase Sequence Over Current trigger levels are also independently configurable for the Pre-Alarm and Alarm. There are separate Delay times for Pre-Alarm and Alarm. The Negative Phase Sequence Current must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and Alarm events are envisioned to operate. Only the Over Voltage portion of the diagram is used. The Negative Phase Sequence Over Current protective relay function operates in the same manner as the Over Voltage protective relay function.

Phase Over Current

The Phase Over Current protective relay is an inverse time relay. It operates by comparing the actual phase current to the level set point for this relay. The highest current of the 3 phase inputs is always used for the Phase Over Current protective relay. Total current is not evaluated. This protective relay is NOT meant to replace a breaker.

A configurable time delay setting is provided to shift the inverse time curve along the time axis. This movement allows adjustment of the minimum trip time at the configured level. The same shifted curve is used for Pre-Alarms and Alarms so a time shift done for one will affect the other as well.

The worst case current level must exceed the configured level continuously for the calculated delay time before the Alarm or Pre-Alarm action is taken. The delay time is always being recalculated for the present current level input. Once an alarm is issued, it is latched until the GTC is reset. The Phase Over Current protective relay is continuously enabled.

The diagram in Directional Power above shows how the Pre-Alarm and final Alarm events are envisioned to operate as well as the interaction with the inverse time curve. Only the Over Power portion of the diagram is used. The Phase Over Current protective relay function operates in the same manner as the Over Power protective relay function.

Directional VAR

The Over and Reverse VAR (Import and Export VAR) protective relay is definite time. It operates by comparing the actual reactive power to the level set points for this relay. Only reactive power is of interest for this protection. Over VAR for the generator is reactive power flowing out of the generator (produced by the generator) and is representative of lagging power factor. Over VAR for the Bus is defined as reactive power flowing into the Bus. We will refer to this as Export VAR for the Bus. Reverse VAR for the Bus will be referred to as Import VAR. Once an alarm is issued, it is latched until the GTC is reset.

The action to be taken for an Over (Export) VAR Pre-Alarm, Over (Export) VAR Alarm, Reverse (Import) VAR Pre-Alarm, and Reverse (Import) VAR Alarm are all independently configurable. There are separate Delay times for Pre-Alarm and Alarm. The delay times for Forward and Reverse VAR are identical but Generator and Bus are independently configured.

The Alarm and Pre-Alarm trigger levels for an Over (Export) VAR Pre-Alarm, Over (Export) VAR Alarm, Reverse (Import) VAR Pre-Alarm, and Reverse (Import) VAR Alarm are all independently configurable. The reactive power level must exceed the trigger level continuously for the delay time before the Alarm or Pre-Alarm action is taken.

The diagram in Over and Under Voltage above shows how the Pre-Alarm and Alarm events are envisioned to operate. The Directional VAR protective relay function operates in the same manner as the Over and Under Voltage protective relay function.

Phase Current Imbalance

The Phase-balance Current protective relay is an inverse time relay. It operates by comparing the actual current between each phase to the level set point for this relay. The highest differential current of the 3 comparisons is always used for the Phase Current Imbalance protective relay.

A configurable time delay setting is provided to shift the inverse time curve along the time axis. This movement allows adjustment of the minimum trip time at the configured level. The same shifted curve is used for Pre-Alarms and Alarms so a time shift done for one will affect the other as well.

The worst case current differential must exceed the trigger level continuously for the calculated delay time before the Alarm or Pre-Alarm action is taken. The delay time is always being recalculated for the present current imbalance level input. Once an alarm is issued, it is latched until the GTC is reset. The Phase Current Differential protective relay is continuously enabled.

The below graph shows how the Pre-Alarm and Alarm settings relate to actual current imbalance levels. The current imbalance levels are internally normalized against the rated current. This provides the inverse time function with a valid comparison because the IEEE definition is only valid above 1 per unit. Nevertheless, the configuration values for the Alarm and Pre-Alarm Level are to be entered as the actual allowed difference. The GTC will automatically add Rated Current to the configured value.

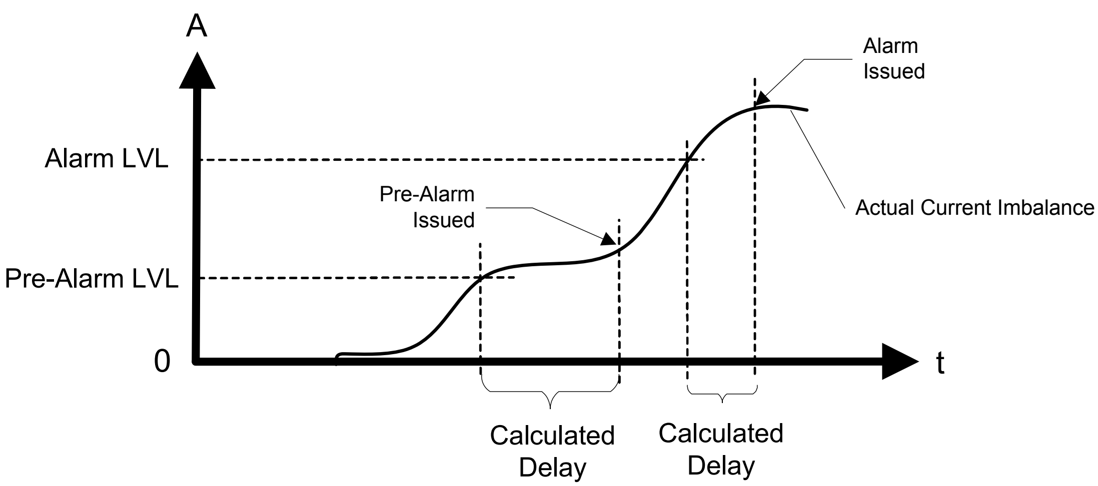


Figure 7-4. Phase Current Imbalance

In order to determine the calculated delay and to see how the curve shift is used, refer to the graph below. The Phase Current Imbalance protective relay function operates in nearly the same manner as the Over Power protective relay function except that rated current is automatically added into the percentage calculation for the IEEE inverse time curve input. The information is provided in case an exact trip time must be calculated.

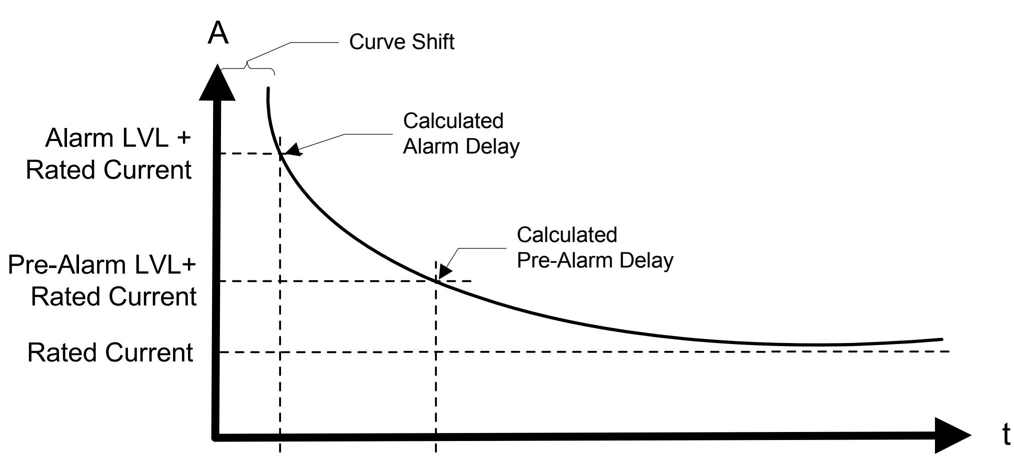


Figure 7-5. Phase-Balance Current, Inverse Time Delay

Sync Check

The GTC synchronizer provides the Sync Check protective relay function. It is listed here due to its nature as a protective relay. It is enabled during synchronizing only. The synchronizer always performs a Sync Check function regardless of the configured mode since it will never assert the breaker close output unless the two A-phase inputs are in sync with each other. The synchronizer may also be placed in the Permissive Mode which mimics a typical ANSI 25 device by closing the output when the two sources are in sync.

Voltage (VAR/PF) Bias Limit Reached

The Limits Reached alarm function applies to the two closed loop analog outputs – one for voltage adjust and the other for speed adjust. Each output has separate alarm due to exceeding the limits in the high direction or low direction. There is a fixed timeout of 10 seconds to ensure that a short bump into the limit does not cause an alarm. The alarm action is configurable.

This protection determines if the analog output or digital outputs (depending on configuration) have reached their limits. Since a digital output has no definite limit, the protection also reacts to the situation where the control is requesting more adjustment but the system is not responding. This condition would be indicative of reaching a limit.

Speed / Frequency Mismatch

The Speed/Frequency Mismatch protection watches the magnetic pickup speed input and the measured frequency on the generator input. It compares the scaled value of the MPU (the rpm value) to the frequency using a simple formula. The formula also depends on the configured number of generator poles.

$$Frequency = \frac{\#GenPoles \bullet RPM}{120}$$

The purpose of this protection is partly to identify an incorrect configuration for the number of teeth but primarily to diagnose a failed MPU signal or a generator failure. If the one of the signals fail, a mismatch will occur between the measured MPU speed and the measured generator frequency. Since over speed is determined from the MPU input, this protection is an important adder to the over speed protection.

A fixed delay of 5 seconds is incorporated. A one hertz margin is allowed. How the alarm reacts is configurable.

Inverse Time Curve

All protective relays that utilize inverse time trips will use the same curve shape as defined below. Each relay will be allowed to independently adjust the curve along the time axis. This adjustment does not alter the curve shape. The reason for the adjustment is to allow fine tuning of the alarm levels and timing.

The GTC takes the ratio of the input being used (phase current, power, etc.) to the rated value of that unit. The inverse time curve always uses a ratio of rated for its data element.

The inverse time curve plotted below is defined in IEEE C37.112 as the Very Inverse formula

$$Time = \left(\frac{A}{x^p - 1} + B \right) * D$$

where:

Time	The amount of time to wait before an alarm is issued for the given value of x. As x increases, the time will decrease.
X	A ratio of the measured parameter in protection to rated value.
A	IEEE defined constant that affects the curve shape. It is fixed at **19.61.**
B	IEEE defined constant that affects the curve position. It is fixed at **0.491**
P	IEEE defined constant that defines the curve type. It is fixed at **2.**
D	Adjustable time delay. This allows the curve to be shifted along the time axis by a variable amount.**, 0.01 to 10.0, default =1.0**

For high alarms: If the input is less than the Alarm level and Pre-Alarm level, no action will be taken. When the input is above the Pre-Alarm level, the configured action will be taken for the pre-alarm after the timeout defined by the formula. When the input is above the Alarm level, the appropriate (and typically more severe) action will be taken after the (shorter) timeout defined by the formula.

For low alarms: If the input is greater than the Alarm level and Pre-Alarm level, no action will be taken. When the input is less than the Pre-Alarm level, the configured action will be taken for the pre-alarm after the timeout defined by the formula. When the input is less than the Alarm level, the appropriate (and typically more severe) action will be taken after the (shorter) timeout defined by the formula.

The IEEE curve implemented is the Very Inverse curve defined in IEEE C37.112 and also matches the IEC curve defined in IEC 255-03 except for the additional time shift (B) that is not defined in IEC. The formula will not function at rated or below rated for the parameter in protection. Therefore, if a trip value is set at or below rated, the timeout for these conditions will be fixed at 10 seconds. This causes a discontinuity in the curve at 100% rated. The values for A and B in the IEEE formula change at the discontinuity point. The constant A becomes 0 and the constant B becomes 10. Due to the location of the B constant and the D variable, the 10 second timeout will also adjust with the curve shift.

The figure below is a set of curves showing the IEEE Very Inverse formula plotted three times. The center plot is the default curve with no level shift, Shift value = 1.0. The upper plot is the same curve with a level shift of five. The lower plot is the same curve with a level shift of 0.1. Note the curve shape does not change. Also note the fixed timing at or below rated as shown by the straight horizontal line; and note how the fixed timing is varied with the curve shift. The GTC curve does extend to the right beyond the time shown.

Also shown below is a figure with the Inverse Time Curve converted to linear axis scale. The values used in the GTC extend above 25 second delay between 1.0 and 1.35, and also extend to the right beyond the ratio of 5.0.

Example: If the alarm set point is 150% of the rated (1.5 ratio) and the input is at this set point value and the shift = 1.0, the delay will be 16 seconds. When shift = 5, delay will be 80 seconds. When shift = 0.1, delay will be 1.6 seconds. As the input value exceeds the set point, the delay will become shorter.

Example: For an Over Current Trip Relay function: If Rated Phase Current is 500 Amps, and a trip delay of 5.0 second is desired at 700 Amp.
Ratio = 1.4, from formula (or reading from curve below) the Normalized Delay = 20.9 sec.
5.0 / 21.0 = 0.24

The curve shift value of 0.24 is required to meet the desired level and delay requirement.

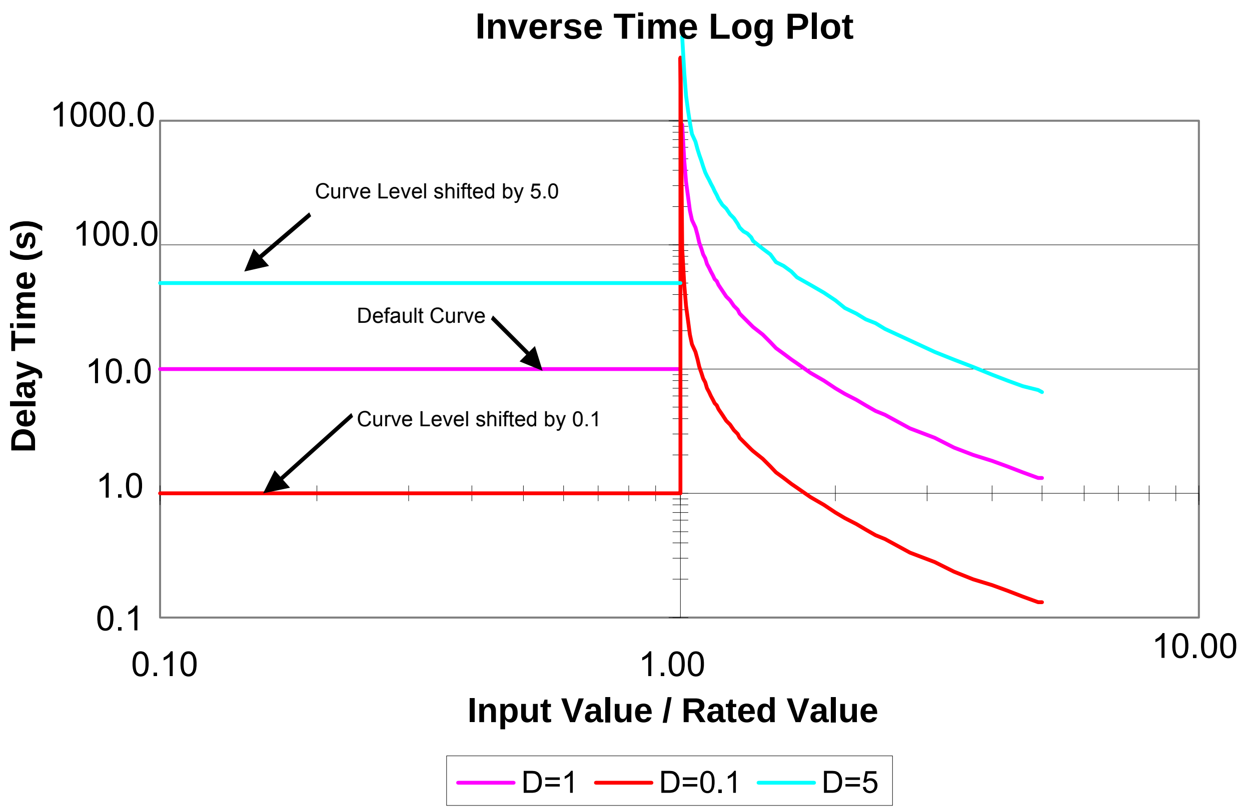


Figure 7-6. Inverse Curve Time Delay, Level Shift

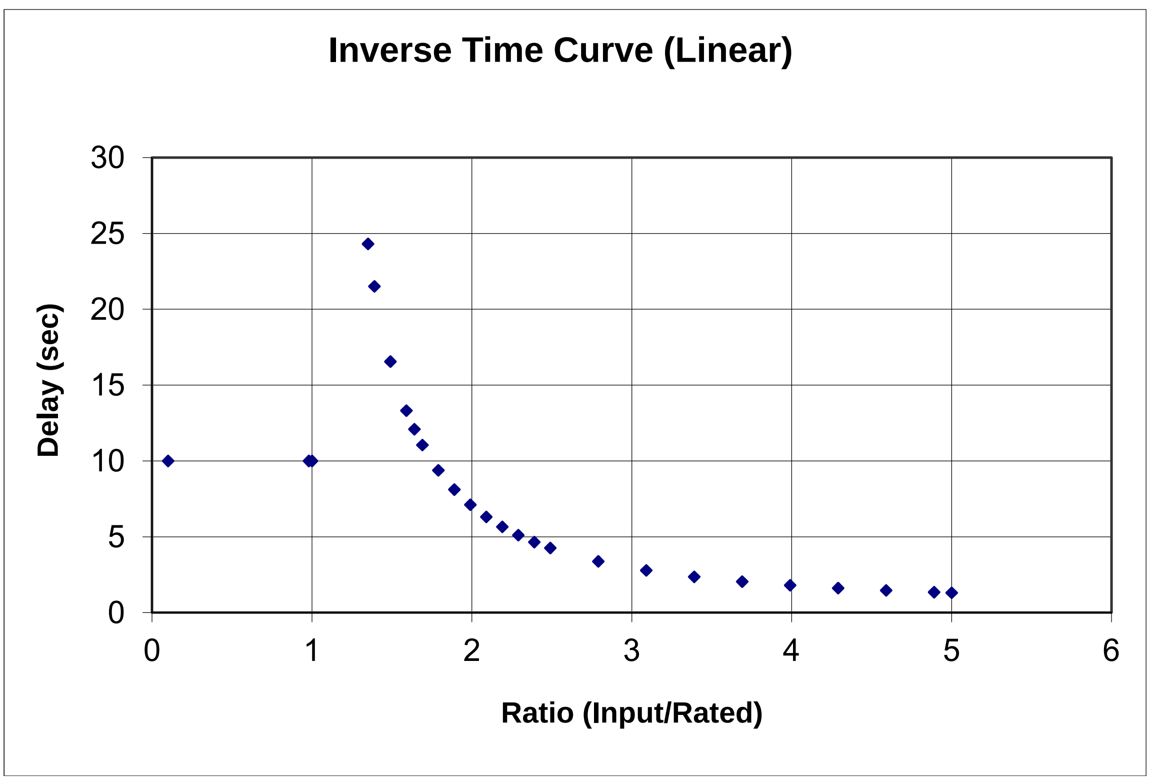


Figure 7-7. Inverse Curve Time Delay, Linear Graph

Chapter 8.
Troubleshooting

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 8-1.

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.

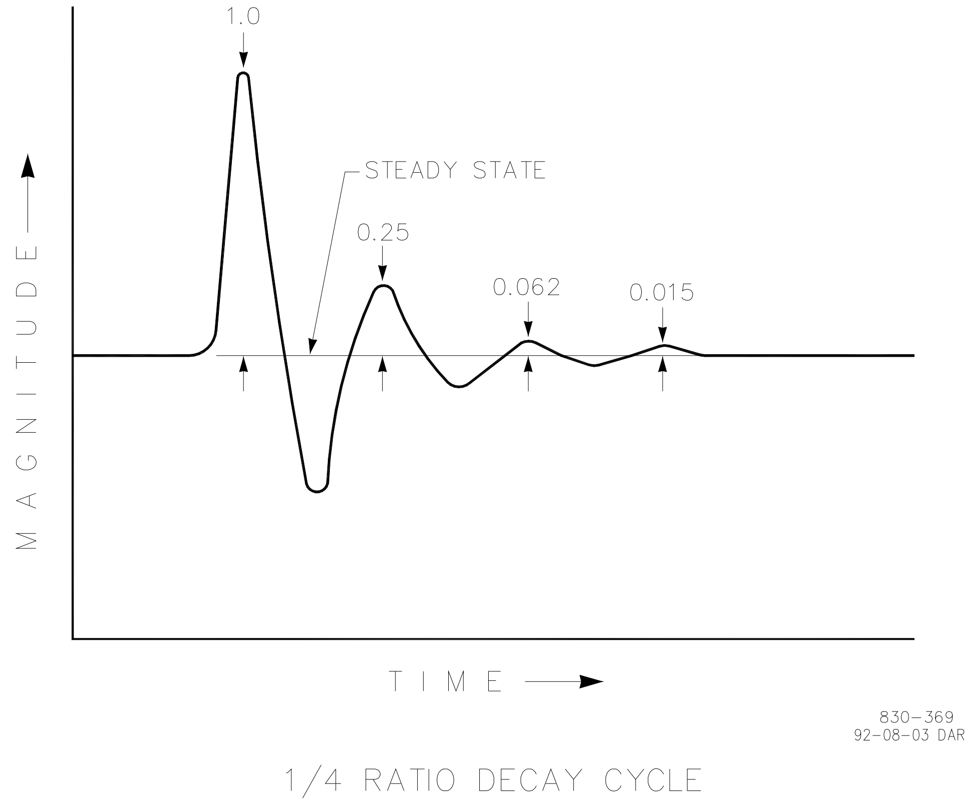


Figure 8-1. Ratio Decay Cycle

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 an SDR of 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.

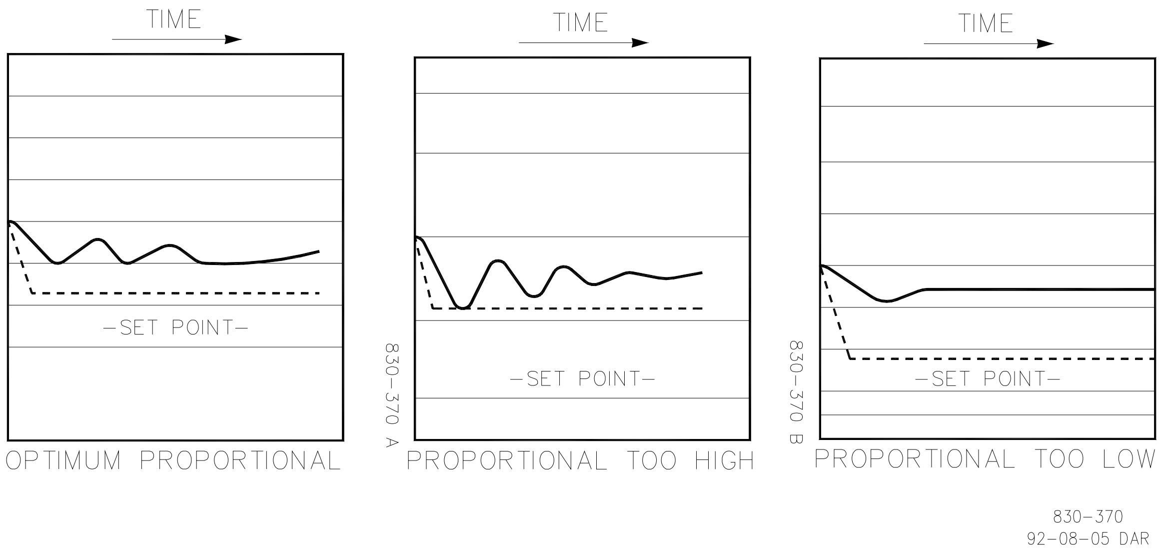


Figure 8-2. Proportional Gain Settings

* 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 GTC200 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 (for Accel) or minimum (for Decel) fuel flow allowed for a given CDP. The information below will assist the user in programming these parameters in the service category. 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).

IMPORTANT	**For all Curves in the GTC Products, the control software will not allow the user to tune X values (inputs) of curves to a value equal to or higher than the point above it, or equal to or lower than the point below it. This is to protect the curve block from calculating infinite slopes that could cause problems during block runtime execution.**

CDP Accel Schedule (Service–CDP to Fuel Limit Curve)—The curve-defined acceleration rate limiter based on CDP scaled in same units as above. Outputs are scaled from 0 to 100% of valve travel. Since gas flow is not proportional to actuator current or valve angle, the Accel Schedule breakpoints should be calculated based on fuel flow and then fuel flow converted to actuator current using valve test data.

Note on completing Accel and Decel Schedules: Gas flow in pph or BTU/hr vs. actuator current data is required. Also required are the turbine manufacturer's acceleration and deceleration specifications.

1. 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 AtlasSC 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.

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

3. 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.

4. 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.

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

6. 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 AtlasSC Digital Control System.

   For example, see the linearized sample manufacturers specification, Figure 8-3, and the valve test data example Table 8-1.

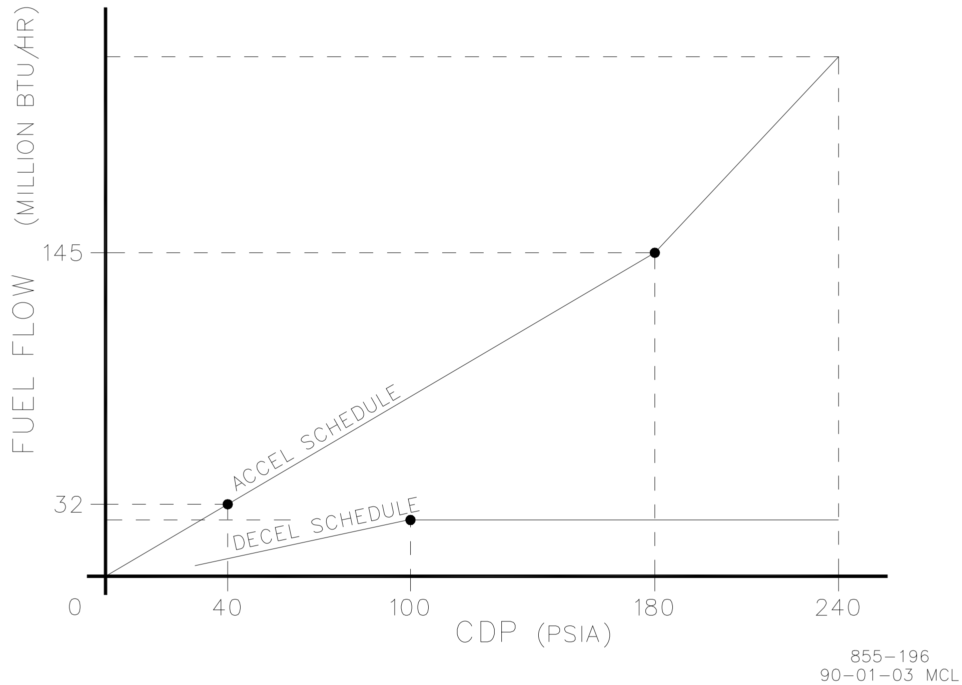


Figure 8-3. Linearized Flow Schedule

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 8-1. 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 often 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 AtlasSC 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)

Table 8-2. Serial Port Configurations

Serial Null Modem Cable Reference

The following defines a standard null modem cable which can be purchased at any electronics store. This cable is useful for interfacing a Woodward control to a PC running 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 9.
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 ____________________

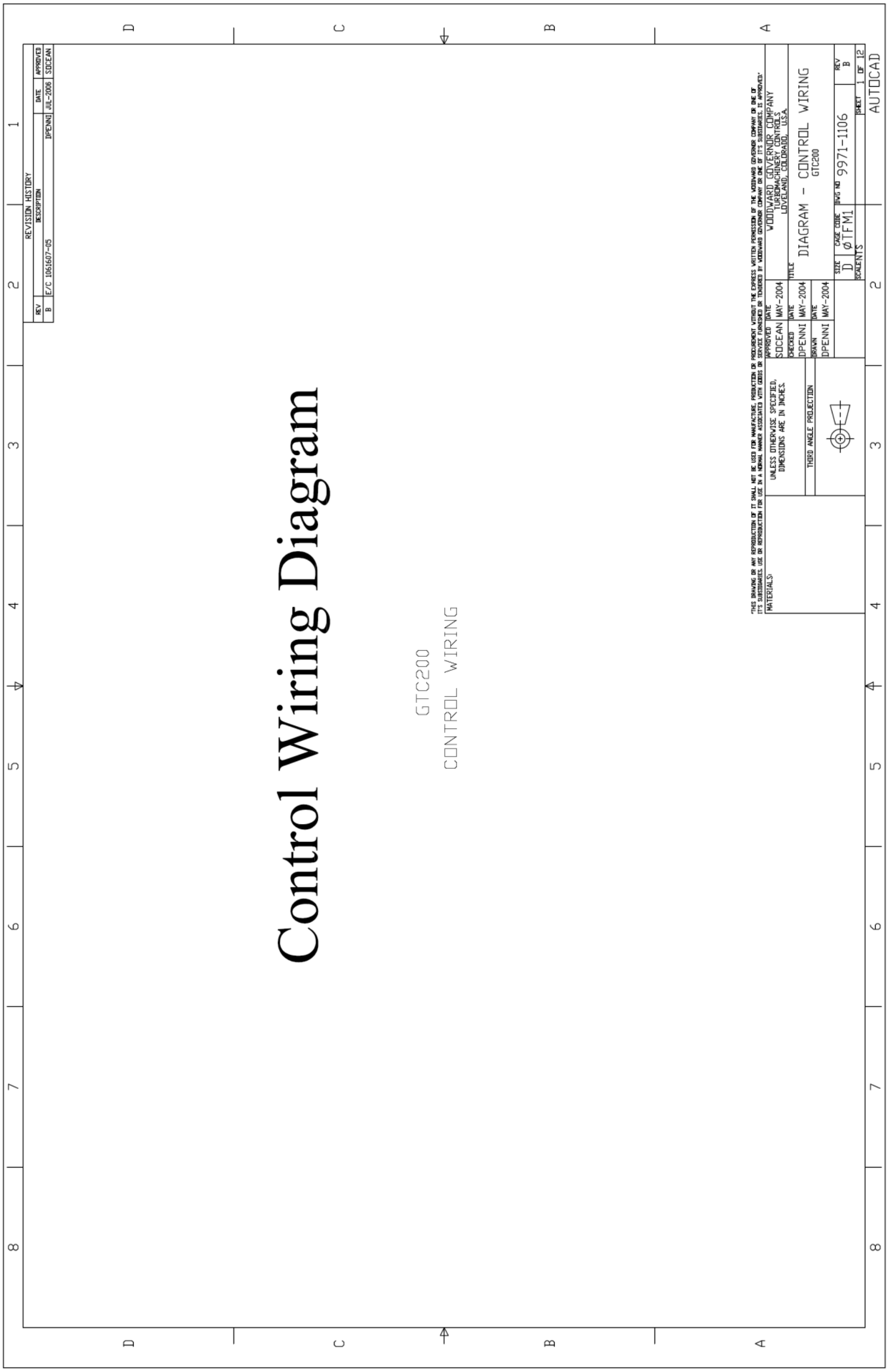
Control/Governor #1
Woodward Part Number & Rev. Letter ____________________
Control Description or Governor Type ____________________
Serial Number ____________________

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



SHEET NUMBER	DESIGNATION	DESCRIPTION	REV. DATE	
SHEET 1	COVER	COVER SHEET	MAY-2006	
SHEET 2	INDEX	SHEET INDEX SHEET	MAY-2006	
SHEET 3	CHASSIS LAYOUT	ATLAS CHASSIS	MAY-2006	
SHEET 4	PS BOARD	POWER & DISCRETE OUTPUTS	MAY-2006	
SHEET 5	A02 SMARTCORE1	DISCRETE INPUTS	MAY-2006	
SHEET 6	A02 SMARTCORE2	ANALOG INPUTS & SPEED INPUTS	MAY-2006	
SHEET 7	A02 SMARTCORE3	ANALOG OUTPUTS AND ACTUATOR OUTPUTS	MAY-2006	
SHEET 8	A02 SMARTCORE4	COMMUNICATION PORTS	MAY-2006	
SHEET 9	A02 POWERSENSE1	LOAD BUS PT/CT's AND VOLTAGE/SPEED BIAS OUTPUTS	MAY-2006	Note 3
SHEET 10	A02 POWERSENSE2	GENERATOR PT/CT's AND LON/CAN COMMUNICATIONS	MAY-2006	Note 3
SHEET 11	A03 ANALOGCOMBO1	ANALOG INPUTS 1-11	MAY-2006	
SHEET 12	A03 ANALOGCOMBO2	ANALOG OUTPUTS & SPEED SIGNAL INPUTS	MAY-2006	

NOTES:

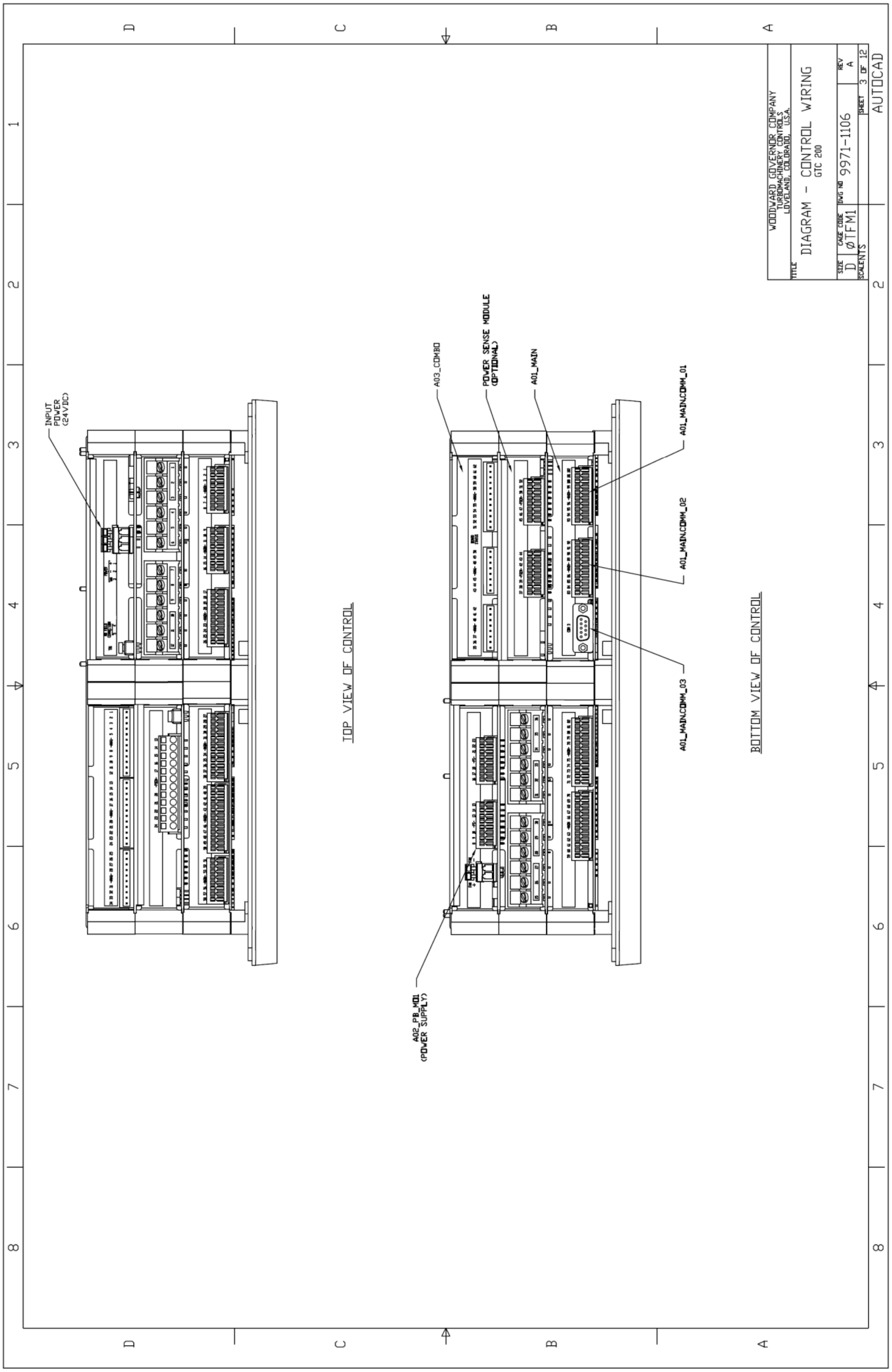
1) Descriptions in **BOLD** are fixed I/O points that are used to implement functionality in the GTC200. The ones with an **asterisk** are required by the GTC200.
2) The Analog Combo board is configured in the following manner:
   - Channels 1-10 Thermocouple Input
   - Channels 11-13 Analog 4-20 mA Input
   - Channels 14-15 RTD Input (100 or 200 Ohm only)
3) Only applies the GTC200 w/PowerSense model.

WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.

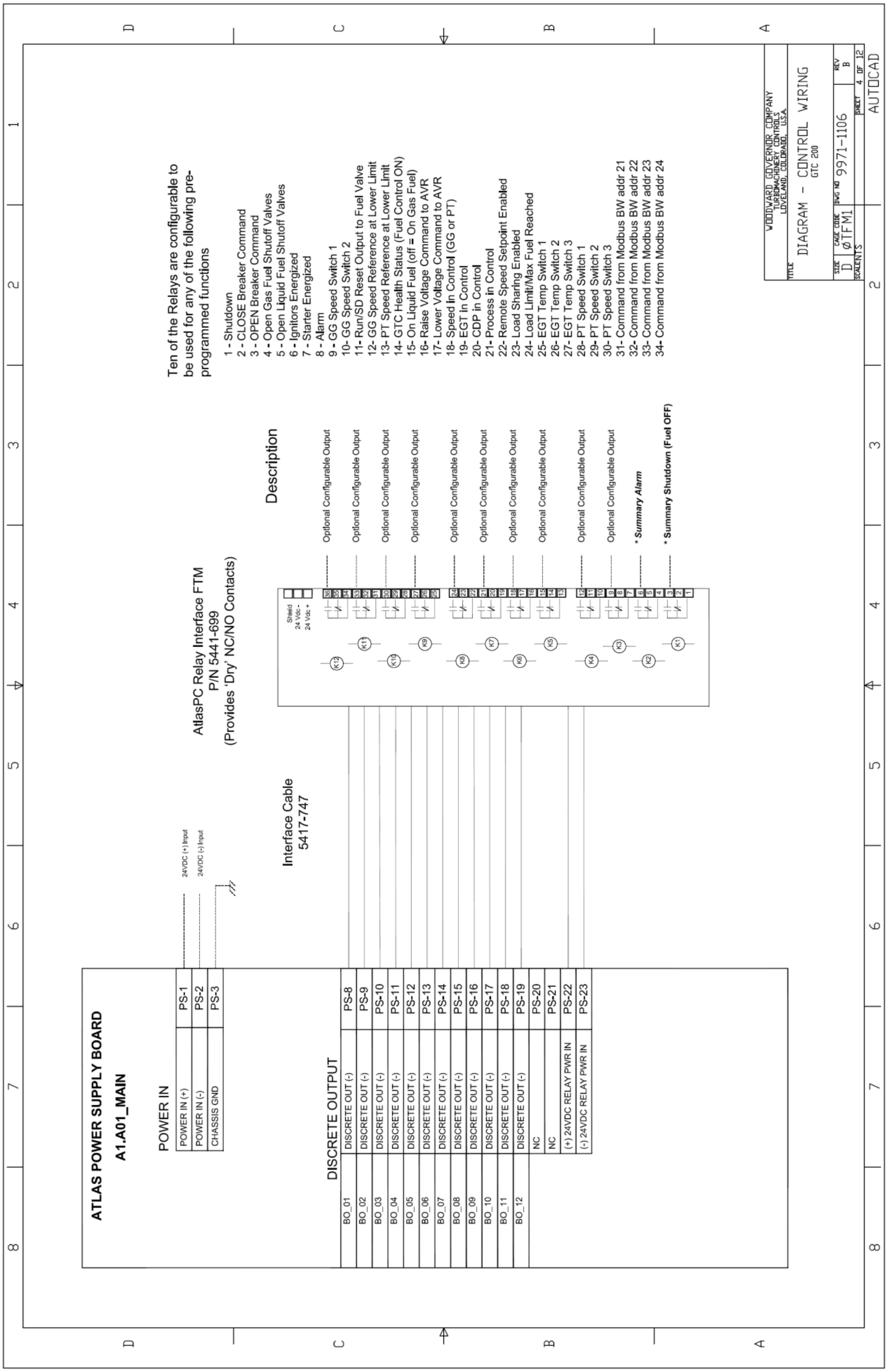
TITLE: DIAGRAM - CONTROL WIRING
GTC 200

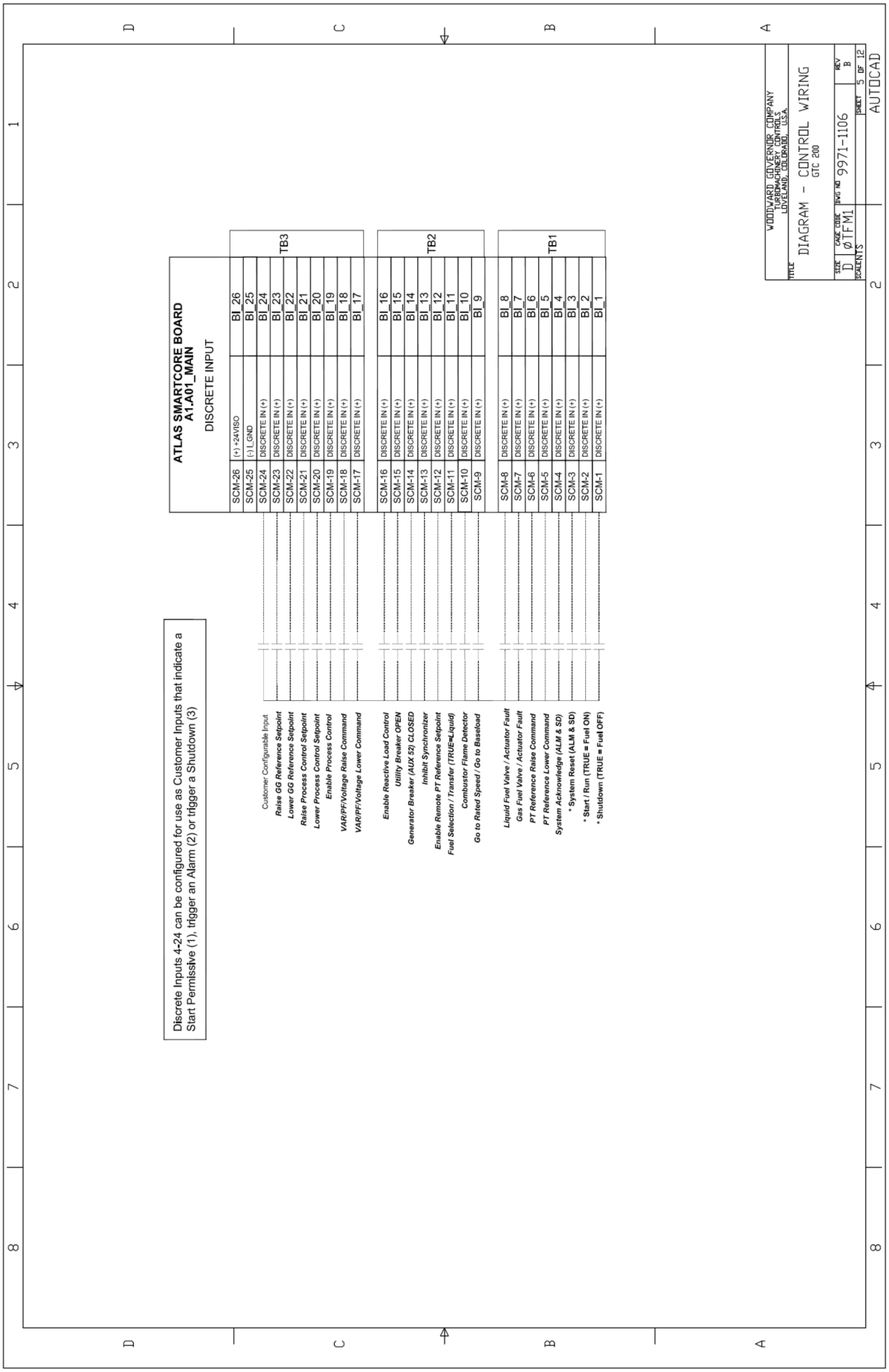
SIZE	CAGE CODE	DWG NO	REV
D	ØTFM1	9971-1106	A

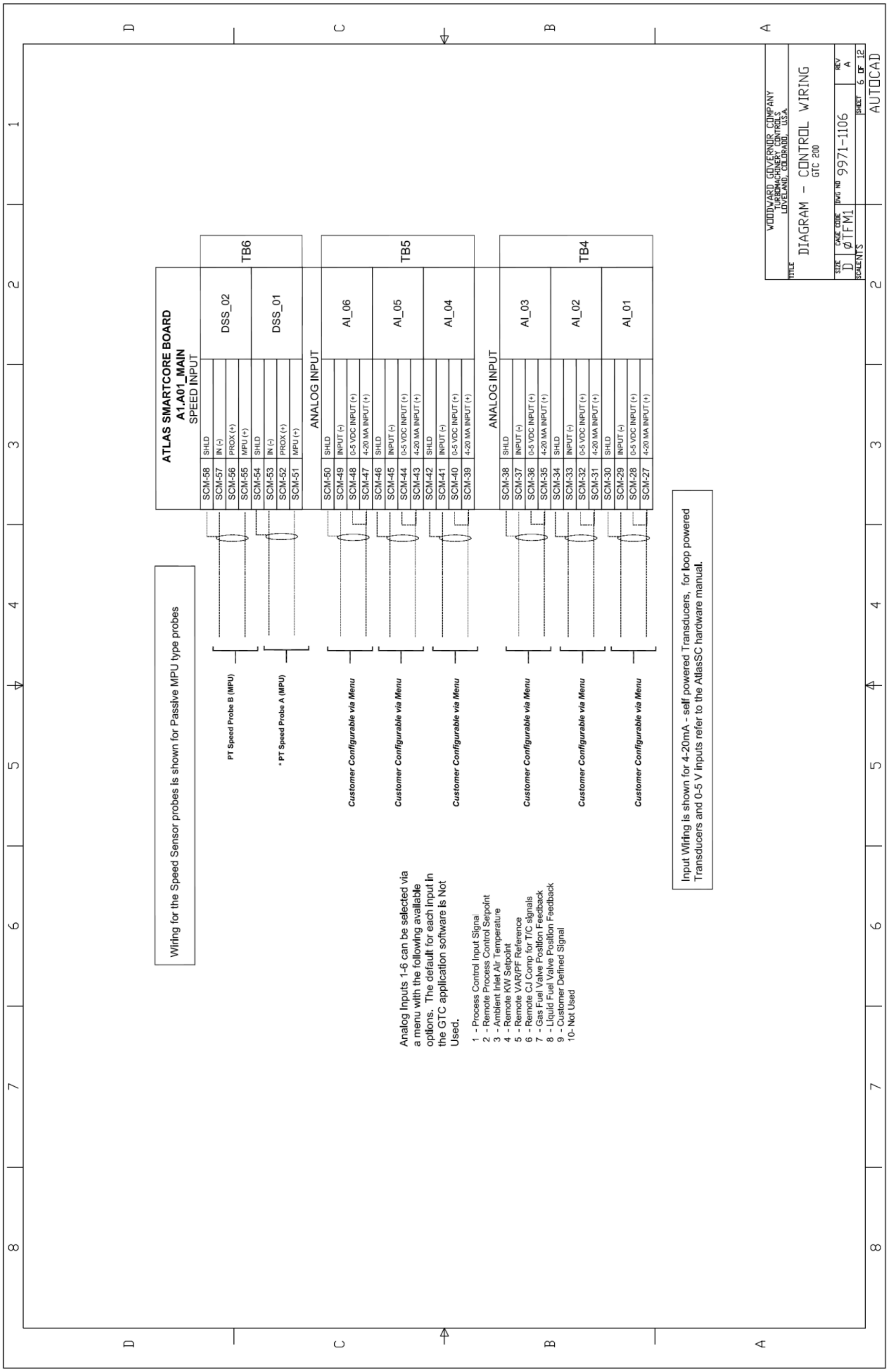
SCALE: NTS — SHEET 2 OF 12 — AUTOCAD

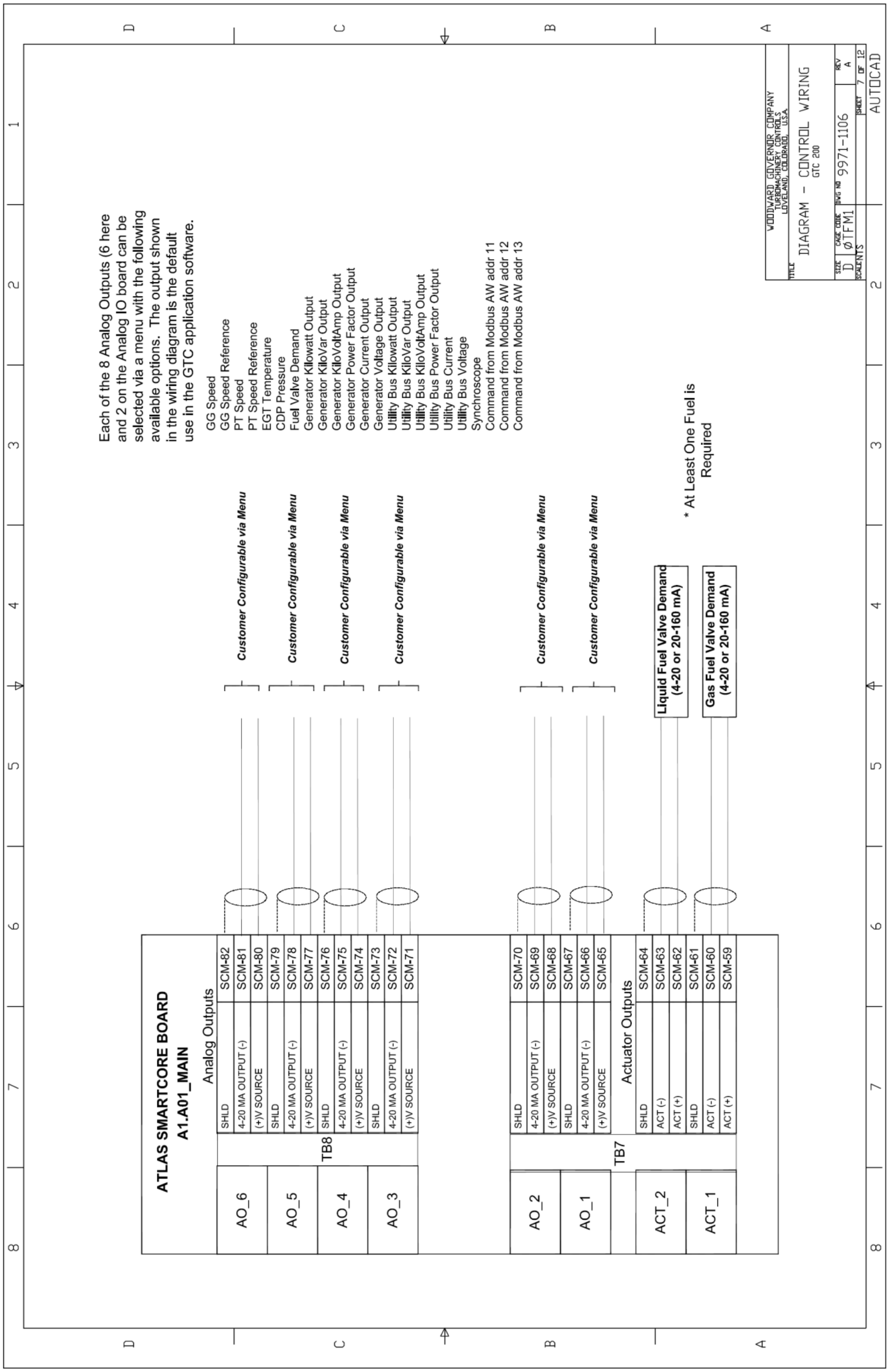


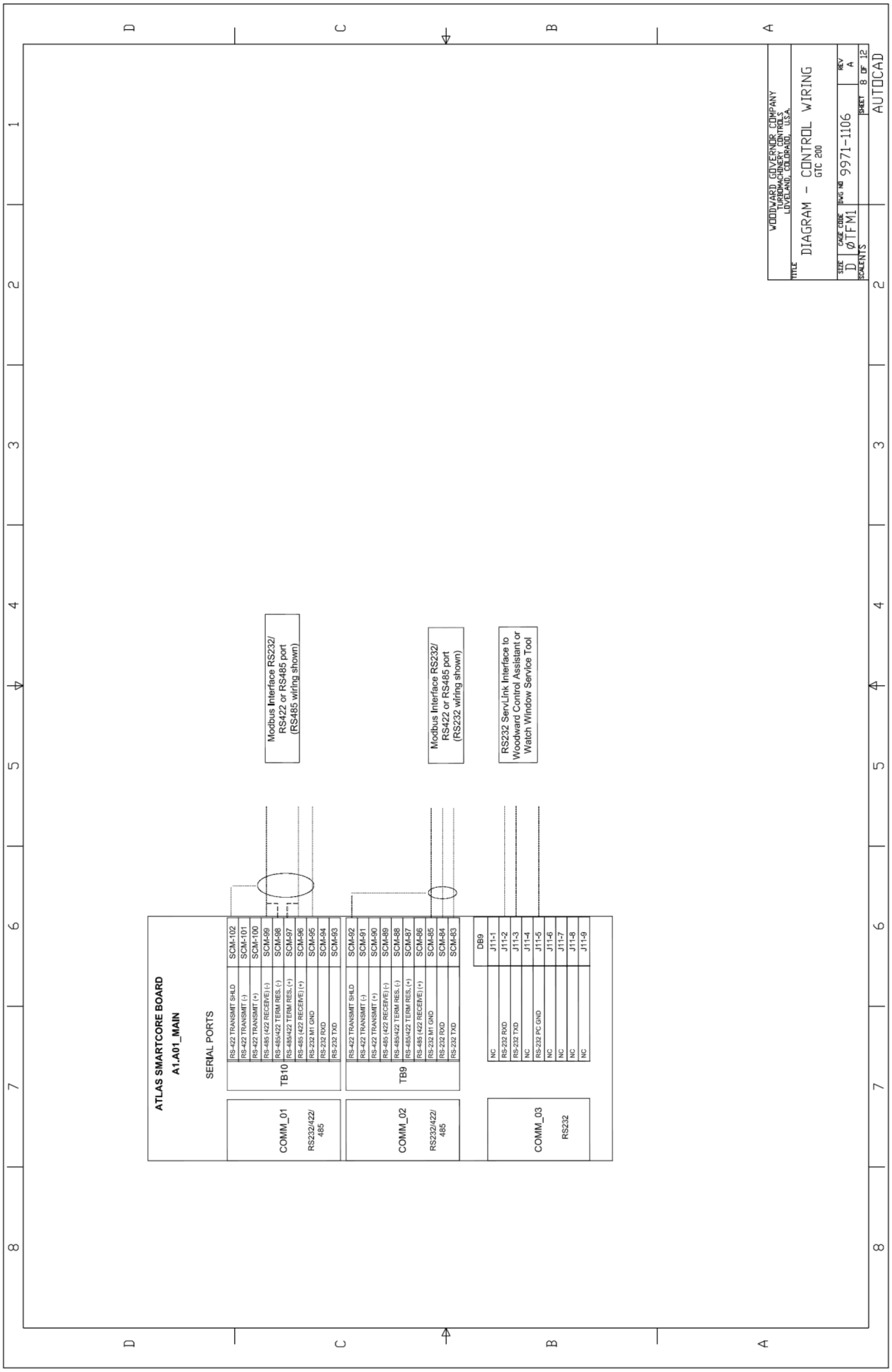
TOP VIEW OF CONTROL
BOTTOM VIEW OF CONTROL
INPUT POWER (24VDC)
A03_COMBO
POWER SENSE MODULE (OPTIONAL)
A01_MAIN
A01_MAIN.COMM_01
A01_MAIN.COMM_02
A01_MAIN.COMM_03
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO U.S.A.
DIAGRAM - CONTROL WIRING
GTC 200
9971-1106
AUTOCAD

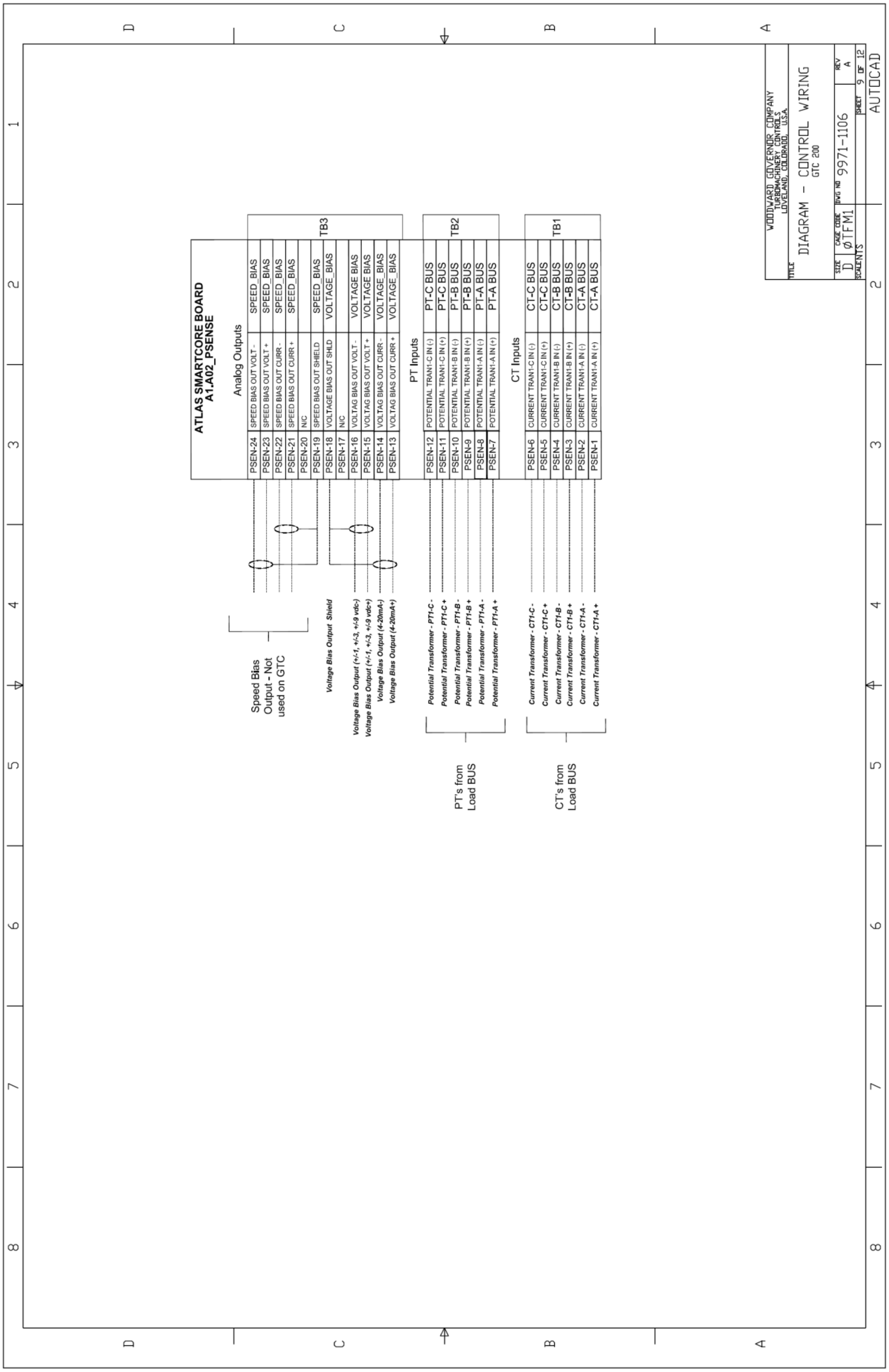

ATLAS POWER SUPPLY BOARD
A1.A01_MAIN
POWER IN
POWER IN (+) PS-1
POWER IN (-) PS-2
CHASSIS GND PS-3
24VDC (+) Input
24VDC (-) Input
DISCRETE OUTPUT
BO_01 DISCRETE OUT (-) PS-8
BO_02 DISCRETE OUT (-) PS-9
BO_03 DISCRETE OUT (-) PS-10
BO_04 DISCRETE OUT (-) PS-11
BO_05 DISCRETE OUT (-) PS-12
BO_06 DISCRETE OUT (-) PS-13
BO_07 DISCRETE OUT (-) PS-14
BO_08 DISCRETE OUT (-) PS-15
BO_09 DISCRETE OUT (-) PS-16
BO_10 DISCRETE OUT (-) PS-17
BO_11 DISCRETE OUT (-) PS-18
BO_12 DISCRETE OUT (-) PS-19
NC PS-20
NC PS-21
(+) 24VDC RELAY PWR IN PS-22
(-) 24VDC RELAY PWR IN PS-23
Interface Cable
5417-747
AtlasPC Relay Interface FTM
P/N 5441-699
(Provides 'Dry' NC/NO Contacts)
Shield
24 Vdc -
24 Vdc +
Description
Optional Configurable Output
* Summary Alarm
* Summary Shutdown (Fuel OFF)
Ten of the Relays are configurable to be used for any of the following pre-programmed functions
1 - Shutdown
2 - CLOSE Breaker Command
3 - OPEN Breaker Command
4 - Open Gas Fuel Shutoff Valves
5 - Open Liquid Fuel Shutoff Valves
6 - Ignitors Energized
7 - Starter Energized
8 - Alarm
9 - GG Speed Switch 1
10- GG Speed Switch 2
11- Run/SD Reset Output to Fuel Valve
12- GG Speed Reference at Lower Limit
13- PT Speed Reference at Lower Limit
14- GTC Health Status (Fuel Control ON)
15- On Liquid Fuel (off = On Gas Fuel)
16- Raise Voltage Command to AVR
17- Lower Voltage Command to AVR
18- Speed In Control (GG or PT)
19- EGT In Control
20- CDP in Control
21- Process in Control
22- Remote Speed Setpoint Enabled
23- Load Sharing Enabled
24- Load Limit/Max Fuel Reached
25- EGT Temp Switch 1
26- EGT Temp Switch 2
27- EGT Temp Switch 3
28- PT Speed Switch 1
29- PT Speed Switch 2
30- PT Speed Switch 3
31- Command from Modbus BW addr 21
32- Command from Modbus BW addr 22
33- Command from Modbus BW addr 23
34- Command from Modbus BW addr 24
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, USA
TITLE
DIAGRAM - CONTROL WIRING
GTC 200
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1106
REV B
SHEET 4 OF 12
SCALE NTS
AUTOCAD

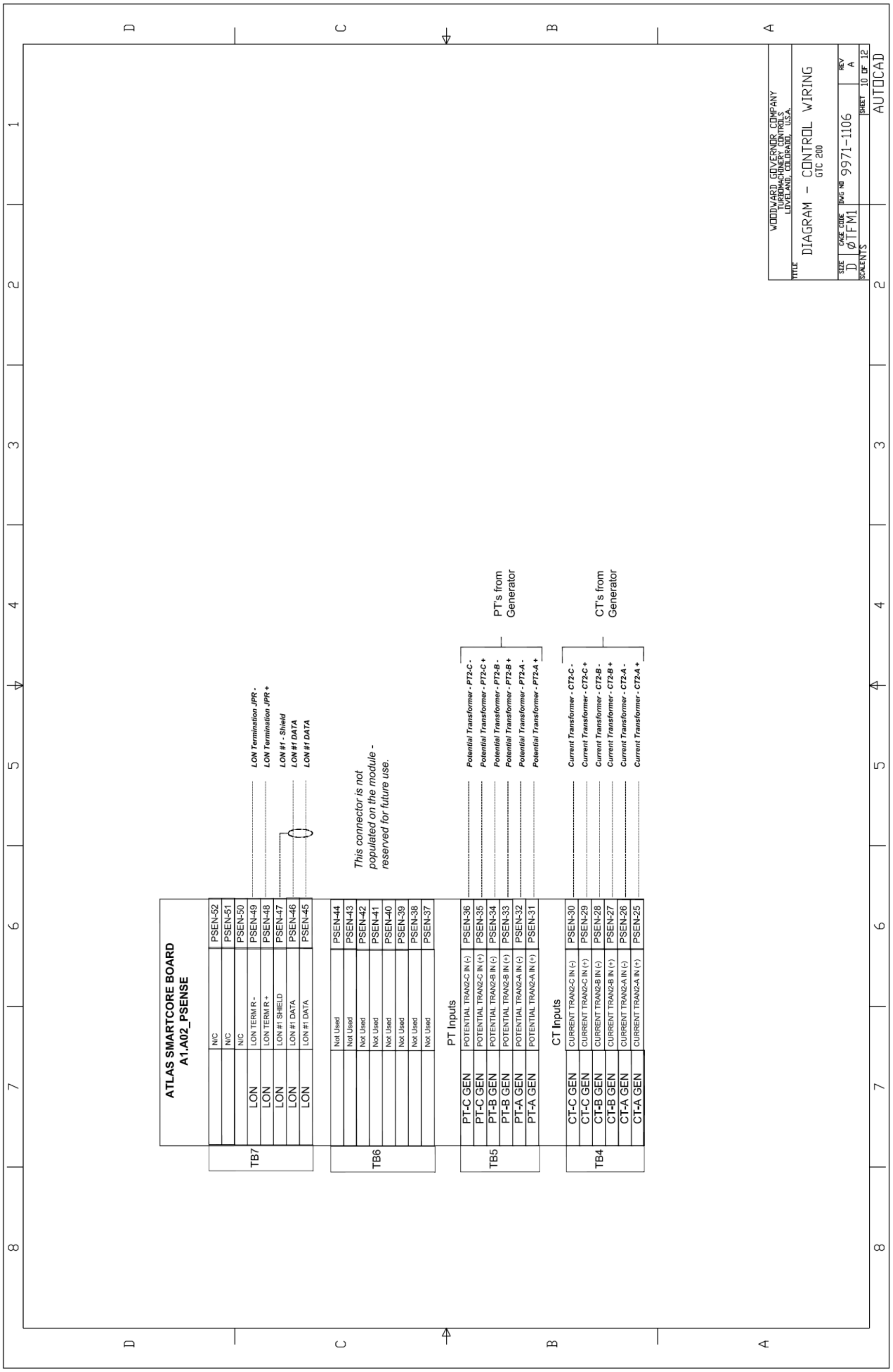

Discrete Inputs 4-24 can be configured for use as Customer Inputs that indicate a Start Permissive (1), trigger an Alarm (2) or trigger a Shutdown (3)
ATLAS SMARTCORE BOARD
A1.A01_MAIN
DISCRETE INPUT
SCM-26 (+) +24VISO BI_26
SCM-25 (-) I_GND BI_25
Customer Configurable Input SCM-24 DISCRETE IN (+) BI_24
Raise GG Reference Setpoint SCM-23 DISCRETE IN (+) BI_23
Lower GG Reference Setpoint SCM-22 DISCRETE IN (+) BI_22
Raise Process Control Setpoint SCM-21 DISCRETE IN (+) BI_21
Lower Process Control Setpoint SCM-20 DISCRETE IN (+) BI_20
Enable Process Control SCM-19 DISCRETE IN (+) BI_19
VAR/PF/Voltage Raise Command SCM-18 DISCRETE IN (+) BI_18
VAR/PF/Voltage Lower Command SCM-17 DISCRETE IN (+) BI_17
TB3
Enable Reactive Load Control SCM-16 DISCRETE IN (+) BI_16
Utility Breaker OPEN SCM-15 DISCRETE IN (+) BI_15
Generator Breaker (AUX 52) CLOSED SCM-14 DISCRETE IN (+) BI_14
Inhibit Synchronizer SCM-13 DISCRETE IN (+) BI_13
Enable Remote PT Reference Setpoint SCM-12 DISCRETE IN (+) BI_12
Fuel Selection / Transfer (TRUE=Liquid) SCM-11 DISCRETE IN (+) BI_11
Combustor Flame Detector SCM-10 DISCRETE IN (+) BI_10
Go to Rated Speed / Go to Baseload SCM-9 DISCRETE IN (+) BI_9
TB2
Liquid Fuel Valve / Actuator Fault SCM-8 DISCRETE IN (+) BI_8
Gas Fuel Valve / Actuator Fault SCM-7 DISCRETE IN (+) BI_7
PT Reference Raise Command SCM-6 DISCRETE IN (+) BI_6
PT Reference Lower Command SCM-5 DISCRETE IN (+) BI_5
System Acknowledge (ALM & SD) SCM-4 DISCRETE IN (+) BI_4
* System Reset (ALM & SD) SCM-3 DISCRETE IN (+) BI_3
* Start / Run (TRUE = Fuel ON) SCM-2 DISCRETE IN (+) BI_2
* Shutdown (TRUE = Fuel OFF) SCM-1 DISCRETE IN (+) BI_1
TB1
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
TITLE
DIAGRAM - CONTROL WIRING
GTC 200
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1106
REV B
SCALE NTS
SHEET 5 OF 12
AUTOCAD


ATLAS SMARTCORE BOARD
A1.A01_MAIN
SPEED INPUT
ANALOG INPUT
TB6
TB5
TB4
DSS_02
DSS_01
AI_06
AI_05
AI_04
AI_03
AI_02
AI_01
SCM-58 SHLD
SCM-57 IN (-)
SCM-56 PROX (+)
SCM-55 MPU (+)
SCM-54 SHLD
SCM-53 IN (-)
SCM-52 PROX (+)
SCM-51 MPU (+)
SCM-50 SHLD
SCM-49 INPUT (-)
SCM-48 0-5 VDC INPUT (+)
SCM-47 4-20 MA INPUT (+)
SCM-46 SHLD
SCM-45 INPUT (-)
SCM-44 0-5 VDC INPUT (+)
SCM-43 4-20 MA INPUT (+)
SCM-42 SHLD
SCM-41 INPUT (-)
SCM-40 0-5 VDC INPUT (+)
SCM-39 4-20 MA INPUT (+)
SCM-38 SHLD
SCM-37 INPUT (-)
SCM-36 0-5 VDC INPUT (+)
SCM-35 4-20 MA INPUT (+)
SCM-34 SHLD
SCM-33 INPUT (-)
SCM-32 0-5 VDC INPUT (+)
SCM-31 4-20 MA INPUT (+)
SCM-30 SHLD
SCM-29 INPUT (-)
SCM-28 0-5 VDC INPUT (+)
SCM-27 4-20 MA INPUT (+)
PT Speed Probe B (MPU)
* PT Speed Probe A (MPU)
Customer Configurable via Menu
Wiring for the Speed Sensor probes is shown for Passive MPU type probes
Input Wiring is shown for 4-20mA - self powered Transducers, for loop powered Transducers and 0-5 V inputs refer to the AtlasSC hardware manual.
Analog Inputs 1-6 can be selected via a menu with the following available options. The default for each input in the GTC application software is Not Used.
1 - Process Control Input Signal
2 - Remote Process Control Setpoint
3 - Ambient Inlet Air Temperature
4 - Remote KW Setpoint
5 - Remote VAR/PF Reference
6 - Remote CJ Comp for T/C signals
7 - Gas Fuel Valve Position Feedback
8 - Liquid Fuel Valve Position Feedback
9 - Customer Defined Signal
10- Not Used
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, USA
TITLE
DIAGRAM - CONTROL WIRING
GTC 200
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1106
REV A
SCALE NTS
SHEET 6 OF 12
AUTOCAD


Each of the 8 Analog Outputs (6 here and 2 on the Analog IO board can be selected via a menu with the following available options. The output shown in the wiring diagram is the default use in the GTC application software.
GG Speed
GG Speed Reference
PT Speed
PT Speed Reference
EGT Temperature
CDP Pressure
Fuel Valve Demand
Generator Kilowatt Output
Generator KiloVar Output
Generator KiloVoltAmp Output
Generator Power Factor Output
Generator Current Output
Generator Voltage Output
Utility Bus Kilowatt Output
Utility Bus KiloVar Output
Utility Bus KiloVoltAmp Output
Utility Bus Power Factor Output
Utility Bus Current
Utility Bus Voltage
Synchroscope
Command from Modbus AW addr 11
Command from Modbus AW addr 12
Command from Modbus AW addr 13
Customer Configurable via Menu
* At Least One Fuel is Required
Liquid Fuel Valve Demand (4-20 or 20-160 mA)
Gas Fuel Valve Demand (4-20 or 20-160 mA)
ATLAS SMARTCORE BOARD
A1.A01_MAIN
Analog Outputs
Actuator Outputs
TB8
TB7
AO_6
AO_5
AO_4
AO_3
AO_2
AO_1
ACT_2
ACT_1
SHLD
4-20 MA OUTPUT (-)
(+)V SOURCE
ACT (-)
ACT (+)
SCM-82
SCM-81
SCM-80
SCM-79
SCM-78
SCM-77
SCM-76
SCM-75
SCM-74
SCM-73
SCM-72
SCM-71
SCM-70
SCM-69
SCM-68
SCM-67
SCM-66
SCM-65
SCM-64
SCM-63
SCM-62
SCM-61
SCM-60
SCM-59
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, USA
DIAGRAM - CONTROL WIRING
GTC 200
9971-1106
ØTFM1
SHEET 7 OF 12
AUTOCAD


ATLAS SMARTCORE BOARD
A1.A01_MAIN
SERIAL PORTS
COMM_01
RS232/422/485
TB10
COMM_02
RS232/422/485
TB9
COMM_03
RS232
DB9
RS-422 TRANSMIT SHLD
RS-422 TRANSMIT (-)
RS-422 TRANSMIT (+)
RS-485 (422 RECEIVE) (-)
RS-485/422 TERM RES. (-)
RS-485/422 TERM RES. (+)
RS-485 (422 RECEIVE) (+)
RS-232 M1 GND
RS-232 RXD
RS-232 TXD
SCM-102
SCM-101
SCM-100
SCM-99
SCM-98
SCM-97
SCM-96
SCM-95
SCM-94
SCM-93
SCM-92
SCM-91
SCM-90
SCM-89
SCM-88
SCM-87
SCM-86
SCM-85
SCM-84
SCM-83
NC
RS-232 RXD
RS-232 TXD
NC
RS-232 PC GND
NC
NC
NC
NC
J11-1
J11-2
J11-3
J11-4
J11-5
J11-6
J11-7
J11-8
J11-9
Modbus Interface RS232/ RS422 or RS485 port (RS485 wiring shown)
Modbus Interface RS232/ RS422 or RS485 port (RS232 wiring shown)
RS232 ServLink Interface to Woodward Control Assistant or Watch Window Service Tool
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
TITLE
DIAGRAM - CONTROL WIRING
GTC 200
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1106
REV A
SCALE NTS
SHEET 8 OF 12
AUTOCAD


ATLAS SMARTCORE BOARD
A1.A02_PSENSE
Analog Outputs
PSEN-24 SPEED BIAS OUT VOLT - SPEED_BIAS
PSEN-23 SPEED BIAS OUT VOLT + SPEED_BIAS
PSEN-22 SPEED BIAS OUT CURR - SPEED_BIAS
PSEN-21 SPEED BIAS OUT CURR + SPEED_BIAS
PSEN-20 N/C
PSEN-19 SPEED BIAS OUT SHIELD SPEED_BIAS
PSEN-18 VOLTAGE BIAS OUT SHLD VOLTAGE_BIAS
PSEN-17 N/C
PSEN-16 VOLTAG BIAS OUT VOLT - VOLTAGE BIAS
PSEN-15 VOLTAG BIAS OUT VOLT + VOLTAGE BIAS
PSEN-14 VOLTAG BIAS OUT CURR - VOLTAGE_BIAS
PSEN-13 VOLTAG BIAS OUT CURR + VOLTAGE_BIAS
TB3
PT Inputs
PSEN-12 POTENTIAL TRAN1-C IN (-) PT-C BUS
PSEN-11 POTENTIAL TRAN1-C IN (+) PT-C BUS
PSEN-10 POTENTIAL TRAN1-B IN (-) PT-B BUS
PSEN-9 POTENTIAL TRAN1-B IN (+) PT-B BUS
PSEN-8 POTENTIAL TRAN1-A IN (-) PT-A BUS
PSEN-7 POTENTIAL TRAN1-A IN (+) PT-A BUS
TB2
CT Inputs
PSEN-6 CURRENT TRAN1-C IN (-) CT-C BUS
PSEN-5 CURRENT TRAN1-C IN (+) CT-C BUS
PSEN-4 CURRENT TRAN1-B IN (-) CT-B BUS
PSEN-3 CURRENT TRAN1-B IN (+) CT-B BUS
PSEN-2 CURRENT TRAN1-A IN (-) CT-A BUS
PSEN-1 CURRENT TRAN1-A IN (+) CT-A BUS
TB1
Speed Bias Output - Not used on GTC
Voltage Bias Output Shield
Voltage Bias Output (+/-1, +/-3, +/-9 vdc-)
Voltage Bias Output (+/-1, +/-3, +/-9 vdc+)
Voltage Bias Output (4-20mA-)
Voltage Bias Output (4-20mA+)
Potential Transformer - PT1-C -
Potential Transformer - PT1-C +
Potential Transformer - PT1-B -
Potential Transformer - PT1-B +
Potential Transformer - PT1-A -
Potential Transformer - PT1-A +
PT's from Load BUS
Current Transformer - CT1-C -
Current Transformer - CT1-C +
Current Transformer - CT1-B -
Current Transformer - CT1-B +
Current Transformer - CT1-A -
Current Transformer - CT1-A +
CT's from Load BUS
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, USA
DIAGRAM - CONTROL WIRING
GTC 200
D ØTFM1 9971-1106 A
SHEET 9 OF 12
AUTOCAD


ATLAS SMARTCORE BOARD
A1.A02_PSENSE
TB7
N/C PSEN-52
N/C PSEN-51
N/C PSEN-50
LON LON TERM R - PSEN-49
LON LON TERM R + PSEN-48
LON LON #1 SHIELD PSEN-47
LON LON #1 DATA PSEN-46
LON LON #1 DATA PSEN-45
LON Termination JPR -
LON Termination JPR +
LON #1 - Shield
LON #1 DATA
LON #1 DATA
TB6
Not Used PSEN-44
Not Used PSEN-43
Not Used PSEN-42
Not Used PSEN-41
Not Used PSEN-40
Not Used PSEN-39
Not Used PSEN-38
Not Used PSEN-37
This connector is not populated on the module - reserved for future use.
PT Inputs
TB5
PT-C GEN POTENTIAL TRAN2-C IN (-) PSEN-36
PT-C GEN POTENTIAL TRAN2-C IN (+) PSEN-35
PT-B GEN POTENTIAL TRAN2-B IN (-) PSEN-34
PT-B GEN POTENTIAL TRAN2-B IN (+) PSEN-33
PT-A GEN POTENTIAL TRAN2-A IN (-) PSEN-32
PT-A GEN POTENTIAL TRAN2-A IN (+) PSEN-31
Potential Transformer - PT2-C -
Potential Transformer - PT2-C +
Potential Transformer - PT2-B -
Potential Transformer - PT2-B +
Potential Transformer - PT2-A -
Potential Transformer - PT2-A +
PT's from Generator
CT Inputs
TB4
CT-C GEN CURRENT TRAN2-C IN (-) PSEN-30
CT-C GEN CURRENT TRAN2-C IN (+) PSEN-29
CT-B GEN CURRENT TRAN2-B IN (-) PSEN-28
CT-B GEN CURRENT TRAN2-B IN (+) PSEN-27
CT-A GEN CURRENT TRAN2-A IN (-) PSEN-26
CT-A GEN CURRENT TRAN2-A IN (+) PSEN-25
Current Transformer - CT2-C -
Current Transformer - CT2-C +
Current Transformer - CT2-B -
Current Transformer - CT2-B +
Current Transformer - CT2-A -
Current Transformer - CT2-A +
CT's from Generator
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
TITLE
DIAGRAM - CONTROL WIRING
GTC 200
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1106
REV A
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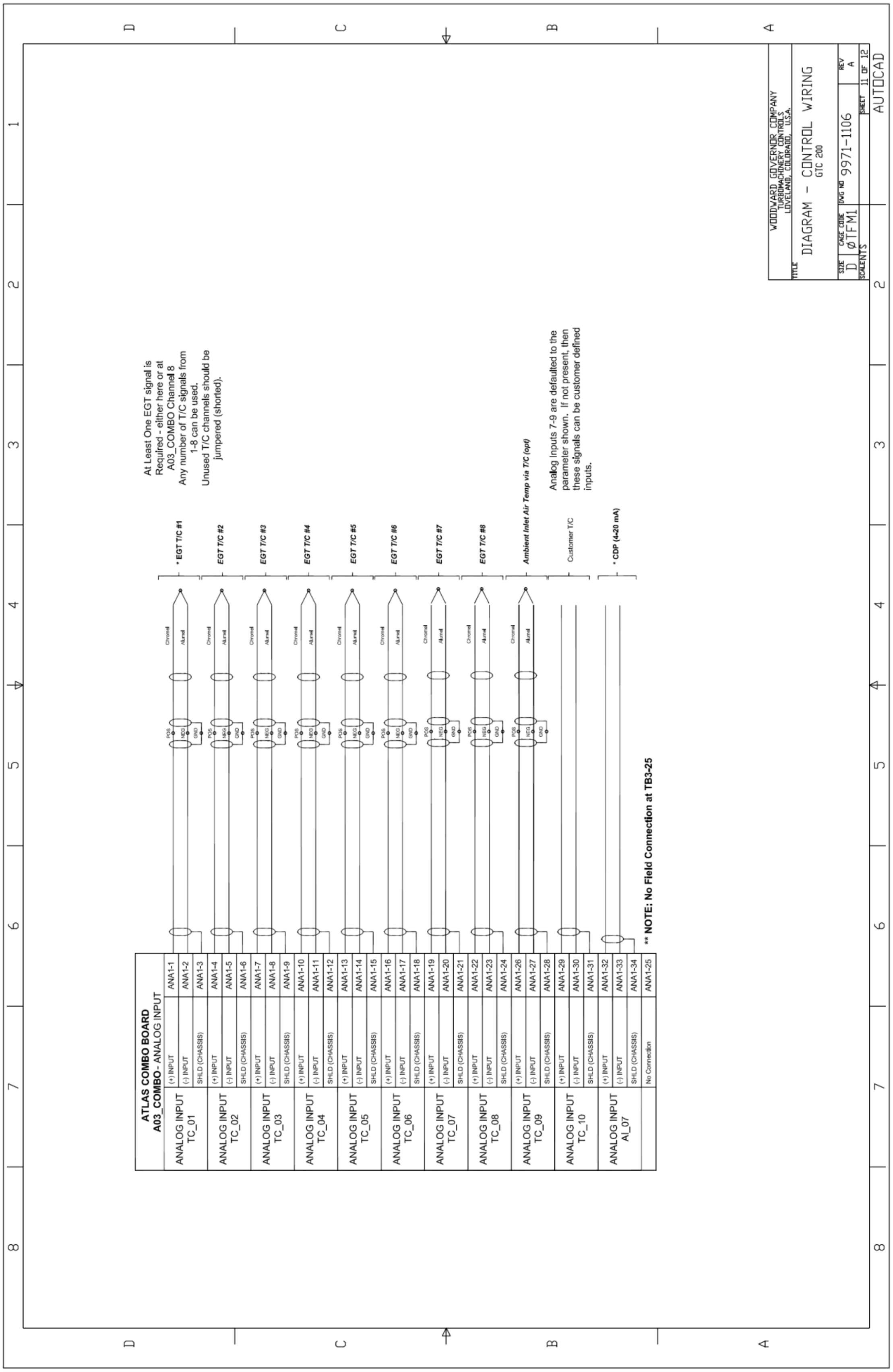
SHEET 10 OF 12
AUTOCAD


ATLAS 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 AI_07
(+) INPUT
(-) INPUT
SHLD (CHASSIS)
No Connection
ANA1-1
ANA1-2
ANA1-3
ANA1-4
ANA1-5
ANA1-6
ANA1-7
ANA1-8
ANA1-9
ANA1-10
ANA1-11
ANA1-12
ANA1-13
ANA1-14
ANA1-15
ANA1-16
ANA1-17
ANA1-18
ANA1-19
ANA1-20
ANA1-21
ANA1-22
ANA1-23
ANA1-24
ANA1-26
ANA1-27
ANA1-28
ANA1-29
ANA1-30
ANA1-31
ANA1-32
ANA1-33
ANA1-34
ANA1-25
** NOTE: No Field Connection at TB3-25
* 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
Ambient Inlet Air Temp via T/C (opt)
Customer T/C
* CDP (4-20 mA)
At Least One EGT signal is Required - either here or at A03_COMBO Channel 8
Any number of T/C signals from 1-8 can be used.
Unused T/C channels should be jumpered (shorted).
Analog Inputs 7-9 are defaulted to the parameter shown. If not present, then these signals can be customer defined inputs.
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
DIAGRAM - CONTROL WIRING
GTC 200
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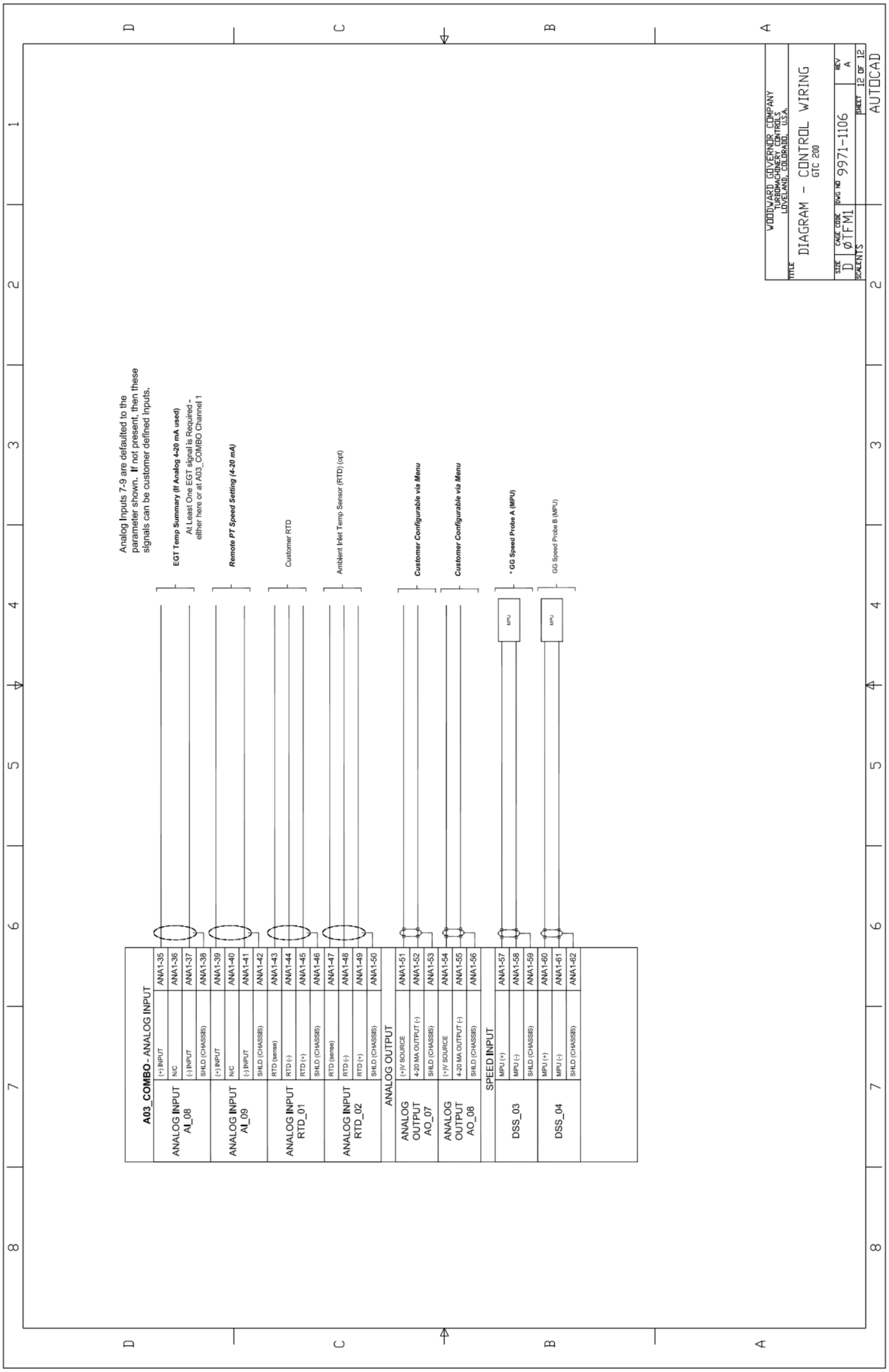
A03_COMBO - ANALOG INPUT
ANALOG INPUT AI_08
ANALOG INPUT AI_09
ANALOG INPUT RTD_01
ANALOG INPUT RTD_02
ANALOG OUTPUT
ANALOG OUTPUT AO_07
ANALOG OUTPUT AO_08
SPEED INPUT
DSS_03
DSS_04
Analog Inputs 7-9 are defaulted to the parameter shown. If not present, then these signals can be customer defined inputs.
EGT Temp Summary (If Analog 4-20 mA used)
At Least One EGT signal is Required - either here or at A03_COMBO Channel 1
Remote PT Speed Setting (4-20 mA)
Customer RTD
Ambient Inlet Temp Sensor (RTD) (opt)
Customer Configurable via Menu
Customer Configurable via Menu
* GG Speed Probe A (MPU)
GG Speed Probe B (MPU)
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
DIAGRAM - CONTROL WIRING
GTC 200
9971-1106
ØTFM1
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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 ports COM1 and COM2.

Boolean Writes (RPTbw)

Addr	Input	Description
0:0001		SHUTDOWN
0:0002		START / RUN
0:0003		RESET
0:0004		ACKNOWLEDGE
0:0005		PT SPEED LOWER
0:0006		PT SPEED RAISE
0:0007		GAS FUEL VALVE HEALTHY
0:0008		LIQUID FUEL VALVE HEALTHY
0:0009		GO TO RATED PT SPEED / GO TO BASELOAD
0:0010		FLAME DETECTOR
0:0011		FUEL TRANSFER (TRUE = LIQ)
0:0012		ENABLE REMOTE SPEED SET POINT
0:0013		INHIBIT SYNCHRONIZER
0:0014		GEN BREAKER AUX 52 CLOSED
0:0015		UTILITY BREAKER OPEN / ENA LS
0:0016		ENABLE REACTIVE LOAD CONTROL
0:0017		LOWER VOLT/PF/VAR COMMAND
0:0018		RAISE VOLT/PF/VAR COMMAND
0:0019		ENABLE PROCESS CONTROL
0:0020		LOWER PROCESS CONTROL SET POINT
0:0021		RAISE PROCESS CONTROL SET POINT
0:0022		LOWER GG REFERENCE
0:0023		RAISE GG REFERENCE
0:0024		Custom Config 24
0:0025		Enable Output Forcing Mode
0:0026		Force-Energize Output #01 Relay
0:0027		Force-Energize Output #02 Relay
0:0028		Force-Energize Output #03 Relay
0:0029		Force-Energize Output #04 Relay
0:0030		Force-Energize Output #05 Relay
0:0031		Force-Energize Output #06 Relay
0:0032		Force-Energize Output #07 Relay
0:0033		Force-Energize Output #08 Relay
0:0034		Force-Energize Output #09 Relay
0:0035		Force-Energize Output #10 Relay
0:0036		Force-Energize Output #11 Relay
0:0037		Force-Energize Output #12 Relay
0:0038		MANUAL CRANK REQUEST
0:0039		Go to Base Load Command
0:0040		ENABLE CALIBRATE MODE
0:0041		EXIT CALIBRATE MODE

0:0042	
0:0043	OPEN Generator Breaker Command
0:0044	
0:0045	PT Fast Rate Select
0:0046	FUEL TRANSFER HOLD
0:0047	
0:0048	Start Datalog File
0:0049	Stop Datalog File
0:0050	Send Datalog out Serial Port

Boolean Reads (RPTbr)

Addr	Input	Description
1:0001	CNFG_BI_01.BI.B_SW	DI01- SHUTDOWN (CHOP FUEL)
1:0002	CNFG_BI_02.BI.B_SW	DI02- START/RUN
1:0003	CNFG_BI_03.BI.B_SW	DI03- SYSTEM RESET (ALM & SD)
1:0004	CNFG_BI_04.BI.B_SW	DI04- SYSTEM ACKNOWLEDGE (ALM & SD)
1:0005	CNFG_BI_05.BI.B_SW	DI05- PT REFERENCE LOWER
1:0006	CNFG_BI_06.BI.B_SW	DI06- PT REFERENCE RAISE
1:0007	CNFG_BI_07.BI.B_SW	DI07- GAS FUEL VALVE HEALTHY
1:0008	CNFG_BI_08.BI.B_SW	DI08- LIQUID FUEL VALVE HEALTHY
1:0009	CNFG_BI_09.BI.B_SW	DI09- GO TO RATED SPEED / BASELOAD
1:0010	CNFG_BI_10.BI.B_SW	DI10- COMBUSTOR FLAME DETECTOR
1:0011	CNFG_BI_11.BI.B_SW	DI11- FUEL TRANSFER (TRUE=LIQ)
1:0012	CNFG_BI_12.BI.B_SW	DI12-ENABLE REMOTE PT REF
1:0013	CNFG_BI_13.BI.B_SW	DI13- INHIBIT SYNCHRONIZER
1:0014	CNFG_BI_14.BI.B_SW	DI14- GENERATOR BREAKER AUX - 52
1:0015	CNFG_BI_15.BI.B_SW	DI15- UTILITY BRKR OPEN / ENABLE LS
1:0016	CNFG_BI_16.BI.B_SW	DI16- ENABLE REACTIVE LOAD CNTRL
1:0017	CNFG_BI_17.BI.B_SW	DI17- LOWER VOLT/PF/VAR COMMAND
1:0018	CNFG_BI_18.BI.B_SW	DI18- RAISE VOLT/PF/VAR COMMAND
1:0019	CNFG_BI_19.BI.B_SW	DI19- ENABLE PROCESS CONTROL
1:0020	CNFG_BI_20.BI.B_SW	DI20- LOWER PROCESS CNTRL SETPT
1:0021	CNFG_BI_21.BI.B_SW	DI21- RAISE PROCESS CNTRL SETPT
1:0022	CNFG_BI_22.BI.B_SW	DI22-LOWER GG SPEED REF
1:0023	CNFG_BI_23.BI.B_SW	DI23- RAISE GG SPEED REF
1:0024	CNFG_BI_24.BI.B_SW	DI24- Customer Configurable DI
1:0025		
1:0026	A01_PB_MO1.BO_01.DISPLAY	RELAY 01 OUTPUT STATE
1:0027	A01_PB_MO1.BO_02.DISPLAY	RELAY 02 OUTPUT STATE
1:0028	A01_PB_MO1.BO_03.DISPLAY	RELAY 03 OUTPUT STATE
1:0029	A01_PB_MO1.BO_04.DISPLAY	RELAY 04 OUTPUT STATE
1:0030	A01_PB_MO1.BO_05.DISPLAY	RELAY 05 OUTPUT STATE
1:0031	A01_PB_MO1.BO_06.DISPLAY	RELAY 06 OUTPUT STATE
1:0032	A01_PB_MO1.BO_07.DISPLAY	RELAY 07 OUTPUT STATE
1:0033	A01_PB_MO1.BO_08.DISPLAY	RELAY 08 OUTPUT STATE
1:0034	A01_PB_MO1.BO_09.DISPLAY	RELAY 09 OUTPUT STATE
1:0035	A01_PB_MO1.BO_10.DISPLAY	RELAY 10 OUTPUT STATE
1:0036	A01_PB_MO1.BO_11.DISPLAY	RELAY 11 OUTPUT STATE
1:0037	A01_PB_MO1.BO_12.DISPLAY	RELAY 12 OUTPUT STATE
1:0038		

1:0039		
1:0040		
1:0041		
1:0042		
1:0043		
1:0044		
1:0045		
1:0046		
1:0047		
1:0048		
1:0049		** CORE Status Indicators at 50 ****
1:0050	CNTRL.GGCTRL.B_NAME	GG Speed Control
1:0051	CNTRL.PTCTRL.B_NAME	PT Speed Control
1:0052	CNTRL.EGTCTRL.B_NAME	EGT Control
1:0053	CNTRL.ACCELCTRL.B_NAME	ACCEL Limiter Control
1:0054	CNTRL.STRTCTRL.B_NAME	Start Ramp Control
1:0055	CNTRL.CDP_CTRL.B_NAME	CDP Limiter Control
1:0056	CNTRL.MAXFL_CTRL.B_NAME	Max Fuel Flow Limiter Control
1:0057	CNTRL.DEC_CTRL.B_NAME	DECEL Limiter Control
1:0058	CNTRL.KWLIMCTRL.B_NAME	Real Load Limit Control
1:0059	CNTRL.FUELOFCTRL.B_NAME	Shutdown - Fuel OFF
1:0060	DRIVER.GAS_100.B_NAME	Running 100% Gas Fuel
1:0061	DRIVER.LIQ_100.B_NAME	Running 100% Liquid Fuel
1:0062	BI_SIGNALS.SD_FUEL.OR	DI 1 Cmd - Fuel SD
1:0063	BI_SIGNALS.START_RUN.OR	DI 2 Cmd - Start/Run
1:0064	BI_SIGNALS.RESET.OR	DI 3 Cmd - Reset Command
1:0065	BI_SIGNALS.ACKN.OR	DI 4 Cmd - Acknwldg Command
1:0066	BI_SIGNALS.PT_LOWER.OR	DI 5 Cmd - Lower PT Speed Ref
1:0067	BI_SIGNALS.PT_RAISE.OR	DI 6 Cmd - Raise PT Speed Ref
1:0068	BI_SIGNALS.GASVLV_FLT.OR	DI 7 Cmd - GAS FUEL VALVE HEALTHY
1:0069	BI_SIGNALS.LIQVLV_FLT.OR	DI 8 Cmd - LIQUID FUEL VALVE HEALTHY
1:0070	BI_SIGNALS.GO_RATE_BL.OR	DI 9 Cmd - Go to Rated Speed
1:0071	BI_SIGNALS.FLAMEDET.OR	DI 10 Cmd - Flame Detector Input
1:0072	BI_SIGNALS.FUEL_XFER.OR	DI 11 Cmd - Fuel XFER (T=LIQ)
1:0073	BI_SIGNALS.ENA_REMOTE.OR	DI 12 Cmd - Ena Remote PT Ref
1:0074	BI_SIGNALS.INHIB_SYNC.OR	DI 13 Cmd - Inhibit Sync
1:0075	BI_SIGNALS.GEN_BRKR.OR	DI 14 Cmd - GEN Brkr CLOSED
1:0076	BI_SIGNALS.UTILBRKOPN.OR	DI 15 Cmd - UTIL Brkr OPEN
1:0077	BI_SIGNALS.ENA_VARPF.OR	DI 16 Cmd - Ena Reactive Load Cntrl
1:0078	BI_SIGNALS.VARPFLOWER.OR	DI 17 Cmd - Lower Volt/VAR/PF
1:0079	BI_SIGNALS.VARPFRAISE.OR	DI 18 Cmd - Raise Volt/VAR/PF
1:0080	BI_SIGNALS.ENA_PROC.OR	DI 19 Cmd - Enable Process Control
1:0081	BI_SIGNALS.PROC_LOWER.OR	DI 20 Cmd - Lower Process Set point
1:0082	BI_SIGNALS.PROC_RAISE.OR	DI 21 Cmd - Raise Process Set point
1:0083	BI_SIGNALS.GG_LOWER.OR	DI 22 Cmd - Lower GG Reference
1:0084	BI_SIGNALS.GG_RAISE.OR	DI 23 Cmd - Raise GG Reference
1:0085	BI_SIGNALS.SPARE_24.OR	DI 24 Cmd - Customer Input
1:0086	START.START_PERM.AND	Start Permissives Met
1:0087	CALMODE.CALPERM.B_NAME	Calibrate Mode Permissive
1:0088	CALMODE.CALMODE.B_NAME	Calibrate Mode Enabled

1:0089	BI_SIGNALS.GL_X_HOLD.OR	Fuel Transfer Hold Active
1:0090	CALMODE.ENA_MODFRC.B_NAME	Calibrate / Force Mode Enabled
1:0091	SYNC_OUT.OPENBRKCMD.B_NAME	Open Breaker Command (OUT)
1:0092	SYNC_OUT.CLOSBRKCMD.B_NAME	Close Breaker Command (OUT)
1:0093	LOAD_REF.BASELOAD.LATCH_R	Baseload Mode Enabled
1:0094	LOAD_SHAR.LS_ENABLED.AND	Load Sharing Mode Enabled
1:0095	PROC_INP.PROC_ON.B_NAME	Process Control Mode Enabled
1:0096		
1:0097		
1:0098		
1:0099		** ALARMS START AT ADDRESS 100 **
1:0100	ALARM.ALM_OUT.B_NAME	CORE SUMMARY ALARM
1:0101	ALARM.ALM_LAT.SEL_1	Atlas H/W Summary Fault
1:0102	ALARM.ALM_LAT.SEL_2	Atlas Input Power Alarm
1:0103	ALARM.ALM_LAT.SEL_3	Atlas H/W Temp Alarm
1:0104	ALARM.ALM_LAT.SEL_4	Control is NOT Configured
1:0105	ALARM.ALM_LAT.SEL_5	Serial Port #1 Fault
1:0106	ALARM.ALM_LAT.SEL_6	Serial Port #2 Fault
1:0107	ALARM.ALM_LAT.SEL_7	Not Used
1:0108	ALARM.ALM_LAT.SEL_8	Speed Signal #1 (PT) Failed
1:0109	ALARM.ALM_LAT.SEL_9	Speed Signal #2 (PT) Failed
1:0110	ALARM.ALM_LAT.SEL_10	AI Signal #1 Failed
1:0111	ALARM.ALM_LAT.SEL_11	AI Signal #2 Failed
1:0112	ALARM.ALM_LAT.SEL_12	AI Signal #3 Failed
1:0113	ALARM.ALM_LAT.SEL_13	AI Signal #4 Failed
1:0114	ALARM.ALM_LAT.SEL_14	AI Signal #5 Failed
1:0115	ALARM.ALM_LAT.SEL_15	AI Signal #6 Failed
1:0116	ALARM.ALM_LAT.SEL_16	Discrete Input #1 Event
1:0117	ALARM.ALM_LAT.SEL_17	Not Used
1:0118	ALARM.ALM_LAT.SEL_18	Not Used
1:0119	ALARM.ALM_LAT.SEL_19	Discrete Input #4 Event
1:0120	ALARM.ALM_LAT.SEL_20	Discrete Input #5 Event
1:0121	ALARM.ALM_LAT.SEL_21	Discrete Input #6 Event
1:0122	ALARM.ALM_LAT.SEL_22	Discrete Input #7 Event
1:0123	ALARM.ALM_LAT.SEL_23	Discrete Input #8 Event
1:0124	ALARM.ALM_LAT.SEL_24	Discrete Input #9 Event
1:0125	ALARM.ALM_LAT.SEL_25	Discrete Input #10 Event
1:0126	ALARM.ALM_LAT.SEL_26	Discrete Input #11 Event
1:0127	ALARM.ALM_LAT.SEL_27	Discrete Input #12 Event
1:0128	ALARM.ALM_LAT.SEL_28	Discrete Input #13 Event
1:0129	ALARM.ALM_LAT.SEL_29	Discrete Input #14 Event
1:0130	ALARM.ALM_LAT.SEL_30	Discrete Input #15 Event
1:0131	ALARM.ALM_LAT.SEL_31	Discrete Input #16 Event
1:0132	ALARM.ALM_LAT.SEL_32	Discrete Input #17 Event
1:0133	ALARM.ALM_LAT.SEL_33	Discrete Input #18 Event
1:0134	ALARM.ALM_LAT.SEL_34	Discrete Input #19 Event
1:0135	ALARM.ALM_LAT.SEL_35	Discrete Input #20 Event
1:0136	ALARM.ALM_LAT.SEL_36	Discrete Input #21 Event
1:0137	ALARM.ALM_LAT.SEL_37	Discrete Input #22 Event
1:0138	ALARM.ALM_LAT.SEL_38	Discrete Input #23 Event

1:0139	ALARM.ALM_LAT.SEL_39	Discrete Input #24 Event
1:0140	ALARM.ALM_LAT.SEL_40	Analog Input Config Error
1:0141	ALARM.ALM_LAT.SEL_41	Speed Signal #3 (GG) Failed
1:0142	ALARM.ALM_LAT.SEL_42	Speed Signal #4 (GG) Failed
1:0143	ALARM.ALM_LAT.SEL_43	AI Signal #7 Failed
1:0144	ALARM.ALM_LAT.SEL_44	AI Signal #8 Failed
1:0145	ALARM.ALM_LAT.SEL_45	AI Signal #9 Failed
1:0146	ALARM.ALM_LAT.SEL_46	RTD Signal #1 Failed
1:0147	ALARM.ALM_LAT.SEL_47	RTD Signal #2 Failed
1:0148	ALARM.ALM_LAT.SEL_48	Not Used
1:0149	ALARM.ALM_LAT.SEL_49	All GG Speed Sig Failed
1:0150	ALARM.ALM_LAT.SEL_50	GG Overspeed ALM Level
1:0151	ALARM.ALM_LAT.SEL_51	GG Speed Signal Difference
1:0152	ALARM.ALM_LAT.SEL_52	GG Overspeed SD Level
1:0153	ALARM.ALM_LAT.SEL_53	All PT Speed Sig Failed
1:0154	ALARM.ALM_LAT.SEL_54	PT Overspeed Test Enabled
1:0155	ALARM.ALM_LAT.SEL_55	PT Overspeed ALM Level
1:0156	ALARM.ALM_LAT.SEL_56	PT Speed Signal Difference
1:0157	ALARM.ALM_LAT.SEL_57	PT Overspeed SD Level
1:0158	ALARM.ALM_LAT.SEL_58	CDP Over High Press Level
1:0159	ALARM.ALM_LAT.SEL_59	Gas Fuel Drive Fault (Running LIQ)
1:0160	ALARM.ALM_LAT.SEL_60	Liquid Fuel Drive Fault (Running GAS)
1:0161	ALARM.ALM_LAT.SEL_61	Gas Fuel Drive Fault
1:0162	ALARM.ALM_LAT.SEL_62	Liquid Fuel Drive Fault
1:0163	ALARM.ALM_LAT.SEL_63	Calibration Mode Enabled
1:0164	ALARM.ALM_LAT.SEL_64	Starter Engaged - No Speed Detected
1:0165	ALARM.ALM_LAT.SEL_65	GT Failed to Lite-off
1:0166	ALARM.ALM_LAT.SEL_66	Loss of Flame in Combustor
1:0167	ALARM.ALM_LAT.SEL_67	Unit Failed to Reach GG Idle
1:0168	ALARM.ALM_LAT.SEL_68	Unit Failed to Reach PT Rated
1:0169	ALARM.ALM_LAT.SEL_69	Start Cmd Lost While Running
1:0170	ALARM.ALM_LAT.SEL_70	Normal STOP Complete - Turnoff start
1:0171	ALARM.ALM_LAT.SEL_71	Not Used
1:0172	ALARM.ALM_LAT.SEL_72	EGT T/C #1 Failed
1:0173	ALARM.ALM_LAT.SEL_73	EGT T/C #2 Failed
1:0174	ALARM.ALM_LAT.SEL_74	EGT T/C #3 Failed
1:0175	ALARM.ALM_LAT.SEL_75	EGT T/C #4 Failed
1:0176	ALARM.ALM_LAT.SEL_76	EGT T/C #5 Failed
1:0177	ALARM.ALM_LAT.SEL_77	EGT T/C #6 Failed
1:0178	ALARM.ALM_LAT.SEL_78	EGT T/C #7 Failed
1:0179	ALARM.ALM_LAT.SEL_79	EGT T/C #8 Failed
1:0180	ALARM.ALM_LAT.SEL_80	Input T/C #9 Failed
1:0181	ALARM.ALM_LAT.SEL_81	Input T/C #10 Failed
1:0182	ALARM.ALM_LAT.SEL_82	Too many T/C Failed ALM
1:0183	ALARM.ALM_LAT.SEL_83	Too many T/C Failed SD
1:0184	ALARM.ALM_LAT.SEL_84	3 Adjacent T/C Failed
1:0185	ALARM.ALM_LAT.SEL_85	EGT T/C Spread ALM
1:0186	ALARM.ALM_LAT.SEL_86	EGT T/C Spread SD
1:0187	ALARM.ALM_LAT.SEL_87	EGT Single T/C Avg Failed
1:0188	ALARM.ALM_LAT.SEL_88	EGT Overtemp SD

1:0189	ALARM.ALM_LAT.SEL_89	EGT Temp Failed Low
1:0190	ALARM.ALM_LAT.SEL_90	EGT Overtemp ALM
1:0191	ALARM.ALM_LAT.SEL_91	Analog EGT Signal Failed
1:0192	ALARM.ALM_LAT.SEL_92	EGT T/C #1 Difference from Avg
1:0193	ALARM.ALM_LAT.SEL_93	EGT T/C #2 Difference from Avg
1:0194	ALARM.ALM_LAT.SEL_94	EGT T/C #3 Difference from Avg
1:0195	ALARM.ALM_LAT.SEL_95	EGT T/C #4 Difference from Avg
1:0196	ALARM.ALM_LAT.SEL_96	EGT T/C #5 Difference from Avg
1:0197	ALARM.ALM_LAT.SEL_97	EGT T/C #6 Difference from Avg
1:0198	ALARM.ALM_LAT.SEL_98	EGT T/C #7 Difference from Avg
1:0199	ALARM.ALM_LAT.SEL_99	EGT T/C #8 Difference from Avg
1:0200	ALARM.ALM_LAT.SEL_100	Not Used
1:0201	ALARM.ALM_LAT.SEL_101	Gen Breaker Fdbk Failed
1:0202	ALARM.ALM_LAT.SEL_102	Gen Breaker Shunt Trip Error
1:0203	ALARM.ALM_LAT.SEL_103	GEN Neg Phaz Current Alarm
1:0204	ALARM.ALM_LAT.SEL_104	GEN Neg Phaz Current Warning
1:0205	ALARM.ALM_LAT.SEL_105	GEN Neg Phaz Voltage Alarm
1:0206	ALARM.ALM_LAT.SEL_106	GEN Neg Phaz Voltage Warning
1:0207	ALARM.ALM_LAT.SEL_107	GEN Over Frequency Alarm
1:0208	ALARM.ALM_LAT.SEL_108	GEN Over Frequency Warning
1:0209	ALARM.ALM_LAT.SEL_109	GEN Under Frequency Alarm
1:0210	ALARM.ALM_LAT.SEL_110	GEN Under Frequency Warning
1:0211	ALARM.ALM_LAT.SEL_111	GEN Over Volts Alarm
1:0212	ALARM.ALM_LAT.SEL_112	GEN Over Volts Warning
1:0213	ALARM.ALM_LAT.SEL_113	GEN Under Volts Alarm
1:0214	ALARM.ALM_LAT.SEL_114	GEN Under Volts Warning
1:0215	ALARM.ALM_LAT.SEL_115	GEN Over Power Protect Alarm
1:0216	ALARM.ALM_LAT.SEL_116	GEN Over Power Protect Warning
1:0217	ALARM.ALM_LAT.SEL_117	GEN Reverse Power Protect Alarm
1:0218	ALARM.ALM_LAT.SEL_118	GEN Reverse Power Protect Warning
1:0219	ALARM.ALM_LAT.SEL_119	GEN VARS Over Protection Alarm
1:0220	ALARM.ALM_LAT.SEL_120	GEN VARS Over Protection Warning
1:0221	ALARM.ALM_LAT.SEL_121	GEN VARS Under Protection Alarm
1:0222	ALARM.ALM_LAT.SEL_122	GEN VARS Under Protection Warning
1:0223	ALARM.ALM_LAT.SEL_123	GEN Phaz Differntial Current Alarm
1:0224	ALARM.ALM_LAT.SEL_124	GEN Phaz Differntial Current Warning
1:0225	ALARM.ALM_LAT.SEL_125	GEN Phaz Over Current Alarm
1:0226	ALARM.ALM_LAT.SEL_126	GEN Phaz Over Current Warning
1:0227	ALARM.ALM_LAT.SEL_127	KVA Switch Active
1:0228	ALARM.ALM_LAT.SEL_128	Speed / Frequency Mismatch
1:0229	ALARM.ALM_LAT.SEL_129	Phaz Rotation Alarm (Sync Inhibit)
1:0230	ALARM.ALM_LAT.SEL_130	Process Value High Alarm
1:0231	ALARM.ALM_LAT.SEL_131	Process Value Low Alarm
1:0232	ALARM.ALM_LAT.SEL_132	Unit Failed to Sync
1:0233	ALARM.ALM_LAT.SEL_133	Voltage Bias Range Alarm
1:0234	ALARM.ALM_LAT.SEL_134	High Load Alarm
1:0235	ALARM.ALM_LAT.SEL_135	Low Load Alarm
1:0236	ALARM.ALM_LAT.SEL_136	Not Used
1:0237	ALARM.ALM_LAT.SEL_137	Not Used
1:0238	ALARM.ALM_LAT.SEL_138	Not Used

1:0239	ALARM.ALM_LAT.SEL_139	Not Used
1:0240	ALARM.ALM_LAT.SEL_140	Not Used
1:0241	ALARM.ALM_LAT.SEL_141	Not Used
1:0242	ALARM.ALM_LAT.SEL_142	Not Used
1:0243	ALARM.ALM_LAT.SEL_143	Not Used
1:0244	ALARM.ALM_LAT.SEL_144	Not Used
1:0245	ALARM.ALM_LAT.SEL_145	Not Used
1:0246	ALARM.ALM_LAT.SEL_146	Not Used
1:0247	ALARM.ALM_LAT.SEL_147	Not Used
1:0248	ALARM.ALM_LAT.SEL_148	Not Used
1:0249	ALARM.ALM_LAT.SEL_149	Not Used
1:0250	ALARM.ALM_LAT.SEL_150	Not Used
1:0251	ALARM.ALM_LAT.SEL_151	Custom Configured Event AI # 1
1:0252	ALARM.ALM_LAT.SEL_152	Custom Configured Event AI # 2
1:0253	ALARM.ALM_LAT.SEL_153	Custom Configured Event AI # 3
1:0254	ALARM.ALM_LAT.SEL_154	Custom Configured Event AI # 4
1:0255	ALARM.ALM_LAT.SEL_155	Custom Configured Event AI # 5
1:0256	ALARM.ALM_LAT.SEL_156	Custom Configured Event AI # 6
1:0257	ALARM.ALM_LAT.SEL_157	Custom Configured Event AI # 7
1:0258	ALARM.ALM_LAT.SEL_158	Custom Configured Event AI # 8
1:0259	ALARM.ALM_LAT.SEL_159	Custom Configured Event AI # 9
1:0260	ALARM.ALM_LAT.SEL_160	Custom Configured Event RTD # 1
1:0261	ALARM.ALM_LAT.SEL_161	Custom Configured Event RTD # 2
1:0262	ALARM.ALM_LAT.SEL_162	Custom Configured Event T/C # 1
1:0263	ALARM.ALM_LAT.SEL_163	Custom Configured Event T/C # 2
1:0264	ALARM.ALM_LAT.SEL_164	Not Used
1:0265	ALARM.ALM_LAT.SEL_165	Not Used
1:0266	ALARM.ALM_LAT.SEL_166	Not Used
1:0267	ALARM.ALM_LAT.SEL_167	Not Used
1:0268	ALARM.ALM_LAT.SEL_168	Not Used
1:0269	ALARM.ALM_LAT.SEL_169	Not Used
1:0270	ALARM.ALM_LAT.SEL_170	Not Used
1:0271	ALARM.ALM_LAT.SEL_171	Not Used
1:0272	ALARM.ALM_LAT.SEL_172	Not Used
1:0273	ALARM.ALM_LAT.SEL_173	Not Used
1:0274	ALARM.ALM_LAT.SEL_174	Not Used
1:0275	ALARM.ALM_LAT.SEL_175	Not Used
1:0276 thru 1:0298		NOT USED
1:0299		** SOFT SD ADDRESSES 300-499 **
1:0300	SHUTDOWN.SOFTSD_LAT.LATCH1	SUMMARY OF SOFT SD LATCH
1:0301 thru 1:0498	SHUTDOWN.SOFTSD_LAT.SEL_1	*If any of the Events 1-175 is configured as a “Soft Shutdown” the corresponding output is displayed on addresses 301-475. Descriptions for these addresses are the same as the Alarm list above (addresses 101-275)*
1:0499		** HARD SD ADDRESSES 500-699 **
1:0500	SHUTDOWN.HARDSD_LAT.LATCH1	SUMMARY HARD SD (FUEL CHOP)
1:0501 thru 1:0678		*If any of the Events 1-175 is configured as a “Soft Shutdown” the corresponding output is displayed on addresses 501-675. Descriptions for these addresses are the same as the Alarm list above*

		(addresses 101-275)
1:0679		
1:0680	A2_PS_OUTG.PTUNITINFO.LT	GEN PT Units are Volts
1:0681	A2_PS_OUTG.PTUNITINFO.EQ	GEN PT Units are kV
1:0682	A2_PS_OUTG.CTUNITINFO.LT	GEN CT Units are Amps
1:0683	A2_PS_OUTG.CTUNITINFO.EQ	GEN CT Units are kA
1:0684	A2_PS_OUTG.PWRUNITS.LT	GEN Power Units are Watts
1:0685	A2_PS_OUTG.PWRUNITS.EQ	GEN Power Units are kW
1:0686	A2_PS_OUTG.PWRUNITS.GT	GEN Power Units are MW
1:0687	A2_PS_OUTB.PTUNITINFO.LT	BUS PT Units are Volts
1:0688	A2_PS_OUTB.PTUNITINFO.EQ	BUS PT Units are kV
1:0689	A2_PS_OUTB.CTUNITINFO.LT	BUS CT Units are Amps
1:0690	A2_PS_OUTB.CTUNITINFO.EQ	BUS CT Units are kA
1:0691	A2_PS_OUTB.PWRUNITS.LT	BUS Power Units are Watts
1:0692	A2_PS_OUTB.PWRUNITS.EQ	BUS Power Units are kW
1:0693	A2_PS_OUTB.PWRUNITS.GT	BUS Power Units are MW
1:0694		
1:0695		
1:0696		
1:0697		
1:0698		
1:0699		
1:0700		

Analog Reads (RPTar)

Addr	**Input**	**Description**	**Multiplier**
3:0001	DISPLAY.ACCEL_100.MULTIPLY	ACCEL CONTROL	
3:0002	DISPLAY.DECEL_100.MULTIPLY	DECEL CONTROL	
3:0003	START_MODE.RAMP_STRT.RAMP	START RAMP CONTROL	
3:0004	CDP.CDP_HSS.A_NAME	CDP HIGH SIGNAL SELECT	
3:0005	DRIVER.GAS_DMD.A_NAME	GAS VALVE DEMAND	*10.0 (1.0, 10.0)
3:0006	DRIVER.LIQ_DMD.A_NAME	LIQUID VALVE DEMAND	*10.0 (1.0, 10.0)
3:0007	DRIVER.VLV_DMND.A_NAME	VALVE DEMAND	*10.0 (1.0, 10.0)
3:0008	EGT.EGT_AVG.A_NAME	EGT AVERAGE	
3:0009	DISPLAY.EGTPID_100.MULTIPLY	EGT CONTROL	
3:0010	DISPLAY.GGPID_100.MULTIPLY	GG Speed Control	
3:0011	ACCEL.CORR_CURV.MULTIPLY	CDP vs FUEL MAX LIMIT	
3:0012	DISPLAY.CDPPID_100.MULTIPLY	CDP TOPPING CONTROL	
3:0013	A2_PS_OUTG.GEN_KWATTS.A_NAME	GEN kW Output	
3:0014	A2_PS_OUTG.GEN_KVA.A_NAME	GEN KVA Output	
3:0015	A2_PS_OUTG.GEN_KVAR.A_NAME	GEN KVAR Output	
3:0016	LOAD_LIM.KW_LIM.A_NAME	MAX MW CONTROL LIMIT	100
3:0017	START_SEQ.SEQ_MUX.A_MUX_HSS	START SEQUENCE STEP	
3:0018	STOP_SEQ.SEQ_MUX.A_MUX_HSS	STOP SEQUENCE STEP	
3:0019	GG_CNTRL.GG_HSS.A_NAME	GG SPEED HIGH SIGNAL SELECT	
3:0020	GG_REF.GG_REF.A_NAME	GG Speed Reference Set point	
3:0021			
3:0022	PT_CNTRL.PT_HSS.A_NAME	PT SPEED HIGH SIGNAL SELECT	
3:0023	DISPLAY.PTPID_100.MULTIPLY	PT SPEED CONTROL	1
3:0024	PT_REF.PTREF.RAMP	PT SPEED REFERENCE	
3:0025	SYNC_OUT.SYNC_INFO.OUT_1	Synchronizer State	

3:0026	SYNC_OUT.SYNC_INFO.OUT_2	Synchronizer Mode	
3:0027	ALARM.AL_FRSTOUT.A_NAME	First Alarm to set Latch (#)	
3:0028	SHUTDOWN.OB_FRSTOUT.A_NAME	First SOFT SD to set Latch (#)	
3:0029	SHUTDOWN.SD_FRSTOUT.A_NAME	First HARD SD to set Latch (#)	
3:0030	DISPLAY.EGT_REF.A_SW	EGT REFERENCE	
3:0031	DRIVER.LSS_1.LSS_BUS	Fuel Demand LSS Bus 1	100
3:0032	DRIVER.HSS.HSS_BUS	Fuel Demand HSS Bus	100
3:0033	DRIVER.LSS_2.LSS_BUS	Fuel Demand LSS Bus 2	100
3:0034	DISPLAY.AMB_TEMP.A_SW	Ambient Inlet Temp	
3:0035	COND_MON.FIRE_STRTS.A_NAME	Number of Fired Starts	
3:0036	COND_MON.STRT_ATTMT.A_NAME	Number of Starts Attempted	
3:0037	COND_MON.SD_NUM.A_NAME	Number of Shutdowns	
3:0038	COND_MON.TRUNHRS.A_NAME	Number of Turbine Run Hours	
3:0039	COND_MON.TRUNMINS.A_NAME	Number of Turbine Run Minutes	
3:0040	START_SEQ.PURGE_CYCL.ACTIVETIME	Purge Cycle Timer	
3:0041	START_SEQ.LIGHT_OFF.ACTIVETIME	Accelerating to GG Idle Timer	
3:0042	START_SEQ.IN_WARMUP.ACTIVETIME	Warm-up Cycle Timer	
3:0043	START_SEQ.TM_TORATED.OUT_1	Accelerating to PT Rated Timer	
3:0044			
3:0045			
3:0046			
3:0047			
3:0048			
3:0049		*** Atlas H/W Analog Signals ***	
3:0050	A01_MAIN.DSS_01.TSS_ATL	PT SPEED PROBE A	
3:0051	A01_MAIN.DSS_02.TSS_ATL	PT SPEED PROBE B	
3:0052	A01_MAIN.AI_01.AI_ATL	Analog Input #1	
3:0053	A01_MAIN.AI_02.AI_ATL	Analog Input #2	
3:0054	DISPLAY.CDPHSS.A_SW	Analog Input #3	
3:0055	A01_MAIN.AI_04.AI_ATL	Analog Input #4	
3:0056	A01_MAIN.AI_05.AI_ATL	Analog Input #5	
3:0057	DISPLAY.EGT_IN.A_SW	Analog Input #6	
3:0058	A01_MAIN.AO_01.DISPLAY	PT ACTUAL SPEED READOUT	
3:0059	A01_MAIN.AO_02.DISPLAY	PT REFERENCE SPEED READOUT	
3:0060	A01_MAIN.AO_03.DISPLAY	FUEL VALVE DEMAND READOUT	
3:0061	A01_MAIN.AO_04.DISPLAY	EXHAUST GAS TEMP READOUT	
3:0062	A01_MAIN.AO_05.DISPLAY	CDP READOUT	
3:0063	A01_MAIN.AO_06.DISPLAY	CUSTOMER AO	
3:0064	A01_MAIN.ACT_01.ACT_ATL	GAS FUEL VALVE DEMAND	
3:0065	A01_MAIN.ACT_02.ACT_ATL	LIQUID FUEL VALVE DEMAND	
3:0066	A02_PSENSE.VOLTBIASRO.A_SW	Voltage Bias Output	
3:0067	V_REF.REF.A_NAME	Voltage Reference Set point	
3:0068	A03_COMBO.DSS_03.MONITOR	GG SPEED PROBE A	
3:0069	A03_COMBO.DSS_04.MONITOR	GG SPEED PROBE B	
3:0070	DISPLAY.TC_01.A_SW	EGT T/C # 1 Sensor	
3:0071	DISPLAY.TC_02.A_SW	EGT T/C # 2 Sensor	
3:0072	DISPLAY.TC_03.A_SW	EGT T/C # 3 Sensor	
3:0073	DISPLAY.TC_04.A_SW	EGT T/C # 4 Sensor	
3:0074	DISPLAY.TC_05.A_SW	EGT T/C # 5 Sensor	
3:0075	DISPLAY.TC_06.A_SW	EGT T/C # 6 Sensor	

3:0076	DISPLAY.TC_07.A_SW	EGT T/C # 7 Sensor
3:0077	DISPLAY.TC_08.A_SW	EGT T/C # 8 Sensor
3:0078	DISPLAY.TC_09.A_SW	T/C # 9 Sensor
3:0079	DISPLAY.TC_10.A_SW	T/C # 10 Sensor
3:0080	DISPLAY.RTD_01.A_SW	RTD # 1 Sensor
3:0081	DISPLAY.RTD_02.A_SW	RTD # 2 Sensor
3:0082	A03_COMBO.CJ_01.AI_CJ_ATL	CJ Compensation (Atlas Internal)
3:0083	A03_COMBO.AI_07.AI_420_ATL	Analog Input #7
3:0084	A03_COMBO.AI_08.AI_420_ATL	Analog Input #8
3:0085	A03_COMBO.AI_09.AI_420_ATL	Analog Input #9
3:0086		
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		*** Power Sense Info ***
3:0101	A2_PS_OUTG.PT_A_GEN.A_NAME	GEN PT A Voltage
3:0102	A2_PS_OUTG.PT_B_GEN.A_NAME	GEN PT B Voltage
3:0103	A2_PS_OUTG.PT_C_GEN.A_NAME	GEN PT C Voltage
3:0104	A2_PS_OUTG.PT_GEN_AVG.A_NAME	GEN PT Average Voltage
3:0105	A2_PS_OUTG.CT_A_GEN.A_NAME	GEN CT A Current
3:0106	A2_PS_OUTG.CT_B_GEN.A_NAME	GEN CT B Current
3:0107	A2_PS_OUTG.CT_C_GEN.A_NAME	GEN CT C Current
3:0108	A2_PS_OUTG.CT_GEN_AVG.A_NAME	GEN Average Current
3:0109	A2_PS_OUTG.GEN_PWR_A.A_NAME	GEN Power from Phase A
3:0110	A2_PS_OUTG.GEN_PWR_B.A_NAME	GEN Power from Phase B
3:0111	A2_PS_OUTG.GEN_PWR_C.A_NAME	GEN Power from Phase C
3:0112	A2_PS_OUTG.GEN_WATTS.A_NAME	GEN Total Power
3:0113	A2_PS_OUTG.GEN_VA_A.A_NAME	GEN VA from Phase A
3:0114	A2_PS_OUTG.GEN_VA_B.A_NAME	GEN VA from Phase B
3:0115	A2_PS_OUTG.GEN_VA_C.A_NAME	GEN VA from Phase C
3:0116	A2_PS_OUTG.GEN_KVA.A_NAME	GEN Total VA
3:0117	A2_PS_OUTG.GEN_VAR_A.A_NAME	GEN VAR from Phase A
3:0118	A2_PS_OUTG.GEN_VAR_B.A_NAME	GEN VAR from Phase B
3:0119	A2_PS_OUTG.GEN_VAR_C.A_NAME	GEN VAR from Phase C
3:0120	A2_PS_OUTG.GEN_KVAR.A_NAME	GEN Total VAR
3:0121	A2_PS_OUTG.GEN_NPHV.A_NAME	GEN Negative Phase Voltage
3:0122	A2_PS_OUTG.GEN_NPHA.A_NAME	GEN Negative Phase Current
3:0123	A2_PS_OUTG.GEN_PF_T.A_NAME	GEN Total PF
3:0124		
3:0125	A2_PS_OUTB.PT_A_BUS.A_NAME	BUS PT A Voltage

3:0126	A2_PS_OUTB.PT_B_BUS.A_NAME	BUS PT B Voltage
3:0127	A2_PS_OUTB.PT_C_BUS.A_NAME	BUS PT C Voltage
3:0128	A2_PS_OUTB.PT_BUS_AVG.A_NAME	BUS PT Average Voltage
3:0129	A2_PS_OUTB.CT_A_BUS.A_NAME	BUS CT A Current
3:0130	A2_PS_OUTB.CT_B_BUS.A_NAME	BUS CT B Current
3:0131	A2_PS_OUTB.CT_C_BUS.A_NAME	BUS CT C Current
3:0132	A2_PS_OUTB.CT_BUS_AVG.A_NAME	BUS CT Average Current
3:0133	A2_PS_OUTB.BUS_PWR_A.A_NAME	BUS Power from Phase A
3:0134	A2_PS_OUTB.BUS_PWR_B.A_NAME	BUS Power from Phase B
3:0135	A2_PS_OUTB.BUS_PWR_C.A_NAME	BUS Power from Phase C
3:0136	A2_PS_OUTB.BUS_WATTS.A_NAME	BUS Total Power
3:0137	A2_PS_OUTB.BUS_VA_A.A_NAME	BUS VA from Phase A
3:0138	A2_PS_OUTB.BUS_VA_B.A_NAME	BUS VA from Phase B
3:0139	A2_PS_OUTB.BUS_VA_C.A_NAME	BUS VA from Phase C
3:0140	A2_PS_OUTB.BUS_VA.A_NAME	BUS Total VA
3:0141	A2_PS_OUTB.BUS_VAR_A.A_NAME	BUS VAR from Phase A
3:0142	A2_PS_OUTB.BUS_VAR_B.A_NAME	BUS VAR from Phase B
3:0143	A2_PS_OUTB.BUS_VAR_C.A_NAME	BUS VAR from Phase C
3:0144	A2_PS_OUTB.BUS_VAR.A_NAME	BUS Total VAR
3:0145	A2_PS_OUTB.BUS_NPHV.A_NAME	BUS Negative Phase Voltage
3:0146	A2_PS_OUTB.BUS_NPHA.A_NAME	BUS Negative Phase Current
3:0147		
3:0148		
3:0149		
3:0150		

Analog Writes (RPTaw)

Addr	Description	Multiplier
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	PSense Spd Bias Out Force	
4:0008	PSense Volt Bias Out Force	
4:0009	Analog Out #7 Force	
4:0010	Analog Out #8 Force	
4:0011	spare	
4:0012	spare	
4:0013	Actuator Out #1 Force	
4:0014	Actuator Out #2 Force	
4:0015	Fuel Valve Manual Stroke	
4:0016	PT (Load) Control Ref Set point	
4:0017	VAR Control Set point	
4:0018	PF Control Set point	
4:0019	Process Control Set point	
4:0020		

Appendix C. Event List (Alarms and Shutdowns)

When an event occurs, the application sets a numbered Alarm flag (latch) as per the list below. The action to be taken is determined by the configuration option that the user selects for each event. The Quick Service inspector file has a user tunable value for the configuration number as per the chart below. The programmed default actions for these events are shown in the list below. The ACKNOWLEDGE input will turn off the Horn output. The RESET will clear the event latch, if the event condition no longer exists. Event options are as follows:

Configuration Number	Description
1	Disabled (No action taken)
2	Alarm (Audible & Visual annunciation of event)
3	Soft Shutdown (same as Alarm w/ Open Gen Breaker Command
4	Hard Shutdown (same as Soft w/ Fuel Shut-off)
5	Reserved (Not currently used)

IMPORTANT

Some events are defaulted as Hard Shutdowns and should NOT be changed, such as All Speed Sensors Failed, PT Overspeed, EGT Overtemp, and the Fuel Driver Faults.

Event #	DESCRIPTION	DEFAULT	Site Option
AL_001	Atlas HW/OpSys Summary Fault	HARD SHUTDOWN	
AL_002	Atlas Input Power Alarm	ALARM	
AL_003	Atlas HW Hi Temp	ALARM	
AL_004	Control is NOT Configured	HARD SHUTDOWN	
AL_005	Serial Port #1 Fault	ALARM	
AL_006	Serial Port #2 Fault	Disabled	
AL_007	Spare	Disabled	
AL_008	Speed Signal #1 (PT A) Failed	ALARM	
AL_009	Speed Signal #2 (PT B) Failed	ALARM	
AL_010	Analog Input # 1 Failed	Disabled	
AL_011	Analog Input # 2 Failed	Disabled	
AL_012	Analog Input # 3 Failed	Disabled	
AL_013	Analog Input # 4 Failed	Disabled	
AL_014	Analog Input # 5 Failed	Disabled	
AL_015	Analog Input # 6 Failed	Disabled	
AL_016	Discrete Input # 01 External Shutdown	HARD SHUTDOWN	No Option
AL_017	Not Used	Disabled	
AL_018	Not Used	Disabled	
AL_019	Discrete Input # 04 triggered event	Disabled	
AL_020	Discrete Input # 05 triggered event	Disabled	
AL_021	Discrete Input # 06 triggered event	Disabled	
AL_022	Discrete Input # 07 triggered event	Disabled	
AL_023	Discrete Input # 08 triggered event	Disabled	
AL_024	Discrete Input # 09 triggered event	Disabled	
AL_025	Discrete Input # 10 triggered event	Disabled	
AL_026	Discrete Input # 11 triggered event	Disabled	
AL_027	Discrete Input # 12 triggered event	Disabled	

AL_028	Discrete Input # 13 triggered event	Disabled	
AL_029	Discrete Input # 14 triggered event	Disabled	
AL_030	Discrete Input # 15 triggered event	Disabled	
AL_031	Discrete Input # 16 triggered event	Disabled	
AL_032	Discrete Input # 17 triggered event	Disabled	
AL_033	Discrete Input # 18 triggered event	Disabled	
AL_034	Discrete Input # 19 triggered event	Disabled	
AL_035	Discrete Input # 20 triggered event	Disabled	
AL_036	Discrete Input # 21 triggered event	Disabled	
AL_037	Discrete Input # 22 triggered event	Disabled	
AL_038	Discrete Input # 23 triggered event	Disabled	
AL_039	Discrete Input # 24 triggered event	Disabled	
AL_040	Analog Input Configuration Error	ALARM	
AL_041	Speed Signal #3 Failed (GG A)	ALARM	
AL_042	Speed Signal #4 Failed (GG B)	ALARM	
AL_043	Analog Input # 7 Failed	HARD SHUTDOWN	
AL_044	Analog Input # 8 Failed	HARD SHUTDOWN	
AL_045	Analog Input # 9 Failed	ALARM	
AL_046	RTD # 1 Signal Failed	Disabled	
AL_047	RTD # 2 Signal Failed	Disabled	
AL_048	Not Used	Disabled	
AL_049	All GG Speed Sig Failed	HARD SHUTDOWN	
AL_050	GG Overspeed ALM level	ALARM	
AL_051	GG Speed Signal Difference	ALARM	
AL_052	GG Overspeed SD Level	HARD SHUTDOWN	
AL_053	All PT Speed Sig Failed	HARD SHUTDOWN	
AL_054	PT Overspeed Test Enabled	ALARM	
AL_055	PT Overspeed ALM level	ALARM	
AL_056	PT Speed Signal Difference	Disabled	
AL_057	PT Overspeed SD Level	HARD SHUTDOWN	
AL_058	CDP Over High Press Level	ALARM	
AL_059	Gas Fuel Driver Fault (Running LIQ)	ALARM	
AL_060	Liquid Fuel Driver Fault (Running GAS)	ALARM	
AL_061	Gas Fuel Driver Fault	HARD SHUTDOWN	
AL_062	Liquid Fuel Driver Fault	HARD SHUTDOWN	
AL_063	Calibration Mode Enabled	ALARM	
AL_064	Start Engaged - No Speed Detected	HARD SHUTDOWN	
AL_065	GT Failed to Lite_off	HARD SHUTDOWN	
AL_066	Loss of Flame in Combustor	HARD SHUTDOWN	
AL_067	Unit Failed to Reach GG Idle	HARD SHUTDOWN	
AL_068	Unit Failed to Reach PT Rated	HARD SHUTDOWN	
AL_069	Start Command Lost While Running	Disabled	
AL_070	Normal Stop Complete - Turn Off Starter	ALARM	
AL_071	Not Used	Disabled	
AL_072	EGT T/C # 1 Signal Failed	ALARM	
AL_073	EGT T/C # 2 Signal Failed	ALARM	
AL_074	EGT T/C # 3 Signal Failed	ALARM	
AL_075	EGT T/C # 4 Signal Failed	ALARM	
AL_076	EGT T/C # 5 Signal Failed	ALARM	
AL_077	EGT T/C # 6 Signal Failed	ALARM	

AL_078	EGT T/C # 7 Signal Failed	ALARM	
AL_079	EGT T/C # 8 Signal Failed	ALARM	
AL_080	Input T/C # 9 Signal Failed	Disabled	
AL_081	Input T/C # 10 Signal Failed	Disabled	
AL_082	Too Many T/C Failed - ALM	Disabled	
AL_083	Too Many T/C Failed - SD	HARD SHUTDOWN	
AL_084	3 Adjacent T/C Signals Failed	HARD SHUTDOWN	
AL_085	EGT T/C Spread ALM	ALARM	
AL_086	EGT T/C Spread SD	HARD SHUTDOWN	
AL_087	EGT Single T/C Avg Failed	Disabled	
AL_088	EGT Overtemp SD	HARD SHUTDOWN	
AL_089	EGT Temp Failed Low	Disabled	
AL_090	EGT Overtemp ALM	Disabled	
AL_091	Analog EGT Signal Failed	Disabled	
AL_092	EGT T/C # 1 Difference from Avg	ALARM	
AL_093	EGT T/C # 2 Difference from Avg	ALARM	
AL_094	EGT T/C # 3 Difference from Avg	ALARM	
AL_095	EGT T/C # 4 Difference from Avg	ALARM	
AL_096	EGT T/C # 5 Difference from Avg	ALARM	
AL_097	EGT T/C # 6 Difference from Avg	ALARM	
AL_098	EGT T/C # 7 Difference from Avg	ALARM	
AL_099	EGT T/C # 8 Difference from Avg	ALARM	
AL_100	Not Used		
AL_101	Gen Breaker Fdbck Failed	SOFT SHUTDOWN	
AL_102	Gen Breaker Shunt Trip Error	SOFT SHUTDOWN	
AL_103	GEN Negative Phase Current Alarm	ALARM	
AL_104	GEN Negative Phase Current Warning	Disabled	
AL_105	GEN Negative Phase Volt Alarm	ALARM	
AL_106	GEN Negative Phase Volt Warning	Disabled	
AL_107	Gen Over Frequency Alarm	ALARM	
AL_108	Gen Over Frequency Warning	Disabled	
AL_109	Gen Under Frequency Alarm	ALARM	
AL_110	Gen Under Frequency Warning	Disabled	
AL_111	Gen Over Volts Alarm	ALARM	
AL_112	Gen Over Volts Warning	Disabled	
AL_113	Gen Under Volts Alarm	ALARM	
AL_114	Gen Under Volts Warning	Disabled	
AL_115	GEN Over Power Protect Alarm	SOFT SHUTDOWN	
AL_116	GEN Over Power Protect Warning	ALARM	
AL_117	GEN Reverse Power Protect Alarm	SOFT SHUTDOWN	
AL_118	GEN Reverse Power Protect Warning	ALARM	
AL_119	GEN VARS Over Protection Alarm	ALARM	
AL_120	GEN VARS Over Protection Warning	Disabled	
AL_121	GEN VARS Under Protection Alarm	ALARM	
AL_122	GEN VARS Under Protection Warning	Disabled	
AL_123	GEN Phase Differential Current Alarm	ALARM	
AL_124	GEN Phase Differential Current Warning	Disabled	
AL_125	GEN Phase Over Current Alarm	SOFT SHUTDOWN	
AL_126	GEN Phase Over Current Warning	ALARM	
AL_127	KVA Switch Active	Disabled	

AL_128	Speed / Frequency Mismatch	SOFT SHUTDOWN	
AL_129	Phase Rotation Alarm (Sync Inhibit)	SOFT SHUTDOWN	
AL_130	Process Value High Alarm	Disabled	
AL_131	Process Value Low Alarm	Disabled	
AL_132	Unit Failed to Sync	ALARM	
AL_133	Voltage Bias Range Alarm	Disabled	
AL_134	High Load Alarm	Disabled	
AL_135	Low Load Alarm	Disabled	
AL_136	Not Used	Disabled	
AL_137	Not Used	Disabled	
AL_138	Not Used	Disabled	
AL_139	Not Used	Disabled	
AL_140	Not Used	Disabled	
AL_141	Not Used	Disabled	
AL_142	Not Used	Disabled	
AL_143	Not Used	Disabled	
AL_144	Not Used	Disabled	
AL_145	Not Used	Disabled	
AL_146	Not Used	Disabled	
AL_147	Not Used	Disabled	
AL_148	Not Used	Disabled	
AL_149	Not Used	Disabled	
AL_150	Not Used	Disabled	
AL_151	Custom Configured Event AI # 1	Disabled	
AL_152	Custom Configured Event AI # 2	Disabled	
AL_153	Custom Configured Event AI # 3	Disabled	
AL_154	Custom Configured Event AI # 4	Disabled	
AL_155	Custom Configured Event AI # 5	Disabled	
AL_156	Custom Configured Event AI # 6	Disabled	
AL_157	Custom Configured Event AI # 7	Disabled	
AL_158	Custom Configured Event AI # 8	Disabled	
AL_159	Custom Configured Event AI # 9	Disabled	
AL_160	Custom Configured Event RTD # 1	Disabled	
AL_161	Custom Configured Event RTD # 2	Disabled	
AL_162	Custom Configured Event T/C # 9	Disabled	
AL_163	Custom Configured Event T/C # 10	Disabled	
AL_164	Not Used	Disabled	
AL_165	Not Used	Disabled	
AL_166	Not Used	Disabled	
AL_167	Not Used	Disabled	
AL_168	Not Used	Disabled	
AL_169	Not Used	Disabled	
AL_170	Not Used	Disabled	
AL_171	Not Used	Disabled	
AL_172	Not Used	Disabled	
AL_173	Not Used	Disabled	
AL_174	Not Used	Disabled	
AL_175	Not Used	Disabled	

Appendix D. Configuration and Service Tunables Worksheet

Control Part Number ____________________

Software Number & Revision Letter ____________________

Control Serial Number ____________________

NOTICE

This device is a standard gas turbine control product that must be configured by the user to safely control the gas turbine. Improper configuration or setup of the control could result in damage to equipment.

I/O CONFIGURATION NOTES

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

TEMPERATURE INPUT (summary input):
EGT: display in Deg. F, 4-20mA

TEMPERATURE INPUT (Optional):
T/C #1-8: display in Deg. F, all these channels must be configured as the same “type” of thermocouple

AMBIENT SENSOR:
AMBIENT TEMP: display in Deg. F

CONFIGURE SHEETS

The following section outlines optional configurations that can be adjusted in this standard control. These must be tuned at the site to be sure they are correct for the turbine being controlled. The default value and range are shown for each tunable. The turbine must be shutdown to adjust the tunables in Configure mode, as it will place the control in IO LOCK.

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** LIST OF CONFIGURE SHEET TAB HEADERS **

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** CONFIGURE: A- SYSTEM SETTINGS**
** CONFIGURE: B- POWERSENSE SETTINGS**
** CONFIGURE: C- GG SPEED SENSOR SETTINGS **
** CONFIGURE: D- PT SPEED SENSOR SETTINGS **
** CONFIGURE: E- ANALOG INPUT OPTIONS**
** CONFIGURE: F- EGT SETTINGS**

Configure: A - SYSTEM

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Use Gas Fuel Valve	*	TRUE			
Configure	02 Gas Valve Reverse Act?	*	FALSE			
Configure	03 Use Liq Fuel Valve	*	TRUE			
Configure	04 Liq Valve Reverse Act?	*	FALSE			
Configure	05 PT Idle Speed Ref (Min)	*	3500	100	20000	
Configure	06 PT Rated Speed	*	3600	100	20000	
Configure	07 PT Max Spd Ref Set point	*	3780	1000	30000	
Configure	08 GG Speed for SD Reset	*	1000	100	10000	
Configure	09 Flame Detect Options 1= EGT >400 deg, 2= UV sensors, 3= Use both, 4= GG Speed	*	1	1	4	
Configure	10 Flame Detect Option Fdbk		EGT > 400 Deg F			
Configure	11 GG Spd to Enabl FlamOut GG speed with either UV sensors or temperature flameout detection activated		2500			
Configure	12 Fuel Transfer Rate (sec)	*	60	10	120	
Configure	13 Gen Freq (1=50, 2=60) HZ	*	2	1	2	
Configure	14 Use Sync/Breaker Cmds?	*	TRUE			
Configure	15 Init Mode at Brkr Close 0=Manual loading via PT Reference 1=Ramp up to Baseload control 2=Go into Isoch Load Sharing (Util Breaker must be open)	*	0	0	2	
Configure	16 Initial Mode Selected		Manual Loading			
Configure	17 Use Load Sharing by LON?	*	FALSE			
Configure	18 Use Reactive Load Cntrl?	*	TRUE			
Configure	19 Display Temps in Deg C	*	FALSE			
Configure	20 Disable all ACCEL Cntrl	*	FALSE			
Configure	21 SD BO True=SD	*	TRUE			
Configure	22 ALM Out Summary or Horn False = Output On (True) when any alarm exists (Summary) True = Output On (True) when any new alarm comes in and an Acknowledge input pulse will turn the output off (false)	*	FALSE			
Configure	23 Tune True= CNFGComplete THIS MUST BE TUNED TRUE TO RUN TURBINE	*	FALSE			

Configure: B - PSense SETTINGS

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 GEN CT Ratio	*	150	5	30000	
Configure	02 GEN PT Ratio	*	5	1	1000	
Configure	03 GEN Sensing Type T=3 Phz True = 3 Phase	*	TRUE			
Configure	04 GEN H/W Volt(70/120/240) 1=70v, 2=120v, 3=240volt range	*	2	1	3	
Configure	05 Mains CT Ratio	*	150	5	30000	
Configure	06 Mains PT Ratio	*	5	1	1000	
Configure	07 Mains Sensing Type (T=3) True = 3 Phase	*	TRUE			

Configure	08 Mains H/W Vlt 70/120/240 1=70v, 2=120v, 3=240volt range	*	2	1	3	
Configure	09 Num of Poles in GEN	*	2	2	18	
Configure	10 Rated GEN KVA	*	12500	10	30000	
Configure	11 Rated GEN KVAR	*	2500	0.001	30000	
Configure	12 Rated GEN KW	*	10000	0.001	30000	
Configure	13 Rated GEN Volt	*	4160	0.001	30000	
Configure	14 GEN Line Config 1=Delta	*	2	1	2	
Configure	15 GEN Rotation (T=ABC)	*	TRUE			
Configure	16 Rated Mains KVA	*	1000	10	30000	
Configure	17 Rated Mains KVAR	*	1000	0.001	30000	
Configure	18 Rated Mains KW	*	10000	0.001	30000	
Configure	19 Rated Mains Volts	*	480	0.001	30000	
Configure	20 Mains Line Config (2=Y) 1 = Delta, 2 = Y	*	1	1	2	
Configure	21 Voltage Bias Type 1=4-20mA, 2=+/-9vdc, 3=+/-3vdc, 4=+/-1vdc, 5=Discrete Raise/Lower	*	3	1	5	
Configure	22 Voltage Bias Selected		+/- 3 Volt			
Configure	23 LON Unit Number	*	1	1	16	

Configure: C -GG SPEED SENSOR SETTINGS

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Use Two GG Sensors	*	TRUE			
Configure	02 GG Max Speed Maximum range of sensed speed of GG	*	12000	1000	30000	
Configure	03 GG1 Gear Ratio	*	1	0.01	100	
Configure	04 GG1 Numbr of Gear Teeth	*	47	1	1000	
Configure	05 GG2 Gear Ratio	*	1	0.01	100	
Configure	06 GG2 Numbr of Gear Teeth	*	47	1	1000	
Configure	07 GG Failed High Set point Speed setting for sensor failure	*	10400	1000	30000	
Configure	08 GG Failed Low Set point	*	300	0	30000	
Configure	09 GG Spread Alarm Level Max difference between two speed sensors for alarm. If using one speed sensor, set this to zero	*	1000	0	30000	
Configure	10 GG Hi Speed Alarm Setpnt	*	10100	100	30000	
Configure	11 GG Overspeed SD Set point	*	10200	100	30000	

Configure: D -PT SPEED SENSOR SETTINGS

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Use Two PT Sensors	*	TRUE			
Configure	02 PT Max Speed Maximum range of sensed speed of PT	*	5000	0	30000	
Configure	03 PT Gear Ratio	*	1	0.01	100	
Configure	04 PT Number of Gear Teeth	*	83	1	1000	
Configure	05 PT Failed High Set point Speed setting for sensor failure	*	5000	0	30000	
Configure	06 PT Failed Low Set point	*	300	0	30000	
Configure	07 PT Spread Alarm Level Max difference between two speed sensors for alarm. If using one speed sensor, set this to zero	*	1000	0	30000	

Configure	08 PT Hi Speed Alarm Setpnt	*	4000	100	10000	
Configure	09 PT Overspeed SD Set point	*	4000	100	10000	

Configure: E - ANALOG IN OPTS (4=MAX)

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Process Control Signal	*	FALSE			
Configure	02 Remote Process Set point	*	FALSE			
Configure	03 Amb Inlet Air Temp	*	FALSE			
Configure	04 Remote KW Reference	*	FALSE			
Configure	05 Remote VAR/PF REF	*	FALSE			
Configure	06 Remote CJ Comp for T/C	*	FALSE			
Configure	07 Gas Fuel Valve Pos Fdbk	*	FALSE			
Configure	08 Liq Fuel Valve Pos Fdbk	*	FALSE			

Configure: F - EGT SETTINGS

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Select EGT Input Type 1 = Analog 4-20 mA, 2 = Common TC Harness, 3 = Individual TCs	*	3	1	3	
Configure	02 Feedback of Selection		Individual T/C's			
Configure	03 EGT Low Temp Setpnt	*	500	-100	2500	
Configure	04 EGT Overtemp Alm Setpnt	*	1600	0	2500	
Configure	05 EGT Overtemp SD Setpnt	*	1650	0	2500	
Configure	06 EGT Temp Switch 1 Setpnt	*	400	0	2500	
Configure	07 EGT Temp Switch 2 Setpnt	*	1000	0	2500	
Configure	08 EGT Temp Switch 3 Setpnt	*	1500	0	2500	
Configure	09 Select T/C Type (Ch 1-8) 1=E, 2=J, 3=K, 4=N, 5=R, 6=S, 7=T	*	3	1	7	
Configure	10 Feedback - Type Selected		Type K thermocouple			
Configure	11 T/C Minimum Value	*	-100	-1000	2500	
Configure	12 T/C Maximum Value	*	2000	-1000	2500	
Configure	13 Latch Delay for T/C Fail	*	500	0	5000	

SERVICE SHEETS

The following section outlines Optional configurations that can be adjusted in this standard control. These must be tuned at the site to be sure they are correct for the turbine being controlled. The default value and range are shown for each tunable. In Service mode, these are values that can be adjusted without shutting down the turbine, however, caution should always be used when making on-line adjustments.

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** LIST OF SERVICE SHEET TAB HEADERS **

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** SERVICE: S01 AI 1 Setup **
** SERVICE: S02 AI 2 Setup **
** SERVICE: S03 AI 3 Setup **
** SERVICE: S04 AI 4 Setup **
** SERVICE: S05 AI 5 Setup **
** SERVICE: S06 AI 6 Setup **

** SERVICE: S07 AI 7 Setup **
** SERVICE: S08 AI 8 Setup **
** SERVICE: S09 AI 9 Setup **
** SERVICE: S10 T/C 1-8 Setup **
** SERVICE: S11 T/C 09 Setup **
** SERVICE: S12 T/C 10 Setup **
** SERVICE: S13 RTD 1 Setup **
** SERVICE: S14 RTD 2 Setup **
** SERVICE: S15 AO 1-4 Setup**
** SERVICE: S16 AO 5-8 Setup **
** SERVICE: S17 DI 1-6 Setup **
** SERVICE: S18 DI 7-11 Setup **
** SERVICE: S19 DI 12-16 Setup **
** SERVICE: S20 DI 17-21 Setup **
** SERVICE: S21 DI 22-24 Setup **
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** SERVICE: S24 Relay Output Forcing **
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** SERVICE: S26 Serial Port #1 Setup **
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** SERVICE: S28 Ambient Temp Setup **
** SERVICE: S29 Remote Speed Reference Setup **
** SERVICE: S30 Start / Lite-off Setup **
** SERVICE: S31 Valve Calibration & Stroke **
** SERVICE: S32 GG Speed Control Setup **
** SERVICE: S33 PT Speed Control Setup **
** SERVICE: S34 ACCEL (CDP based) Fuel Limit Curve **
** SERVICE: S35 ACCEL Control PID / Schedule **
** SERVICE: S36 DECEL Control PID **
** SERVICE: S37 Decel Curve (CDP) Setup **
** SERVICE: S38 CDP Control PID Setup **
** SERVICE: S39 EGT Control PID Setup **
** SERVICE: S40 Real Load Control Limits Setup **
** SERVICE: S41 PowerSense Module Setup **
** SERVICE: S42 Synchronizer Functions**
** SERVICE: S43 Reactive Load Control **
** SERVICE: S44 Process Control Setup**
** SERVICE: S45 Generator Protection Page 1**
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** SERVICE: S47 Alarm/Shutdown Events Page 1 **
** SERVICE: S48 Alarm/Shutdown Events Page 2 **
** SERVICE: S49 Alarm/Shutdown Events Page 3 **
** SERVICE: S50 Alarm/Shutdown Events Page 4 **
** SERVICE: S51 Alarm/Shutdown Events Page 5 **
** SERVICE: S52 Alarm/Shutdown Events Page 6 **
** SERVICE: S53 Start / Stop Sequence Setup **
** SERVICE: S54 Turbine Parameters **

Analog Input Selection Menu:

1. Process Control Input Signal
2. Remote Process Control Set point
3. Ambient Inlet Air Temperature Sensor
4. Remote KW Reference Set point
5. Remote VAR/PF Reference Signal
6. Remote CJ Comp for T/C Signals
7. Gas Fuel Valve Position Feedback
8. Liquid Fuel Valve Position Feedback
9. Customer Defined Signal
10. Reserved – Not Used

Service: S01 AI 1 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI01	*	1	0	10	
Service	02 Mode =		Process Control Input Signal			
Service	03 1=4-20mA 2=0-5V	*	1	1	2	
Service	04 Mode =		Channel configured as 4-20 mA			
Service	05 Analog 1 Value @ 4 mA =	*	0	-20000	20000	
Service	06 Analog 1 Value @ 20 mA =	*	100	-32768	32768	
Service	07 Analog 1 Value		-24.82			
Service	08 Analog 1 Offset	*	0	-10000	10000	
Service	09 Analog 1 Gain	*	1	0	2	
Service	10 Failed sensor delay time	*	0.1	0	5	
Service	11 Configured for Custom Sig		FALSE			
Service	12 Custom Use Event Level	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD 1=Disabled, 2=Alm, 3=OB, 4=SD	*	1	1	4	
Service	16 Mode =		Disabled			
Service	17 Alarm delay time	*	0.1	0	500	
Service	18 Action on Failed Signal 1=Disabled, 2=Alm, 3=OB, 4=SD, 5=Not Used	*	1	1	5	
Service	19 Mode =		Disabled			

Service: S02 AI 2 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI02	*	2	0	10	
Service	02 Mode =		Remote Process Set point			
Service	03 1=4-20mA 2=0-5V	*	1	1	2	
Service	04 Mode =		Channel configured as 4-20 mA			
Service	05 Analog 2 Value @ 4 mA =	*	3600	-20000	20000	
Service	06 Analog 2 Value @ 20 mA =	*	3780	-30000	30000	
Service	07 Analog 2 Value		3555.18			
Service	08 Analog 2 Offset	*	0	-10000	10000	
Service	09 Analog 2 Gain	*	1	0	2	

Service	10 Failed sensor delay time	*	0.1	0	5	
Service	11 Configured for Custom Sig		FALSE			
Service	12 Custom Use Event Level	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD	*	1	1	4	
Service	16 Mode =		Disabled			
Service	17 Alarm delay time	*	0.1	0	500	
Service	18 Action on Failed Signal	*	1	1	5	
Service	19 Mode =		Disabled			

Service: S03 AI 3 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI03	*	2	0	10	
Service	02 Mode =		Remote Process Set point			
Service	03 1=4-20mA 2=0-5V	*	1	1	2	
Service	04 Mode =		Channel configured as 4-20 mA			
Service	05 Analog 3 Value @ 4 mA =	*	0	-20000	20000	
Service	06 Analog 3 Value @ 20 mA =	*	300	-30000	30000	
Service	07 Analog 3 Value		-74.83			
Service	08 Analog 3 Offset	*	0	-10000	10000	
Service	09 Analog 3 Gain	*	1	0	2	
Service	10 Failed sensor delay time	*	0.1	0	5	
Service	11 Configured for Custom Sig		FALSE			
Service	12 Custom Use Event Level	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD	*	1	1	4	
Service	16 Mode =		Disabled			
Service	17 Alarm delay time	*	0.1	0	500	
Service	18 Action on Failed Signal	*	1	1	5	
Service	19 Mode =		Disabled			

Service: S04 AI 4 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI04	*	3	0	10	
Service	02 Mode =		Ambient Inlet Air Temp			
Service	03 1=4-20mA 2=0-5V	*	1	1	2	
Service	04 Mode =		Channel configured as 4-20 mA			
Service	05 Analog 4 Value @ 4 mA =	*	-40	-20000	20000	
Service	06 Analog 4 Value @ 20 mA =	*	140	-30000	30000	
Service	07 Analog 4 Value		-84.83			
Service	08 Analog 4 Offset	*	0	-10000	10000	
Service	09 Analog 4 Gain	*	1	0	2	

Service	10 Failed sensor delay time	*	0.1	0	5	
Service	11 Configured for Custom Sig		FALSE			
Service	12 Custom Use Event Level	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD	*	1	1	4	
Service	16 Mode =		Disabled			
Service	17 Alarm delay time	*	0.1	0	500	
Service	18 Action on Failed Signal	*	1	1	5	
Service	19 Mode =		Disabled			

Service: S05 AI 5 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI05	*	5	0	10	
Service	02 Mode =		Remote VAR/PF Reference			
Service	03 1=4-20mA 2=0-5V	*	1	1	2	
Service	04 Mode =		Channel configured as 4-20 mA			
Service	05 Analog 5 Value @ 4 mA =	*	-0.5	-20000	20000	
Service	06 Analog 5 Value @ 20 mA =	*	0.5	-30000	30000	
Service	07 Analog 5 Value		-0.7			
Service	08 Analog 5 Offset	*	0	-10000	10000	
Service	09 Analog 5 Gain	*	1	0	2	
Service	10 Failed sensor delay time	*	0.1	0	5	
Service	11 Configured for Custom Sig		FALSE			
Service	12 Custom Use Event Level	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD	*	1	1	4	
Service	16 Mode =		Disabled			
Service	17 Alarm delay time	*	0.1	0	500	
Service	18 Action on Failed Signal	*	1	1	5	
Service	19 Mode =		Disabled			

Service: S06 AI 6 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI06	*	1	0	10	
Service	02 Mode =		Process Control Input Signal			
Service	03 1=4-20mA 2=0-5V	*	1	1	2	
Service	04 Mode =		Channel configured as 4-20 mA			
Service	05 Analog 6 Value @ 4 mA =	*	0	-20000	20000	
Service	06 Analog 6 Value @ 20 mA =	*	2000	-30000	30000	
Service	07 Analog 6 Value		-500.21			
Service	08 Analog 6 Offset	*	0	-10000	10000	
Service	09 Analog 6 Gain	*	1	0	2	

Service	10 Failed sensor delay time	*	0.1	0	5	
Service	11 Configured for Custom Sig		FALSE			
Service	12 Custom Use Event Level	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD	*	1	1	4	
Service	16 Mode =		Disabled			
Service	17 Alarm delay time	*	0.1	0	500	
Service	18 Action on Failed Signal	*	1	1	5	
Service	19 Mode =		Disabled			

Service: S07 AI 7 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI07	*	1	1	3	
Service	02 Mode =		Compressor Discharge Pressure			
Service	03 Analog 7 Value @ 4 mA =	*	1	1	2	
Service	04 Analog 7 Value @ 20 mA =	*	300	0.10	1000	
Service	05 Analog 7 Value		-74.39			
Service	06 Analog 7 Offset	*	0	-50	50	
Service	07 Analog 7 Gain	*	1	0	2	
Service	08 Failed sensor delay time	*	0.1	0	5	
Service	09 Configured for Custom Sig		FALSE			
Service	10 Custom Use Event Level	*	1000	-15000	15000	
Service	11 Alarm Low=T Hi=F	*	FALSE			
Service	12 Mode =		Alarm on rising signal (High)			
Service	13 1=N_Used 2=Alrm 3=SD	*	1	1	4	
Service	14 Mode =		Disabled			
Service	15 Alarm delay time	*	0.1	0	500	
Service	16 Action on Failed Signal	*	4	1	5	
Service	17 Mode =		Hard Shutdown			

Service: S08 AI 8 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI08	*	1	1	3	
Service	02 Mode =		Exhaust Gas Temperature			
Service	03 Analog 8 Value @ 4 mA =	*	0	-20000	20000	
Service	04 Analog 8 Value @ 20 mA =	*	2000	-30000	30000	
Service	05 Analog 8 Value		-499.96			
Service	06 Analog 8 Offset	*	0	-10000	10000	
Service	07 Analog 8 Gain	*	1	0	2	
Service	08 Failed sensor delay time	*	0.1	0	5	
Service	09 Configured for Custom Sig		FALSE			
Service	10 Custom Use Event Level	*	1000	-15000	15000	
Service	11 Alarm Low=T Hi=F	*	FALSE			
Service	12 Mode =		Alarm on rising signal (High)			

Service	13 1=N_Used 2=Alrm 3=SD	*	1	1	3	
Service	14 Mode =		Alarm for High/Low signal			
Service	15 Alarm delay time	*	0.1	0	500	
Service	16 Action on Failed Signal	*	4	1	5	
Service	17 Mode =		Hard Shutdown			

Service: S09 AI 9 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI09	*	1	1	3	
Service	02 Mode =		Remote Speed Reference			
Service	03 Analog 9 Value @ 4 mA =	*	0	-20000	20000	
Service	04 Analog 9 Value @ 20 mA =	*	100	-32768	32768	
Service	05 Analog 9 Value		-24.8			
Service	06 Analog 9 Offset	*	0	-10000	10000	
Service	07 Analog 9 Gain	*	1	0	2	
Service	08 Failed sensor delay time	*	100	0	500	
Service	09 Configured for Custom Sig		FALSE			
Service	10 Custom Use Event Level	*	1000	-15000	15000	
Service	11 Alarm Low=T Hi=F	*	FALSE			
Service	12 Mode =		Alarm on rising signal (High)			
Service	13 1=N_Used 2=Alrm 3=SD	*	1	1	3	
Service	14 Mode =		Alarm for High/Low signal			
Service	15 Alarm delay time	*	0.1	0	500	
Service	16 Action on Failed Signal	*	2	1	5	
Service	17 Mode =		Alarm			

Service: S10 T/C 1-8 SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01T/C 01 Input Value		2500			
Service	02 T/C 01 Offset	*	0	-200	200	
Service	03 T/C 01 Gain	*	1	0.80	1.2	
Service	04 T/C 02 Input Value		2500			
Service	05 T/C 02 Offset	*	0	-200	200	
Service	06 T/C 02 Gain	*	1	0.80	1.2	
Service	07 T/C 03 Input Value		2500			
Service	08 T/C 03 Offset	*	0	-200	200	
Service	09 T/C 03 Gain	*	1	0.80	1.2	
Service	10 T/C 04 Input Value		2500			
Service	11 T/C 04 Offset	*	0	-200	200	
Service	12 T/C 04 Gain	*	1	0.80	1.2	
Service	13 T/C 05 Input Value		2500			
Service	14 T/C 05 Offset	*	0	-200	200	
Service	15 T/C 05 Gain	*	1	0.80	1.2	
Service	16 T/C 06 Input Value		2500			
Service	17 T/C 06 Offset	*	0	-200	200	
Service	18 T/C 06 Gain	*	1	0.80	1.2	
Service	19 T/C 07 Input Value		2500			

Service	20 T/C 07 Offset	*	0	-200	200	
Service	21 T/C 07 Gain	*	1	0.80	1.2	
Service	22 T/C 08 Input Value		2500			
Service	23 T/C 08 Offset	*	0	-200	200	
Service	24 T/C 08 Gain	*	1	0.80	1.2	

Service: S11 T/C 09 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use T/C Input # 09?	*	3	1	3	
Service	02 Selected Use for TC09		T/C Not Used			
Service	03 T/C 09 Type 1=E, 2=J, 3=K, 4=N, 5=R, 6=S, 7=T	*	3	1	7	
Service	04 T/C 09 Type Chosen		Type K thermocouple			
Service	05 T/C Input 09 Value		2499.96			
Service	06 T/C 09 Offset	*	0	-200	200	
Service	07 T/C 09 Gain	*	1	0.80	1.2	
Service	08 T/C 09 Min Value	*	-40	-1000	2500	
Service	09 T/C 09 Max Value	*	140	-1000	2500	
Service	10 Failed sensor delay time	*	500	0	5000	
Service	11 Custom Use Event Level	*	1000	-15000	15000	
Service	12 Alarm Low=T Hi=F	*	FALSE			
Service	13 Mode =		Alarm on rising temp (High)			
Service	14 1=Alrm 2=SD 3=N_used	*	1	1	3	
Service	15 Mode =		Alarm for High/Low temp			
Service	16 Event/Alarm delay time	*	1	0	500	
Service	17 SNSR FLT T=SD F=Alrm	*	FALSE			
Service	18 Mode =		Alarm on sensor fault			

Service: S12 T/C 10 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use T/C Input # 10?	*	3	1	3	
Service	02 Selected Use for TC10		T/C Not Used			
Service	03 T/C 10 Type	*	3	1	7	
Service	04 T/C 10 Type Chosen		Type K thermocouple			
Service	05 T/C Input 10 Value		2499.96			
Service	06 T/C 10 Offset	*	0	-200	200	
Service	07 T/C 10 Gain	*	1	0.80	1.2	
Service	08 T/C 10 Min Value	*	-100	-1000	2500	
Service	09 T/C 10 Max Value	*	2000	-1000	2500	
Service	10 Failed sensor delay time	*	500	0	5000	
Service	11 Custom Use Event Level	*	1000	-15000	15000	
Service	12 Alarm Low=T Hi=F	*	FALSE			
Service	13 Mode =		Alarm on rising temp (High)			
Service	14 1=Alrm 2=SD 3=N_used	*	1	1	3	
Service	15 Mode =		Alarm for High/Low temp			

Service	16 Event/Alarm delay time	*	1	0	500	
Service	17 SNSR FLT T=SD F=Alrm	*	FALSE			
Service	18 Mode =		Alarm on sensor fault			

Service: S13 RTD 1 SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 1=GTC 2=Cust 3=n_used	*	3	1	3	
Service	02 Mode =		Not Used			
Service	03 RTD 01 Type 1=100 Ohm, 2=200Ohm	*	1	1	2	
Service	04 RTD 01 Type Selected		100-Ohm RTD			
Service	05 RTD 01 Curve Type 1=American Standard 2=European	*	1	1	2	
Service	06 RTD 01 Curve Type Selctd		alpha = 0.00392 (American)			
Service	07 RTD 01 Value		853.6			
Service	08 RTD 01 Offset	*	0	-32768	32768	
Service	09 RTD 01 Gain	*	1	0	2	
Service	10 RTD 01 Low Fault	*	0	-20000	20000	
Service	11 RTD 01 High Fault	*	1000	-20000	20000	
Service	12 RTD01 Temp Level Setpnt	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising temp (High)			
Service	15 RTD01 Event at Temp Levl	*	1	1	3	
Service	16 RTD01 Event Action Fdbk		Alarm for High/Low temp			
Service	17 RTD01 Event Delay Time	*	1	0	500	
Service	18 RTD01 Failed T=SD, F=ALM False = Alarm, True = Shutdown	*	FALSE			

Service: S14 RTD 2 SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 1=GTC 2=Cust 3=n_used	*	3	1	3	
Service	02 Mode =		Not Used			
Service	03 RTD 02 Type 1=100 Ohm, 2=200Ohm	*	1	1	2	
Service	04 RTD 02 Type Selected		100-Ohm RTD			
Service	05 RTD 02 Curve Type 1=American Standard 2=European	*	1	1	2	
Service	06 RTD 02 Curve Type Selctd		alpha = 0.00392 (American)			
Service	07 RTD 02 Value		853.6			
Service	08 RTD 02 Offset	*	0	-32768	32768	
Service	09 RTD 02 Gain	*	1	0	2	
Service	10 RTD 02 Low Fault	*	0	-20000	20000	
Service	11 RTD 02 High Fault	*	100	-20000	20000	
Service	12 RTD02 Temp Level Setpnt	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F	*	FALSE			
Service	14 Mode =		Alarm on rising temp (High)			

Service	15 RTD02 Event at Temp Levl	*	1	1	3	
Service	16 RTD02 Event Action Fdbk		Alarm for High/Low temp			
Service	17 RTD02 Event Delay Time	*	1	0	500	
Service	18 RTD02 Failed T=SD, F=ALM False = Alarm, True = Shutdown	*	FALSE			

Service: S15 AO 1-4 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select function for AO01	*	1	1	24	
Service	02 Mode =		GG actual speed readout			
Service	03 Analog Out1 Val at 4 mA	*	0	-20000	20000	
Service	04 Analog Out1 Val at 20 mA	*	5000	-30000	30000	
Service	05 Present AO_01 dmd value		0			
Service	06 Select function for AO02	*	2	1	24	
Service	07 Mode =		GG reference speed readout			
Service	08 Analog Out2 Val at 4 mA	*	0	-20000	20000	
Service	09 Analog Out2 Val at 20 mA	*	5000	-20000	20000	
Service	10 Present AO_02 dmd value		6000			
Service	11 Select function for AO03	*	3	1	24	
Service	12 Mode =		PT actual speed readout			
Service	13 Analog Out3 Val at 4 mA	*	0	-20000	20000	
Service	14 Analog Out3 Val at 20 mA	*	2000	-30000	30000	
Service	15 Present AO_03 dmd value		0			
Service	16 Select function for AO04	*	4	1	24	
Service	17 Mode =		PT reference speed readout			
Service	18 Analog Out4 Val at 4 mA	*	0	-20000	20000	
Service	19 Analog Out4 Val at 20 mA	*	300	-30000	30000	
Service	20 Present AO_04 dmd value		3500			

Service: S16 AO 5-8 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select function for AO05	*	5	1	24	
Service	02 Mode =		Exh gas temp readout			
Service	03 Analog Out5 Val at 4 mA	*	0	-20000	20000	
Service	04 Analog Out5 Val at 20 mA	*	100	-30000	30000	
Service	05 Present AO_05 dmd value		0			
Service	06 Select function for AO06	*	6	1	24	
Service	07 Mode =		Comp disch press readout (psia)			
Service	08 Analog Out6 Val at 4 mA	*	0	-20000	20000	
Service	09 Analog Out6 Val at 20 mA	*	10	-30000	30000	
Service	10 Present AO_06 dmd value		10			
Service	11 Select function for AO07	*	1	1	24	
Service	12 Mode =		GG actual speed readout			
Service	13 Analog Out7 Val at 4 mA	*	0	-20000	20000	

Service	14 Analog Out7 Val at 20 mA	*	10000	-20000	20000	
Service	15 Present AO_07 dmd value		0			
Service	16 Select function for AO08	*	3	1	24	
Service	17 Mode =		PT actual speed readout			
Service	18 Analog Out8 Val at 4 mA	*	0	-20000	20000	
Service	19 Analog Out8 Val at 20 mA	*	10000	-20000	20000	
Service	20 Present AO_08 dmd value		0			

Service: S17 DI 1-6 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI01 T=NO F=NC	*	FALSE			
Service	02 Mode =		Normally closed switch			
Service	03 DI02 T=NO F=NC	*	FALSE			
Service	04 Mode =		Normally closed switch			
Service	05 DI03 T=NO F=NC	*	FALSE			
Service	06 Mode =		Normally closed switch			
Service	07 DI04 F=GTC T=Customer	*	FALSE			
Service	08 Mode =		System Acknowledge (ALM & SD)			
Service	09 DI04 T=NO F=NC	*	FALSE			
Service	10 Mode =		Normally closed switch			
Service	11 DI05 F=GTC T=Customer	*	FALSE			
Service	12 Mode =		PT Reference Lower Command			
Service	13 DI05 T=NO F=NC	*	FALSE			
Service	14 Mode =		Normally closed switch			
Service	15 Use PERM, ALM, SD? 0=Disabled, 1=Start Permissive, 2=Alarm, 3=Soft SD, 4=Hard SD	*	0	0	4	
Service	16 DI06 F=GTC T=Customer	*	FALSE			
Service	17 Mode =		PT Reference Raise Command			
Service	18 DI06 T=NO F=NC	*	FALSE			
Service	19 Mode =		Normally closed switch			
Service	20 Use PERM, ALM, SD?	*	0	0	4	

Service: S18 DI 7-11 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI07 F=GTC T=Customer	*	FALSE			
Service	02 Mode =		PT Reference Select Fast Rate			
Service	03 DI07 T=NO F=NC	*	FALSE			
Service	04 Mode =		Normally closed switch			
Service	05 Use PERM, ALM, SD? 0=Disabled, 1=Start Permissive, 2=Alarm, 3=Soft SD, 4=Hard SD	*	0	0	4	
Service	06 DI08 F=GTC T=Customer	*	FALSE			

Service	07 Mode =		PT Speed Signal Failed Override			
Service	08 DI08 T=NO F=NC	*	FALSE			
Service	09 Mode =		Normally closed switch			
Service	10 Use PERM, ALM, SD?	*	0	0	4	
Service	11 DI09 F=GTC T=Customer	*	FALSE			
Service	12 Mode =		Go To Rated Speed			
Service	13 DI09 T=NO F=NC	*	FALSE			
Service	14 Mode =		Normally closed switch			
Service	15 Use PERM, ALM, SD?	*	0	0	4	
Service	16 DI10 F=GTC T=Customer	*	FALSE			
Service	17 Mode =		Combustor Flame Detector			
Service	18 DI10 T=NO F=NC	*	FALSE			
Service	19 Mode =		Normally closed switch			
Service	20 Use PERM, ALM, SD?	*	0	0	4	
Service	21 DI11 F=GTC T=Customer	*	FALSE			
Service	22 Mode =		Fuel Selection / Transfer TRUE=Liquid			
Service	23 DI11 T=NO F=NC	*	FALSE			
Service	24 Mode =		Normally closed switch			
Service	25 Use PERM, ALM, SD?	*	0	0	4	

Service: S19 DI 12-16 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI12 F=GTC T=Customer	*	FALSE			
Service	02 Mode =		Enable Remote PT Reference			
Service	03 DI12 T=NO F=NC	*	FALSE			
Service	04 Mode =		Normally closed switch			
Service	05 Use PERM, ALM, SD? 0=Disabled, 1=Start Permissive, 2=Alarm, 3=Soft SD, 4=Hard SD	*	0	0	4	
Service	06 DI13 F=GTC T=Customer	*	FALSE			
Service	07 Mode =		Inhibit Synchronizer			
Service	08 DI13 T=NO F=NC	*	FALSE			
Service	09 Mode =		Normally closed switch			
Service	10 Use PERM, ALM, SD?	*	0	0	4	
Service	11 DI14 F=GTC T=Customer	*	FALSE			
Service	12 Mode =		Generator Breaker AUX (52) Closed			
Service	13 DI14 T=NO F=NC	*	FALSE			
Service	14 Mode =		Normally closed switch			
Service	15 Use PERM, ALM, SD?	*	0	0	4	
Service	16 DI15 F=GTC T=Customer	*	FALSE			
Service	17 Mode =		Utility/Mains			

			Breaker AUX Open			
Service	18 DI15 T=NO F=NC	*	FALSE			
Service	19 Mode =		Normally closed switch			
Service	20 Use PERM, ALM, SD?	*	0	0	4	
Service	21 DI16 F=GTC T=Customer	*	FALSE			
Service	22 Mode =		Enable Reactive Load Control (VAR/PF)			
Service	23 DI16 T=NO F=NC	*	FALSE			
Service	24 Mode =		Normally closed switch			
Service	25 Use PERM, ALM, SD?	*	0	0	4	

Service: S20 DI 17-21 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI17 F=GTC T=Customer	*	FALSE			
Service	02 Mode =		VAR/PF/Voltage Lower Command			
Service	03 DI17 T=NO F=NC	*	FALSE			
Service	04 Mode =		Normally closed switch			
Service	05 Use PERM, ALM, SD? 0=Disabled, 1=Start Permissive, 2=Alarm, 3=Soft SD, 4=Hard SD	*	0	0	4	
Service	06 DI18 F=GTC T=Customer	*	FALSE			
Service	07 Mode =		VAR/PF/Voltage Raise Command			
Service	08 DI18 T=NO F=NC	*	FALSE			
Service	09 Mode =		Normally closed switch			
Service	10 Use PERM, ALM, SD?	*	0	0	4	
Service	11 DI19 F=GTC T=Customer	*	FALSE			
Service	12 Mode =		Enable Process Control			
Service	13 DI19 T=NO F=NC	*	FALSE			
Service	14 Mode =		Normally closed switch			
Service	15 Use PERM, ALM, SD?	*	0	0	4	
Service	16 DI20 F=GTC T=Customer	*	FALSE			
Service	17 Mode =		Process Control Set point Lower Command			
Service	18 DI20 T=NO F=NC	*	FALSE			
Service	19 Mode =		Normally closed switch			
Service	20 Use PERM, ALM, SD?	*	0	0	4	
Service	21 DI21 F=GTC T=Customer	*	FALSE			
Service	22 Mode =		Process Control Set point Raise Command			
Service	23 DI21 T=NO F=NC	*	FALSE			
Service	24 Mode =		Normally closed switch			
Service	25 Use PERM, ALM, SD?	*	0	0	4	

Service: S21 DI 22-24 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI22 F=GTC T=Customer	*	FALSE			
Service	02 Mode =		Lower GG Reference			
Service	03 DI22 T=NO F=NC	*	FALSE			
Service	04 Mode =		Normally closed switch			
Service	05 Use PERM, ALM, SD? 0=Disabled, 1=Start Permissive, 2=Alarm, 3=Soft SD, 4=Hard SD	*	0	0	4	
Service	06 DI23 F=GTC T=Customer	*	FALSE			
Service	07 Mode =		Raise GG Reference			
Service	08 DI23 T=NO F=NC	*	FALSE			
Service	09 Mode =		Normally closed switch			
Service	10 Use PERM, ALM, SD?	*	0	0	4	
Service	11 DI24 F=GTC T=Customer	*	FALSE			
Service	12 Mode =		Spare Input - Not Used			
Service	13 DI24 T=NO F=NC	*	FALSE			
Service	14 Mode =		Normally closed switch			
Service	15 Use PERM, ALM, SD?	*	0	0	4	

Service: S22 DO 3-7 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select DO_03 function	*	3	1	35	
Service	02 Mode =		OPEN BREAKER COMMAND	<		
Service	03 DO_03 State =		Energized			
Service	04 Select DO_04 function	*	4	1	35	
Service	05 Mode =		Open Gas Fuel Shutoff Valves			
Service	06 DO_04 State =		De-energized			
Service	07 Select DO_05 function	*	5	1	35	
Service	08 Mode =		Open Liquid Fuel Shutoff Valves			
Service	09 DO_05 State =		De-energized			
Service	10 Select DO_06 function	*	6	1	35	
Service	11 Mode =		Ignitors On			
Service	12 DO_06 State =		De-energized			
Service	13 Select DO_07 function	*	7	1	35	
Service	14 Mode =		Starter Engaged			
Service	15 DO_07 State =		De-energized			

Service: S23 DO 8-12 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select DO_08 function	*	8	1	35	
Service	02 Mode =		ALARM			
Service	03 DO_08 State =		De-energized			

Service	04 Select DO_09 function	*	9	1	35	
Service	05 Mode =		GG SPEED SW1			
Service	06 DO_09 State =		De-energized			
Service	07 Select DO_10 function	*	12	1	35	
Service	08 Mode =		GG SPEED REF. LOWER LIMIT			
Service	09 DO_10 State =		Energized			
Service	10 Select DO_11 function	*	13	1	35	
Service	11 Mode =		PT SPEED REF. LOWER LIMIT			
Service	12 DO_11 State =		Energized			
Service	13 Select DO_12 function	*	18	1	35	
Service	14 Mode =		SPEED IN CONTROL			
Service	15 DO_12 State =		De-energized			

Service: S24 RELAY OUTPUT FORCING

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 OK to Enter Cal Mode?		TRUE			
Service	02 Enable Calibration Mode	*	FALSE			
Service	03 Relay Out 01 Dmd State	*	FALSE			
Service	04 Relay Out 02 Dmd State	*	FALSE			
Service	05 Relay Out 03 Dmd State	*	FALSE			
Service	06 Relay Out 04 Dmd State	*	FALSE			
Service	07 Relay Out 05 Dmd State	*	FALSE			
Service	08 Relay Out 06 Dmd State	*	FALSE			
Service	09 Relay Out 07 Dmd State	*	FALSE			
Service	10 Relay Out 08 Dmd State	*	FALSE			
Service	11 Relay Out 09 Dmd State	*	FALSE			
Service	12 Relay Out 10 Dmd State	*	FALSE			
Service	13 Relay Out 11 Dmd State	*	FALSE			
Service	14 Relay Out 12 Dmd State	*	FALSE			

Service: S25 ANALOG OUTPUT FORCING

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Analog Out 01 Demand Val	*	0	-20000	20000	
Service	02 Analog Out 01 Offset	*	0	-1000	1000	
Service	03 Analog Out 01 Gain	*	1	0	2	
Service	04 Analog Out 02 Demand Val	*	0	-20000	20000	
Service	05 Analog Out 02 Offset	*	0	-1000	1000	
Service	06 Analog Out 02 Gain	*	1	0	2	
Service	07 Analog Out 03 Demand Val	*	0	-20000	20000	
Service	08 Analog Out 03 Offset	*	0	-1000	1000	
Service	09 Analog Out 03 Gain	*	1	0	2	
Service	10 Analog Out 04 Demand Val	*	0	-20000	20000	
Service	11 Analog Out 04 Offset	*	0	-1000	1000	
Service	12 Analog Out 04 Gain	*	1	0	2	
Service	13 Analog Out 05 Demand Val	*	0	-20000	20000	
Service	14 Analog Out 05 Offset	*	0	-1000	1000	
Service	15 Analog Out 05 Gain	*	1	0	2	

Service	16 Analog Out 06 Demand Val	*	0	-20000	20000	
Service	17 Analog Out 06 Offset	*	0	-1000	1000	
Service	18 Analog Out 06 Gain	*	1	0	2	
Service	19 Voltage Bias Demand Val	*	0	-100	100	
Service	20 Voltage Bias Out Offset	*	0	-50	50	
Service	21 Voltage Bias Out Gain	*	1	0.20	1.5	

Service: S26 SERIAL PORT 1 SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Serial Port # 1? True= Modbus comms out Port 1	*	TRUE			
Service	02 Port 1 Set Baud Rate	*	10	1	12	
Service	03 Port 1 Baud Rate Fdbk		38,400			
Service	04 Port 1 Set Data Bits	*	2	1	2	
Service	05 Port 1 - Data Bits Fdbk		8 Data Bits			
Service	06 Port 1 Set Stop Bits	*	1	1	3	
Service	07 Port 1 Stop Bits Fdbk		1 Stop Bit			
Service	08 Port 1 Set Parity	*	1	1	3	
Service	09 Port 1 Parity Fdbk		OFF			
Service	10 Port 1 Set Driver Type	*	1	1	3	
Service	11 Port 1 Driver Type Fdbk		RS232			
Service	12 Modbus 1=ASCII, 2=RTU	*	1	1	2	
Service	13 Modbus Net Address	*	1	1	247	
Service	14 Modbus Time Out (sec)	*	3	1	30	
Service	15 Disable Modbus Writes Prohibits any Modbus Write Values from being used in the control	*	FALSE			

Service: S27 SERIAL PORT 2 SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Serial Port # 2? 1=Disabled 2=Modbus port 1 3=Modbus port 2 4=Control Assistant datalog capture 5=Not Used	*	3	2	5	
Service	02 Port 2 Choice Feedback		Modbus Port 2			
Service	03 Port 2 Set Baud Rate	*	10	1	12	
Service	04 Port 2 Baud Rate Fdbk		38,400			
Service	05 Port 2 Set Data Bits	*	2	1	2	
Service	06 Port 2 - Data Bits Fdbk		8 Data Bits			
Service	07 Port 2 Set Stop Bits	*	1	1	3	
Service	08 Port 2 Stop Bits Fdbk		1 Stop Bit			
Service	09 Port 2 Set Parity	*	1	1	3	
Service	10 Port 2 Parity Fdbk		OFF			
Service	11 Port 2 Set Mode	*	1	1	2	
Service	12 Port 2 Mode Fdbk		Line			
Service	13 Port 2 Set Flow Control	*	1	1	3	
Service	14 Port 2 Flow Fdbk		ON			
Service	15 Port 2 Set Echo	*	1	1	2	
Service	16 Port 2 Echo Fdbk		OFF			
Service	17 Port 2 End of Line	*	3	1	3	

Service	18 Port 2 Endline Fdbk		CRLF			
Service	19 Port 2 Set IGNCR	*	2	1	2	
Service	20 Port 2 IGNCR Fdbk		Ignore CR ON			
Service	21 Port 2 Set Driver Type	*	1	1	3	
Service	22 Port 2 Driver Type Fdbk		RS232			

Service: S28 AMBIENT TEMP SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Sel Amb Inlet Temp Type 1=No Ambient Temp Sensor 2=Amb Temp via T/C #9 3=Amb Temp via RTD #2 4=Amb Temp via 4-20mA	*	1	1	4	
Service	02 Sensor Type Selected		No Amb Temp Sensor			
Service	03 Ambient Inlet Temp Value		60			
Service	04 Ambient Sensor Default	*	60	20	200	
Service	05 Amb Bias EGT Curve X1	*	-50	-300	300	
Service	06 Amb Bias EGT Curve Y1	*	1	0	10	
Service	07 Amb Bias EGT Curve X2	*	0	-300	300	
Service	08 Amb Bias EGT Curve Y2	*	1	0	10	
Service	09 Amb Bias EGT Curve X3	*	59	-300	300	
Service	10 Amb Bias EGT Curve Y3	*	1	0	10	
Service	11 Amb Bias EGT Curve X4	*	140	-300	300	
Service	12 Amb Bias EGT Curve Y4	*	1	0	10	

Service: S29 REMOTE SPEED REF SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Using Rem PT Ref Snsr?		FALSE			
Service	02 Remote Ref Low Limit		0			
Service	03 Remote Ref High Limit		300			
Service	04 Remote Ref Lrg Error Rate	*	4	0	100	
Service	05 Remote Ref Small Window	*	0.4	0	10	
Service	06 Remote Ref Large Window	*	5	0	100	
Service	07 Always Enable Remote Ref	*	FALSE			

Service: S30 START / LITE-OFF SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Electric Lite-off?	*	TRUE			
Service	02 Start Ramp Rate	*	0.3	0.10	100	
Service	03 Start Ramp Gas Min Fuel	*	0	0	100	
Service	04 Start Ramp Liq Min Fuel	*	0	0	100	
Service	05 Manual Crank/Starter ON	*	FALSE			

Service: S31 VALVE CALIB & STROKE

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 OK to Enter Cal Mode?		TRUE			
Service	02 Enable Calibration Mode	*	FALSE			
Service	03 Gas Fuel Metr VLV Stroke	*	0	0	100	

Service	04 Gas Fuel Act 1 Output		0			
Service	05 Act1 Type 0-20 / 0-200mA 1=0-20 mA, 2=0-200mA range	*	0	0	1	
Service	06 Act1 Type Chosen		Current Output 0-20 mA			
Service	07 Act1 mA at 0% Dmnd	*	4	-200	200	
Service	08 Readback of Min mA value		4			
Service	09 Act1 mA at 100% Dmnd	*	20	-200	200	
Service	10 Readback of Max mA value		20			
Service	11 Act1 Offset	*	0	-200	200	
Service	12 Act1 Gain	*	1	0	2	
Service	13 Act1 Dither	*	0	0	3	
Service	14 Liq Fuel Metr VLV Stroke	*	0	0	100	
Service	15 Liquid Fuel Act 2 Output		0			
Service	16 Act2 Type 0-20 / 0-200mA	*	0	0	1	
Service	17 Act2 Type Chosen		Current Output 0-20 mA			
Service	18 Act2 mA at 0% Dmnd	*	4	-200	200	
Service	19 Readback of Min mA value		4			
Service	20 Act2 mA at 100% Dmnd	*	20	-200	200	
Service	21 Readback of Max mA value		20			
Service	22 Act2 Offset	*	0	-200	200	
Service	23 Act2 Gain	*	1	0	2	
Service	24 Act2 Dither	*	0	0	3	
Service	25 Initiate Fuel XFER T=Liq	*	FALSE			

Service: S32 GG SPEED CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 GG Prop Gain	*	0.06	0.001	100	
Service	02 GG Integral Gain	*	0.28	0.005	50	
Service	03 GG SDR	*	100	0.010	100	
Service	04 GG Ref Low Limit	*	6000	100	10000	
Service	05 GG Ref High Limit Base	*	10100	1000	30000	
Service	06 GG Corrected Ref Limit	*	10100	0	32768	
Service	07 GG Reference Default Rate	*	20	0	1000	
Service	08 GG Reference Fast Rate	*	50	0	1000	
Service	09 OVRD PT Sig below speed	*	7000	1000	30000	
Service	10 GG Speed Switch 1	*	1000	0	32768	
Service	11 GG Speed Switch 2	*	5000	0	32768	
Service	12 GG Overspeed Test Enable	*	FALSE			
Service	13 GG OVRSPD bias (+/-100)	*	0	-100	100	
Service	14 Use Corrected GG Spd?	*	FALSE			
Service	15 GG Speed Value		240			
Service	16 GG Speed Set point		6000			
Service	17 GG Control PID Output		33.98			

Service: S33 PT SPEED CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 PT Prop Gain 1	*	0.5	0	100	

Service	02 PT Integral Gain 1	*	0.8	0.010	50	
Service	03 PT SDR 1	*	0.2	0.010	100	
Service	04 Use Dual Dynamics	*	TRUE			
Service	05 PT Prop Gain 2	*	0.15	0	100	
Service	06 PT Integral Gain 2	*	0.5	0.010	50	
Service	07 PT SDR 2	*	0.2	0.010	100	
Service	08 PT Low Limit		3500			
Service	09 PT High Limit		3780			
Service	10 PT Reference Default Rate	*	2	0	1000	
Service	11 PT Reference Fast Rate	*	10	1	1000	
Service	12 Use PT Auto Override Tune True if using GTC start sequence, False for external seq.	*	TRUE			
Service	13 Time to wait for Speed		15			
Service	14 PT Speed Switch 1	*	1000	50	32768	
Service	15 PT Speed Switch 2	*	2000	50	32768	
Service	16 PT Speed Switch 3	*	3600	50	32768	
Service	17 PT Overspeed Test Enable	*	FALSE			
Service	18 PT OVRSPD bias (+/-100)	*	0	-100	100	
Service	19 PT Speed Value		100			
Service	20 PT Speed Set point		3500			
Service	21 PT Control PID Output		110			
Service	22 Raise PT Reference	*	FALSE			
Service	23 Lower PT Reference	*	FALSE			

Service: S34 CDP to Fuel Limit Curve
**** If unfamiliar with setting up these schedules – refer to the CDP/Fuel area of the Troubleshooting Section ****
CDP/Fuel SCHEDULE biased on CDP (as the X value) as scaled by the user. Output of curves block (Y value) will limit LSS bus in scale of 0-100%, i.e. 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 or liquid fuel.
**** These curves are required for each fuel used – turbine will not run with default values ****
**** If a Fuel is not used – place all Y values at 100 % ****

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Gas CDP/WF CURVE X1 =	*	2	0	1000	
Service	02 Gas CDP/WF CURVE Y1 =	*	0	0	100	
Service	03 Gas CDP/WF CURVE X2 =	*	10	0	1000	
Service	04 Gas CDP/WF CURVE Y2 =	*	5	0	100	
Service	05 Gas CDP/WF CURVE X3 =	*	90	0	1000	
Service	06 Gas CDP/WF CURVE Y3 =	*	25	0	100	
Service	07 Gas CDP/WF CURVE X4 =	*	120	0	1000	
Service	08 Gas CDP/WF CURVE Y4 =	*	50	0	100	
Service	09 Gas CDP/WF CURVE X5 =	*	250	0	1000	
Service	10 Gas CDP/WF CURVE Y5 =	*	100	0	100	
Service	11 Curve Output Value (Gas)		5			
Service	12 Liq CDP/WF CURVE X1 =	*	2	0	1000	
Service	13 Liq CDP/WF CURVE Y1 =	*	0	0	100	

Service	14 Liq CDP/WF CURVE X2 =	*	10	0	1000	
Service	15 Liq CDP/WF CURVE Y2 =	*	5	0	100	
Service	16 Liq CDP/WF CURVE X3 =	*	90	0	1000	
Service	17 Liq CDP/WF CURVE Y3 =	*	25	0	100	
Service	18 Liq CDP/WF CURVE X4 =	*	120	0	1000	
Service	19 Liq CDP/WF CURVE Y4 =	*	50	0	100	
Service	20 Liq CDP/WF CURVE X5 =	*	250	0	1000	
Service	21 Liq CDP/WF CURVE Y5 =	*	100	0	100	
Service	22 Curve Output Value (Liq)		5			

Service: S35 ACCEL CONTROL PID
**** If unfamiliar with setting up these schedules – refer to the Accel/Decel area of the Troubleshooting Section. Use of this control PID is optional ****
The reference for the PID set point is defined by the curve entered here. The forcing function (X values) input is the corrected GG speed and the output (Y values) is the acceptable acceleration limit of the GG shaft in rpm/sec.

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Accel PID?	*	FALSE			
Service	02 Confirm Choice		FALSE			
Service	03 Accel PID Prop Gain	*	0.004	0.001	1	
Service	04 Accel PID Integral Gain	*	20	0.100	50	
Service	05 Accel Ref Curv X1 =	*	0	0	500	
Service	06 Accel Ref Curv Y1 =	*	75	10	2000	
Service	07 Accel Ref Curv X2 =	*	5900	1000	20000	
Service	08 Accel Ref Curv Y2 =	*	75	10	2000	
Service	09 Accel Ref Curv X3 =	*	6800	1000	20000	
Service	10 Accel Ref Curv Y3 =	*	200	10	2000	
Service	11 Accel Ref Curv X4 =	*	8130	1000	20000	
Service	12 Accel Ref Curv Y4 =	*	1545	100	2000	
Service	13 Accel Ref Curv X5 =	*	9530	1000	20000	
Service	14 Accel Ref Curv Y5 =	*	725	100	2000	
Service	15 Accel Ref Curv X6 =	*	10200	1000	20000	
Service	16 Accel Ref Curv Y6 =	*	725	100	2000	
Service	17 GG ACCEL Value		240			
Service	18 GG ACCEL Set point		75			
Service	19 ACCEL Control PID Output		5			
Service	20 ACCEL Prop Gain Sub-Idle	*	0.044	0.0010	1	

Service: S36 DECEL CONTROL PID
DECEL SCHEDULE based on the Derivative of the GG speed (as the X value). Output of curves block will be the negative speed rate of change limit that will be the Reference signal for the PID.

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Decel PID?	*	FALSE			
Service	02 Confirm Choice		FALSE			
Service	03 Decel PID Prop Gain	*	0.008	0.001	1	

Service	04 Decel PID Integral Gain	*	20	0.10	50	
Service	05 Decel Ref Curv X1 =	*	0	1000	15000	
Service	06 Decel Ref Curv Y1 =	*	-100	-5000	5000	
Service	07 Decel Ref Curv X2 =	*	7200	1000	15000	
Service	08 Decel Ref Curv Y2 =	*	-100	-5000	5000	
Service	09 Decel Ref Curv X3 =	*	7763	1000	15000	
Service	10 Decel Ref Curv Y3 =	*	-750	-5000	5000	
Service	11 Decel Ref Curv X4 =	*	7930	1000	15000	
Service	12 Decel Ref Curv Y4 =	*	-2400	-5000	5000	
Service	13 Decel Ref Curv X5 =	*	8353	1000	15000	
Service	14 Decel Ref Curv Y5 =	*	-4200	-5000	5000	
Service	15 Decel Ref Curv X6 =	*	10050	1000	15000	
Service	16 Decel Ref Curv Y6 =	*	-4200	-5000	5000	
Service	17 GG DECEL Value		240			
Service	18 GG DECEL Set point		-100			
Service	19 DECEL Control PID Output		0			

Service: S37 DECEL Curve (CDP) SETUP
DECEL SCHEDULE biased by CDP (as the X value) as scaled by the user. Output of curves block will limit HSS bus in scale of 0-100%, i.e. if output is 50, for a given input, then fuel flow will not be able to decrease below 50%. There are separate curves for gas or liquid fuel.

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Decel (CDP) Curve?		TRUE			
Service	02 Gas DECEL CURVE X1 =	*	0	0	1000	
Service	03 Gas DECEL CURVE Y1 =	*	0	0	100	
Service	04 Gas DECEL CURVE X2 =	*	35	0	1000	
Service	05 Gas DECEL CURVE Y2 =	*	5	0	100	
Service	06 Gas DECEL CURVE X3 =	*	75	0	1000	
Service	07 Gas DECEL CURVE Y3 =	*	5	0	100	
Service	08 Gas DECEL CURVE X4 =	*	250	0	1000	
Service	09 Gas DECEL CURVE Y4 =	*	5	0	100	
Service	10 Gas DECEL CURVE X5 =	*	300	0	1000	
Service	11 Gas DECEL CURVE Y5 =	*	5	0	100	
Service	12 Curve Output Value (Gas)		1.43			
Service	13 Liq DECEL CURVE X1 =	*	0	0	1000	
Service	14 Liq DECEL CURVE Y1 =	*	0	0	100	
Service	15 Liq DECEL CURVE X2 =	*	35	0	1000	
Service	16 Liq DECEL CURVE Y2 =	*	5	0	100	
Service	17 Liq DECEL CURVE X3 =	*	75	0	1000	
Service	18 Liq DECEL CURVE Y3 =	*	5	0	100	
Service	19 Liq DECEL CURVE X4 =	*	250	0	1000	
Service	20 Liq DECEL CURVE Y4 =	*	5	0	100	
Service	21 Liq DECEL CURVE X5 =	*	300	0	1000	
Service	22 Liq DECEL CURVE Y5 =	*	5	0	100	
Service	23 Curve Output Value (Liq)		1.43			

Service: S38 CDP CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value

Service	01 CDP Control Set point	*	180	20	500	
Service	02 CDP PID Proportional Gn	*	0.25	0.001	100	
Service	03 CDP PID Integral Gain	*	2	0	50	
Service	04 CDP PID SDR term	*	100	0.010	100	
Service	05 Use Corrected CDP Setpt	*	FALSE			
Service	06 Turbine CDP (psia)		10			
Service	07 CDP Control PID		101			
Service	08 CDP Overpressur Set point	*	190	50	500	

Service: S39 EGT CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 EGT Contrl Base Set point	*	1200	100	2500	
Service	02 EGT PID Proportional Gn	*	0.1	0.001	100	
Service	03 EGT PID Integral Gain	*	2	0	50	
Service	04 EGT PID SDR term	*	100	0.010	100	
Service	05 Use Temp Start Ramp	*	FALSE			
Service	06 Temp Ramp Lo Temp	*	1575	100	2000	
Service	07 Temp Ramp Hi Temp	*	1575	100	2000	
Service	08 Temp Ramp Rise Rate	*	10	1	100	
Service	09 Use Corrected Temp?	*	FALSE			
Service	10 EGT Average Temp		0			
Service	11 EGT Control PID Output		110			

Service: S40 REAL LOAD CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Confirm KW Sensr Range		10000			
Service	02 Droop Percent	*	5	0.010	8	
Service	03 Min Load KW Set point	*	500	10	30000	
Service	04 Base Load KW Set point	*	9000	10	30000	
Service	05 Use Remote KW Set point	*	FALSE			
Service	06 Auto Loading Rate (sec)	*	60	1	7200	
Service	07 Normal Unload Rate	*	60	1	7200	
Service	08 Low Load / Open Brkr Lvl		500			
Service	09 Low Load Alarm Level KW level set point	*	5	0	30000	
Service	10 High Load Alarm Level	*	300	0	30000	
Service	11 Use Load Limiter (=2)	*	1	1	2	
Service	12 Load PID Prop Gain	*	0.1	0.001	100	
Service	13 Load PID Integral Gain	*	2	0	50	
Service	14 Load PID Output Value		9.36			
Service	15 Enable LS Functions	*	TRUE			
Service	16 Utility Breaker Open?		FALSE			
Service	17 XFER Rate IN/OUT of LS	*	10	0.10	60	
Service	18 Number of Network Nodes		1			
Service	19 Number of Nodes in LS		1			
Service	20 Enable Baseload Mode	*	FALSE			

Service: S41 PowerSense SETUP

Category	Field Name	T	Initial Value	Low	High	User Value

Service	01 GEN Phase A Cur Gain	*	1	0.5	1.5	
Service	02 GEN Phase B Cur Gain	*	1	0.5	1.5	
Service	03 GEN Phase C Cur Gain	*	1	0.5	1.5	
Service	04 GEN Phase A Volt Gain	*	1	0.5	1.5	
Service	05 GEN Phase B Volt Gain	*	1	0.5	1.5	
Service	06 GEN Phase C Volt Gain	*	1	0.5	1.5	
Service	07 GEN PT Avg Volts		0			
Service	08 Voltage Units		VOLTS			
Service	09 GEN CT Avg Amps		0			
Service	10 Current Units		AMPS			
Service	11 Mains Phase A Cur Gain	*	1	0.5	1.5	
Service	12 Mains Phase B Cur Gain	*	1	0.5	1.5	
Service	13 Mains Phase C Cur Gain	*	1	0.5	1.5	
Service	14 Mains Phase A Volt Gain	*	1	0.5	1.5	
Service	15 Mains Phase B Volt Gain	*	1	0.5	1.5	
Service	16 Mains Phase C Volt Gain	*	1	0.5	1.5	
Service	17 BUS PT Avg Volts		0			
Service	18 Voltage Units		VOLTS			
Service	19 BUS CT Avg Amps		0			
Service	20 Current Units		AMPS			

Service: S42 SYNCHRONIZER

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 SYNC MODE 1=Disable, 2= Permissive, 3=Run, 4= Check	*	4	1	4	
Service	02 SYNC MODE		RUN/AUTO			
Service	03 SYNC GAIN	*	0.15	0.001	100	
Service	04 SYNC INTEGRAL	*	0.56	0.010	100	
Service	05 VOLTAGE RAMP TIME	*	300	1	600	
Service	06 SYNCHROSCOPE		180			
Service	07 VOLTAGE MATCHING	*	TRUE			
Service	08 VOLTAGE MATCHING		ENABLED			
Service	09 VOLTAGE WINDOW	*	1	0.10	10	
Service	10 SYNC TYPE True=Phase Matching False=Slip Frequency	*	TRUE			
Service	11 SYNC TYPE		PHASE CONTROL			
Service	12 PHASE WINDOW	*	10	2	20	
Service	13 SLIP WINDOW	*	0.1	-0.3	0.30	
Service	14 SLIP FREQUENCY	*	0.1	-0.3	0.30	
Service	15 CLOSE ATTEMPTS	*	3	0	20	
Service	16 RECLOSE DELAY	*	5	1	1200	
Service	17 AUTO RESYNCHRONIZE	*	TRUE			
Service	18 AUTO RESYNCHRONIZE		ENABLED			
Service	19 CIRCUIT BREAKER TYPE True = Breaker, False = Contactor	*	TRUE			
Service	20 CIRCUIT BREAKER TYPE		BREAKER			
Service	21 SYNCH TIMEOUT	*	180	0	1200	
Service	22 DEADBUS CLOSURE	*	TRUE			
Service	23 DEADBUS CLOSURE		ENABLED			

Service	24 BREAKER HOLD TIME	*	1	0	5	
Service	25 BKR CLOSE DLY TIME	*	0.1	0.010	2	
Service	26 ENABLE SYNC TEST	*	FALSE			
Service	27 ENABLE SYNC TEST		DISABLED			
Service	28 SLIP WITHIN LIMITS		FALSE			
Service	29 PHASE WITHIN LIMITS		FALSE			
Service	30 VOLTAGE WITHIN LIMITS		FALSE			
Service	31 RECLOSE ATTEMPTS		0			
Service	32 SYNC TIMEOUT REMAINING		180			
Service	33 SYNC STATE		DISABLED			
Service	34 SYNC MODE		DISABLED			
Service	35 GEN STABLIZE TIME DELAY	*	30	1	30000	
Service	36 OPEN GEN BREAKER CMD	*	FALSE			

Service: S43 REACTIVE LOAD CONTROL

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select VAR/PF Mode 1=VAR Control, 2=Power Factor	*	0	0	2	
Service	02 Mode Selected		Disabled			
Service	03 VARPF GAIN	*	0.2	0.009995	20	
Service	04 VOLTAGE RAMP TIME	*	20	0	1000	
Service	05 PF SHARE GAIN	*	0.2	0.001007	20	
Service	06 VARPF INTEGRAL GN	*	0.1	0	20	
Service	07 VAR/PF PID Output		0			
Service	08 INITIAL VAR REFERENCE	*	10	-30000	30000	
Service	09 VAR REFERENCE		0			
Service	10 GEN TOTAL VAR		0			
Service	11 INITIAL PF REFERENCE	*	0	-0.5	0.5	
Service	12 PF REFERENCE		1			
Service	13 PF REF DIRECTION		Lag			
Service	14 PF DEADBAND	*	0.025	0	1	
Service	15 GEN AVERAGE PF		1			
Service	16 PF ACTUAL DIRECTION		Lag			
Service	17 OPERATING VOLTAGE	*	480	0.001007	30000	
Service	18 ENABLE VAR/PF CNTRL	*	FALSE			
Service	19 VAR/PF CNTRL STATUS		VAR/PF Disabled			
Service	20 LOWER SETPT	*	FALSE			
Service	21 RAISE SETPT	*	FALSE			
Service	22 VOLTAGE BIAS OUTPUT		0			
Service	23 KVA Switch Hi Level	*	30	0	30000	
Service	24 KVA Switch Lo Level	*	5	0	30000	
Service	25 Use Voltage Trim?	*	FALSE			

Service: S44 PROCESS CONTROL

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 PROCESS GAIN	*	0.05	0.001	20	
Service	02 PROCESS INTEGRAL GN	*	0.3	0	20	
Service	03 PROCESS DERIVATIVE	*	100	0.010	100	
Service	04 PROCESS PID OUTPUT		0			
Service	05 PROCESS DEADBAND	*	0	-30000	30000	

Service	06 PROCESS DROOP	*	0	0	50	
Service	07 PROCESS FILTER	*	1	0.010	10	
Service	08 PROCESS SET POINT	*	0	-30000	30000	
Service	09 ENABLE MODBUS SETPT	*	FALSE			
Service	10 MODBUS REF VALUE		0			
Service	11 ENABLE REM ANALOG SET	*	FALSE			
Service	12 PROCESS REF VALUE		-500.18			
Service	13 PROCESS INPUT VALUE		-500.21			
Service	14 ENABLE PROC CNTRL	*	FALSE			
Service	15 PROCESS PERMS MET?		FALSE			
Service	16 PROCESS CNTRL ON?		FALSE			
Service	17 ENABLE DISCRET INS	*	FALSE			
Service	18 LOWER PROCESS SETPT	*	FALSE			
Service	19 RAISE PROCESS SETPT	*	FALSE			
Service	20 Direct Proc (F=Indirect)	*	TRUE			
Service	21 Process Load Rate	*	0.2	0	10	
Service	22 Process Unload Rate	*	0.2	0	10	
Service	23 This Unit is Proc Master	*	TRUE			

Service: S45 GENERATOR PROTECTION 1

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 GEN Over Volt Alm Level	*	4400	0	30000	
Service	02 GEN Under Volt Alm Level	*	3900	0	30000	
Service	03 GEN Over/Under Vlt Delay	*	10	0.10	120	
Service	04 GEN Phas OverCur AlmLvl	*	2600	0	3000	
Service	05 GENPhas OverCur CurvShft	*	1	0.010	10	
Service	06 GEN Over Freq Alm Level	*	70	40	70	
Service	07 GEN Under Freq Alm Level	*	40	40	70	
Service	08 GEN Over/Undr Freq Delay	*	10	0.10	120	
Service	09 GEN Over Power Alm Level	*	11000	-30000	30000	
Service	10 GEN Reverse Powr Alm Lvl	*	-50	-30000	30000	
Service	11 GEN Direct Pwr Curv Shft	*	1	0.010	10	
Service	12 GEN Over VAR Alm Level	*	3300	-30000	30000	
Service	13 GEN Reverse VAR Alm Lvl	*	-50	-30000	30000	
Service	14 GEN Direct VAR Alm Delay	*	10	0.10	120	
Service	15 GEN NegPhzSeq OvrVlt Lvl	*	150	0	30000	
Service	16 GEN NegPhzSeq OvrVlt Dly	*	10	0.10	120	
Service	17 GEN NegPhzSeq OvrCur Lvl	*	150	0	30000	
Service	18 GEN NegPhzSeq OvrCur Dly	*	10	0.10	120	
Service	19 GEN PhasCur Diff Alm Lvl	*	150	0	30000	
Service	20 GEN PhasCurDiff CurvShft	*	1	0.010	10	

Service: S46 GENERATOR PROTECTION 2

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 GEN Over Volt Warn Level	*	4300	0	30000	
Service	02 GEN Under Volt Warn Levl	*	300	0	30000	
Service	03 GEN Over/Under Vlt Delay	*	10	0.10	120	
Service	04 GEN Phas OverCur WarnLvl	*	2600	0	3000	
Service	05 GEN Over Freq Warn Level	*	70	40	70	

Service	06 GEN Under Freq Warn Levl	*	40	40	70	
Service	07 GEN Over/Undr Freq Delay	*	10	0.10	120	
Service	08 GEN Over Power Warn Levl	*	11000	-30000	30000	
Service	09 GEN Revers Powr Warn Lvl	*	-50	-30000	30000	
Service	10 GEN Over VAR Warn Level	*	3300	-30000	30000	
Service	11 GEN Reverse VAR Warn Lvl	*	-50	-30000	30000	
Service	12 GEN Direct VAR Warn Dely	*	10	0.10	120	
Service	13 GEN NegPhzSeq OvrVlt Lvl	*	150	0	30000	
Service	14 GEN NegPhzSeq OvrVlt Dly	*	10	0.10	120	
Service	15 GEN NegPhzSeq OvrCur Lvl	*	150	0	30000	
Service	16 GEN NegPhzSeq OvrCur Dly	*	10	0.10	120	
Service	17 GEN PhasCur Dif Warn Lvl	*	150	0	30000	

Service: S47 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Atlas HW/OpSys Fault	*	4	3	4	
Service	02 Atlas Input Power Alm For all following Events – 1 = Disabled 2 = Alarm 3= Soft Shutdown (Open Breaker) 4 = Hard Shutdown (Fuel Chop) 5 = Reserved/future (Not Used)	*	2	1	5	
Service	03 Atlas H/W High Temp	*	2	1	5	
Service	04 Control is NOT Configurd	*	4	1	5	
Service	05 Serial Port #1 Fault	*	2	1	5	
Service	06 Serial Port #2 Fault	*	1	1	5	
Service	07 Not Used	*	1	1	5	
Service	08 Speed Signal #1 Failed	*	2	1	5	
Service	09 Speed Signal #2 Failed	*	2	1	5	
Service	10 Analog Input #1 Failed		1			
Service	11 Analog Input #2 Failed		1			
Service	12 Analog Input #3 Failed		1			
Service	13 Analog Input #4 Failed		1			
Service	14 Analog Input #5 Failed		1			
Service	15 Analog Input #6 Failed		1			
Service	16 Alms 16-39 are Configurd		in DI Setup Menus			
Service	40 AI Configuration Error	*	2	1	5	

Service: S48 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
Service	41 Speed Signal #3 Failed	*	2	1	5	
Service	42 Speed Signal #4 Failed	*	2	1	5	
Service	43 Analog Input #7 Failed		4			
Service	44 Analog Input #8 Failed		4			
Service	45 Analog Input #9 Failed		2			
Service	46 RTD Signal #1 Failed	*	1	1	5	
Service	47 RTD Signal #2 Failed	*	1	1	5	
Service	48 Not Used	*	1	1	5	
Service	49 All GG Speed Sig Failed	*	4	1	5	

Service	50 GG Overspeed Alm Level	*	2	1	5	
Service	51 GG Speed Signal Diff	*	2	1	5	
Service	52 GG Overspeed SD Level		4			
Service	53 All PT Spd Sig Failed		4			
Service	54 PT Overspeed Test Enabld	*	2	1	5	
Service	55 PT Overspeed Alm Level		2			
Service	56 PT Speed Signal Diff	*	1	1	5	
Service	57 PT Overspeed SD Level	*	4	1	5	
Service	58 CDP Over High Press Levl	*	2	1	5	
Service	59 Gas Fuel Drivr Flt (Alt)	*	2	1	5	
Service	60 Liq Fuel Drivr Flt (Alt)	*	2	1	5	

Service: S49 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
Service	61 Gas Fuel Driver Fault		4			
Service	62 Liquid Fuel Driver Fault		4			
Service	63 Calibration Mode Enabled	*	2	1	5	
Service	64 Starter Engaged - No Spd	*	2	1	5	
Service	65 GT Failed to Lite-off	*	4	1	5	
Service	66 Lost Flame in Combustor	*	4	1	5	
Service	67 Failed to Reach GG Idle	*	4	1	5	
Service	68 Fail to Reach PT Rated	*	4	1	5	
Service	69 Start Cmd Lost whil Run	*	1	1	5	
Service	70 NStop Cmplt-Turnoff Strt	*	2	1	5	
Service	71 Not Used	*	1	1	5	
Service	72 T/C Sensor #1 Failed	*	2	1	5	
Service	73 T/C Sensor #2 Failed	*	2	1	5	
Service	74 T/C Sensor #3 Failed	*	2	1	5	
Service	75 T/C Sensor #4 Failed	*	2	1	5	
Service	76 T/C Sensor #5 Failed	*	2	1	5	
Service	77 T/C Sensor #6 Failed	*	2	1	5	
Service	78 T/C Sensor #7 Failed	*	2	1	5	
Service	79 T/C Sensor #8 Failed	*	2	1	5	
Service	80 T/C Sensor #9 Failed	*	1	1	5	
Service	81 T/C Sensor #10 Failed	*	1	1	5	
Service	82 Too Many T/C Failed ALM	*	1	1	5	
Service	83 Too Many T/C Failed SD	*	4	1	5	
Service	84 3 Adjacent T/C Failed	*	4	1	5	
Service	85 Excessive EGT Spread ALM	*	2	1	5	

Service: S50 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
Service	86 Excessive EGT Spread SD	*	4	1	5	
Service	87 EGT single T/C Avg Faild	*	1	1	5	
Service	88 EGT Overtemp SD	*	4	1	5	
Service	89 EGT Temp Failed Low	*	1	1	5	
Service	90 EGT Overtemp ALM	*	1	1	5	
Service	91 Analog EGT Input Failed	*	1	1	5	
Service	92 EGT T/C #1 Diff from Avg	*	1	1	5	

Service	93 EGT T/C #2 Diff from Avg	*	1	1	5	
Service	94 EGT T/C #3 Diff from Avg	*	1	1	5	
Service	95 EGT T/C #4 Diff from Avg	*	1	1	5	
Service	96 EGT T/C #5 Diff from Avg	*	1	1	5	
Service	97 EGT T/C #6 Diff from Avg	*	1	1	5	
Service	98 EGT T/C #7 Diff from Avg	*	1	1	5	
Service	99 EGT T/C #8 Diff from Avg	*	1	1	5	
Service	100 Following Alarms are		Power Sense Options			
Service	101 Gen Brkr Feedback Fail	*	3	1	5	
Service	102 Gen Brkr Shunt Trip Err	*	3	1	5	
Service	103 GEN Neg Phase Curr Alm	*	2	1	5	
Service	104 GEN Neg Phase Curr Warn	*	1	1	5	
Service	105 GEN Neg Phase Volt Alm	*	2	1	5	
Service	106 GEN Neg Phase Volt Warn	*	1	1	5	
Service	107 GEN Over Frequency Alm	*	2	1	5	
Service	108 GEN Over Frequncy Warn	*	1	1	5	
Service	109 GEN Under Frequncy Alm	*	2	1	5	
Service	110 GEN Under Frequncy Warn	*	1	1	5	

Service: S51 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
Service	111 GEN Over Volts Alm	*	2	1	5	
Service	112 GEN Over Volts Warn	*	1	1	5	
Service	113 GEN Under Volts Alm	*	2	1	5	
Service	114 GEN Under Volts Warn	*	1	1	5	
Service	115 GEN OverPowr Protct Alm	*	3	1	5	
Service	116 GEN OverPwr Protct Warn	*	2	1	5	
Service	117 GEN Revrs Pwr Prot Alm	*	3	1	5	
Service	118 GEN Revrs Pwr Prot Wrn	*	2	1	5	
Service	119 GEN Over VARS Prot Alm	*	2	1	5	
Service	120 GEN Over VARS Prot Wrn	*	1	1	5	
Service	121 GEN Under VARS Prot Alm	*	2	1	5	
Service	122 GEN Under VARS Prot Wrn	*	1	1	5	
Service	123 GEN Phase Diff Curr Alm	*	2	1	5	
Service	124 GEN Phaz Diff Curr Warn	*	1	1	5	
Service	125 GEN Phaz Over Curr Alm	*	3	1	5	
Service	126 GEN Phaz Over Curr Warn	*	2	1	5	
Service	127 KVA Switch Active	*	1	1	5	
Service	128 Speed / Freq Mismatch	*	3	1	5	
Service	129 Phase Rotation Alarm	*	3	1	5	
Service	130 Process Value High Alm	*	1	1	5	
Service	131 Process Value Low Alm	*	1	1	5	
Service	132 Unit Fail to Synchroniz	*	2	1	5	
Service	133 Voltage Bias Range Alm	*	1	1	5	
Service	134 High Load Alarm Level	*	1	1	5	
Service	135 Low Load Alarm Level	*	1	1	5	

Service: S52 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value

Service	136 Not Used	*	1	1	5	
Service	137 Not Used	*	1	1	5	
Service	138 Not Used	*	1	1	5	
Service	139 Not Used	*	1	1	5	
Service	140 Not Used	*	1	1	5	
Service	141 Not Used	*	1	1	5	
Service	142 Not Used	*	1	1	5	
Service	143 Not Used	*	1	1	5	
Service	144 Not Used	*	1	1	5	
Service	145 Not Used	*	1	1	5	
Service	146 Not Used	*	1	1	5	
Service	147 Not Used	*	1	1	5	
Service	148 Not Used	*	1	1	5	
Service	149 Not Used	*	1	1	5	
Service	150 Not Used	*	1	1	5	

Service: S53 START/STOP SEQUENCE

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Auto Start/Stop SEQ?	*	TRUE			
Service	02 Use Fuel SOV/IGN Output?	*	TRUE			
Service	03 Min Starter Crank Speed	*	2000	100	2000	
Service	04 Time to wait for Speed	*	15	0	120	
Service	05 Purge Timer/Crank Time?	*	20	0	3000	
Service	06 Wait for Lite-off Tmr Gas	*	10	2	30	
Service	07 Wait for Lite-off Tmr Liq	*	15	2	30	
Service	08 Starter Cutout Speed	*	3500	100	5000	
Service	09 Ignitors OFF Speed	*	5400	100	10000	
Service	10 Max Time to GG Idle	*	60	5	600	
Service	11 Warmup Time at GG Idle	*	20	2	600	
Service	12 Raise GGRef at FastRate?	*	TRUE			
Service	13 GG Fast Rate Setting		50			
Service	14 Max Time to PT Rated	*	60	5	600	
Service	15 Cooldown Time/Idle	*	10	0	1800	

Service: S54 TURBINE PARAMETERS

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Alarm Latch Status		FALSE			
Service	02 Alarm Condition #		0			
Service	03 Shutdown Latch Status		TRUE			
Service	04 Shutdown Condition #		4			
Service	05 LSS Bus Position %		0			
Service	06 HSS Bus Position %		0			
Service	07 Fuel Valve Demand %		0			
Service	08 Control Mode		Shutdown Exists			
Service	09 PT Speed (rpm)		100			
Service	10 PT Speed Ref (rpm)		3500			
Service	11 EGT Temp (deg F)		0			
Service	12 Amb Inlet Temp (deg F)		60			
Service	13 CDP (psia)		10			

Service	14 GEN Breaker Closed?		FALSE			
Service	15 Utility Breaker Closed?		TRUE			
Service	16 Turbine Load		0			
Service	17 GEN Volt Amps		0			
Service	18 GEN Volt Amps Reactive		0			
Service	19 Power Units		KW, KVA, KVAR			
Service	20 Start Sequence Step		Not in a Start Sequence			
Service	21 Stop Sequence Step		Not in a Stop Sequence			
Service	22 Load Control Mode		Manual PT Ref Control			
Service	23 Alarm Acknowledge	*	FALSE			
Service	24 Alarm Reset	*	FALSE			

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 hi or lo
- Relay outputs – NO or NC, contact load ratings
- MPU Speed sensor specifications (# of teeth, gear ratio, hi/lo fail spds)
- 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)

Start-up Information

- Electrical or Mechanical lite-off, valve degrees, start ramp percent
- Fuel Info – Type, supply pressure, LHV, SG
- Manifold pressure at lite-off
- Any EGT Start overtemp limit
- Time from Lite-off to GG Control (typically GG Lower Ref limit)
- Time from GG Idle to PT Rated speed

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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Please reference publication 26262B.

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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