WOODWARD

Product Manual 26284
(Revision D)
Original Instructions

GTC100 Gas Turbine Control for Generator or Compressor Applications

8262-1001—with PowerSense (for Power Gen)
8262-1003—typically for Compressor Drive

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.**

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

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Important Definitions

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

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

WARNING

Overspeed / Overtemperature / Overpressure

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

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

WARNING

Personal Protective Equipment

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

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

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

WARNING

Start-up

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

WARNING

Automotive Applications

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

NOTICE

Battery Charging Device

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

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

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

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

Follow these precautions when working with or near the control.

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

Chapter 1.
General Information

Introduction

This manual describes the GTC100 Digital Control System designed to control single-shaft gas turbines for compressor or generator applications. It is pre-programmed to perform fuel metering control, start/stop sequencing and communications to a package OI (Operator Interface) or plant DCS (Distributed Control System). There are two models, one with a PowerSense module and one without that module. This 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 GTC100 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.

- The **GTC100** performs the functions described above. It is intended for applications on turbine compressor packages, but can also be applied on power generation packages.
- The **GTC100 with PowerSense** includes a module in the control package that will enable the GTC to receive generator and bus signals so that the control can add synchronization, load sharing and power metering functions to the features of the base GTC100 listed above. For isolated bus operation the control will operate in isochronous, and can close the generator to a dead bus. It is intended for use on systems where generator sets operate in parallel on a common bus and may be tied to the utility mains.

Scope of Supply

Item #	Description
8262-1001	GTC100—AtlasSC w/ PSENS (Single Shaft Gas Turbine Fuel Control)
8262-1003	GTC100—AtlasSC (Single Shaft Gas Turbine Fuel Control)
BCD85213	CD—GTC100 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 GTC100 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. The model with PowerSense includes an I/O module that interfaces to Generator and Utility bus PT's and CT's allowing this version to include synchronization, power metering, breaker commands and load sharing to the base offering of the GTC100. 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 GTC100 AtlasSC Digital Control is designed to be bulkhead mounted in a control panel. The complete unit contains a 'SmartCore' CPU module, a Power Supply board, and may contain the optional PowerSense module. 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, signal accuracy or environmental specifications, 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 GTC100 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 LED's 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	6	Current 4-20 mA dc or Voltage 0-5 Vdc
MPU Speed Sensor	2	100–20 000 Hz
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	6	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 memory on the CPU module circuit board. The GTC100 application is designed as a fuel control for a single-shaft gas turbine and is intended to provide proper fuel demand control from the initial 'Fuel On' signal to 'Fuel Off'. The GTC100 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 unit with the PowerSense option includes monitoring of the generator and Bus power, synchronization and load sharing. 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.

In summary, the GTC100 can be configured to provide complete automated control of a gas turbine from start to light off, to rated speed, synchronization, breaker closure and ramp up to full load set point.

⚠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 GTC100 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 are 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

Start Ramp/Start Control

The control contains options for Start mode, including an open loop start ramp and an EGT-temperature-controlled start. This control mode accelerates the turbine from initial 'Lite-off' to a point where the PT speed control PID can take control of the fuel valve demand. Once speed control is reached the start ramp is taken to 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 the internal turbine air and any downstream boiler system, if no boiler is present then this time can be minimized. Once this timer is complete the control will move to the Attempt Lite-off step

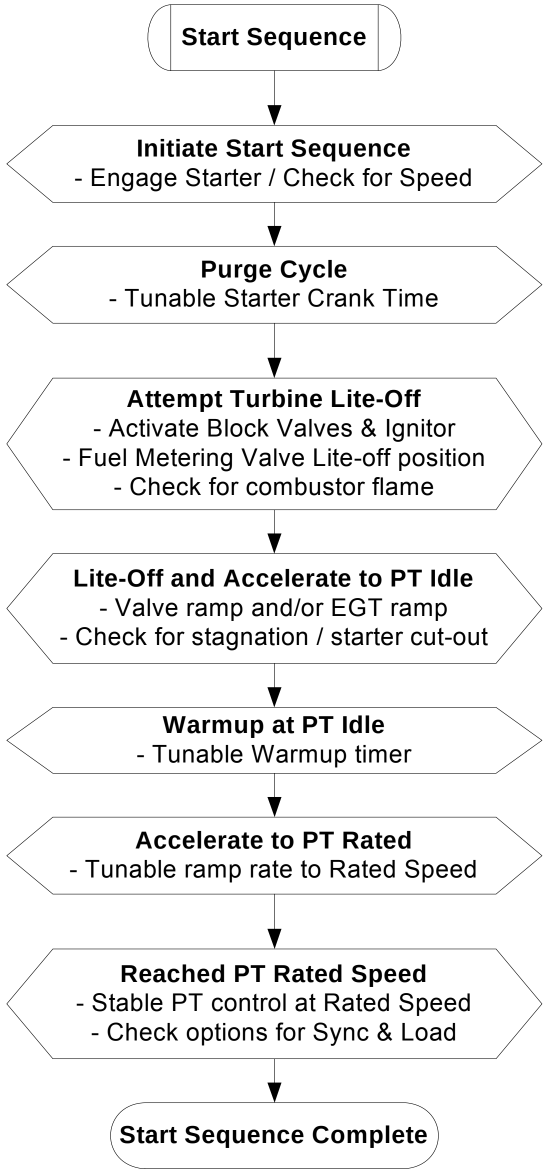


Figure 2-1. GTC100 Start Sequence Logic Flow Diagram

Attempt Lite-off / Activate Fuel Shutoff Valves & Ignitor

At this step, the control will issue relay commands to 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 detection). 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.

Lite-off and Accel to PT Idle Speed

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 PT speed set point. During this acceleration the PT 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 PT speed set point (PT Idle). If it does not reach PT idle within this time frame a shutdown command is issued and annunciated as a PT Failed to Accel. Once PT Idle is reached then the sequence proceeds to the Warm-up step.

PT Idle Warm-up Cycle Sequence

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

Accelerate to PT Rated Sequence

At this step, the control will begin to raise the PT reference at the default or fast ramp rate, as determined by the user. 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 (using the programmed ramp rate and rpm range between Idle and Rated). Once the unit achieves control at PT Sync the sequence proceeds to the Reached PT rated speed step.

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 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 (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
- PT Speed Reference Logic
- Remote Speed Reference Logic
- 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 GTC100 control.

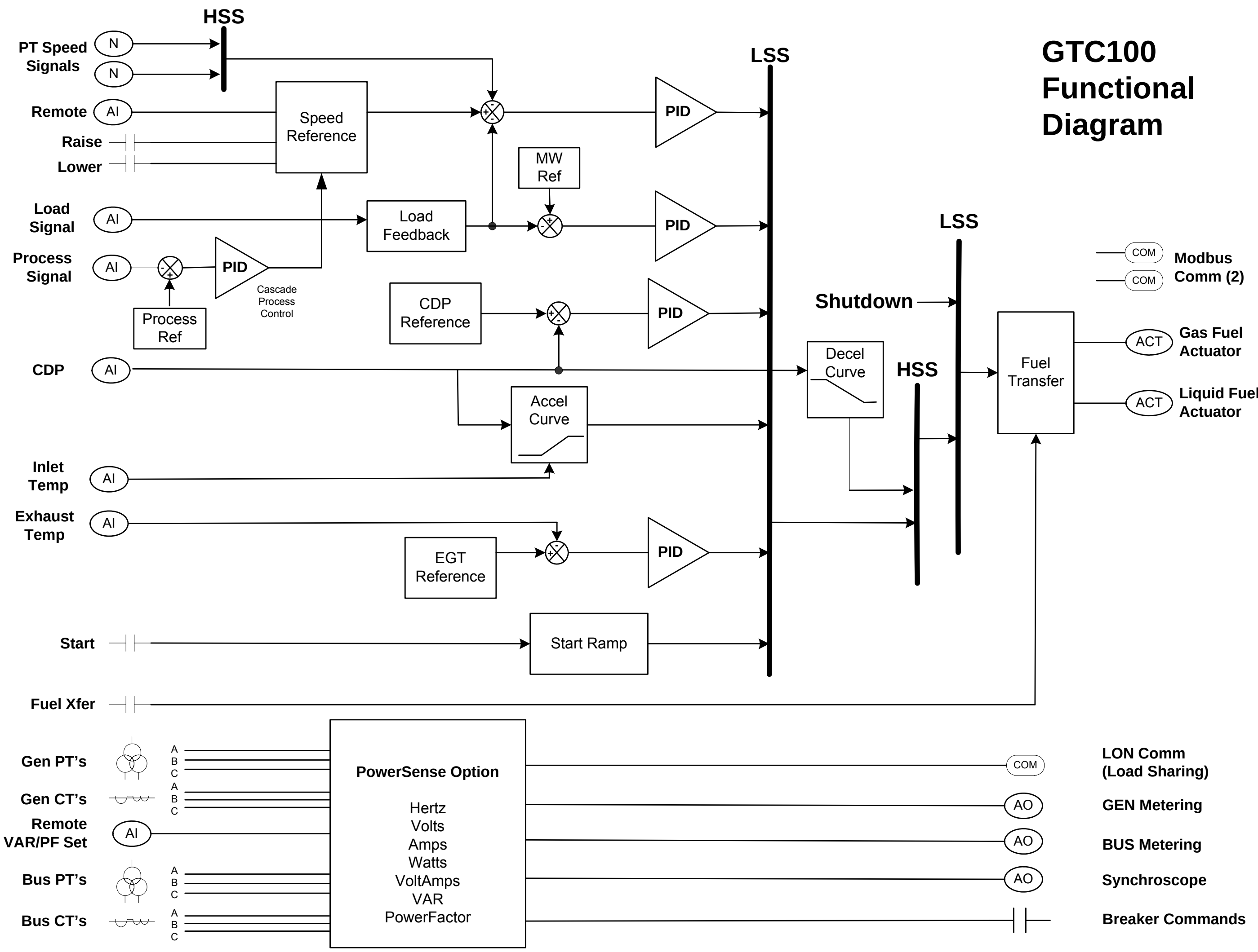


Figure 2-2. GTC100 Functional Block Diagram

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. There is an option to switch between a Base setpoint and a Peak setpoint by configuring the unit to utilize a Discrete input to select between the 2 operating modes. The EGT Control PID has three inputs:

- Analog Input signal of EGT or Alternate Turbine Inlet Temp
- EGT temperature reference set point
- Feedback from the LSS

There is an option to use the EGT Temperature Control PID as a limiter on the calculated turbine inlet temperature (CTIT). Configuration options are available to use this option if a direct temperature signal of the limiting temperature parameter cannot be obtained. Additional alarms and shutdowns are available if this optional logic is used. There is also a CTIT setpoint curve (driven by PT Speed) that is configurable via Control Assistant/WinPanel (EGT_REF.CIT_SPD). It is a 2D curve with two sets of X-Y curves, one at compressor inlet temp (CIT) of –40 and one at CIT of 130. The X input is the PT speed and the Y output is the CTIT setpoint temperature.

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. 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.

This fuel demand limiter feeds 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. Discrete output indications are available to indicate operation on full, gas, full liquid, or transfer in progress. There are also separate rates available for setting the desired time to make the fuel transfer in either direction.

⚠WARNING	**Recommended transfer times are 20–60 seconds. If fuel transfers faster than this are required, the system should be reviewed to ensure safe and reliable operation. Flame detectors (not EGT or Speed indication options) are recommended for these applications.**

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 GTC100 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 GTC100 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 GTC100 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 re-closing, 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 GTC100 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 GTC100 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 auto-loading, 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 GTC100 control. The control includes an internal digital process reference set point controlled by raise and lower switch contacts or by a Modbus or Serving 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 GTC100 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 GTC100 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 GTC100 control has a selectable voltage range alarm that is activated if the analog output to the voltage regulator reaches high or low saturation. The GTC100 control also has selectable and adjustable high and low voltage limit switches and alarm outputs.

The GTC100 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 GTC100 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 GTC100 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 GTC100 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 GTC100 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 GTC100 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

Introduction

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 GTC100 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 GTC100 are made through “CageClamp” terminal blocks. The GTC100 is shipped with mating connectors for all terminals. Most of the GTC100 control’s terminal blocks are designed for removal by hand. After GTC100 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 GTC100 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 GTC100 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 GTC100 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.

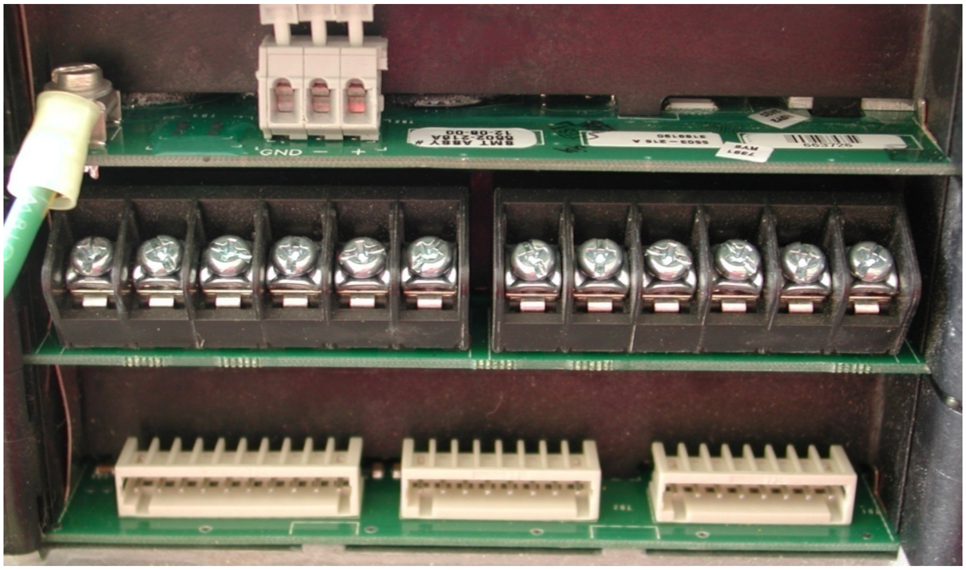


Figure 3-1. Fixed Ring Terminals

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 GTC100 is important. Improper connection of the GTC100 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 GTC100. 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 GTC100 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 GTC100. Typically this point is the designated ground for the generator set and related instrument transformers.

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.

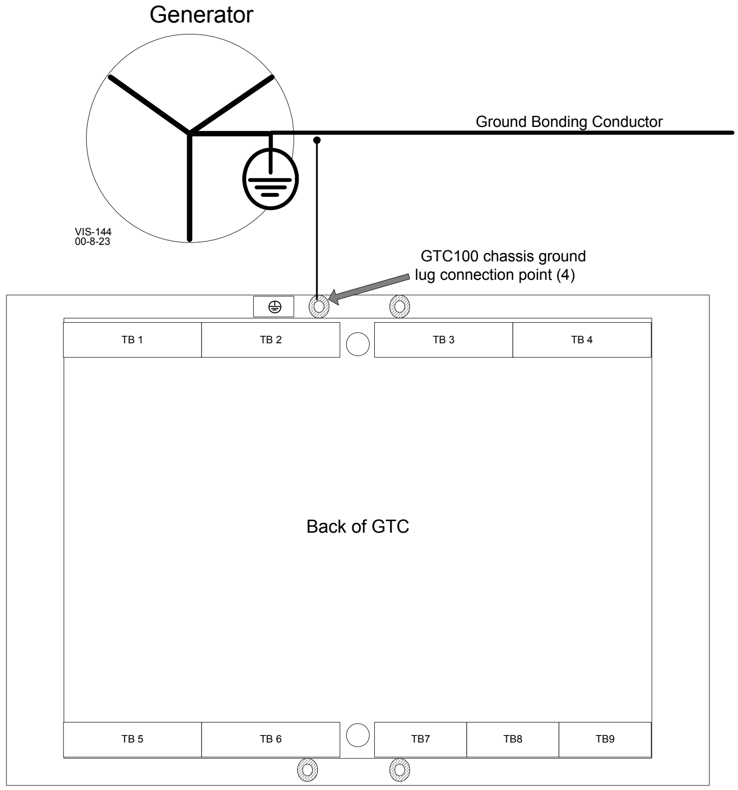


Figure 3-2. Recommended Single Point Grounding Scheme

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.

Terminal Locations

All terminals are located on the top and bottom of the GTC100. 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 GTC100 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.

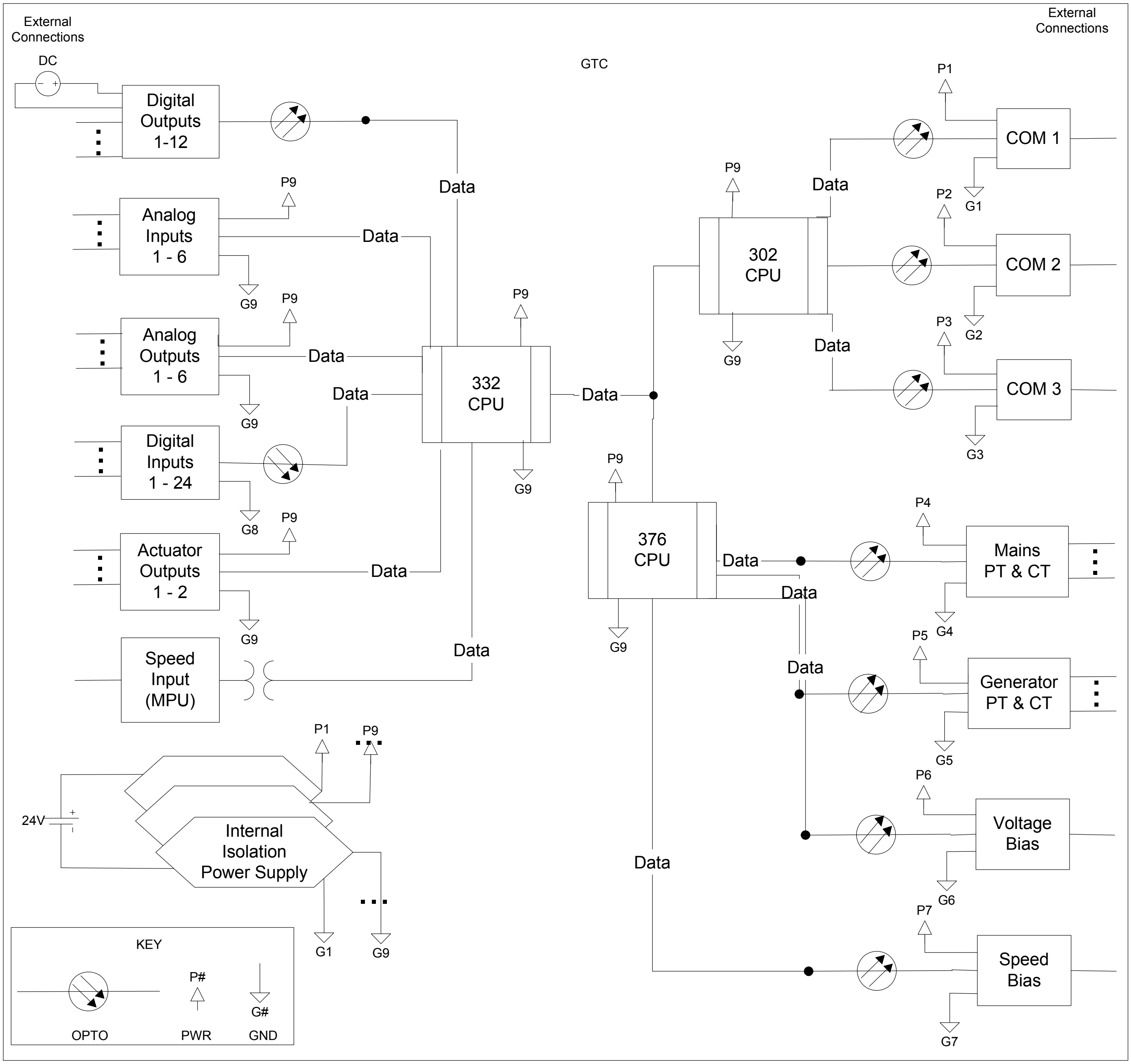
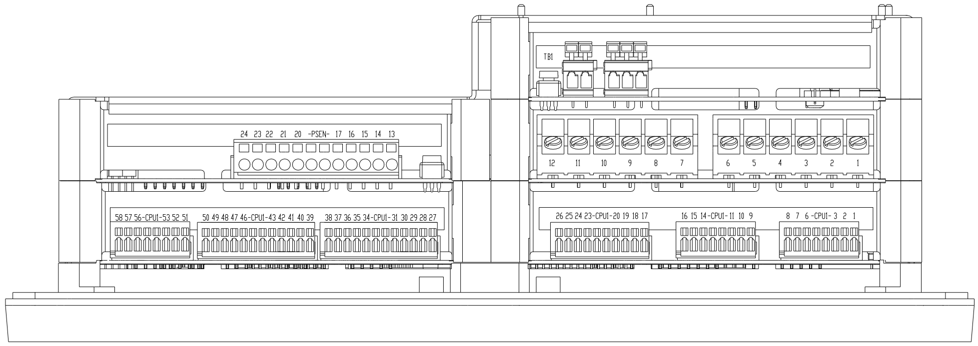
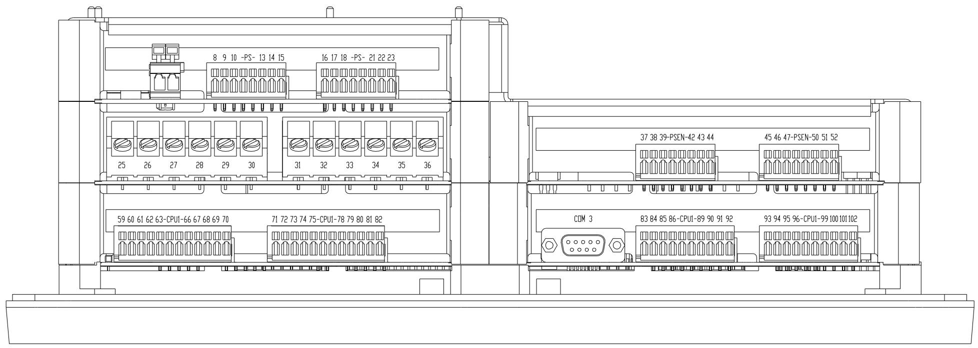


Figure 3-3. I/O Isolation



(Top View)



(Bottom View)

Figure 3-4. GTC100 Terminal Strip Location View

Input Power

⚠WARNING

The GTC100 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 GTC100 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 GTC100 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.

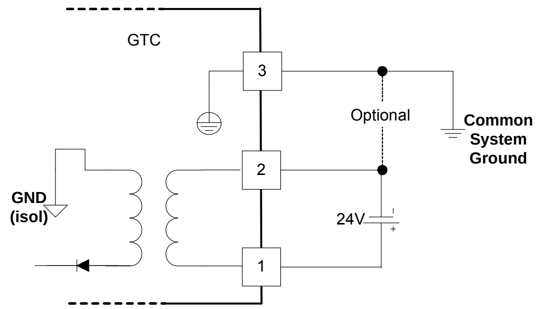


Figure 3-5. Input Power Wiring Diagram

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 GTC100 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 GTC100 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 GTC100. 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 GTC100 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 GTC100 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 GTC100 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 GTC100 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 GTC100 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 GTC100 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

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 GTC100. 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 GTC100. This is described in the Configuration section of the Operation Manual. The GTC100 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 GTC100 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 GTC100 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 GTC100 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.

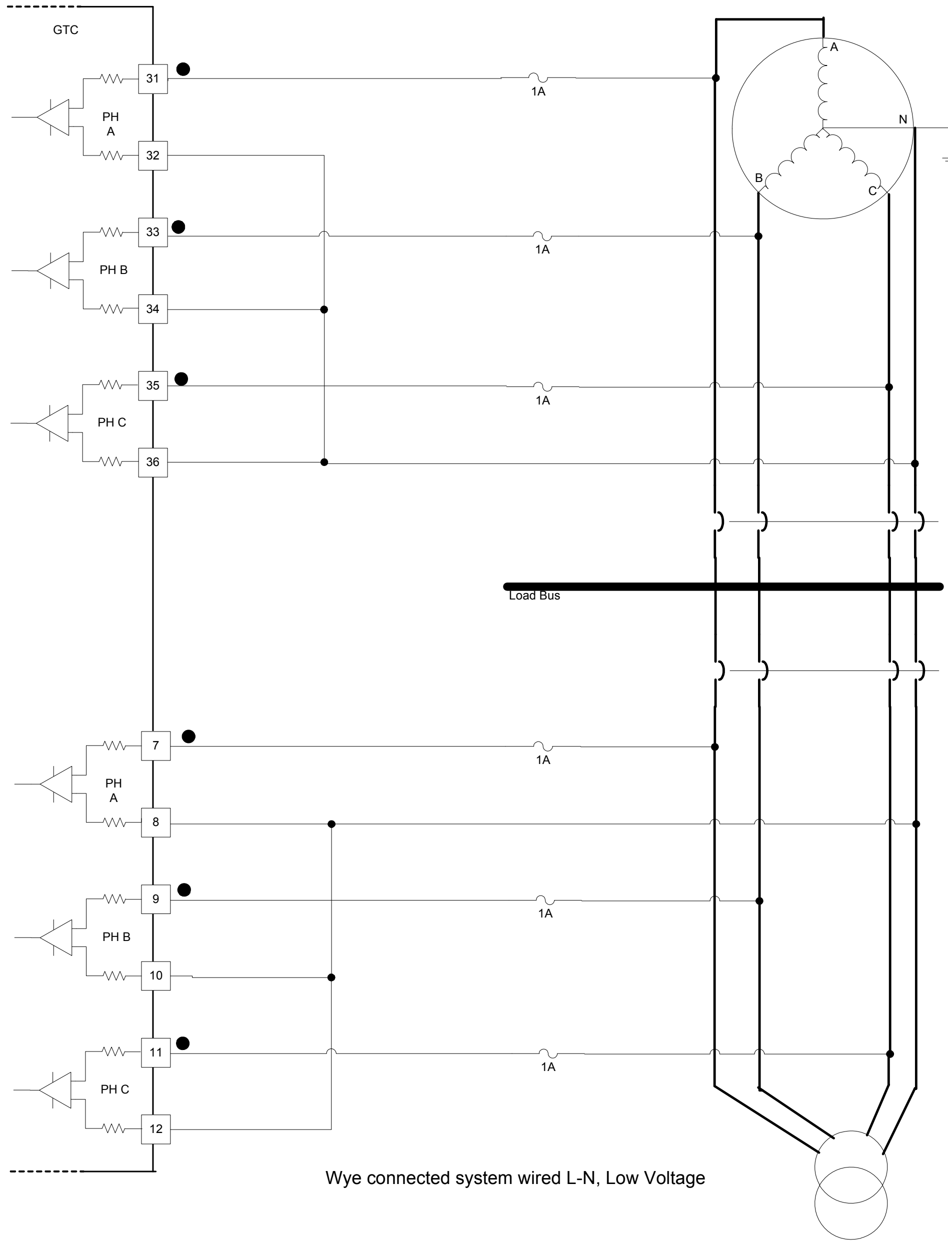
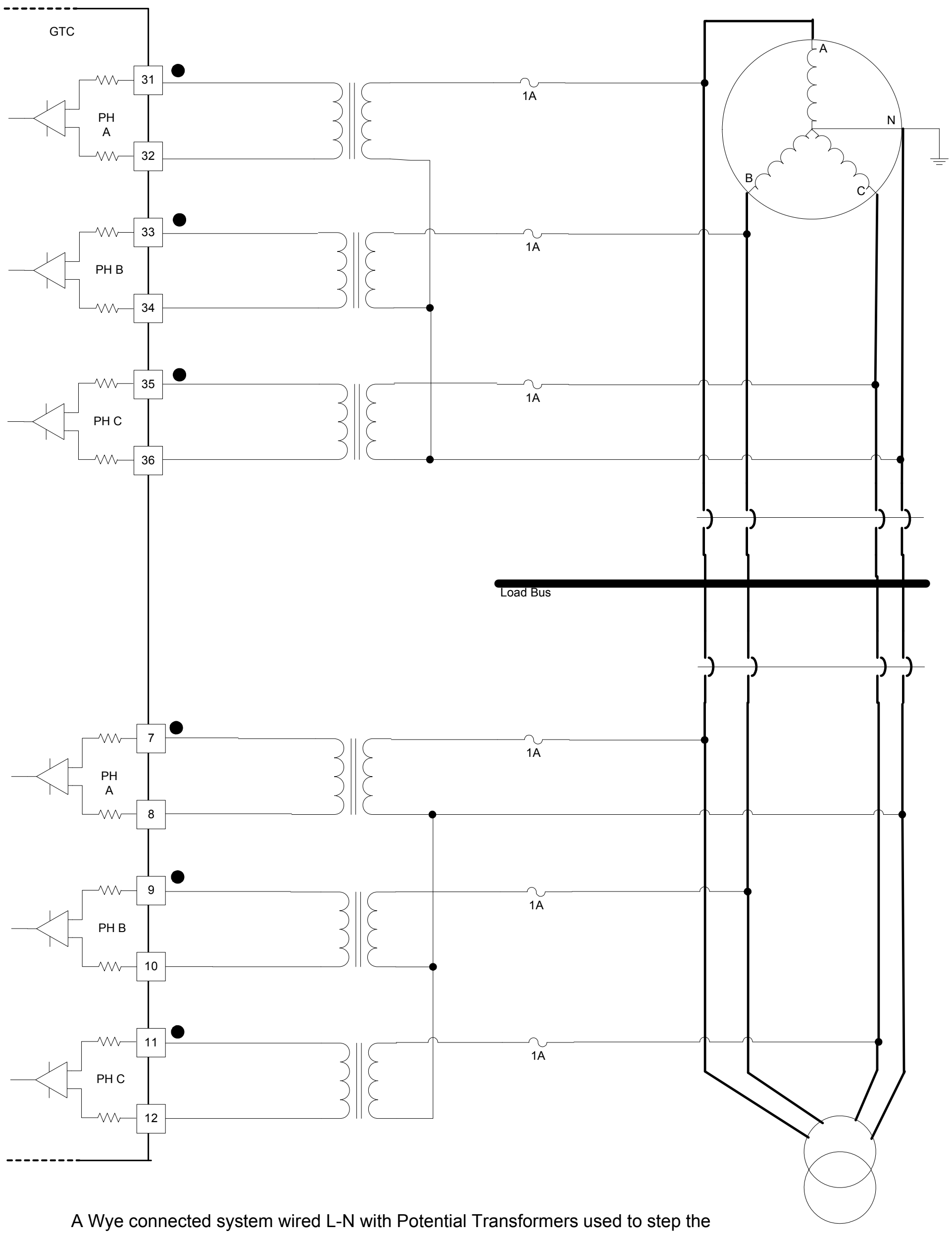


Figure 4-1. PT Wiring—3Ø Wye, L-N, without Transformer

PT—3∅ Wye, L-N, with Transformers

Transformers are necessary if the voltage input to the GTC100 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 GTC100 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 GTC100 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 GTC100 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 GTC100 should be configured as a Delta L-L.

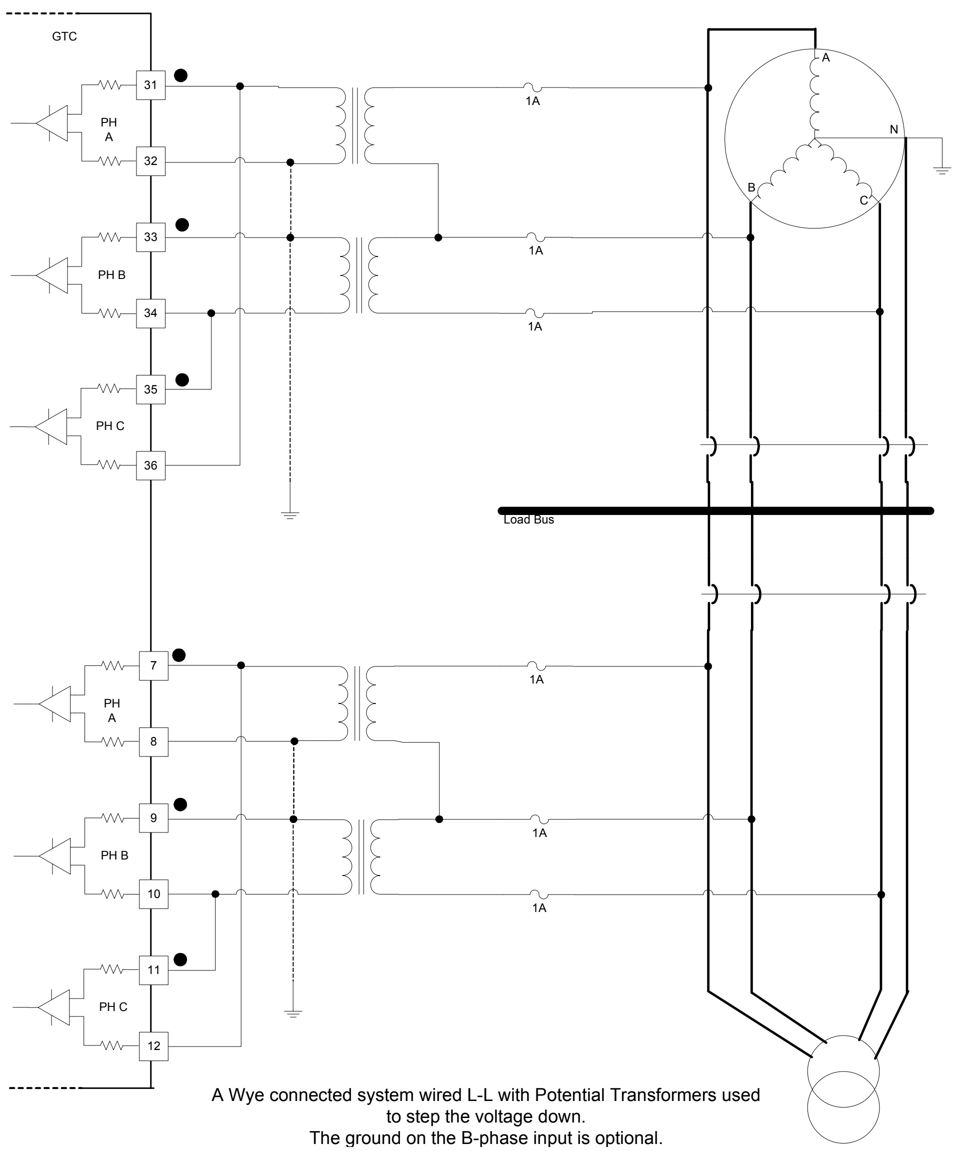


Figure 4-3. PT Wiring—3∅ Wye, L-L, with Transformers

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

Transformers are necessary if the voltage input to the GTC100 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.

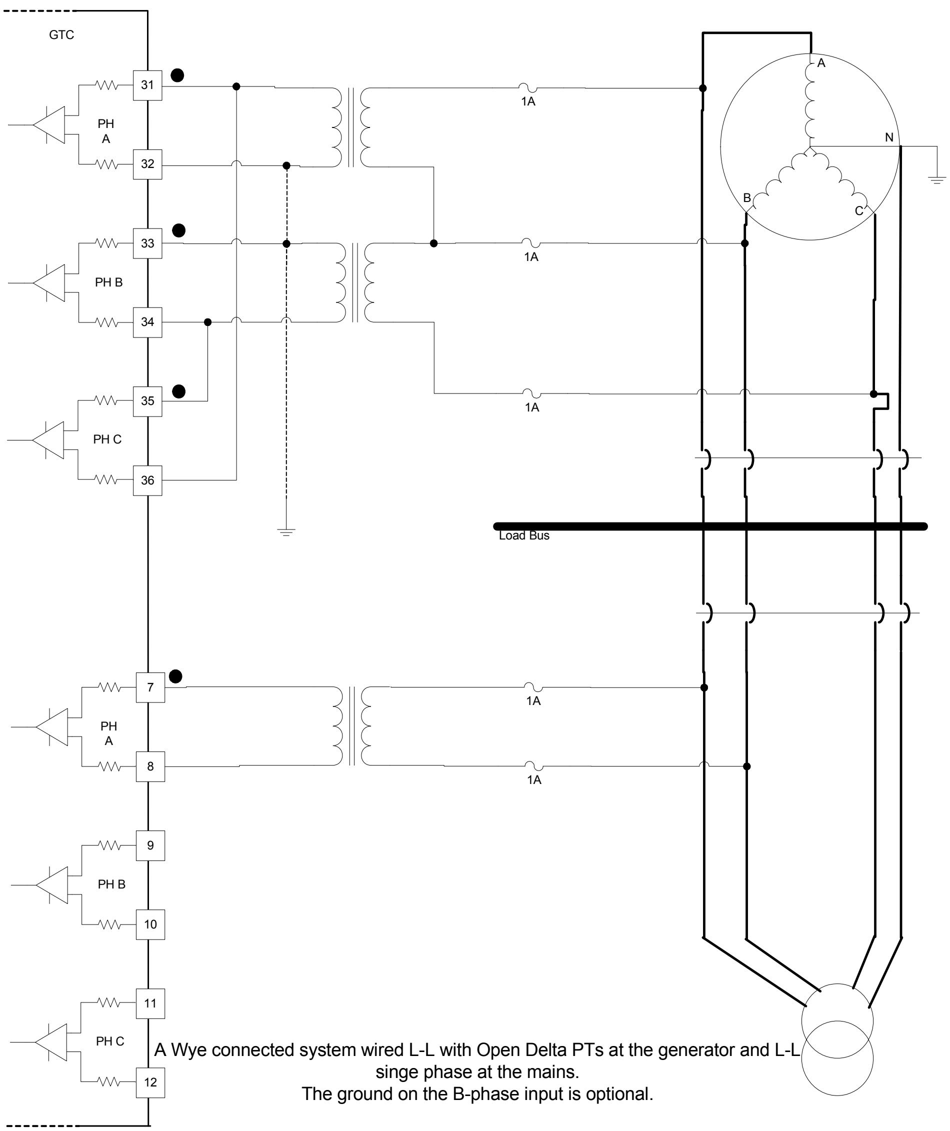


Figure 4-4. PT Wiring—3∅ Wye, & 1∅ Wye, L-L, with Transformers

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

Transformers are necessary if the voltage input to the GTC100 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.

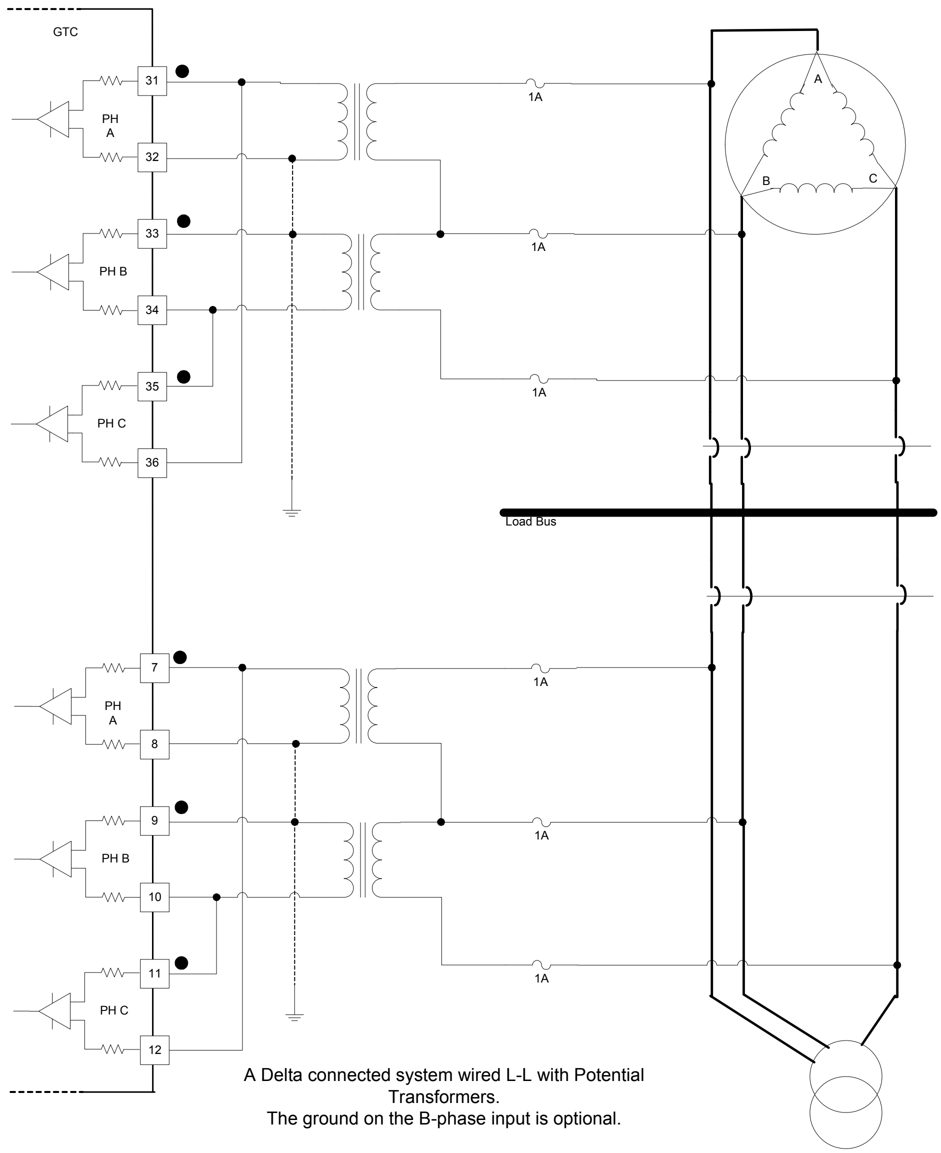


Figure 4-5. PT Wiring—3∅ Delta, L-L, with Transformers

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

Transformers are necessary if the voltage input to the GTC100 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 GTC100 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.

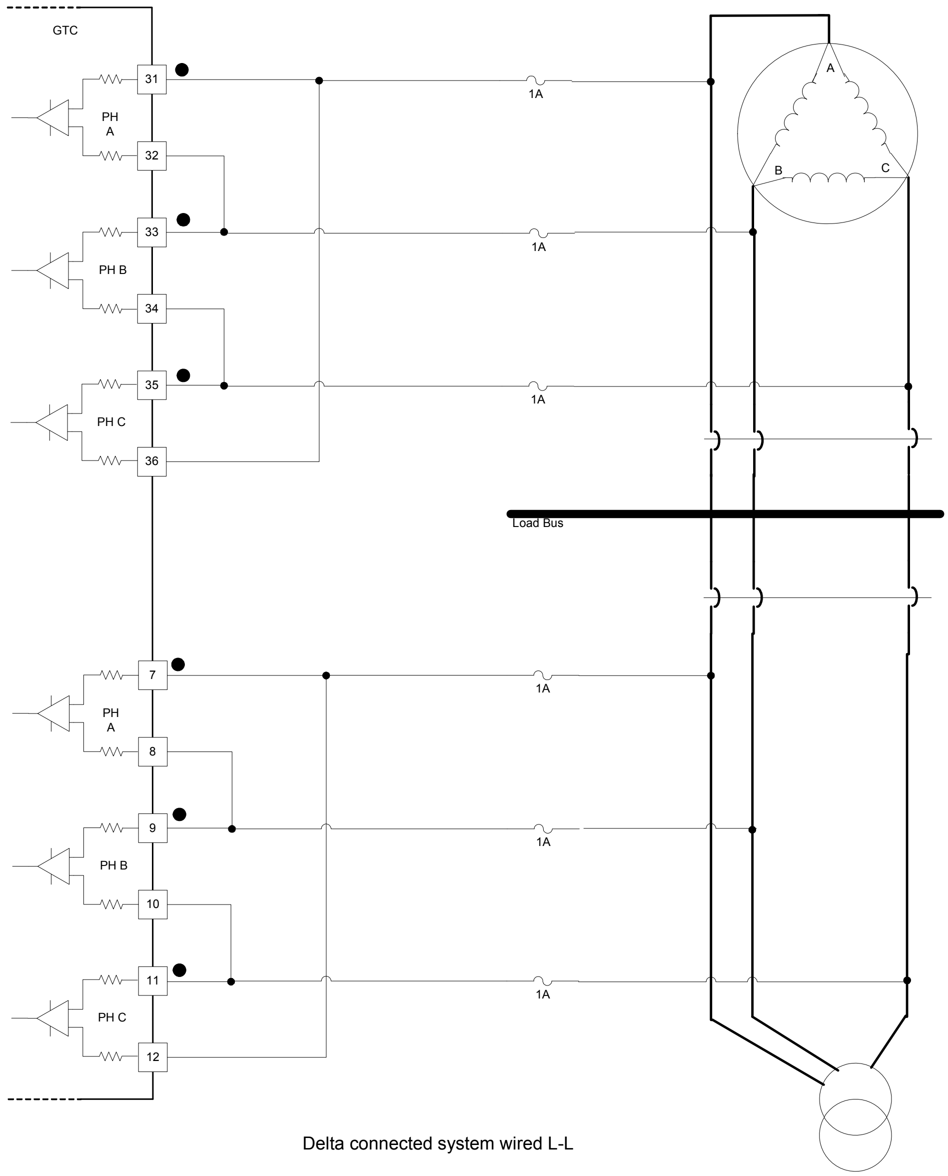


Figure 4-6. PT Wiring—3∅ Delta, L-L, without Transformers

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 GTC100. 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 GTC100 does not require three phases for current calculations. The user can configure the GTC100 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 GTC100. This is described in the Configuration section of the Operators Manual (26137). The GTC100 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 GTC100 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.

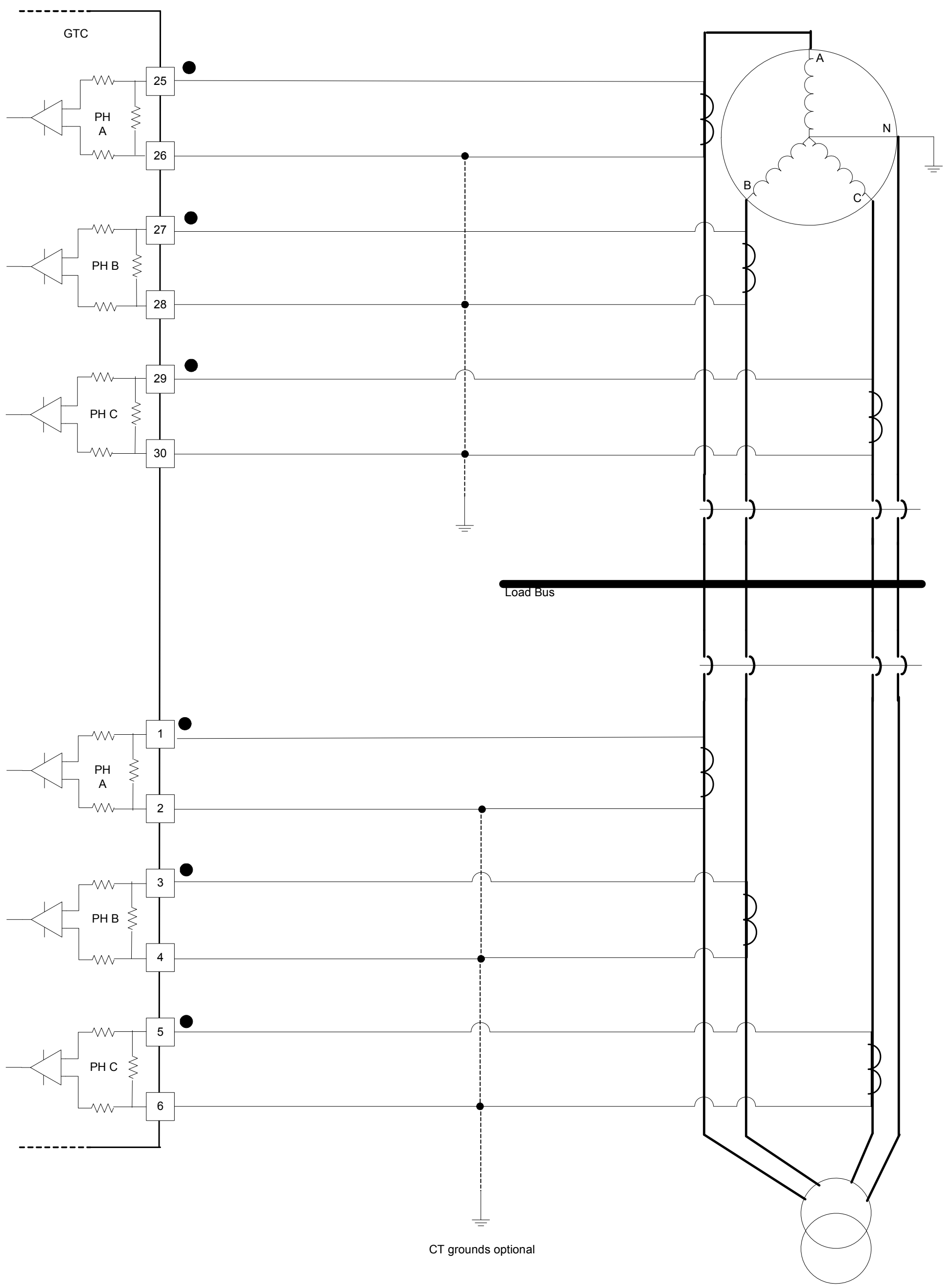


Figure 4-7. CT Wiring—3∅ Wye

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.

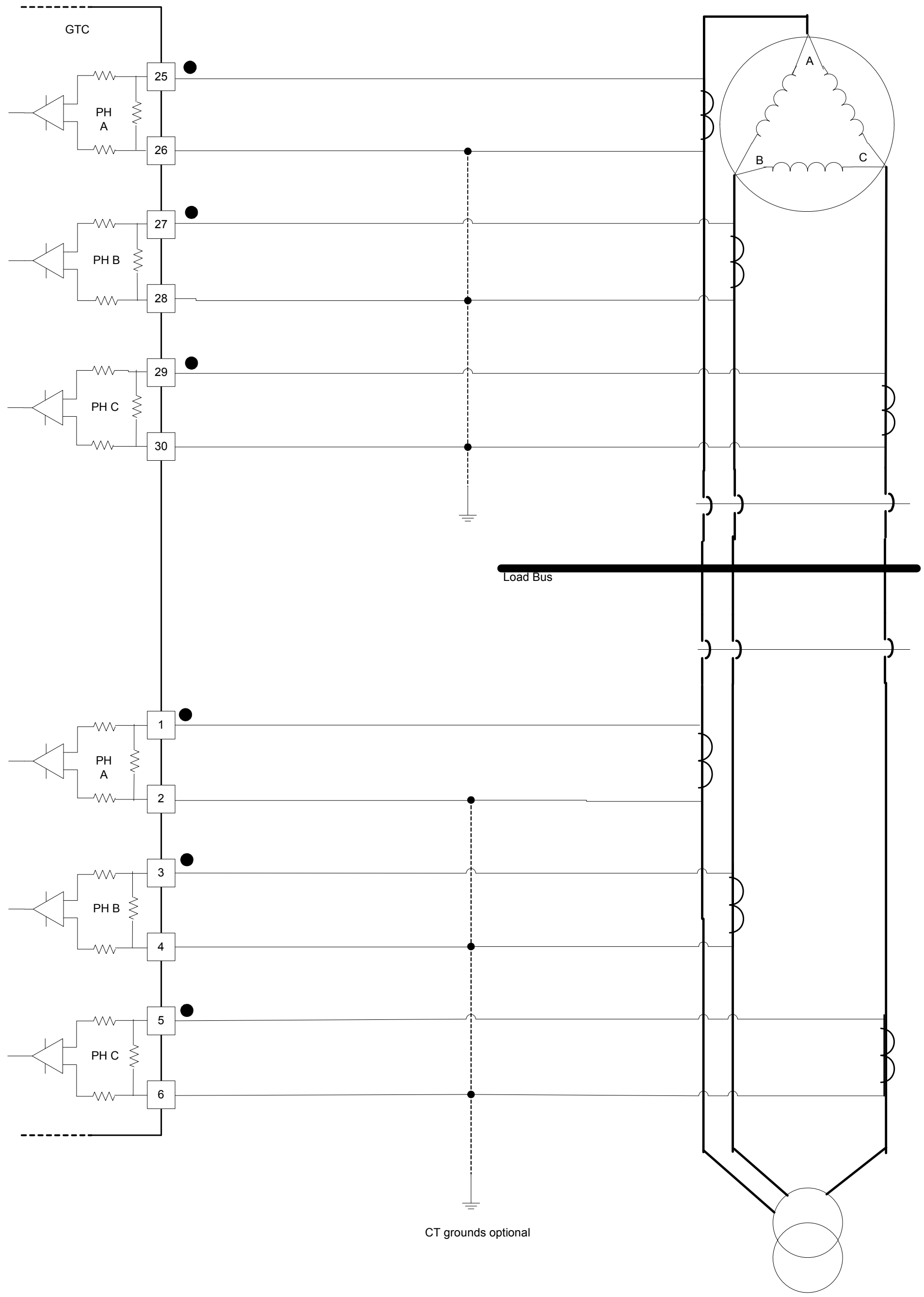


Figure 4-8. CT Wiring—3∅ Delta

Single Phase Monitoring

In a single phase monitoring system, the GTC100 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 GTC100 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 GTC100.

Voltage Bias Output

The Voltage Bias allows the GTC100 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 GTC100 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

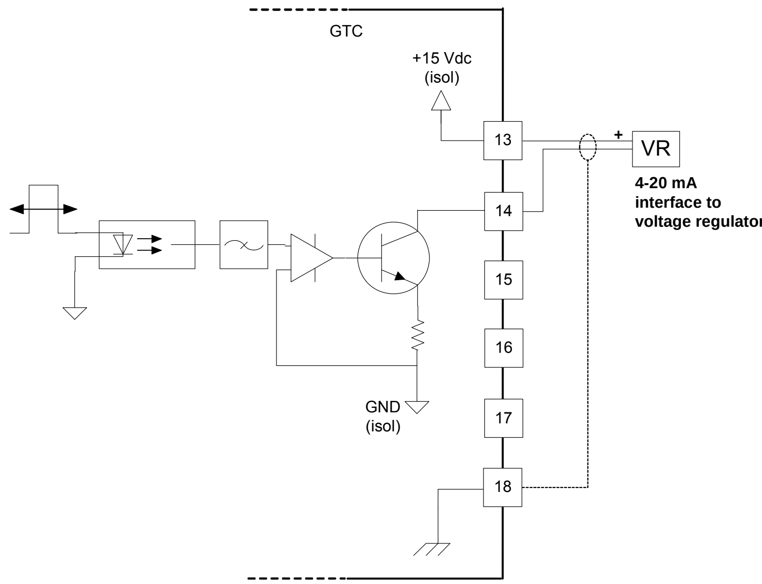


Figure 4-9. Voltage Bias Wiring Diagram, 4–20 mA Output

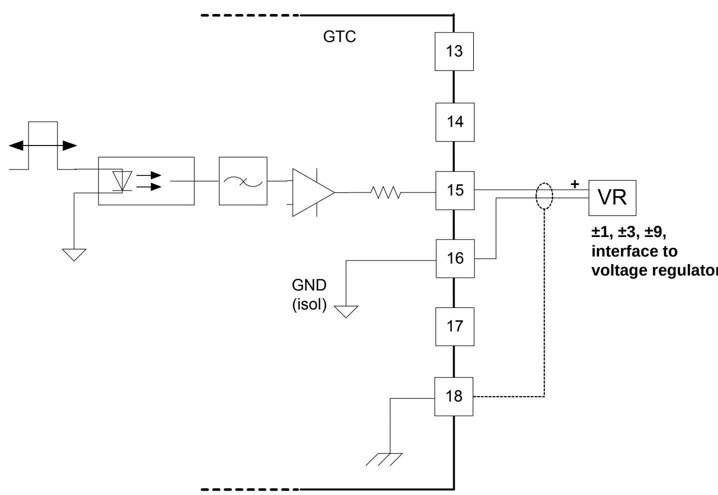


Figure 4-10. Voltage Bias Wiring Diagram, Bi-polar Voltage Output

LON Communication Port

The LON port is used to communicate with up to 16 other GTC100 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 GTC100 is the last device of the LON string, the termination jumper at 48 and 49 should be installed

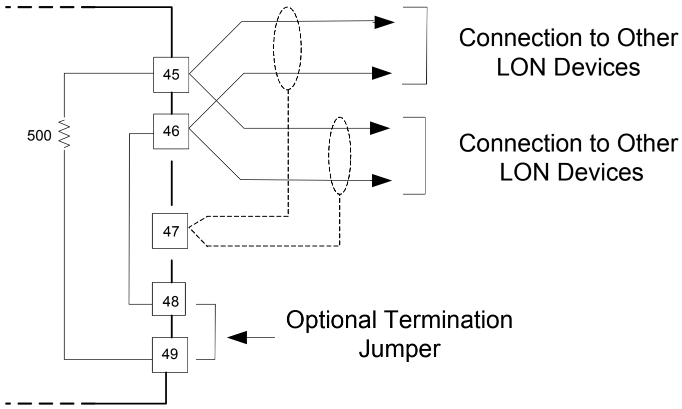


Figure 4-11. LON Connections

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

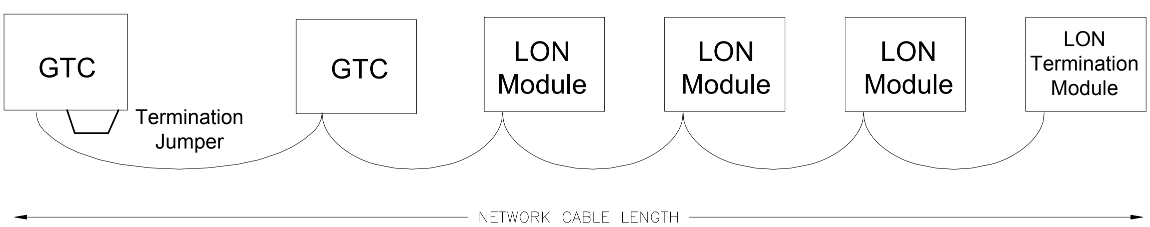


Figure 4-12. Direct Wired LON Network

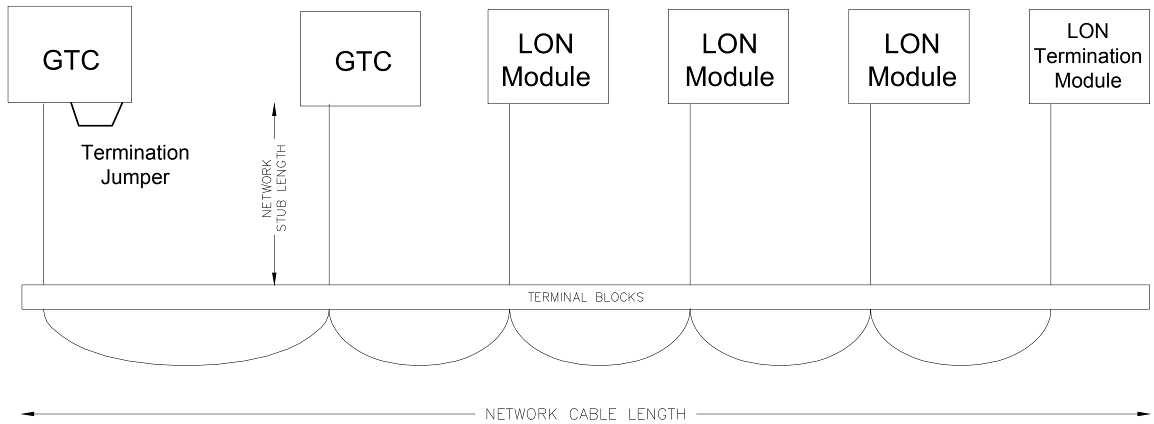


Figure 4-13. Stub Wired LON Network

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

Introduction

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 GTC100 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 GTC100 input/output channels. This section should be used in conjunction with Appendix E which lists the information that the user will see on the Service and Configure screens when using Watch Window to configure the control. Appendix E will guide the user in the specific detailed configuration options of the control for each turbine. Most of the I/O channels in the GTC100 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

Fuel Control Input/Output Signals

SmartCore Board Wiring Pinout

The SmartCore board (**SCM**) contains circuitry for the two speed sensor inputs, six analog inputs, six analog outputs, 3 serial ports, and 24 discrete inputs. The speed sensor input is from a magnetic pick-up, each Analog input may be 4–20 mA or 0–5 V, and two of the serial ports, may be RS-232, RS-422, or RS-485. The other serial port is a dedicated RS-232 port.

Features

- On-board processor for automatic calibration of the I/O channels
- Analog inputs have 14-bit resolution
- Analog outputs have 12-bit resolution
- Actuator outputs have 12-bit resolution
- Serial Ports are configurable

MPU (Speed) Inputs

The GTC100 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

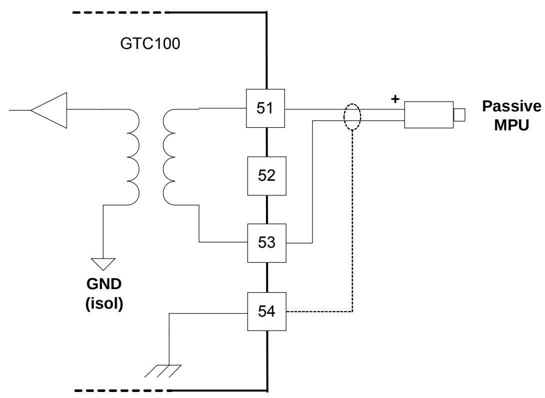


Figure 5-1. MPU Wiring Diagram

IMPORTANT

When wiring speed sensor signals, verify the correct wiring with the probe type being used. The above example shows the typical passive probe connection of an MPU. However if this is mis-wired as a proximity probe input, the GTC will receive valid voltages but will calculate the speed incorrectly.
- **Passive MPU uses pins 51, 53, 54.**
- **Proximity probes use pins 51, 52, 53.**

Speed Sensing (DSS_01 and DSS_02)

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 two speed sensors in this system for sensing the PT shaft speed. One or both can be used. 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 are high signal selected with only the one indicating the higher speed being sent to the control PID.

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 PT signals 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 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 PT which will trigger a Shutdown. Each of these switches can be configured to activate at any speed.

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)

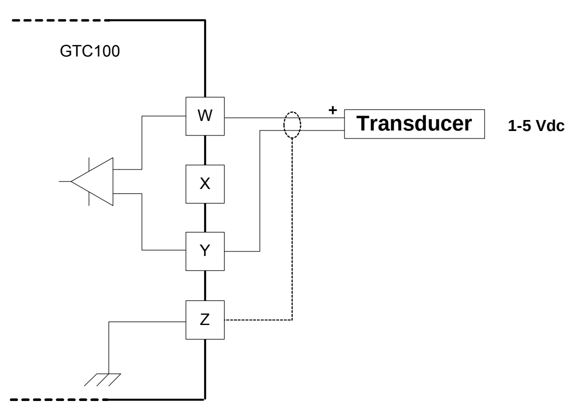


Figure 5-2. Analog Input Wiring Diagram, 1–5 V

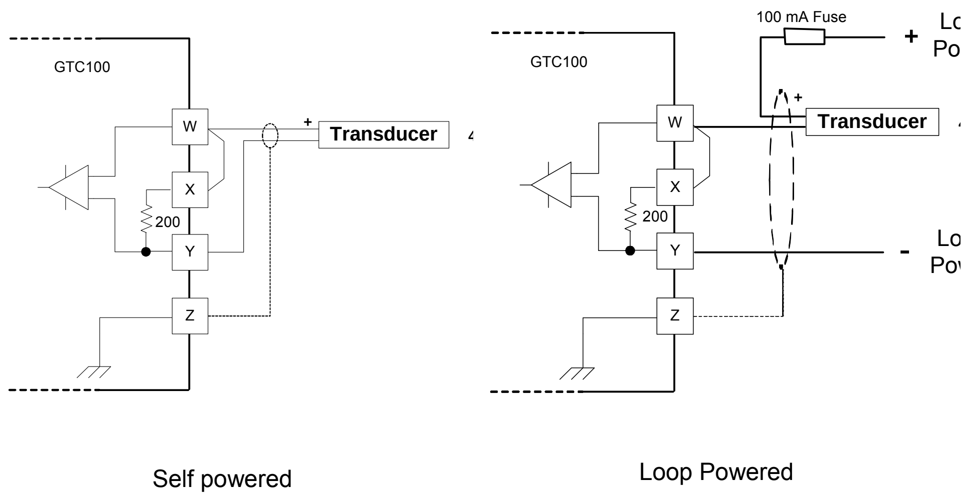


Figure 5-3. Analog Input Wiring Diagram; 4–20 mA

Analog Inputs (AI_01 thru AI_06)

The analog input signals in the GTC100 application are allocated in the following way:

- 6 Analog 4-20 mA inputs (which can be 0-5 Vdc)
- 12 PT and CT Inputs—Three each for the Generator & Utility Bus

The turbine CDP and EGT signals are required to be wired into Analog Inputs AI 03 and AI 06 respectfully, but the other 4 AI 4-20 signals can be configured via a menu selection. Each can be used for a pre-programmed GTC function or they can be configured to handle customer-defined inputs. If the input is used for a customer-defined signal 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 PT Speed Reference Signal
3. Ambient Inlet Air Temperature Sensor
4. Remote KW Reference Set Point
5. Remote VAR/PF Reference Signal
6. Remote Process Set Point
7. Gas Fuel Valve Position Feedback
8. Liquid Fuel Valve Position Feedback
9. Turbine Temp Signal (Other than EGT)
10. Customer Defined Signal
11. Reserved—Not Used

Compressor Discharge Pressure – CDP (must be on AI_03)

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

- CDP Sensing

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. This must be used unless the fuel valve system includes CDP acceleration limiting (some valves and on-engine fuel systems do this).

Exhaust Gas Temperature – EGT (must be on AI_06)

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

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

EGT Sensing

This input is programmed to receive a single 4–20 mA input that 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.

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.

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.

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 this output to determine the turbine load set point.

Remote PT Speed Reference - (Option #2)

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.

Ambient or Compressor Inlet Temperature Sensor - (Option #3)

The control is designed to receive an ambient temperature signal or a compressore inlet 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.

Remote KW Reference - (Option #4)

A remote KW 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 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 Process Reference Set Point - (Option #6)

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.

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.

Turbine Temperature Signal (other than EGT) - (Option #9)

This option is designed for use with some turbines that utilize a turbine temperature signal which is located close to the combustor. The GTC application is designed to allow this signal to be used as an alternate temperature control signal (instead of the EGT signal). EGT is still used as an overtemperature protection signal. This input can be used as the process signal for the temperature control PID, the start overtemp trip level, and the running overtemp trip level.

Customer Defined Signal - (Option #10)

The customer can bring in a 4–20 mA signal for any desired site-specific parameter. 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.

Discrete Inputs

There are 24 discrete inputs which are all individually optically isolated; however, all 24 share a common power supply return. The inputs expect 24 Vdc for an asserted state.

Number of channels	24
Input type	Optically isolated discrete input
Input thresholds	< 8 Vdc = “OFF” > 16 Vdc = “ON”
Input current	3 mA @ 24 Vdc
Contact voltage	24 Vdc isolated
Max input voltage	28 Vdc
Isolation voltage	500 Vac, all channels are isolated from the other I/O

An external 18–28 Vdc power source can be used to source the circuit wetting voltage for the discrete inputs. Due to circuit isolation, the external power supply common must be connected to the GTC100 terminal 25 as shown in the wiring diagrams in Appendix A. However, for EMC Compliance, the on board, isolated, +24 Vdc supply is recommended for use as the contact wetting voltage. The internal supply should only be used for the discrete inputs as shown in the diagrams; use in other, unrelated, circuits could overload the supply or create ground loops. The internal, isolated, supply is limited to approximately 300 mA maximum.

Discrete Inputs (BI_01 thru BI_24)

These 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. All other inputs (4-24) are configurable to be used for the function shown or to be used for custom signals. If the discrete inputs is used for a custom signal, the have been pre-programmed with the following optional functionality:

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

The default function and active state of each of these signals are shown, **any of these can be altered in the configuration of the control**. The signal status of each input will be sent through the Modbus communication link as indications.

IMPORTANT

SPECIAL NOTE ON BI-20 AND BI-24

These two inputs can also have a delay (0–30 s) and a speed switch enable/disable function added to them. They are connected to Speed Switch #1, and the action (disable or enable above this speed) can be set in DEBUG mode by tuning CNFG_BI_xx.OVR_EVENT.CTRL. ***For example, a low lube pressure trip input that is sensing lube oil pressure produced by the turbine accessory gearbox may need to be disabled until a certain speed is achieved.***

GTC Function	Active State
1. Shutdown (Fuel Off)	* TRUE = Shutdown / Fuel OFF
2. Start/Run (ON to 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. PT Reference Select Fast Rate	TRUE = PT Speed Set Point Rate = Fast
8. PT Speed Signal Failed Override	TRUE = Override PT sensor failure (to Start)
9. Set Ref to Rated Speed / Go Baseload	TRUE = if GEN Breaker is Open then PT Ref = Rated Speed / if GEN Breaker is Closed then Enable Baseload Control
10. Combustor Flame Detector	TRUE = Flame Detected
11. Fuel Selection/Transfer	TRUE = Liquid Fuel (False = Gas Fuel)
12. Enable Remote PT Reference Set Point	TRUE = Actively follow remote set point
13. Inhibit Synchronizer	TRUE = Disable Synchronization logic
14. Generator Breaker Aux (52)	TRUE = Generator Breaker Open (Isoch)
15. Utility Breaker Open	TRUE = Utility Breaker Open (Permissive for LS)
16. Enable Reactive Load Control	TRUE = Enables unit VAR/PF Control
17. Voltage/VAR/PF Lower Command	TRUE = Lower the Reactive Load set point
18. Voltage/VAR/PF Raise Command	TRUE = Raise the Reactive Load set point
19. Enable Process Control	TRUE = Enable Process Control
20. Process Set Point Lower Command	TRUE = Lower the Process set point
21. Process Set Point Raise Command	TRUE = Raise the Process set point
22. Gas Fuel Valve/Actuator Fault	TRUE = Gas Fuel Valve/Actuator Fault
23. Liquid Fuel Valve/Actuator Fault	TRUE = Liquid Fuel Valve/Actuator Fault
24. Select EGT Peak Setpoint	TRUE = Use Peak Setpoint

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 GTC100. Due to circuit isolation, the external power supply common must be connected to the GTC100 terminal 23 as shown in the wiring diagrams in Appendix A.

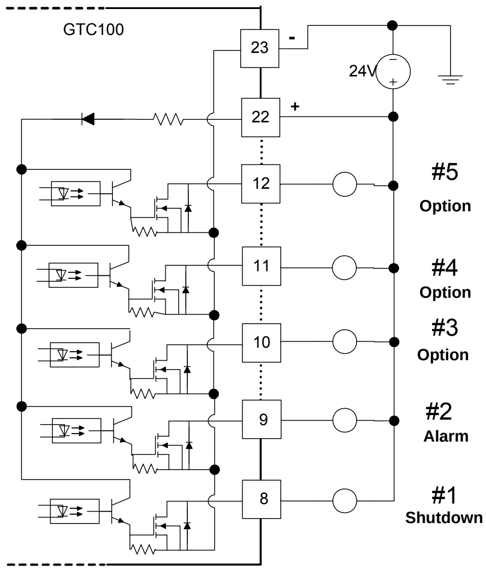


Figure 5-4. Discrete Output Wiring Diagram

Relay Driver Outputs

Twelve relay driver outputs are available from the GTC100 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 GTC100 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 to be updated at the following recursion rates:

- **Outputs 1-6 =10 ms**
- **Outputs 7-9 = 40 ms**
- **Outputs 10-12 =160 ms**

1) SHUTDOWN
2) Open Breaker Command
3) Close 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) PT Speed Switch 1
10) PT Speed Switch 2
11) PT Speed Switch 3
12) Run/Reset Output to Fuel Valve
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
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 Temp Switch 1
26) EGT Temp Switch 2
27) EGT Temp Switch 3
28) Customer Command from Modbus BW 21
29) Customer Command from Modbus BW 22
30) Customer Command from Modbus BW 23
31) Customer Command from Modbus BW 24
32) Transferring Fuels

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

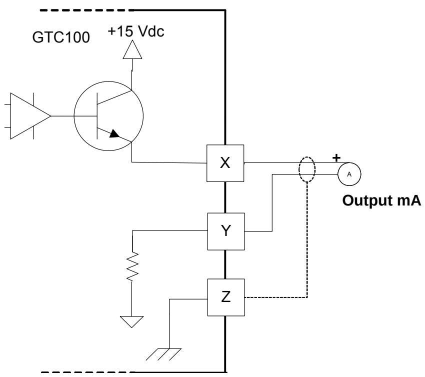


Figure 5-5. Actuator Output Wiring Diagram

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 GTC100. Wiring for each is shown below but only the terminal numbers change for each output.

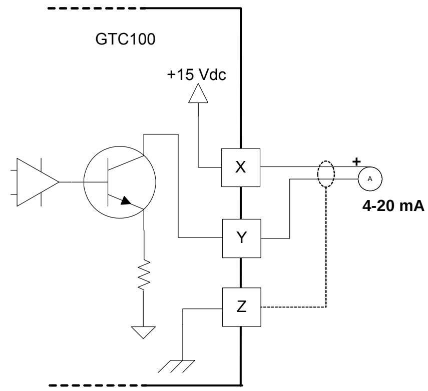


Figure 5-6. Analog Output Wiring Diagram

Analog Outputs (AO_01 thru AO_06)

The system includes six 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 1-6 respectively.

1. PT Actual Speed Readout
2. PT Reference Speed Readout
3. Fuel Valve Demand Readout
4. Exhaust Gas Temperature Readout
5. Compressor Discharge Pressure Readout
6. Generator MW Sensor Readout
7. Generator MegaVar Output Readout
8. Generator MegaVoltAmp Output Readout
9. Generator Power Factor Output Readout
10. Generator Current
11. Generator Voltage
12. Utility Bus MW Sensor Readout
13. Utility Bus MegaVar Output Readout
14. Utility Bus MegaVoltAmp Output Readout
15. Utility Bus Power Factor Output Readout
16. Utility Bus Current
17. Utility Bus Voltage
18. Synchroscope Output
19. Customer Configurable Analog Output (from Modbus AW_11)
20. Customer Configurable Analog Output (from Modbus AW_12)
21. Customer Configurable Analog Output (from Modbus AW_13)

*Via the Watch Window 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.

Communication Ports

There are three serial ports on the GTC100. They may all be used simultaneously and may all be configured independently. Performance of any one port will depend on how many ports are in use and the port traffic. Ports 1 and 2 may be configured as RS-232, RS-422, or RS-485 to match the intended application. All ports are optically isolated from each other.

Any port configured as RS-232 will meet the RS-232C standard for communications. The wiring shall meet the requirements of EIA RS-232. This standard states a maximum cable length of 15 m (50 ft) with a total capacitance less than 2500 pF and a data rate not exceeding 56 kbps. All GTC100 serial ports may be configured for data rates up to 115 200 bps but may not function properly at this high data rate when a full 15 meters of cable length is used. Do not leave an RS-232 null modem cable attached to the GTC100 if it is removed from the PC, to avoid the possibility of EMC noise being introduced to the GTC100.

Any port configured as RS-422 or RS-485 meets the ANSI standards for this type of communications. The wiring shall be one continuous cable between nodes and shall meet the requirements of EIA RS-422 or EIA RS-485 for 500 kbps. However, one half of the cable length limits is recommended due to harsh environments typical of prime mover installations as follows:

Cable	**Length**	**Example**
Standard shielded twisted pair cable	30 m (100 ft)	
24 AWG, low-capacitance cable	75 m (250 ft)	Belden 9841
22 AWG, low-capacitance cable	120 m (400 ft)	Belden 3105A
20 AWG, low-capacitance cable	150 m (500 ft)	Belden 89207
Fiber optic cable with optical repeaters	> 150 m (500 ft)	

The last unit in the network chain, and only the last unit, should have its receiver terminated with a resistor. If the GTC100 is the last unit, installing jumpers as shown on the following diagrams may use the internal resistors

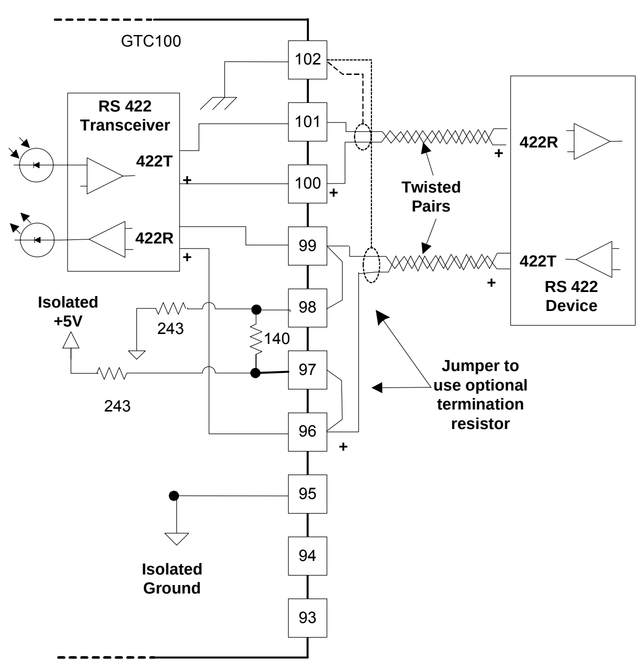


Figure 5-7. Serial 1 Wiring Diagrams, RS-422

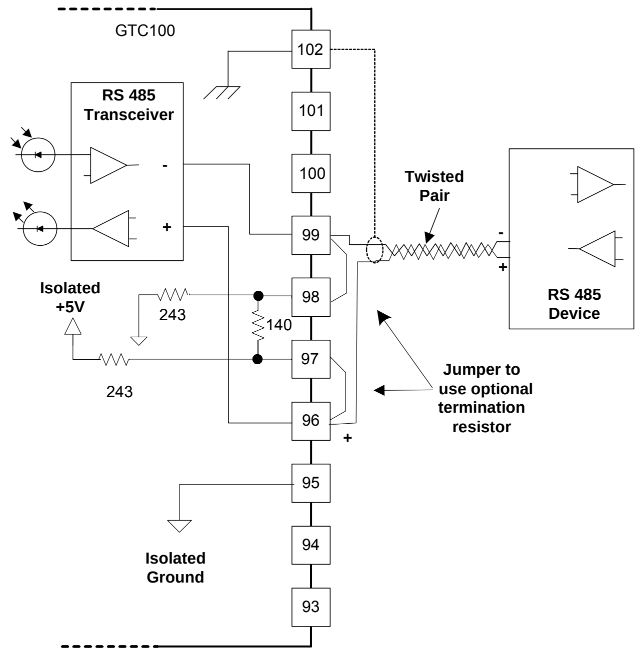


Figure 5-8. Serial 1 Wiring Diagrams, RS-485

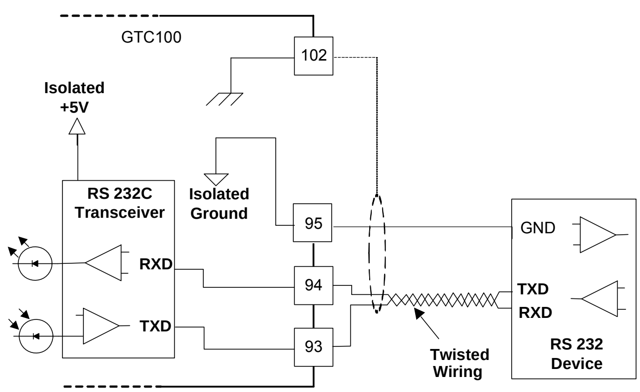


Figure 5-9. Serial 1 Wiring Diagrams, RS-232

Configurable Port (COM 1)

This port may be configured to use Modbus protocol and communicate as a Modbus Slave with any other plant device (typically an Operator Interface or a plant DCS system). A list of the Modbus data that is programmed in the GTC100 application can be found in Appendix B.

This port configuration is defaulted as an RS-485 port, with a baud rate of 38.4 kbps, no parity, 8 data bits, and 1 stop bit.

Configurable Port (COM 2)

The port may be configured for RS-232, RS-422, or RS-485 by using the correct wiring connections and selecting the correct protocol mode.

This port may be configured to use Modbus protocol and communicate as a Modbus Slave with any other plant device (typically an Operator Interface or a plant DCS system). A list of the Modbus data that is programmed in the GTC100 application can be found in Appendix B.

This port configuration is defaulted as an RS-232 port, with a baud rate of 38.4 kbps, no parity, 8 data bits, and 1 stop bit.

RS-232 Configuration Port (COM 3)

This port may only be used as a Woodward ServLink port. Its primary purpose is for configuration using a PC with Woodward's Watch Window.

The port is fixed as an RS-232 port only. The RS-232 port configuration is defaulted at 115200 bps, no parity, 8 data bits, and 1 stop bit. A Null Modem cable must be used to connect to this port. The GTC100 has a standard DB-9 Female receptacle. It is best to use a metal shell connector at both ends with the shell connected to the cable shield but isolated from the ground signal wire. The shell of the 9-pin D-sub on the GTC100 is chassis grounded.

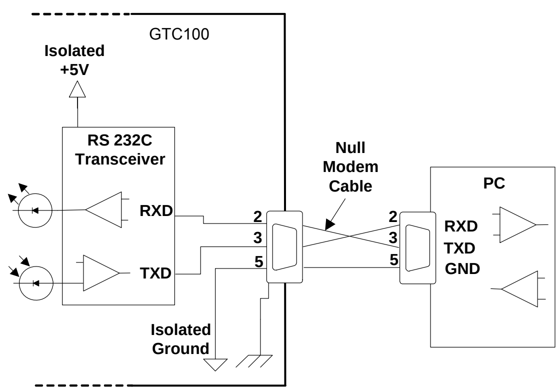


Figure 5-10. Serial 3 Wiring Diagram, RS-232

Software Interface Tools Setup

Watch Window Standard (WWI)

The WWI tool permits you to talk to the AtlasSC Digital Control System via a serial port on the AtlasSC SmartCore module. It limits the users view into the control system by only allowing them to see the blocks programmed into the Service and Configure modes. This tool is free-issue from Woodward and exists on the system documentation CD or is available from the woodward.com website.

Watch Window Professional (WWPro)

The WWPro tool permits you to talk to the AtlasSC Digital Control System via a serial port on the AtlasSC SmartCore module. It allows the users to view all of the application program blocks that exist in the control system.

Watch Window Program (Both Standard and Professional)

Use of one of the WW tools (Standard or Professional) is required to access the application software tunable values of the AtlasSC Digital Control System. Software setup for the GTC100 begins with the Software Configuration & Service Tunables Worksheet. When the worksheet is completed, the values are then entered into the GTC100 with the WW tool. This tool can also be used to upload (from the control to a file on the user PC) the tunable settings from the control. This file then can be downloaded (from the user PC to the control) into another control of the same part number and revision number. Keep this tunable file archived, as it will simplify configuration of other spare units and aid technical support in commissioning and troubleshooting.

WWI runs on a PC connected to the control system through a serial communications port. The PC may be permanently connected to the control or connected only as needed. The communications server, ServLink I/O Server, is included in the same CD-ROM with the Watch Window software.

An “inspector” provides a window for real-time monitoring and editing of all control Configuration and Service Menu parameters and values. Custom “inspectors” can easily be created and saved (WWPro only). Each window can display up to 28 lines of monitoring and tuning parameters without scrolling. The number with scrolling is unlimited. Two windows can be open simultaneously to display up to 56 parameters without scrolling. Tunable values can be adjusted at the inspector window. Watch Window communicates with the control through an RS-232 cable connection to the comm port configured as a point-to-point only ServLink Server.

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

Watch Window performs these primary functions:

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

Control Configuration and Set Point Management—Watch Window can upload or download all tunable variables from the control system. This feature allows a user (e.g., fleet owner, distributor, packager) to upload (and save) all tunable parameters from one control and download the same settings to other controls for similar turbine configurations.


Watch Window version 1.05 and higher, allows for automatic generation of inspector sheets. Click on the Q icon (Quick Inspector) on the tool bar. A sheet will automatically be created from each Service and Configure Header programmed into the control. Multiple inspectors can be created to allow for viewing more than one sheet at a time.


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


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


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


If an application configuration has been previously saved to a *.CFG file, the saved set of parameters can be loaded into the control as a group by selecting the Load Application Settings icon.


To save the configuration to a file in the external computer for backup or download later into another control, select the Save Application Settings icon. All the tunable values presently set in the control will be saved to a file and can be loaded into this control to reprogram it to the saved values or into another control at a later time.

Install Watch Window Software

Woodward's Watch Window Standard configuration and service tool may be downloaded at no cost from the Woodward website (**www.woodward.com/software**). As an alternative, a Watch Window CD Install Kit may be purchased from the nearest Woodward distributor. Once downloaded, select the kit's Setup.exe program on the computer on which you wish to install the Watch Window software program. Please refer the product specification 03202 for detailed installation procedures.

Connect PC to GTC100

The connection of a computer is only required for calibration and setup of the GTC100. The computer and WWI 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 GTC100 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 WWI service tool (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.

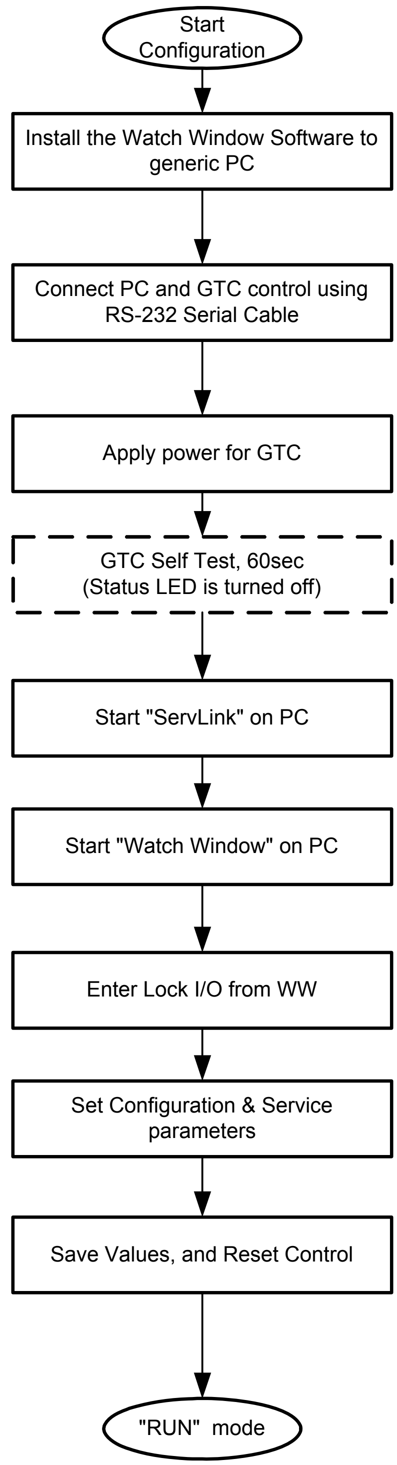


Figure 5-11. Basic Configuration Procedures

Apply Power to the GTC100

At power-up, the GTC100 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.

Initial GTC100 Communications:
Before communications can begin between the WWI program and a control, a network definition file must be created. Once this network definition file is created and saved, it never has to be recreated, unless a new program is loaded into the control.

To create a network definition file:

1. Open the Watch Window program's associated ServLink server by clicking on Start > Programs > Woodward > ServLink Server.exe.
2. Select the communications port the control is connected to.
3. Select "Point-to-Point" communications.
4. Select the Baud Rate of 115200.
5. Select the OK button.

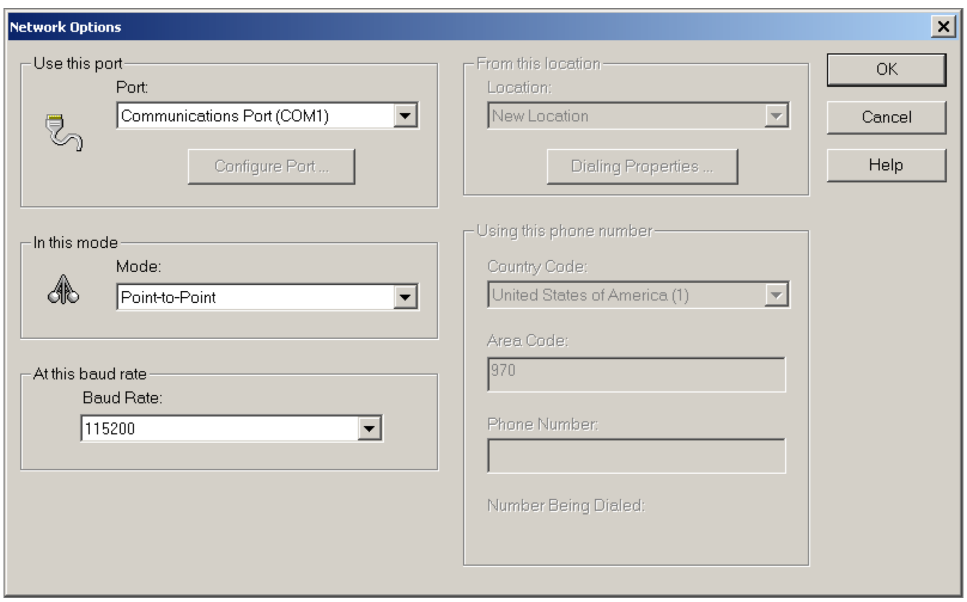


Figure 5-12. Setup ServLink Communication

At this point the ServLink Server program will establish control communications, begin reading all control setting registers, and create a lookup table for these registers to expedite future control communications. Upon reading register location information from the control, the following Windows pop-up box will appear. (This step can take several minutes to complete.)

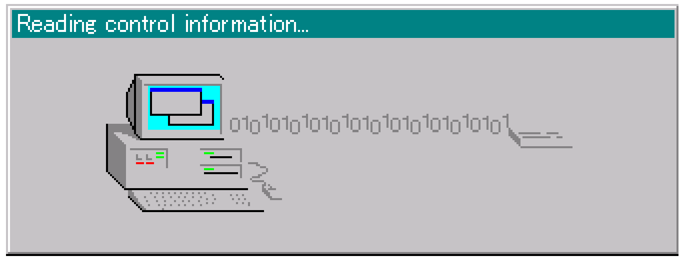


Figure 5-13. Reading Control Information

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

Start Watch Window Software

At this point, start the Watch Window software program by clicking on Start > Programs > Woodward > Watch Window Standard.exe.

The Watch Window Menu bar, Explorer and Inspector will appear as shown in Figure 5-14. Click on the icon (Quick Inspector) on the tool bar. Multiple sheets will automatically be created from each Service and Configure Header programmed into the control. Optionally, other inspectors can be created to allow viewing of more than one sheet at a time.

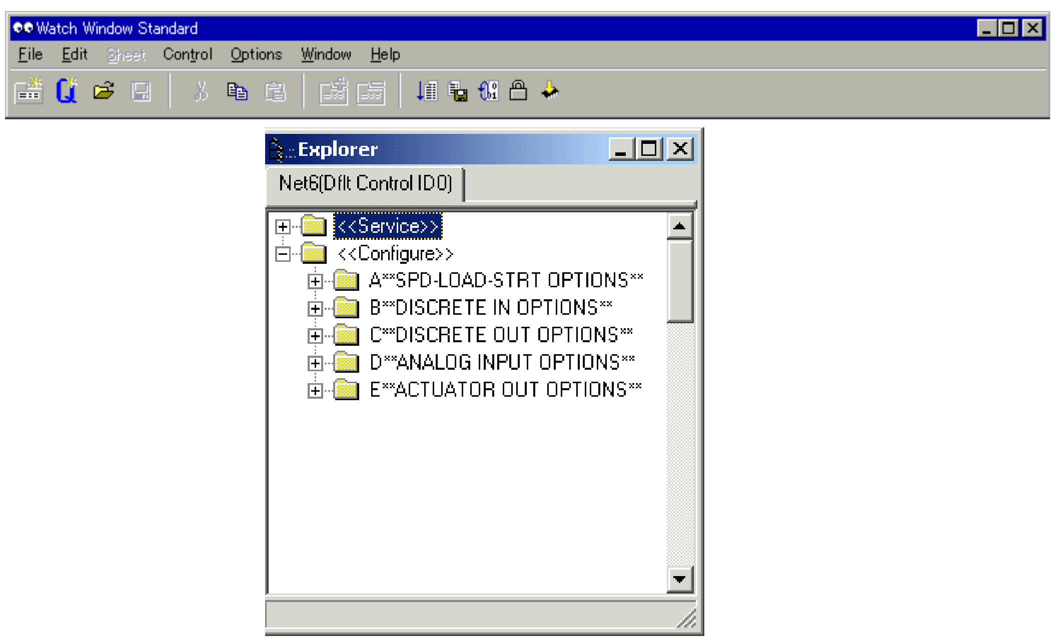


Figure 5-14. Watch Window Menu and Explorer

Configure Menu Descriptions

The GTC100 has multiple Configure and Service menus to simplify and protect control settings and their adjustments. All menus appear as pages (or sheets), are arranged alphabetically, and can be located by using the inspector's arrow buttons located above the pages to scroll to the desired menu.

The program's Configure menu items are protected when the control is in operation and cannot be changed. Before configuration values can be changed, the control must be in its I/O Lock mode. Service menus are not protected and can be modified at any time.

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

Once the configuration changes have been completed click on the Reset icon to allow the control to store the configured parameters, return the outputs to their active state and resume executing the application software.

Control Assistant Software

This tool is an optional utility program that can help manage tunable values and trend values within the control. It can be a useful troubleshooting tool for experienced users. The control has the option of having Port # 2 allocated for use as a control assistant port. If needed this port can be temporarily tuned for interface to control assistant and then later tuned back to communicate Modbus data to another device.

The latest version of this software (not released at the time of this manual being published) can also be used as the main service interface tool, on COM port # 3. It is a purchased product that includes trending capability, tunable maintenance tools, and built-in Watch Window Professional functionality.

Chapter 6.
Configuration and Service Setup Procedures

Introduction

This chapter contains information on control configurations, setting adjustments, and the use of Woodward's Watch Window software tool. Because of the variety of installations, system and component tolerances, the GTC100 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 overspeeding 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 GTC100 application. On the lines provided, enter the values used for your control. Once the worksheet is completed, connect the control with the WWI tool as described in the previous section. 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.

Start Modes

This control contains options for start control, which is the initial control mode for the fuel. These options are intended to provide a consistent acceleration of the turbine, from turbine 'lite-off' up to closed loop speed control. Once the fuel control has reached speed 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 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 PT Speed control at the minimum PT 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 the start 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 enters a Normal Stop routine.

To achieve successful turbine 'lite-off', the unit must first be 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 Acceleration control or EGT Temp limiter control will take over control of fuel demand.

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. 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.

Auto Start/Stop Sequence

The GTC100 has a built in automatic start sequence that can be configured by the user. In addition to this auto sequence, the user has the option to use the GTC relay outputs for the Motor Starter, Ignitors, and Fuel Shutoff (Block) valves. To use these outputs they must be configured in the relay output section of the hardware.

Configuration Items:

- Use Auto Start/Stop SEQ? *True
- Use Fuel SOV & Ignitor relay outputs? *True

The state of these two configuration items (1 and 2) will determine how the GTC will respond to a Start/Run command.
True/True = complete start sequence logic as shown below is followed
True/False = start sequence begins at "Attempt Turbine Lite-off" step, assuming the fuel block valves and ignitors are activated, and then continues as shown
False/Either T or F = control will follow the "Attempt Turbine Lite-off" and "Lite-off and Accelerate to PT Idle" steps, once turbine reaches PT Idle the start sequence is completed.

The GTC100 utilizes Sequential Function blocks that define steps within the sequence. The following steps are included in the GTC100 application:

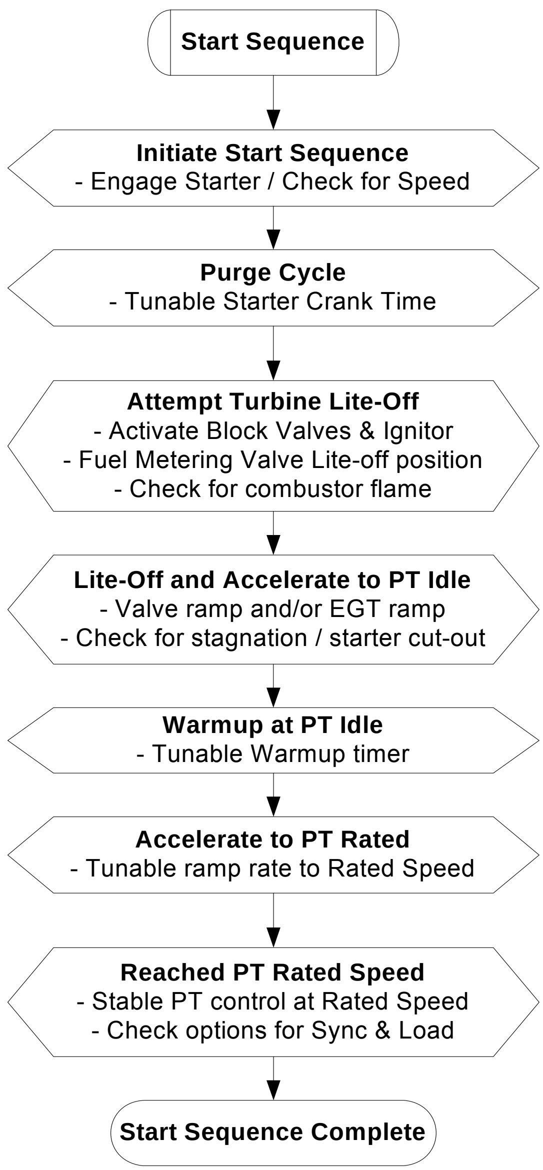


Figure 6-1. Watch Window Menu and Explorer

The following sections will explain the sequence logic above and identify 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
- EGT temp is less than 400 deg F
- Fuel Shutoff Valves are Closed
- Fuel Metering Valve at minimum position
- PT reference set point at minimum value
- Any of the customer Start Permissive inputs
- Not in a Manual Crank mode

If these are all TRUE then the control will energize the Motor Starter relay output and wait to detect that the PT 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. Once speed is detected the Sequence moves into the Purge Cycle step.
Configuration Items:

- Minimum Crank Speed (rpm) *500 (100, 2000)
- Time to wait for PT Speed detection (sec) *10 (1, 120)

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 the internal turbine air and any downstream boiler system, if no boiler 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 (2, 1200)

Attempt Lite-off / Activate Fuel Shutoff Valves & Ignitor

At this step the control will issue relay commands to 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 detection). 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 Accel to PT Idle Speed

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 PT speed set point. During this acceleration the PT 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 PT speed set point (PT Idle). If it does not reach PT idle within this time frame a shutdown command is issued and annunciated as a PT Failed to Accel. Once PT Idle is reached then the sequence proceeds to the Warm-up step.
Configuration Items:

- Maximum Time to Accel to PT Idle (sec) *120 (5, 600)
- Motor Starter Cut-out Speed (PT rpm) *2000 (100, 5000)
- Turn Ignitors OFF Speed (PT rpm) *2400 (100, 10000)
- PT Idle Speed = PT Min Ref Set in System Config

PT Idle Warm-up Cycle Sequence

At this step the control will hold the unit at the PT Idle speed for the amount of time configured by the user. At the end of this cycle the unit will issue a pulse to begin ramping the PT reference to the rated set point. At this point the sequence proceeds to the Accelerate to PT Rated step.
Configuration Items:

- Time to Warm-up at PT Idle (sec) *30 (5, 600)
- Raise PT Ref at Fast Rate (F=Default Rate) *True
- PT Reference Fast Rate (rpm/sec) *100 (5, 1000)

Accelerate to PT Rated Sequence

At this step the control will begin to raise the PT reference at the default or fast ramp rate, as determined by the user. 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 (using the programmed ramp rate and rpm range between Idle and Rated). Once the unit achieves control at PT Sync the sequence proceeds to the Reached PT rated speed step.
Configuration Items:

- Maximum Time to Accel to PT Rated (sec) *60 (5, 600)

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 Start Sequence is completed.

At this point the Start Sequence is completed.

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 receiving a Normal stop command pulse. The control will ramp down the PT reference to the minimum load point and then open the utility/generator breaker. After gaining PT speed control at rated speed, the control will ramp down the PT reference from the rated set point to the minimum set point (PT 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 PT Idle (sec) *30 (5, 600)
- Minimum Load KW Set Point (kW) *500 (10, 30000)

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.

Soft Shutdown Sequence

When a soft shutdown occurs, either a fuel control initiated event or a discrete input contact configured for a soft shutdown, the unit will open the Generator Breaker to take all load off of the turbine. The GTC will 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. The soft shutdown stack and sequence are overridden if a hard shutdown event occurs. This will make the annunciation of the trip clear to the user by the first out indication. If the GTC annunciates a first out indication for both a soft and a hard shutdown – that indicates that the first event was the soft shutdown event, immediately followed by the hard shutdown event indicated.

Hard Shutdown Sequence

When a hard shutdown occurs, either a fuel control initiated event or the discrete contact shutdown input, all of the actuator signals go to zero, the fuel shutoff valve outputs (if used) go False, and the Generator Breaker will be commanded Open 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 PT 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.
When a hard shutdown occurs it will override the soft shutdown stack – so that those events will not come in as nuisance events, since the breaker will be opened as a result of the hard trip.

Setup of PT Speed Control

The GTC100 requires that the user setup reference parameters and dynamic gain values in order to control the PT (Power Turbine) 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 speed set points for each of these 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 control determines that it should be receiving some valid speed signal

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.
Configuration Items:

- Service/Configuration Worksheet: PT SPEED CONTROL SETUP

Setup of the Accel–CDP/Fuel Limiter Curve

The GTC100 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 overfueling (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.

Configuration Items:

- Service/Configuration Worksheet: CDP TO FUEL LIMIT CURVE

Setup of the Accel PID Setup

The GTC100 allows the user to configure an optional acceleration PID to assist in the start-up of the turbine or to protect the turbine from over fueling conditions. The user will configure a speed acceleration limiter curve based on the PT speed of the turbine (as the X value). The output of this curve is the desired acceleration limit of the shaft (rpm/sec) as defined by the user. This output is compared with the calculated PT derivative speed and the error is sent to the PID. The curve is defined with a maximum of 6 breakpoints and should be tuned in sequence from X-Y values 1 through 6.

Configuration Items:

- Service/Configuration Worksheet: ACCEL Control PID SETUP

Setup of the Decel Curve Setup

The GTC100 allows the user to configure a curve to protect the turbine from under fueling (flame out) conditions. 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 high (out of the way).
Configuration Items:

- Service/Configuration Worksheet: DECEL CURVE (CDP) SETUP

Setup of CDP Pressure Control

The GTC100 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.
Configuration Items:

- Service/Configuration Worksheet: CDP CONTROL SETUP

Setup of EGT Temperature Control

The GTC100 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 PT control. This function helps to eliminate potential overtemp shutdowns on initial startup by providing closed loop control at sub-PT Idle conditions. The EGT control automatically resumes to being a topping control once the turbine has reached PT speed control.
Configuration Items:

- Service/Configuration Worksheet: EGT CONTROL SETUP

Setup of Generator Settings

The GTC100 allows the user to setup a KW control loop to limit the maximum KW output of the turbine. The user can adjust the KW 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 KW or horsepower output of the turbine. The user can also setup the Droop percentage and define a curve (CDP versus KW) that can be used for load feedback if the KW sensor fails. In the case of a compressor unit, the user can decide to use CDP as load feedback.
Configuration Items:

- Service/Configuration Worksheet: GENERATOR SETTINGS

Setup of Load Sharing

The GTC100 has the capability to communicate with other GTC products, as well as other Woodward power management products, to allow Load Sharing of multiple units on a local power bus. When the units are isolated from the Utility bus, the LON communication link will allow these devices to balance the output of all available units to supply the total load on the local bus. This mode is described as Isochronous Load Sharing.

NOTE: If it is desirable to include a unit (or units) that load share via an analog signal (such as a Woodward Real Power Sensor) then another device should be added. The Woodward Load Sharing Interface Module (LSIM – p/n 8239-082) will provide a gateway to convert the analog load share signal into a LON signal that can be tied into the above mentioned digital load sharing products.
Configuration Items:
Configuration Worksheet: SYSTEM

- Use Load Sharing Option *True
- Transfer Rate In/Out of LS (sec) *10 (0.1, 60)
- Use LON Communication Link *True

Synchronizer

The GTC100 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 engine 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 GTC100 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 GTC100 control 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.

Off mode, the GTC performs no synchronization functions, The running sequence would stop with the engine at rated speed, and an external function would be required to close the breaker and continue the sequence.
Check mode is used to confirm that the synchronizer works properly by allowing synchronizing to be performed but not closing the breaker. The Synchronizer status screen can be used to observe the Slip, Phase, and voltage indication, (Displays ++ when matched). In the Check mode these indication must match external metering and wiring before allowing the breaker to close.
Permissive mode is used to replace a sync check relay function, the bias outputs are passive, but the breaker command will be given when speed, phase, and voltage parameters are within the window.
Run/Auto mode is the normal mode with active synchronizing and breaker control.

Additional synchronizer features include: voltage matching, time delayed automatic multi-shot re-closing, 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.
Configuration Items:

- Service/Configuration Worksheet: SYNCHRONIZER

Load Control

The GTC100 has 3 different modes for controlling the turbine load. Isochronous, Droop and Isochronous Load Sharing

Droop Mode

When the generator circuit breaker is closed and the utility breaker is closed then the unit is in droop operation. The turbine load will be directly proportional to the speed reference signal, which can be manipulated by Raise/Lower commands, a Remote PT reference signal (analog input) or a Modbus or ServLink DDE communication interface. The load reference can also be driven indirectly through the Process control mode.

The typical application of simple load droop operation is with a unit that normally operates in parallel with a Mains (utility) bus.

Isochronous Mode

When the generator circuit breaker is closed, the utility breaker is open and the Load Sharing mode is not enabled, then the unit is in Isochronous mode and will handle all plant loads up to the upper load output limit of the turbine.

The typical application of this mode is when a unit is a stand-alone power generation site that does not tie to the utility or a unit that droops against the utility but needs to maintain all of the plant load when the utility breaker is opened.

Isochronous Load Sharing Mode

When the generator circuit breaker is closed, the utility breaker is open and the Load Sharing mode is Enabled, the unit will Load Share with other units connected to the bus. The load sharing signal will control the load of each engine by slight changes to the speed control's speed reference.

The typical application of this mode is when a unit is part of a group of stand-alone power generation units at a site that does not tie (or is not currently tied to) the utility.

Process Control

Process Control is a cascade control mode that manipulates the PT reference to maintain the process operation set point. 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. The typical implementations of this feature include, import/export control, pressure maintenance, or other plant dependent load set point parameters.

A 4–20 mA (or 1–5 Vdc) process transmitter provides the process signal to the GTC100 control. The control includes an internal digital process reference value which may be controlled by raise and lower switch contact, 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 GTC100 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.

Additional functions include selectable and adjustable process high and low limit switches and alarm activation.

When multiple gensets and GTC100 LS 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.
Configuration Items:

- Service/Configuration Worksheet: PROCESS CONTROL

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 GTC100 control has a selectable voltage range alarm that is activated if the analog output to the voltage regulator reaches high or low saturation. The GTC100 control also has selectable and adjustable high and low voltage limit switches and alarm outputs.

The GTC100 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 GTC100 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.
Configuration Items:

- Service/Configuration Worksheet: REACTIVE LOAD CONTROL

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 GTC 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 can be configured for generator and bus protective relay (i.e. Reverse power, Under Voltage) functions. Time delay, and separate warning and trip thresholds can be set. A complete list of protective relay functions available is given in the next chapter. Current based protections are implemented using the ANSI/IEEE C37.112 Very Inverse curve.
Configuration Items:

- Service/Configuration Worksheet: ALM/SD EVENTS

Tunable Upload/Download Function

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

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

From WW, go to the Explorer Window and 'right-mouse' click on the control (top level). A pull-down menu will appear and the App Settings selection will allow you to Save to File or Load from File.

- SAVE = Download the tunables in the control to a file on the user PC
- LOAD = Upload tunable settings from a user PC into the control

Loading tunables into the control will cause the unit to Lock the I/O and shutdown the turbine.

> **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.**

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

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.

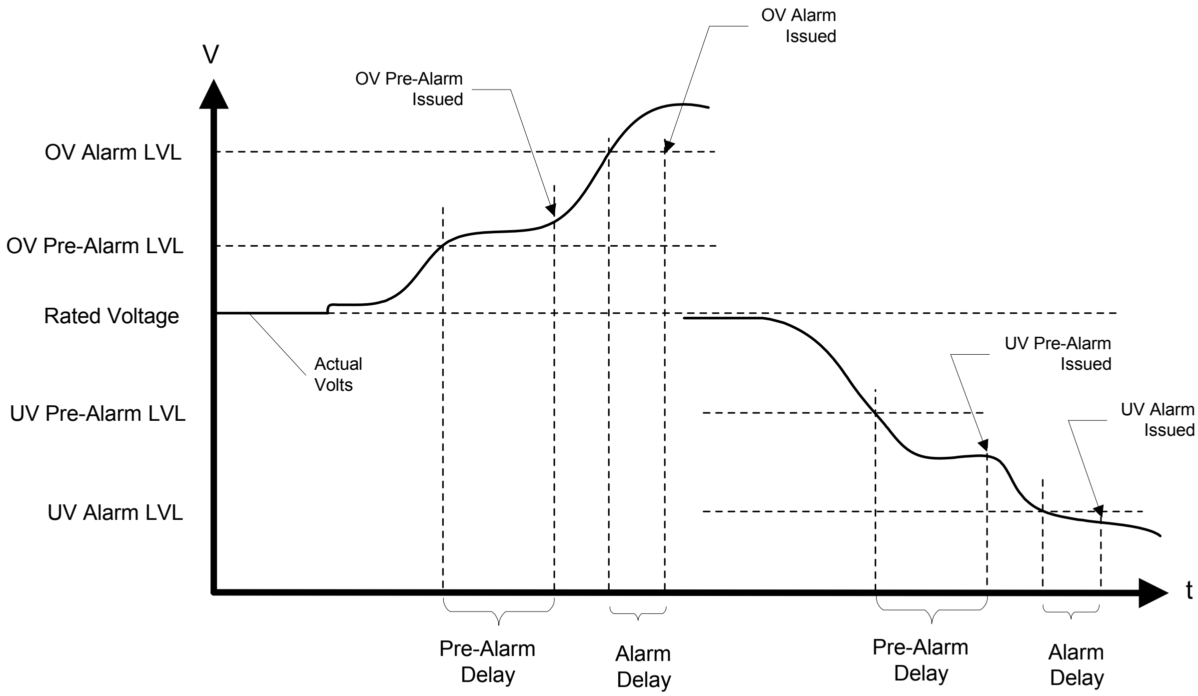


Figure 7-1. Over Voltage/Under Voltage Alarm

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 graph below 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.

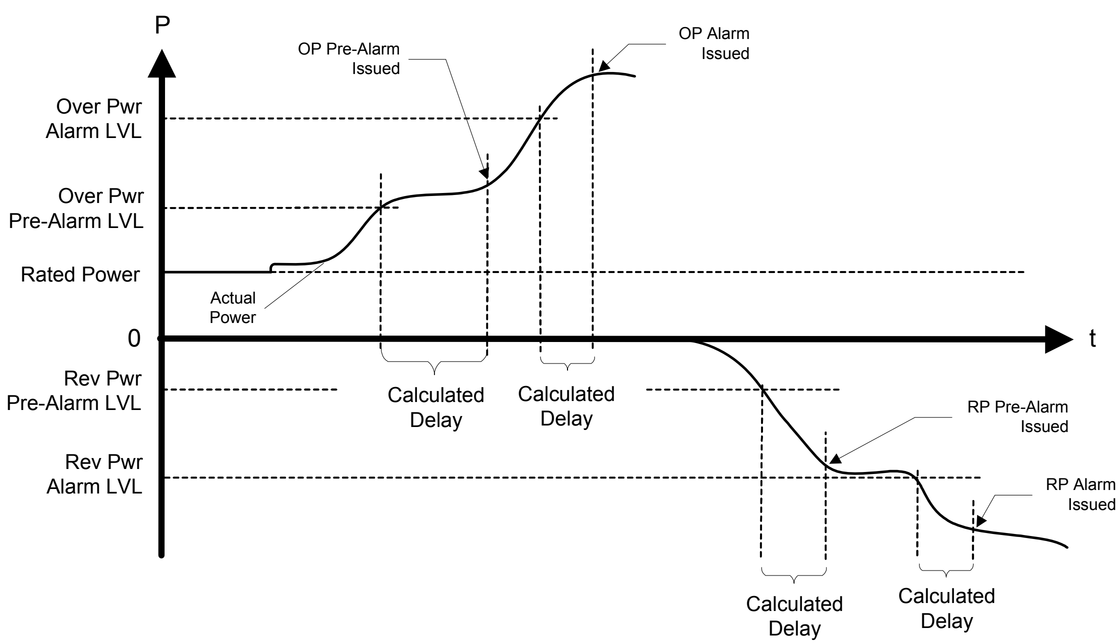


Figure 7-2. Over Power/Reverse Power

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.

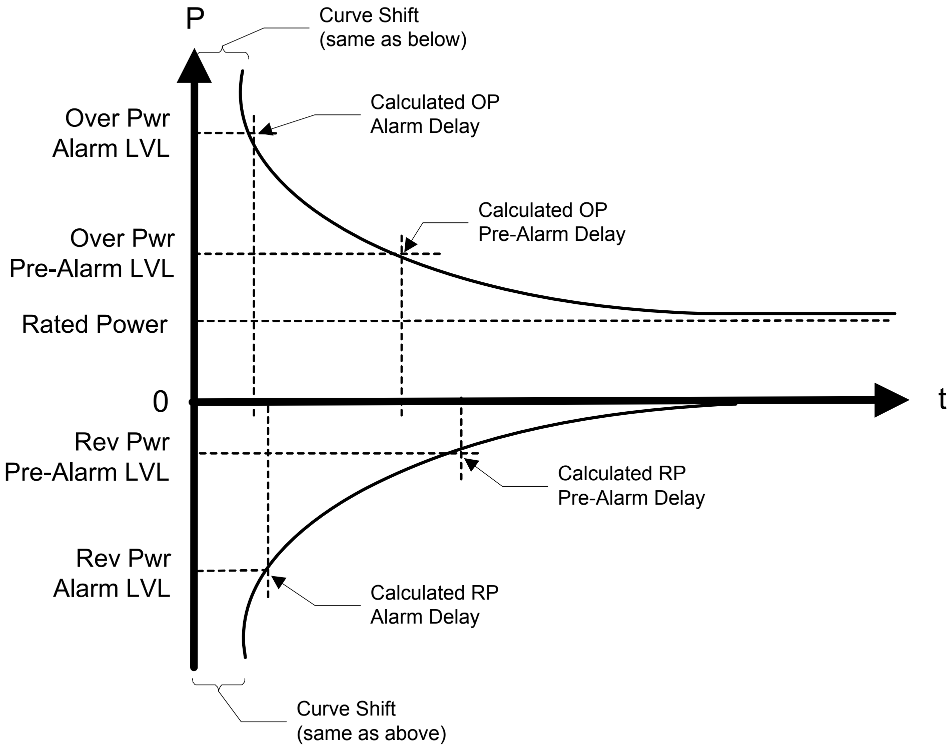


Figure 7-3. Over Power/Reverse Power Time Delay

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 graph below 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.

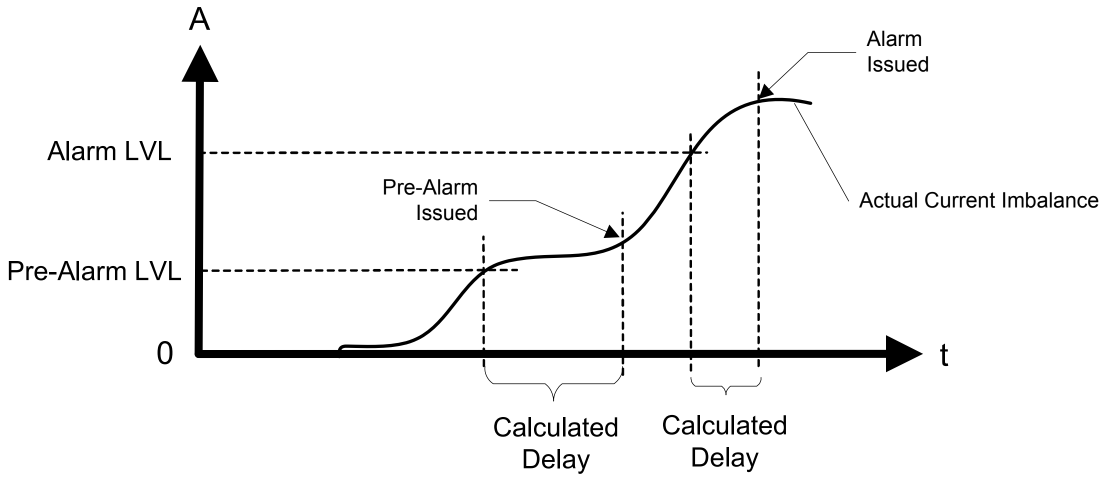


Figure 7-4. Phase Current Imbalance

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.

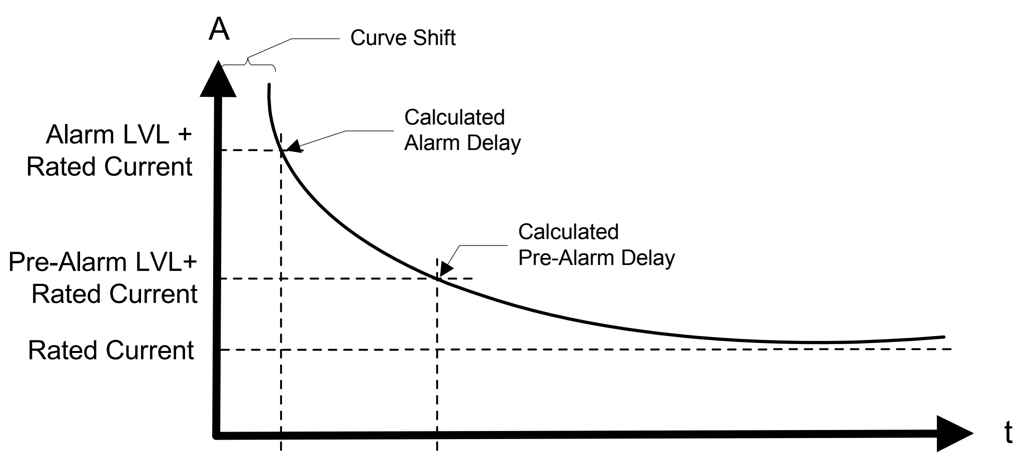


Figure 7-5. Phase-Balance Current, Inverse Time Delay

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.

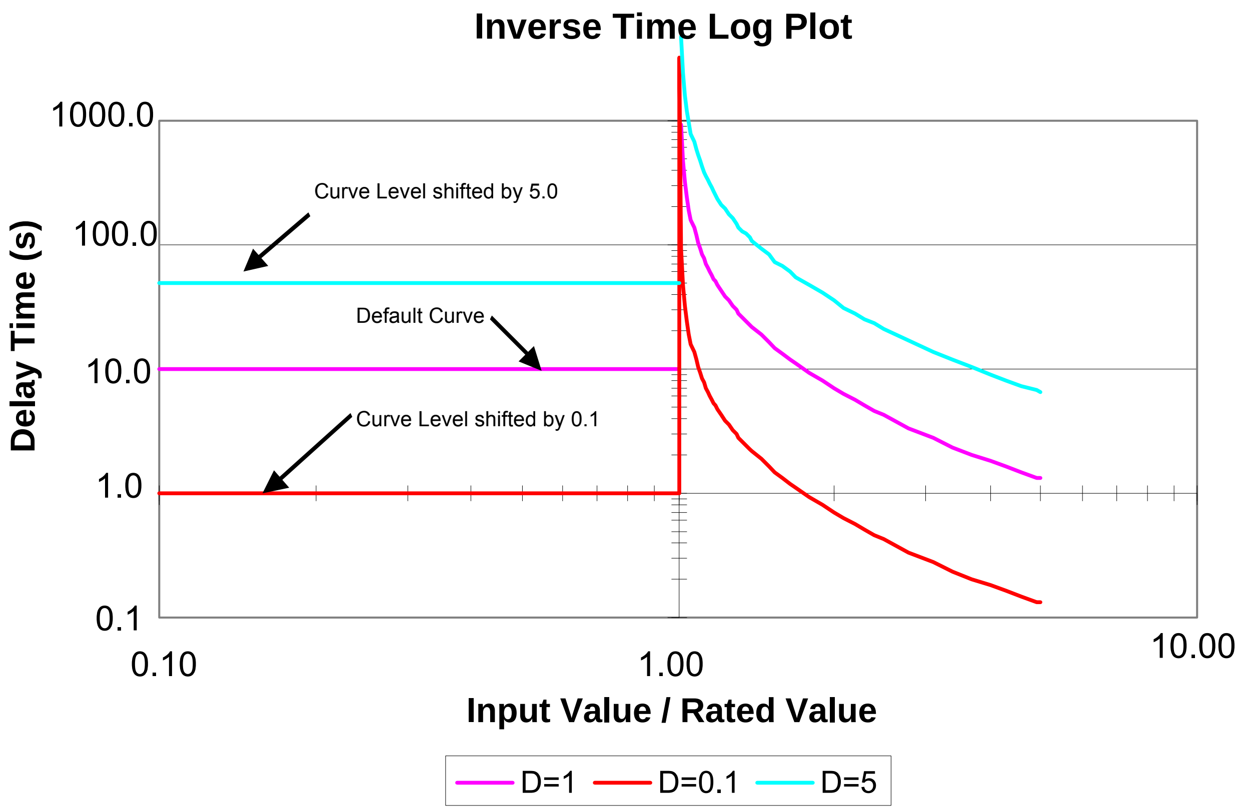


Figure 7-6. Inverse Curve Time Delay, Level Shift

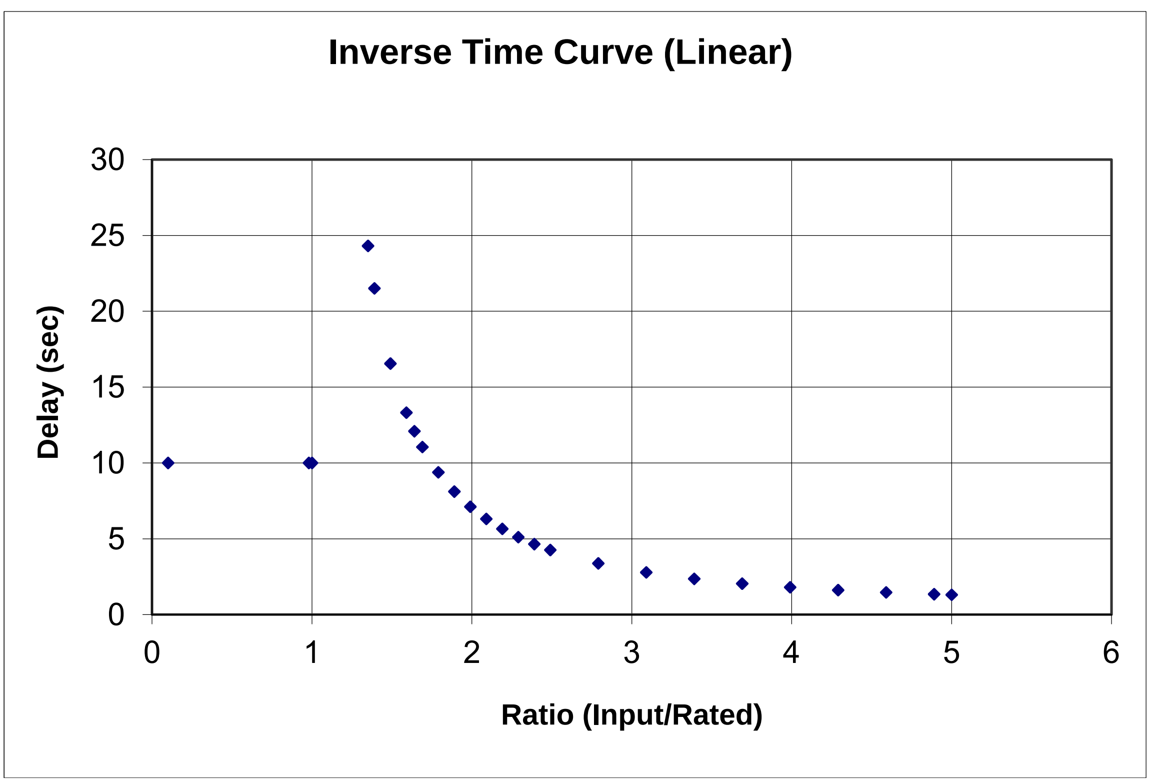


Figure 7-7. Inverse Curve Time Delay, Linear Graph

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.

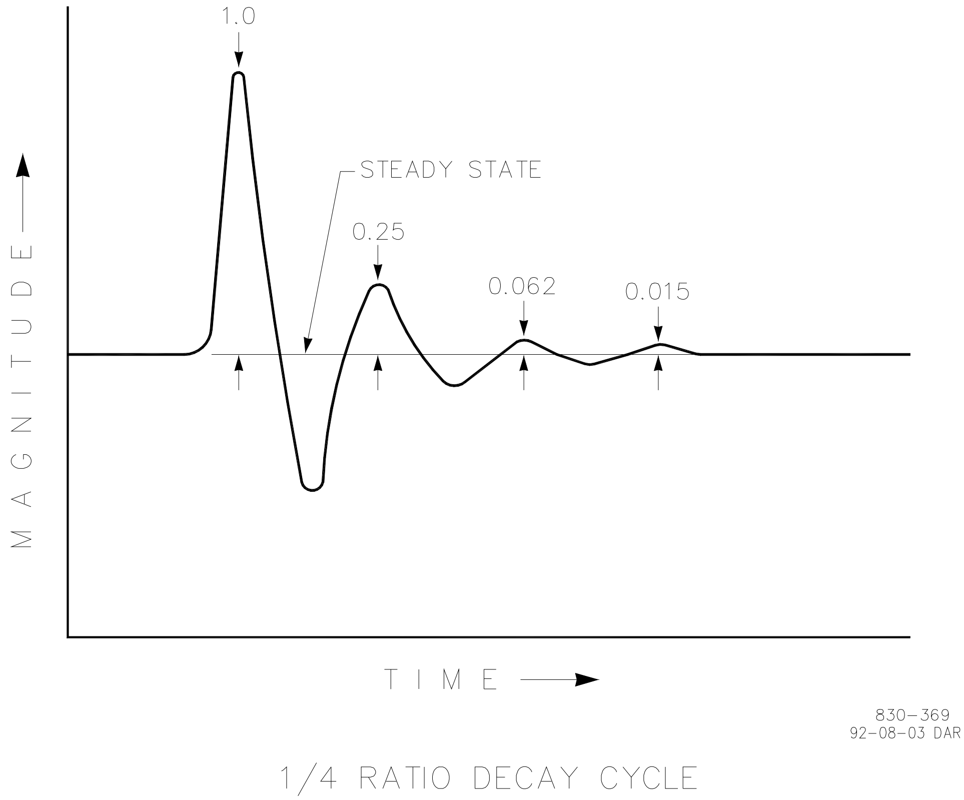


Figure 8-1. Ratio Decay Cycle

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.

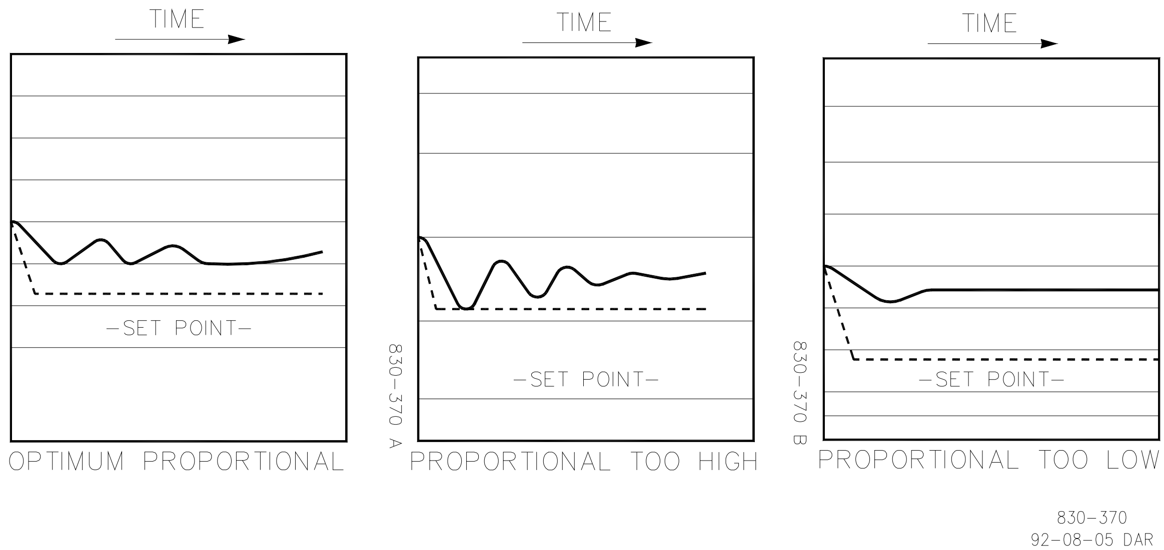


Figure 8-2. Proportional Gain Settings

*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 GTC100 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	**** Note on 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.

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

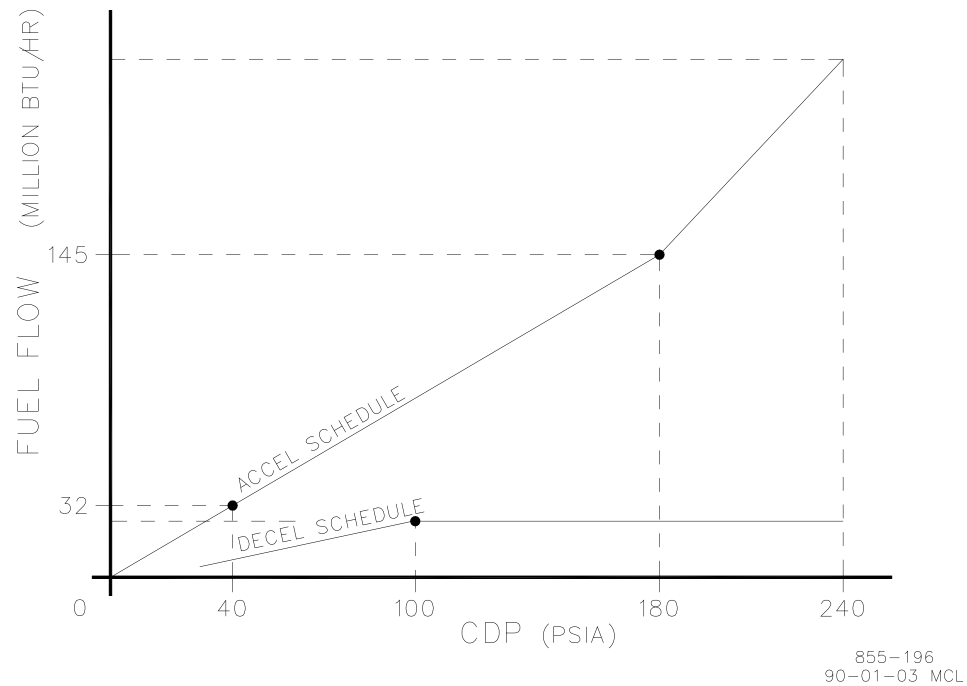


Figure 8-3. Linearized Flow Schedule

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 WatchWindow
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. Valve Test Data

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

This appendix contains the control wiring diagrams.


Control Wiring Diagram
GTC100
CONTROL WIRING
(INCLUDES WIRING FOR
POWERSENSE OPTION)
REVISION HISTORY
REV A E/C 1074409-01 DPENNI AUG-2006 SDCEAN
MATERIALS:
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.
THIRD ANGLE PROJECTION
APPROVED SDCEAN JAN-2005
CHECKED DPENNI JAN-2005
DRAWN DPENNI JAN-2005
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
DIAGRAM - CONTROL WIRING
GTC100
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1128
REV A
SCALE: NTS
SHEET 1 OF 10
AUTOCAD

SHEET NUMBER	DESIGNATION	DESCRIPTION	REV. DATE
SHEET 1	COVER	COVER SHEET	
SHEET 2	INDEX	SHEET INDEX SHEET	
SHEET 3	CHASSIS LAYOUT	ATLAS CHASSIS	
SHEET 4	PS BOARD	POWER & DISCRETE OUTPUTS	
SHEET 5	A01 SMARTCORE 1	DISCRETE INPUTS	
SHEET 6	A01 SMARTCORE 2	ANALOG INPUTS & SPEED INPUTS	
SHEET 7	A01 SMARTCORE 3	ANALOG OUTPUTS AND ACTUATOR OUTPUTS	
SHEET 8	A01 SMARTCORE 4	COMMUNICATION PORTS	
SHEET 9	A02 POWERSENSE01	LOAD BUS PT/CT'S AND VOLTAGE/SPEED BIAS OUTPUTS	NOTE #3
SHEET 10	A02 POWERSENSE02	GENERATOR PT/CT'S AND LON COMMUNICATIONS	NOTE #3

NOTES:

1) DESCRIPTIONS IN BOLD ARE FIXED I/O POINTS THAT ARE USED TO IMPLEMENT FUNCTIONALITY IN THE GTC100.

2) DESCRIPTIONS WITH A * ARE REQUIRED BY THE GTC100.

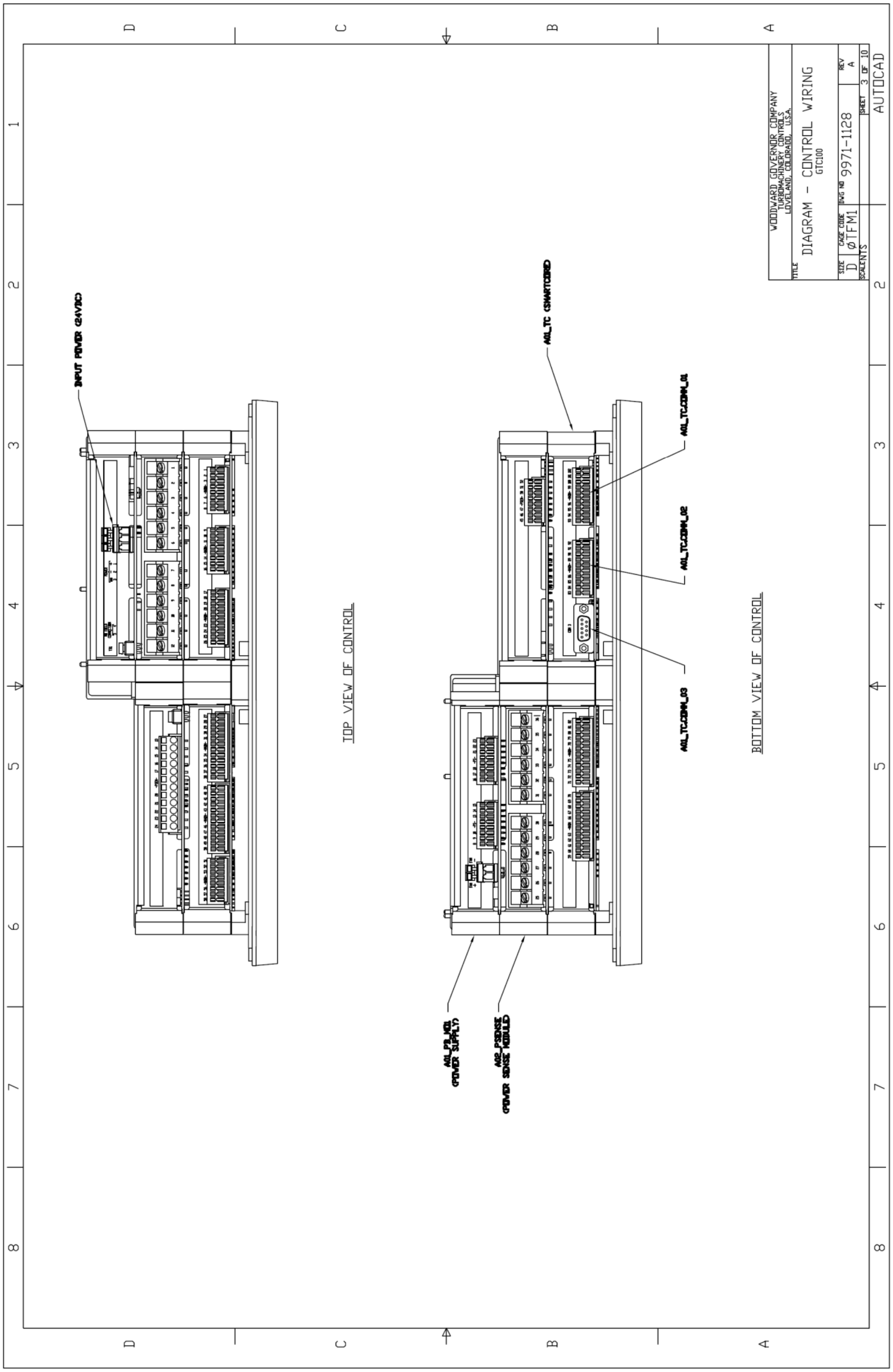
3) THE POWERSENSE BOARD IS ONLY USED ON THE GTC100 W/PSENSE MODEL.

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

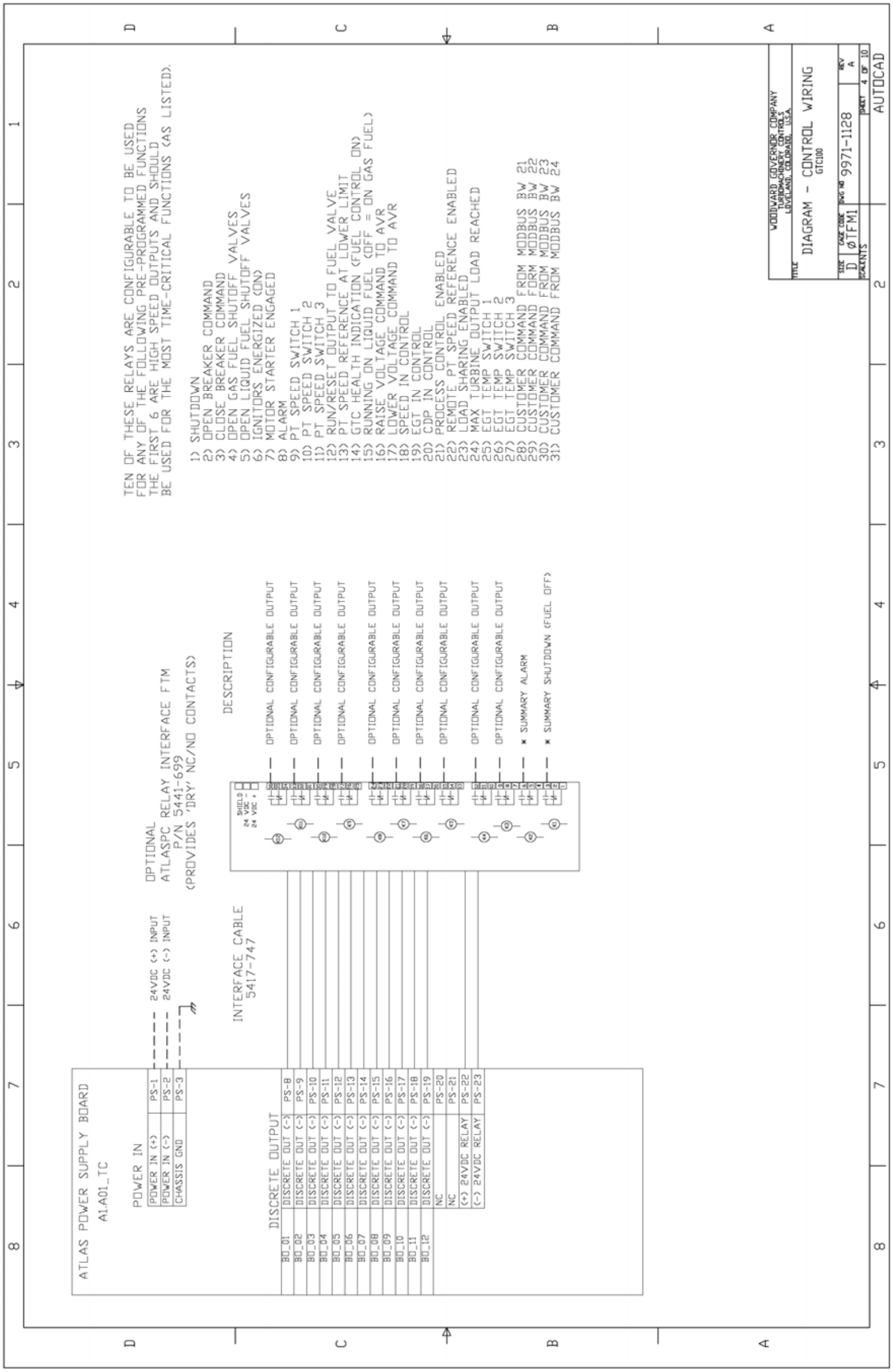
TITLE: DIAGRAM - CONTROL WIRING
GTC100

SIZE: D | CAGE CODE: ØTFM1 | DWG NO: 9971-1128 | REV: A
SCALE: NTS | SHEET 2 OF 10

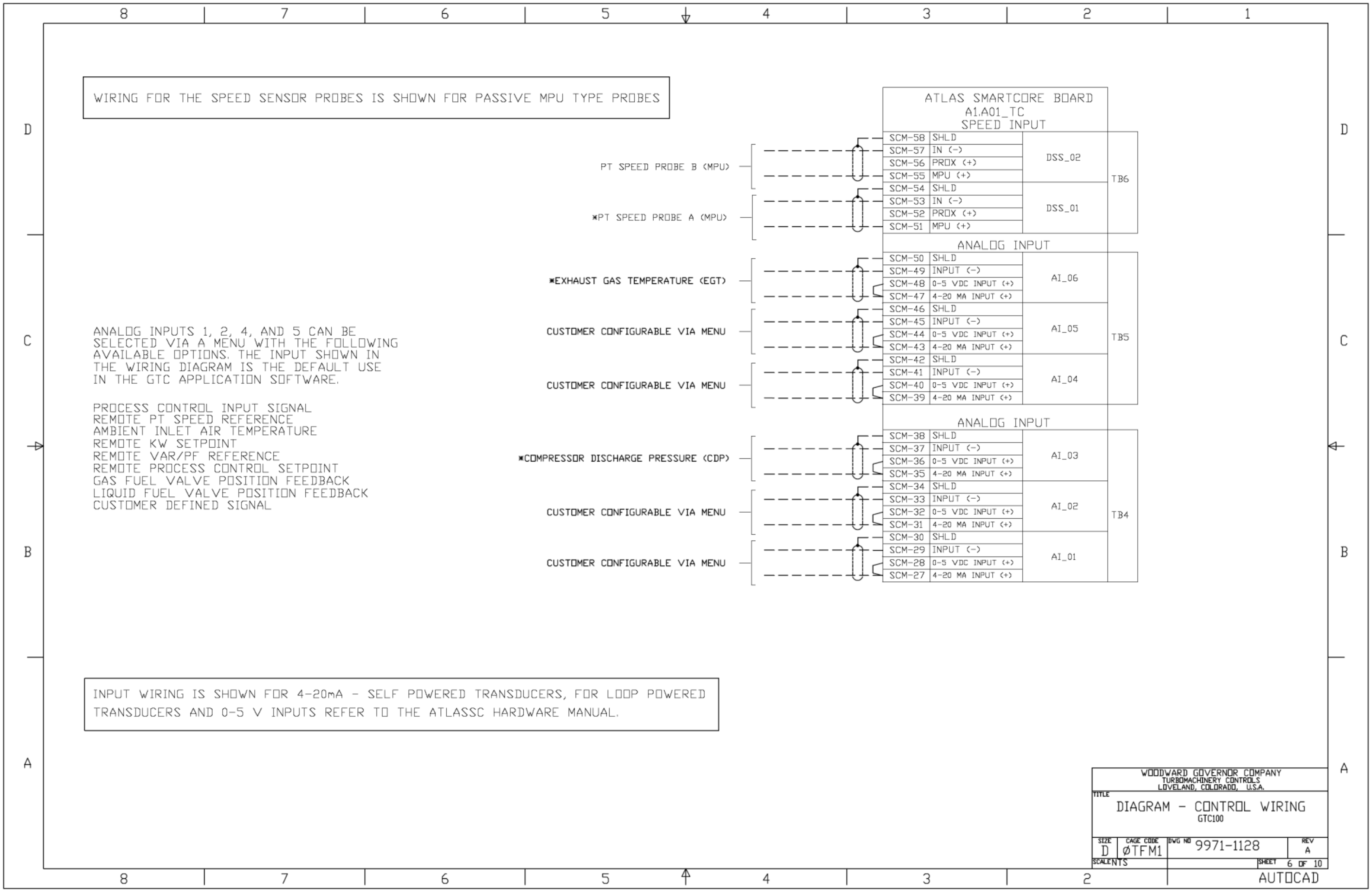
AUTOCAD

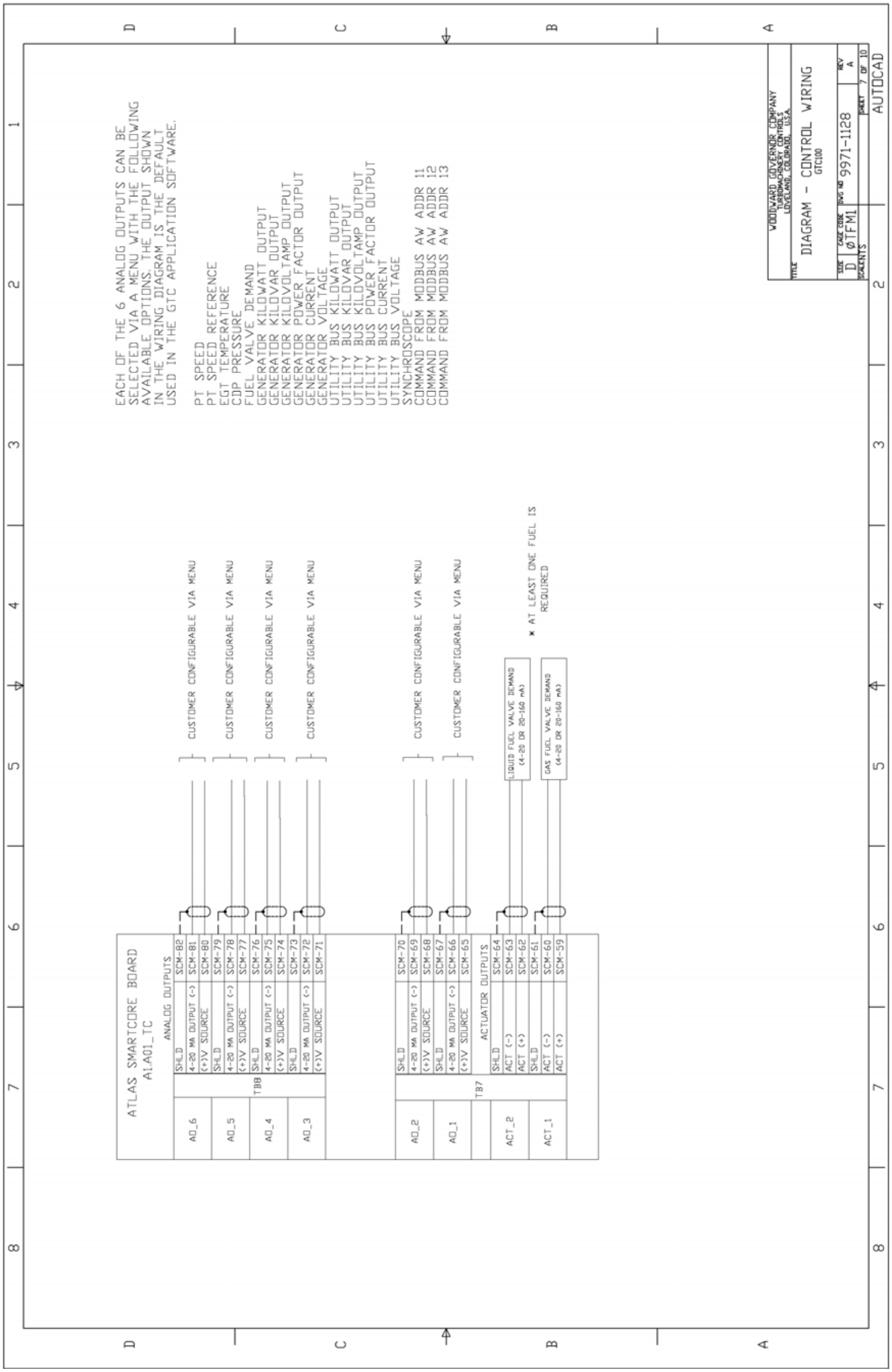


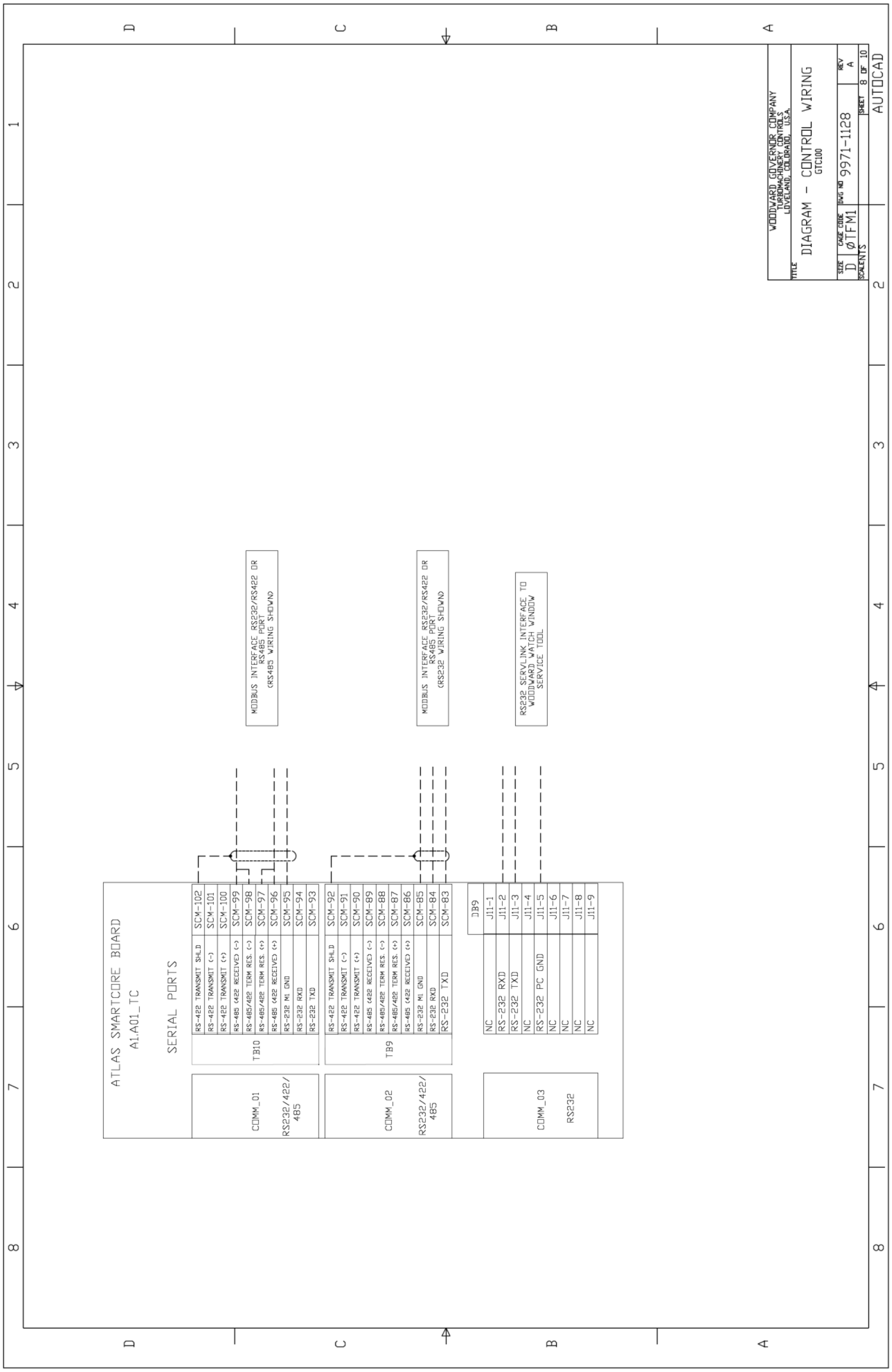
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
DIAGRAM - CONTROL WIRING
GTC100
9971-1128
AUTOCAD
TOP VIEW OF CONTROL
BOTTOM VIEW OF CONTROL
INPUT POWER (24VDC)


ATLAS POWER SUPPLY BOARD
A1.A01_TC
POWER IN
POWER IN (+) PS-1
POWER IN (-) PS-2
CHASSIS GND PS-3
24VDC (+) INPUT
24VDC (-) INPUT
OPTIONAL
ATLASPC RELAY INTERFACE FTM
P/N 5441-699
(PROVIDES 'DRY' NC/NO CONTACTS)
INTERFACE CABLE
5417-747
DESCRIPTION
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 PS-22
(-) 24VDC RELAY PS-23
SHIELD
24 VDC -
24 VDC +
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
OPTIONAL CONFIGURABLE OUTPUT
* SUMMARY ALARM
* SUMMARY SHUTDOWN (FUEL OFF)
TEN OF THESE RELAYS ARE CONFIGURABLE TO BE USED
FOR ANY OF THE FOLLOWING PRE-PROGRAMMED FUNCTIONS
THE FIRST 6 ARE HIGH SPEED OUTPUTS AND SHOULD
BE USED FOR THE MOST TIME-CRITICAL FUNCTIONS (AS LISTED).
1) SHUTDOWN
2) OPEN BREAKER COMMAND
3) CLOSE 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) PT SPEED SWITCH 1
10) PT SPEED SWITCH 2
11) PT SPEED SWITCH 3
12) RUN/RESET OUTPUT TO FUEL VALVE
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
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 TEMP SWITCH 1
26) EGT TEMP SWITCH 2
27) EGT TEMP SWITCH 3
28) CUSTOMER COMMAND FROM MODBUS BW 21
29) CUSTOMER COMMAND FORM MODBUS BW 22
30) CUSTOMER COMMAND FROM MODBUS BW 23
31) CUSTOMER COMMAND FROM MODBUS BW 24
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
TITLE
DIAGRAM - CONTROL WIRING
GTC100
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1128
REV A
SCALE NTS
SHEET 4 OF 10
AUTOCAD

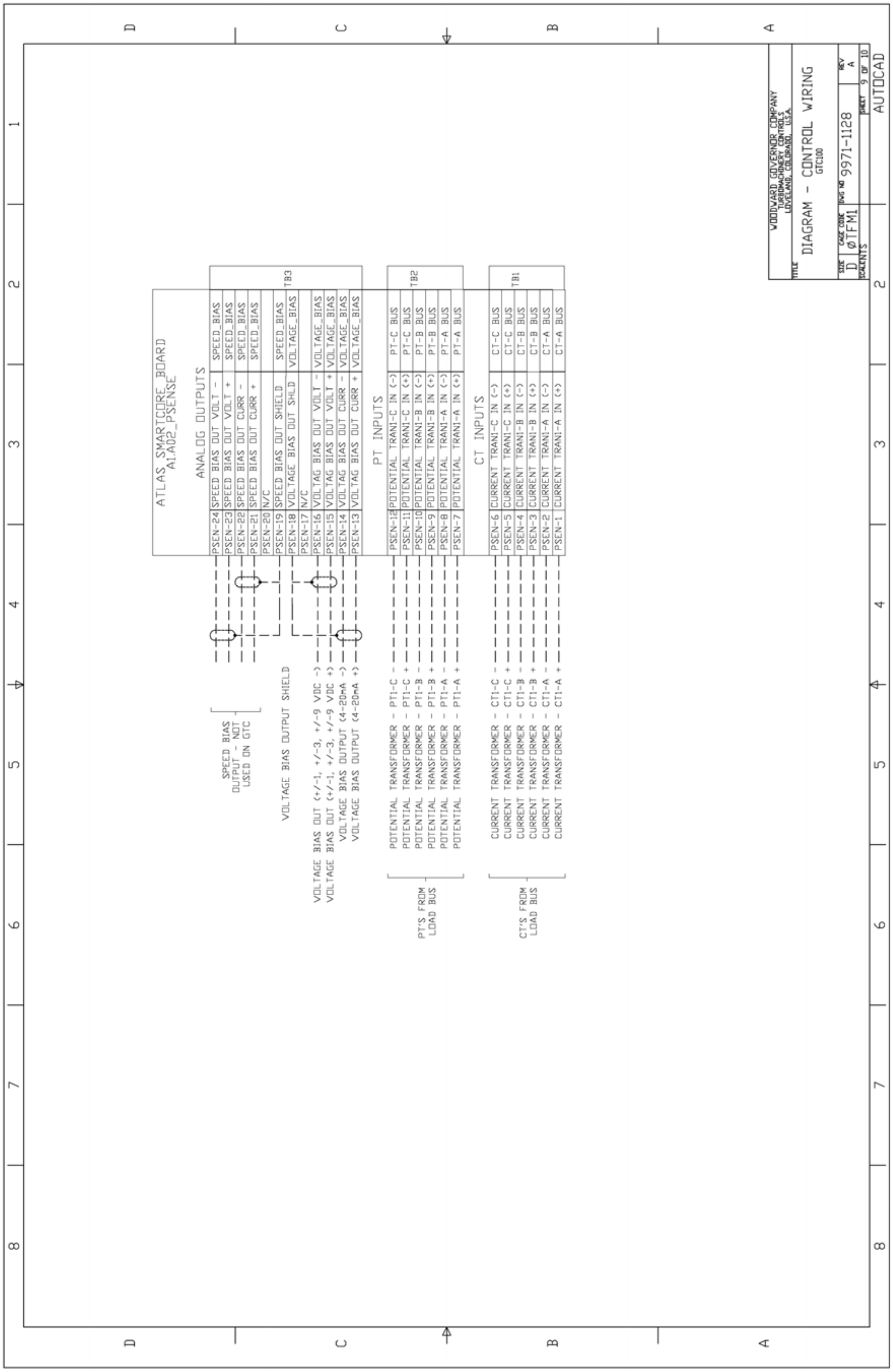

DISCRETE INPUTS 4-24 CAN BE USED FOR THE FUNCTION SHOWN, OR THEY CAN BE CONFIGURED FOR USE AS CUSTOMER INPUTS THAT INDICATE A START PERMISSIVE, TRIGGER AN ALARM OR TRIGGER A SHUTDOWN.
** IF EXTERNAL 24VDC POWER IS USED, THERE SHOULD BE NO CONNECTION TO TERMINAL 26 AND THE COMMON FOR THE EXTERNAL POWER SHOULD BE CONNECTED TO TERMINAL 25
CONTACT WETTING VOLTAGE IF INTERNAL +24VDC IS USED
** SEE NOTE
ATLAS SMARTCORE BOARD
A1.A01_TC
DISCRETE INPUT
A CUSTOMER CONFIGURABLE INPUT
A LIQUID FUEL VALVE/ACTUATOR FAULT
GAS FUEL VALVE/ACTUATOR FAULT
RAISE PROCESS CONTROL SETPOINT
LOWER PROCESS CONTROL SETPOINT
ENABLE PROCESS CONTROL
VOLTAGE/PF/VAR RAISE COMMAND
VOLTAGE/PF/VAR LOWER COMMAND
ENABLE REACTIVE LOAD COMTROL (VAR/PF)
UTILITY BREAKER OPEN (LOAD SHARING PERMISSIVE)
GENERATOR BREAKER AUX (52) (TRUE = CLOSED)
INHIBIT SYNCHRONIZER
ENABLE REMOTE PT REFERENCE SETPOINT
FUEL SELECTION / TRANSFER (TRUE = LIQUID)
COMBUSTOR FLAME DETECTOR
A GO TO RATED SPEED/GO TO BASE LOAD
PT SPEED SIGNAL FAILED OVERRIDE (TO START)
PT REFERENCE SELECT FAST RATE
PT REFERENCE RAISE COMMAND
PT REFERENCE LOWER COMMAND
SYSTEM ACKNOWLEDGE (ALM & SD)
* SYSTEM RESET (ALM & SD)
*START/RUN (TRUE = START INITIATED / FUEL ON FALSE = NORMAL STOP)
* SHUTDOWN (TRUE = FUEL OFF)
SCM-26 (+) +24VISO BI_26
SCM-25 (-) I_GND BI_25
SCM-24 DISCRETE IN (+) BI_24
SCM-23 DISCRETE IN (+) BI_23
SCM-22 DISCRETE IN (+) BI_22
SCM-21 DISCRETE IN (+) BI_21
SCM-20 DISCRETE IN (+) BI_20
SCM-19 DISCRETE IN (+) BI_19
SCM-18 DISCRETE IN (+) BI_18
SCM-17 DISCRETE IN (+) BI_17
TB3
SCM-16 DISCRETE IN (+) BI_16
SCM-15 DISCRETE IN (+) BI_15
SCM-14 DISCRETE IN (+) BI_14
SCM-13 DISCRETE IN (+) BI_13
SCM-12 DISCRETE IN (+) BI_12
SCM-11 DISCRETE IN (+) BI_11
SCM-10 DISCRETE IN (+) BI_10
SCM-9 DISCRETE IN (+) BI_9
TB2
SCM-8 DISCRETE IN (+) BI_8
SCM-7 DISCRETE IN (+) BI_7
SCM-6 DISCRETE IN (+) BI_6
SCM-5 DISCRETE IN (+) BI_5
SCM-4 DISCRETE IN (+) BI_4
SCM-3 DISCRETE IN (+) BI_3
SCM-2 DISCRETE IN (+) BI_2
SCM-1 DISCRETE IN (+) BI_1
TB1
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
TITLE
DIAGRAM - CONTROL WIRING
GTC100
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1128
REV A
SCALE NTS
SHEET 5 OF 10
AUTOCAD

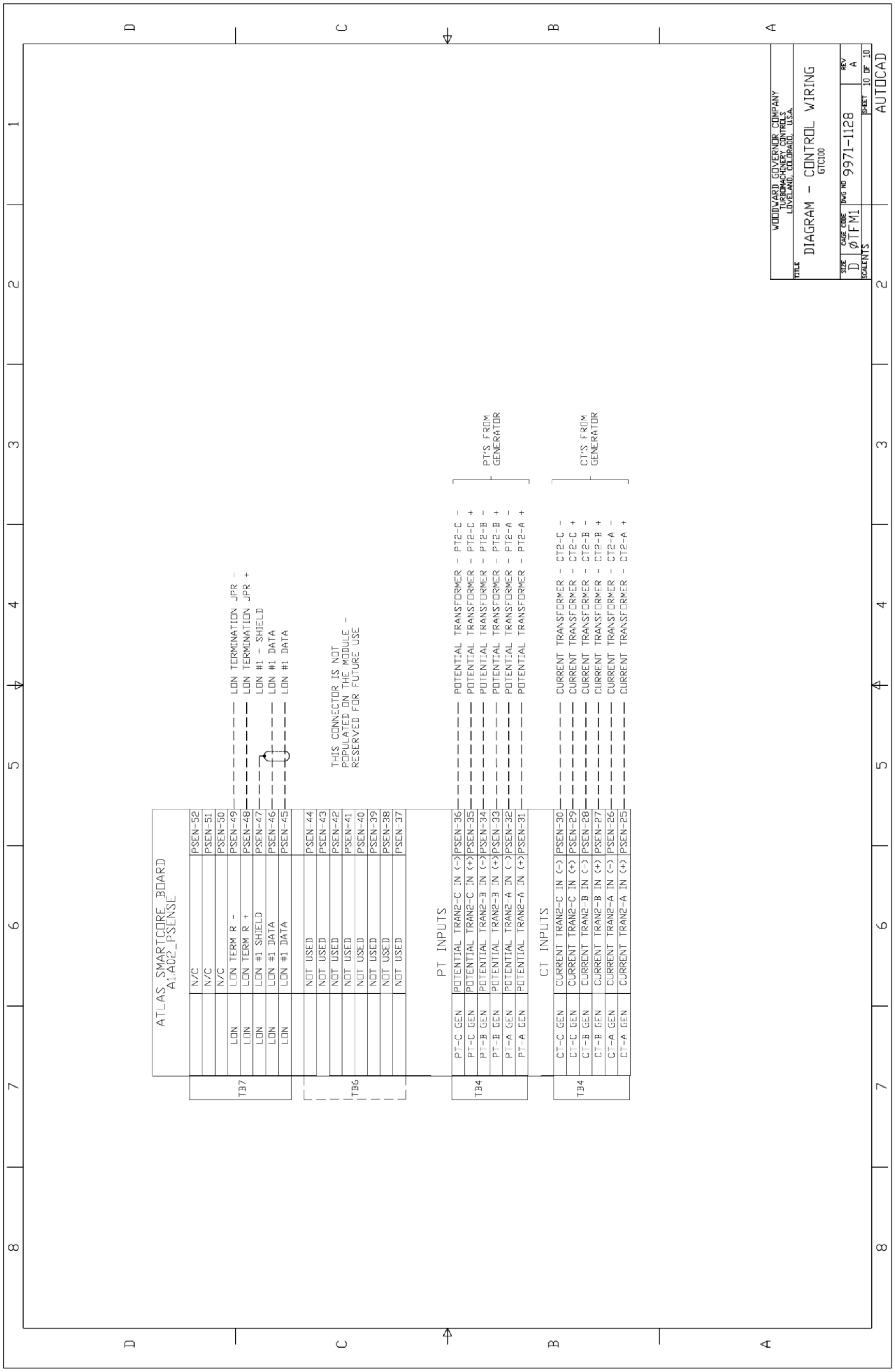

WIRING FOR THE SPEED SENSOR PROBES IS SHOWN FOR PASSIVE MPU TYPE PROBES
ATLAS SMARTCORE BOARD
A1.A01_TC
SPEED INPUT
PT SPEED PROBE B (MPU)
*PT SPEED PROBE A (MPU)
SCM-58 SHLD
SCM-57 IN (-)
SCM-56 PROX (+)
SCM-55 MPU (+)
DSS_02
SCM-54 SHLD
SCM-53 IN (-)
SCM-52 PROX (+)
SCM-51 MPU (+)
DSS_01
TB6
ANALOG INPUT
*EXHAUST GAS TEMPERATURE (EGT)
CUSTOMER CONFIGURABLE VIA MENU
CUSTOMER CONFIGURABLE VIA MENU
SCM-50 SHLD
SCM-49 INPUT (-)
SCM-48 0-5 VDC INPUT (+)
SCM-47 4-20 MA INPUT (+)
AI_06
SCM-46 SHLD
SCM-45 INPUT (-)
SCM-44 0-5 VDC INPUT (+)
SCM-43 4-20 MA INPUT (+)
AI_05
SCM-42 SHLD
SCM-41 INPUT (-)
SCM-40 0-5 VDC INPUT (+)
SCM-39 4-20 MA INPUT (+)
AI_04
TB5
ANALOG INPUT
*COMPRESSOR DISCHARGE PRESSURE (CDP)
CUSTOMER CONFIGURABLE VIA MENU
CUSTOMER CONFIGURABLE VIA MENU
SCM-38 SHLD
SCM-37 INPUT (-)
SCM-36 0-5 VDC INPUT (+)
SCM-35 4-20 MA INPUT (+)
AI_03
SCM-34 SHLD
SCM-33 INPUT (-)
SCM-32 0-5 VDC INPUT (+)
SCM-31 4-20 MA INPUT (+)
AI_02
SCM-30 SHLD
SCM-29 INPUT (-)
SCM-28 0-5 VDC INPUT (+)
SCM-27 4-20 MA INPUT (+)
AI_01
TB4
ANALOG INPUTS 1, 2, 4, AND 5 CAN BE SELECTED VIA A MENU WITH THE FOLLOWING AVAILABLE OPTIONS. THE INPUT SHOWN IN THE WIRING DIAGRAM IS THE DEFAULT USE IN THE GTC APPLICATION SOFTWARE.
PROCESS CONTROL INPUT SIGNAL
REMOTE PT SPEED REFERENCE
AMBIENT INLET AIR TEMPERATURE
REMOTE KW SETPOINT
REMOTE VAR/PF REFERENCE
REMOTE PROCESS CONTROL SETPOINT
GAS FUEL VALVE POSITION FEEDBACK
LIQUID FUEL VALVE POSITION FEEDBACK
CUSTOMER DEFINED SIGNAL
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.
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
TITLE
DIAGRAM - CONTROL WIRING
GTC100
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1128
REV A
SCALE NTS
SHEET 6 OF 10
AUTOCAD


EACH OF THE 6 ANALOG OUTPUTS CAN BE SELECTED VIA A MENU WITH THE FOLLOWING AVAILABLE OPTIONS. THE OUTPUT SHOWN IN THE WIRING DIAGRAM IS THE DEFAULT USED IN THE GTC APPLICATION SOFTWARE.
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
GENERATOR VOLTAGE
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
ATLAS SMARTCORE BOARD
A1A01_TC
ANALOG OUTPUTS
TB8
AO_6
SHLD SCM-82
4-20 MA OUTPUT (-) SCM-81
(+)V SOURCE SCM-80
AO_5
SHLD SCM-79
4-20 MA OUTPUT (-) SCM-78
(+)V SOURCE SCM-77
AO_4
SHLD SCM-76
4-20 MA OUTPUT (-) SCM-75
(+)V SOURCE SCM-74
AO_3
SHLD SCM-73
4-20 MA OUTPUT (-) SCM-72
(+)V SOURCE SCM-71
TB7
AO_2
SHLD SCM-70
4-20 MA OUTPUT (-) SCM-69
(+)V SOURCE SCM-68
AO_1
SHLD SCM-67
4-20 MA OUTPUT (-) SCM-66
(+)V SOURCE SCM-65
ACTUATOR OUTPUTS
ACT_2
SHLD SCM-64
ACT (-) SCM-63
ACT (+) SCM-62
ACT_1
SHLD SCM-61
ACT (-) SCM-60
ACT (+) SCM-59
CUSTOMER CONFIGURABLE VIA MENU
CUSTOMER CONFIGURABLE VIA MENU
CUSTOMER CONFIGURABLE VIA MENU
CUSTOMER CONFIGURABLE VIA MENU
CUSTOMER CONFIGURABLE VIA MENU
CUSTOMER CONFIGURABLE VIA MENU
LIQUID FUEL VALVE DEMAND (4-20 OR 20-160 mA)
GAS FUEL VALVE DEMAND (4-20 OR 20-160 mA)
* AT LEAST ONE FUEL IS REQUIRED
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, USA
DIAGRAM - CONTROL WIRING
GTC100
D ØTFM1 9971-1128 A
SHEET 7 OF 10
AUTOCAD



ATLAS SMARTCORE BOARD
A1.A01_TC
SERIAL PORTS
COMM_01
RS232/422/485
TB10
RS-422 TRANSMIT SHLD SCM-102
RS-422 TRANSMIT (-) SCM-101
RS-422 TRANSMIT (+) SCM-100
RS-485 (422 RECEIVE) (-) SCM-99
RS-485/422 TERM RES. (-) SCM-98
RS-485/422 TERM RES. (+) SCM-97
RS-485 (422 RECEIVE) (+) SCM-96
RS-232 M1 GND SCM-95
RS-232 RXD SCM-94
RS-232 TXD SCM-93
COMM_02
RS232/422/485
TB9
RS-422 TRANSMIT SHLD SCM-92
RS-422 TRANSMIT (-) SCM-91
RS-422 TRANSMIT (+) SCM-90
RS-485 (422 RECEIVE) (-) SCM-89
RS-485/422 TERM RES. (-) SCM-88
RS-485/422 TERM RES. (+) SCM-87
RS-485 (422 RECEIVE) (+) SCM-86
RS-232 M1 GND SCM-85
RS-232 RXD SCM-84
RS-232 TXD SCM-83
COMM_03
RS232
DB9
NC J11-1
RS-232 RXD J11-2
RS-232 TXD J11-3
NC J11-4
RS-232 PC GND J11-5
NC J11-6
NC J11-7
NC J11-8
NC 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 WATCH WINDOW SERVICE TOOL
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, USA
TITLE
DIAGRAM - CONTROL WIRING
GTC100
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1128
REV A
SCALE NTS
SHEET 8 OF 10
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
SPEED BIAS OUTPUT - NOT USED ON GTC
VOLTAGE BIAS OUTPUT SHIELD
VOLTAGE BIAS OUT (+/-1, +/-3, +/-9 VDC -)
VOLTAGE BIAS OUT (+/-1, +/-3, +/-9 VDC +)
VOLTAGE BIAS OUTPUT (4-20mA -)
VOLTAGE BIAS OUTPUT (4-20mA +)
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
PT'S FROM LOAD BUS
POTENTIAL TRANSFORMER - PT1-C -
POTENTIAL TRANSFORMER - PT1-C +
POTENTIAL TRANSFORMER - PT1-B -
POTENTIAL TRANSFORMER - PT1-B +
POTENTIAL TRANSFORMER - PT1-A -
POTENTIAL TRANSFORMER - PT1-A +
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
CT'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 +
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, U.S.A.
TITLE
DIAGRAM - CONTROL WIRING
GTC100
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1128
REV A
SCALE NTS
SHEET 9 OF 10
AUTOCAD
1
2
3
4
5
6
7
8
A
B
C
D


ATLAS SMARTCORE BOARD
A1.A02_PSENSE
TB7
LON TERMINATION JPR -
LON TERMINATION JPR +
LON #1 - SHIELD
LON #1 DATA
LON #1 DATA
PSEN-52 N/C
PSEN-51 N/C
PSEN-50 N/C
PSEN-49 LON TERM R -
PSEN-48 LON TERM R +
PSEN-47 LON #1 SHIELD
PSEN-46 LON #1 DATA
PSEN-45 LON #1 DATA
TB6
THIS CONNECTOR IS NOT POPULATED ON THE MODULE - RESERVED FOR FUTURE USE
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 NOT USED
PT INPUTS
TB4
PT-C GEN POTENTIAL TRAN2-C IN (-) PSEN-36 POTENTIAL TRANSFORMER - PT2-C -
PT-C GEN POTENTIAL TRAN2-C IN (+) PSEN-35 POTENTIAL TRANSFORMER - PT2-C +
PT-B GEN POTENTIAL TRAN2-B IN (-) PSEN-34 POTENTIAL TRANSFORMER - PT2-B -
PT-B GEN POTENTIAL TRAN2-B IN (+) PSEN-33 POTENTIAL TRANSFORMER - PT2-B +
PT-A GEN POTENTIAL TRAN2-A IN (-) PSEN-32 POTENTIAL TRANSFORMER - PT2-A -
PT-A GEN POTENTIAL TRAN2-A IN (+) PSEN-31 POTENTIAL TRANSFORMER - PT2-A +
PT'S FROM GENERATOR
CT INPUTS
TB4
CT-C GEN CURRENT TRAN2-C IN (-) PSEN-30 CURRENT TRANSFORMER - CT2-C -
CT-C GEN CURRENT TRAN2-C IN (+) PSEN-29 CURRENT TRANSFORMER - CT2-C +
CT-B GEN CURRENT TRAN2-B IN (-) PSEN-28 CURRENT TRANSFORMER - CT2-B -
CT-B GEN CURRENT TRAN2-B IN (+) PSEN-27 CURRENT TRANSFORMER - CT2-B +
CT-A GEN CURRENT TRAN2-A IN (-) PSEN-26 CURRENT TRANSFORMER - CT2-A -
CT-A GEN CURRENT TRAN2-A IN (+) PSEN-25 CURRENT TRANSFORMER - CT2-A +
CT'S FROM GENERATOR
WOODWARD GOVERNOR COMPANY
TURBOMACHINERY CONTROLS
LOVELAND, COLORADO, USA
TITLE
DIAGRAM - CONTROL WIRING
GTC100
SIZE D
CAGE CODE ØTFM1
DWG NO 9971-1128
REV A
SCALE NTS
SHEET 10 OF 10
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.

IMPORTANT

If the Communication link is lost while the unit is running, most of the functions that were enabled by the Modbus will be disabled. The start command, however, will be held in the control so that the turbine will keep running. An automated normal stop will not be available until the unit has been shut down and a reset issued to the control. The unit can always be normal-stopped manually.

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

Woodward MODBUS Slave Address Information
File created on 10/30/07
FileName: 5418-2125.C GAP
P/N: 5418-2125 REV:C
GTC100 MASTER
SINGLE SHAFT GAS TURBINE CONTROL
W/ POWERSENSE OPTION
GAP 2.18B / CODER 3.08

MODBUS_S Block Name : MODBUS_COM.MOD_VAL

Boolean Writes (RPTbw)

Addr	Input	Description
0:0001		SHUTDOWN
0:0002		START
0:0003		RESET
0:0004		ACKNOWLEDGE
0:0005		PT SPEED LOWER
0:0006		PT SPEED RAISE
0:0007		PT FAST RATE SELECT
0:0008		PT SPEED SIGNAL OVERRIDE
0:0009		GO TO RATED SPEED / BASELOAD
0:0010		FLAME DETECTOR
0:0011		FUEL TRANSFER (TRUE = LIQ)
0:0012		ENABLE REMOTE SPEED SETPOINT
0:0013		INHIBIT SYNCHRONIZER
0:0014		GEN BREAKER AUX 52
0:0015		ENABLE LOAD SHARING
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 SETPOINT
0:0021		RAISE PROCESS CONTROL SETPOINT
0:0022		GAS FUEL VALVE/ACTUATOR FAULT
0:0023		LIQUID FUEL VALVE/ACTUATOR FAULT
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		FUEL TRANSFER HOLD
0:0043		Open GEN Breaker Command
0:0044		
0:0045		
0:0046		
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- PT REFERENCE SELECT FAST RATE
1:0008	CNFG_BI_08.BI.B_SW	DI08- PT SPEED SIGNAL FAILED OVERRIDE
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- ENABLE LOAD SHARING
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- GAS FUEL VALVE/ACTUATOR FAULT
1:0023	CNFG_BI_23.BI.B_SW	DI23- LIQUID FUEL VALVE/ACTUATOR FAULT
1:0024	CNFG_BI_24.BI.B_SW	DI24- Customer Configurable DI
1:0025	FALSE	
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	S_MODE_SW.PERM_MODE.B_NAME	Synchronizer - Permissiv Mode Selectd
1:0039	S_MODE_SW.CHK_MODE.B_NAME	Synchronizer - Check Mode Selected
1:0040	S_MODE_SW.RUN_MODE.B_NAME	Synchronizer - Run Mode Selected
1:0041	SYNC_OUT.SYNC_ENA.B_NAME	Synchronizer - Enabled
1:0042	S_MODE.CHECK.EQ	Synchronizer - In Check Mode
1:0043	S_MODE.RUN.EQ	Synchronizer - In Run Mode
1:0044		
1:0045		
1:0046		
1:0047		
1:0048		
1:0049		
1:0050		** CORE Status Indicators at 50 ****
1:0051	CNTRL.PTCTRL.B_NAME	Unit in Speed Control
1:0052	CNTRL.EGTCTRL.B_NAME	Unit in Temperature Limited Control
1:0053	CNTRL.ACCELCTRL.B_NAME	Unit in Acceleration Control
1:0054	CNTRL.STRTCTRL.B_NAME	Unit in Start Control Ramp
1:0055	CNTRL.CDP_CTRL.B_NAME	Un it in CDP Pressure Limited Control
1:0056	CNTRL.MAXFL_CTRL.B_NAME	Unit in Max Fuel Valve Control
1:0057	CNTRL.DEC_CTRL.B_NAME	Unit in Deceleration Control
1:0058	CNTRL.KWLIMCTRL.B_NAME	Unit in Load (KW) Limited Control
1:0059	CNTRL.FUELOFCTRL.B_NAME	Unit is Shutdown (Fuel OFF)
1:0060	DRIVER.GAS_100.B_NAME	Gas Fuel 100% in control
1:0061	DRIVER.LIQ_100.B_NAME	Liquid Fuel 100% in control
1:0062	BI_SIGNALS.SD_FUEL.OR	External SD command

1:0063	BI_SIGNALS.START_RUN.OR	Start / RUN command
1:0064	BI_SIGNALS.RESET.OR	Reset Command
1:0065	BI_SIGNALS.ACKN.OR	Acknowledge Event command
1:0066	BI_SIGNALS.PT_LOWER.OR	Lower Speed Reference command
1:0067	BI_SIGNALS.PT_RAISE.OR	Raise Speed Reference command
1:0068	BI_SIGNALS.PT_FSTRATE.OR	Fast Reference Rate selected
1:0069	BI_SIGNALS.PT_OVRD.OR	Override speed probe failed (start only)
1:0070	BI_SIGNALS.GO_RATE_BL.OR	Go to Rated (if brkr Open) or Go to Baseload
1:0071	BI_SIGNALS.FLAMEDET.OR	Flame Detector input
1:0072	BI_SIGNALS.FUEL_XFER.OR	Transfer fuel command
1:0073	BI_SIGNALS.ENA_REMOTE.OR	Enable Remote Speed Reference signal
1:0074	BI_SIGNALS.INHIB_SYNC.OR	Inhibit the Synchronizer
1:0075	BI_SIGNALS.GEN_BRKR.OR	Gen Breaker Closed indication
1:0076	BI_SIGNALS.UTIL_BRKR.OR	Utility Breaker Closed indication
1:0077	BI_SIGNALS.ENA_VARPF.OR	Enable VAR/PF control
1:0078	BI_SIGNALS.VARPFLOWER.OR	Lower VAR/PF setpoint
1:0079	BI_SIGNALS.VARPFRAISE.OR	Raise VAR/PF setpoint
1:0080	BI_SIGNALS.ENA_PROC.OR	Enable Process control
1:0081	BI_SIGNALS.PROC_LOWER.OR	Lower Process setpoint
1:0082	BI_SIGNALS.PROC_RAISE.OR	Raise Process setpoint
1:0083	BI_SIGNALS.GASVLV_FLT.OR	Gas Fuel Valve/Actuator fault
1:0084	BI_SIGNALS.LIQVLV_FLT.OR	Liquid Fuel valve/actuator fault
1:0085	BI_SIGNALS.SPARE_24.OR	Spare / customer input
1:0086	START.START_PERM.AND	Start Permissives met
1:0087	CALMODE.CALPERM.B_NAME	Calibration Permissives met
1:0088	CALMODE.CALMODE.B_NAME	Unit is in Calibration / Forcing Mode
1:0089	BI_SIGNALS.GL_X_HOLD.OR	Hold the fuel transfer at current percent
1:0090	CALMODE.ENA_MODFRC.B_NAME	Enable Modbus Forcing of I/O during Cal mode
1:0091	PT_REF.REF_ATRATE.B_NAME	Speed Reference is at Rated
1:0092	PT_REF.PTREF.MOVING_UP	Speed Reference Moving Up
1:0093	PT_REF.PTREF.MOVING_DN	Speed Reference Moving Down
1:0094		
1:0095		
1:0096		
1:0097		
1:0098		
1:0099		** ALARMS ADDRESSES 100-299 **
1:0100	ALARM.ALM_OUT.B_NAME	CORE SUMMARY ALARM
1:0101	ALARM.ALM_LAT.SEL_1	SEE APPENDIX C FOR NUMERICAL EVENT LIST
1:0102	ALARM.ALM_LAT.SEL_2	
1:0103	ALARM.ALM_LAT.SEL_3	
1:0104	ALARM.ALM_LAT.SEL_4	
1:0105	ALARM.ALM_LAT.SEL_5	
1:0106	ALARM.ALM_LAT.SEL_6	
1:0107	ALARM.ALM_LAT.SEL_7	
1:0108	ALARM.ALM_LAT.SEL_8	
1:0109	ALARM.ALM_LAT.SEL_9	
1:0110	ALARM.ALM_LAT.SEL_10	
1:0111	ALARM.ALM_LAT.SEL_11	

1:0112	ALARM.ALM_LAT.SEL_12
1:0113	ALARM.ALM_LAT.SEL_13
1:0114	ALARM.ALM_LAT.SEL_14
1:0115	ALARM.ALM_LAT.SEL_15
1:0116	ALARM.ALM_LAT.SEL_16
1:0117	ALARM.ALM_LAT.SEL_17
1:0118	ALARM.ALM_LAT.SEL_18
1:0119	ALARM.ALM_LAT.SEL_19
1:0120	ALARM.ALM_LAT.SEL_20
1:0121	ALARM.ALM_LAT.SEL_21
1:0122	ALARM.ALM_LAT.SEL_22
1:0123	ALARM.ALM_LAT.SEL_23
1:0124	ALARM.ALM_LAT.SEL_24
1:0125	ALARM.ALM_LAT.SEL_25
1:0126	ALARM.ALM_LAT.SEL_26
1:0127	ALARM.ALM_LAT.SEL_27
1:0128	ALARM.ALM_LAT.SEL_28
1:0129	ALARM.ALM_LAT.SEL_29
1:0130	ALARM.ALM_LAT.SEL_30
1:0131	ALARM.ALM_LAT.SEL_31
1:0132	ALARM.ALM_LAT.SEL_32
1:0133	ALARM.ALM_LAT.SEL_33
1:0134	ALARM.ALM_LAT.SEL_34
1:0135	ALARM.ALM_LAT.SEL_35
1:0136	ALARM.ALM_LAT.SEL_36
1:0137	ALARM.ALM_LAT.SEL_37
1:0138	ALARM.ALM_LAT.SEL_38
1:0139	ALARM.ALM_LAT.SEL_39
1:0140	ALARM.ALM_LAT.SEL_40
1:0141	ALARM.ALM_LAT.SEL_41
1:0142	ALARM.ALM_LAT.SEL_42
1:0143	ALARM.ALM_LAT.SEL_43
1:0144	ALARM.ALM_LAT.SEL_44
1:0145	ALARM.ALM_LAT.SEL_45
1:0146	ALARM.ALM_LAT.SEL_46
1:0147	ALARM.ALM_LAT.SEL_47
1:0148	ALARM.ALM_LAT.SEL_48
1:0149	ALARM.ALM_LAT.SEL_49
1:0150	ALARM.ALM_LAT.SEL_50
1:0151	ALARM.ALM_LAT.SEL_51
1:0152	ALARM.ALM_LAT.SEL_52
1:0153	ALARM.ALM_LAT.SEL_53
1:0154	ALARM.ALM_LAT.SEL_54
1:0155	ALARM.ALM_LAT.SEL_55
1:0156	ALARM.ALM_LAT.SEL_56
1:0157	ALARM.ALM_LAT.SEL_57
1:0158	ALARM.ALM_LAT.SEL_58
1:0159	ALARM.ALM_LAT.SEL_59
1:0160	ALARM.ALM_LAT.SEL_60

1:0161	ALARM.ALM_LAT.SEL_61
1:0162	ALARM.ALM_LAT.SEL_62
1:0163	ALARM.ALM_LAT.SEL_63
1:0164	ALARM.ALM_LAT.SEL_64
1:0165	ALARM.ALM_LAT.SEL_65
1:0166	ALARM.ALM_LAT.SEL_66
1:0167	ALARM.ALM_LAT.SEL_67
1:0168	ALARM.ALM_LAT.SEL_68
1:0169	ALARM.ALM_LAT.SEL_69
1:0170	ALARM.ALM_LAT.SEL_70
1:0171	ALARM.ALM_LAT.SEL_71
1:0172	ALARM.ALM_LAT.SEL_72
1:0173	ALARM.ALM_LAT.SEL_73
1:0174	ALARM.ALM_LAT.SEL_74
1:0175	ALARM.ALM_LAT.SEL_75
1:0176	ALARM.ALM_LAT.SEL_76
1:0177	ALARM.ALM_LAT.SEL_77
1:0178	ALARM.ALM_LAT.SEL_78
1:0179	ALARM.ALM_LAT.SEL_79
1:0180	ALARM.ALM_LAT.SEL_80
1:0181	ALARM.ALM_LAT.SEL_81
1:0182	ALARM.ALM_LAT.SEL_82
1:0183	ALARM.ALM_LAT.SEL_83
1:0184	ALARM.ALM_LAT.SEL_84
1:0185	ALARM.ALM_LAT.SEL_85
1:0186	ALARM.ALM_LAT.SEL_86
1:0187	ALARM.ALM_LAT.SEL_87
1:0188	ALARM.ALM_LAT.SEL_88
1:0189	ALARM.ALM_LAT.SEL_89
1:0190	ALARM.ALM_LAT.SEL_90
1:0191	ALARM.ALM_LAT.SEL_91
1:0192	ALARM.ALM_LAT.SEL_92
1:0193	ALARM.ALM_LAT.SEL_93
1:0194	ALARM.ALM_LAT.SEL_94
1:0195	ALARM.ALM_LAT.SEL_95
1:0196	ALARM.ALM_LAT.SEL_96
1:0197	ALARM.ALM_LAT.SEL_97
1:0198	ALARM.ALM_LAT.SEL_98
1:0199	ALARM.ALM_LAT.SEL_99
1:0200	ALARM.ALM_LAT.SEL_100
1:0201	ALARM.ALM_LAT.SEL_101
1:0202	ALARM.ALM_LAT.SEL_102
1:0203	ALARM.ALM_LAT.SEL_103
1:0204	ALARM.ALM_LAT.SEL_104
1:0205	ALARM.ALM_LAT.SEL_105
1:0206	ALARM.ALM_LAT.SEL_106
1:0207	ALARM.ALM_LAT.SEL_107
1:0208	ALARM.ALM_LAT.SEL_108
1:0209	ALARM.ALM_LAT.SEL_109

1:0210	ALARM.ALM_LAT.SEL_110
1:0211	ALARM.ALM_LAT.SEL_111
1:0212	ALARM.ALM_LAT.SEL_112
1:0213	ALARM.ALM_LAT.SEL_113
1:0214	ALARM.ALM_LAT.SEL_114
1:0215	ALARM.ALM_LAT.SEL_115
1:0216	ALARM.ALM_LAT.SEL_116
1:0217	ALARM.ALM_LAT.SEL_117
1:0218	ALARM.ALM_LAT.SEL_118
1:0219	ALARM.ALM_LAT.SEL_119
1:0220	ALARM.ALM_LAT.SEL_120
1:0221	ALARM.ALM_LAT.SEL_121
1:0222	ALARM.ALM_LAT.SEL_122
1:0223	ALARM.ALM_LAT.SEL_123
1:0224	ALARM.ALM_LAT.SEL_124
1:0225	ALARM.ALM_LAT.SEL_125
1:0226	ALARM.ALM_LAT.SEL_126
1:0227	ALARM.ALM_LAT.SEL_127
1:0228	ALARM.ALM_LAT.SEL_128
1:0229	ALARM.ALM_LAT.SEL_129
1:0230	ALARM.ALM_LAT.SEL_130
1:0231	ALARM.ALM_LAT.SEL_131
1:0232	ALARM.ALM_LAT.SEL_132
1:0233	ALARM.ALM_LAT.SEL_133
1:0234	ALARM.ALM_LAT.SEL_134
1:0235	ALARM.ALM_LAT.SEL_135
1:0236	ALARM.ALM_LAT.SEL_136
1:0237	ALARM.ALM_LAT.SEL_137
1:0238	ALARM.ALM_LAT.SEL_138
1:0239	ALARM.ALM_LAT.SEL_139
1:0240	ALARM.ALM_LAT.SEL_140
1:0241	ALARM.ALM_LAT.SEL_141
1:0242	ALARM.ALM_LAT.SEL_142
1:0243	ALARM.ALM_LAT.SEL_143
1:0244	ALARM.ALM_LAT.SEL_144
1:0245	ALARM.ALM_LAT.SEL_145
1:0246	ALARM.ALM_LAT.SEL_146
1:0247	ALARM.ALM_LAT.SEL_147
1:0248	ALARM.ALM_LAT.SEL_148
1:0249	ALARM.ALM_LAT.SEL_149
1:0250	ALARM.ALM_LAT.SEL_150
1:0251	
1:0252	
1:0253	
1:0254	
1:0255	
1:0256	
1:0257	
1:0258	

1:0259		
1:0260		
1:0261		
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1:0270		
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1:0296		
1:0297		
1:0298		
1:0299		** SOFT SD ADDRESSES 300-499 **
1:0300	SHUTDOWN.SOFTSD_LAT.LATCH1	SUMMARY OF SOFT SD LATCH
1:0301	SHUTDOWN.SOFTSD_LAT.SEL_1	
1:0302	SHUTDOWN.SOFTSD_LAT.SEL_2	
1:0303	SHUTDOWN.SOFTSD_LAT.SEL_3	
1:0304	SHUTDOWN.SOFTSD_LAT.SEL_4	
1:0305	SHUTDOWN.SOFTSD_LAT.SEL_5	
1:0306	SHUTDOWN.SOFTSD_LAT.SEL_6	
1:0307	SHUTDOWN.SOFTSD_LAT.SEL_7	

1:0308	SHUTDOWN.SOFTSD_LAT.SEL_8
1:0309	SHUTDOWN.SOFTSD_LAT.SEL_9
1:0310	SHUTDOWN.SOFTSD_LAT.SEL_10
1:0311	SHUTDOWN.SOFTSD_LAT.SEL_11
1:0312	SHUTDOWN.SOFTSD_LAT.SEL_12
1:0313	SHUTDOWN.SOFTSD_LAT.SEL_13
1:0314	SHUTDOWN.SOFTSD_LAT.SEL_14
1:0315	SHUTDOWN.SOFTSD_LAT.SEL_15
1:0316	SHUTDOWN.SOFTSD_LAT.SEL_16
1:0317	SHUTDOWN.SOFTSD_LAT.SEL_17
1:0318	SHUTDOWN.SOFTSD_LAT.SEL_18
1:0319	SHUTDOWN.SOFTSD_LAT.SEL_19
1:0320	SHUTDOWN.SOFTSD_LAT.SEL_20
1:0321	SHUTDOWN.SOFTSD_LAT.SEL_21
1:0322	SHUTDOWN.SOFTSD_LAT.SEL_22
1:0323	SHUTDOWN.SOFTSD_LAT.SEL_23
1:0324	SHUTDOWN.SOFTSD_LAT.SEL_24
1:0325	SHUTDOWN.SOFTSD_LAT.SEL_25
1:0326	SHUTDOWN.SOFTSD_LAT.SEL_26
1:0327	SHUTDOWN.SOFTSD_LAT.SEL_27
1:0328	SHUTDOWN.SOFTSD_LAT.SEL_28
1:0329	SHUTDOWN.SOFTSD_LAT.SEL_29
1:0330	SHUTDOWN.SOFTSD_LAT.SEL_30
1:0331	SHUTDOWN.SOFTSD_LAT.SEL_31
1:0332	SHUTDOWN.SOFTSD_LAT.SEL_32
1:0333	SHUTDOWN.SOFTSD_LAT.SEL_33
1:0334	SHUTDOWN.SOFTSD_LAT.SEL_34
1:0335	SHUTDOWN.SOFTSD_LAT.SEL_35
1:0336	SHUTDOWN.SOFTSD_LAT.SEL_36
1:0337	SHUTDOWN.SOFTSD_LAT.SEL_37
1:0338	SHUTDOWN.SOFTSD_LAT.SEL_38
1:0339	SHUTDOWN.SOFTSD_LAT.SEL_39
1:0340	SHUTDOWN.SOFTSD_LAT.SEL_40
1:0341	SHUTDOWN.SOFTSD_LAT.SEL_41
1:0342	SHUTDOWN.SOFTSD_LAT.SEL_42
1:0343	SHUTDOWN.SOFTSD_LAT.SEL_43
1:0344	SHUTDOWN.SOFTSD_LAT.SEL_44
1:0345	SHUTDOWN.SOFTSD_LAT.SEL_45
1:0346	SHUTDOWN.SOFTSD_LAT.SEL_46
1:0347	SHUTDOWN.SOFTSD_LAT.SEL_47
1:0348	SHUTDOWN.SOFTSD_LAT.SEL_48
1:0349	SHUTDOWN.SOFTSD_LAT.SEL_49
1:0350	SHUTDOWN.SOFTSD_LAT.SEL_50
1:0351	SHUTDOWN.SOFTSD_LAT.SEL_51
1:0352	SHUTDOWN.SOFTSD_LAT.SEL_52
1:0353	SHUTDOWN.SOFTSD_LAT.SEL_53
1:0354	SHUTDOWN.SOFTSD_LAT.SEL_54
1:0355	SHUTDOWN.SOFTSD_LAT.SEL_55
1:0356	SHUTDOWN.SOFTSD_LAT.SEL_56

1:0357	SHUTDOWN.SOFTSD_LAT.SEL_57
1:0358	SHUTDOWN.SOFTSD_LAT.SEL_58
1:0359	SHUTDOWN.SOFTSD_LAT.SEL_59
1:0360	SHUTDOWN.SOFTSD_LAT.SEL_60
1:0361	SHUTDOWN.SOFTSD_LAT.SEL_61
1:0362	SHUTDOWN.SOFTSD_LAT.SEL_62
1:0363	SHUTDOWN.SOFTSD_LAT.SEL_63
1:0364	SHUTDOWN.SOFTSD_LAT.SEL_64
1:0365	SHUTDOWN.SOFTSD_LAT.SEL_65
1:0366	SHUTDOWN.SOFTSD_LAT.SEL_66
1:0367	SHUTDOWN.SOFTSD_LAT.SEL_67
1:0368	SHUTDOWN.SOFTSD_LAT.SEL_68
1:0369	SHUTDOWN.SOFTSD_LAT.SEL_69
1:0370	SHUTDOWN.SOFTSD_LAT.SEL_70
1:0371	SHUTDOWN.SOFTSD_LAT.SEL_71
1:0372	SHUTDOWN.SOFTSD_LAT.SEL_72
1:0373	SHUTDOWN.SOFTSD_LAT.SEL_73
1:0374	SHUTDOWN.SOFTSD_LAT.SEL_74
1:0375	SHUTDOWN.SOFTSD_LAT.SEL_75
1:0376	SHUTDOWN.SOFTSD_LAT.SEL_76
1:0377	SHUTDOWN.SOFTSD_LAT.SEL_77
1:0378	SHUTDOWN.SOFTSD_LAT.SEL_78
1:0379	SHUTDOWN.SOFTSD_LAT.SEL_79
1:0380	SHUTDOWN.SOFTSD_LAT.SEL_80
1:0381	SHUTDOWN.SOFTSD_LAT.SEL_81
1:0382	SHUTDOWN.SOFTSD_LAT.SEL_82
1:0383	SHUTDOWN.SOFTSD_LAT.SEL_83
1:0384	SHUTDOWN.SOFTSD_LAT.SEL_84
1:0385	SHUTDOWN.SOFTSD_LAT.SEL_85
1:0386	SHUTDOWN.SOFTSD_LAT.SEL_86
1:0387	SHUTDOWN.SOFTSD_LAT.SEL_87
1:0388	SHUTDOWN.SOFTSD_LAT.SEL_88
1:0389	SHUTDOWN.SOFTSD_LAT.SEL_89
1:0390	SHUTDOWN.SOFTSD_LAT.SEL_90
1:0391	SHUTDOWN.SOFTSD_LAT.SEL_91
1:0392	SHUTDOWN.SOFTSD_LAT.SEL_92
1:0393	SHUTDOWN.SOFTSD_LAT.SEL_93
1:0394	SHUTDOWN.SOFTSD_LAT.SEL_94
1:0395	SHUTDOWN.SOFTSD_LAT.SEL_95
1:0396	SHUTDOWN.SOFTSD_LAT.SEL_96
1:0397	SHUTDOWN.SOFTSD_LAT.SEL_97
1:0398	SHUTDOWN.SOFTSD_LAT.SEL_98
1:0399	SHUTDOWN.SOFTSD_LAT.SEL_99
1:0400	SHUTDOWN.SOFTSD_LAT.SEL_100
1:0401	SHUTDOWN.SOFTSD_LAT.SEL_101
1:0402	SHUTDOWN.SOFTSD_LAT.SEL_102
1:0403	SHUTDOWN.SOFTSD_LAT.SEL_103
1:0404	SHUTDOWN.SOFTSD_LAT.SEL_104
1:0405	SHUTDOWN.SOFTSD_LAT.SEL_105

1:0406	SHUTDOWN.SOFTSD_LAT.SEL_106
1:0407	SHUTDOWN.SOFTSD_LAT.SEL_107
1:0408	SHUTDOWN.SOFTSD_LAT.SEL_108
1:0409	SHUTDOWN.SOFTSD_LAT.SEL_109
1:0410	SHUTDOWN.SOFTSD_LAT.SEL_110
1:0411	SHUTDOWN.SOFTSD_LAT.SEL_111
1:0412	SHUTDOWN.SOFTSD_LAT.SEL_112
1:0413	SHUTDOWN.SOFTSD_LAT.SEL_113
1:0414	SHUTDOWN.SOFTSD_LAT.SEL_114
1:0415	SHUTDOWN.SOFTSD_LAT.SEL_115
1:0416	SHUTDOWN.SOFTSD_LAT.SEL_116
1:0417	SHUTDOWN.SOFTSD_LAT.SEL_117
1:0418	SHUTDOWN.SOFTSD_LAT.SEL_118
1:0419	SHUTDOWN.SOFTSD_LAT.SEL_119
1:0420	SHUTDOWN.SOFTSD_LAT.SEL_120
1:0421	SHUTDOWN.SOFTSD_LAT.SEL_121
1:0422	SHUTDOWN.SOFTSD_LAT.SEL_122
1:0423	SHUTDOWN.SOFTSD_LAT.SEL_123
1:0424	SHUTDOWN.SOFTSD_LAT.SEL_124
1:0425	SHUTDOWN.SOFTSD_LAT.SEL_125
1:0426	SHUTDOWN.SOFTSD_LAT.SEL_126
1:0427	SHUTDOWN.SOFTSD_LAT.SEL_127
1:0428	SHUTDOWN.SOFTSD_LAT.SEL_128
1:0429	SHUTDOWN.SOFTSD_LAT.SEL_129
1:0430	SHUTDOWN.SOFTSD_LAT.SEL_130
1:0431	SHUTDOWN.SOFTSD_LAT.SEL_131
1:0432	SHUTDOWN.SOFTSD_LAT.SEL_132
1:0433	SHUTDOWN.SOFTSD_LAT.SEL_133
1:0434	SHUTDOWN.SOFTSD_LAT.SEL_134
1:0435	SHUTDOWN.SOFTSD_LAT.SEL_135
1:0436	SHUTDOWN.SOFTSD_LAT.SEL_136
1:0437	SHUTDOWN.SOFTSD_LAT.SEL_137
1:0438	SHUTDOWN.SOFTSD_LAT.SEL_138
1:0439	SHUTDOWN.SOFTSD_LAT.SEL_139
1:0440	SHUTDOWN.SOFTSD_LAT.SEL_140
1:0441	SHUTDOWN.SOFTSD_LAT.SEL_141
1:0442	SHUTDOWN.SOFTSD_LAT.SEL_142
1:0443	SHUTDOWN.SOFTSD_LAT.SEL_143
1:0444	SHUTDOWN.SOFTSD_LAT.SEL_144
1:0445	SHUTDOWN.SOFTSD_LAT.SEL_145
1:0446	SHUTDOWN.SOFTSD_LAT.SEL_146
1:0447	SHUTDOWN.SOFTSD_LAT.SEL_147
1:0448	SHUTDOWN.SOFTSD_LAT.SEL_148
1:0449	SHUTDOWN.SOFTSD_LAT.SEL_149
1:0450	SHUTDOWN.SOFTSD_LAT.SEL_150
1:0451	
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1:0498		
1:0499		** HARD SD ADDRESSES 500-699 **
1:0500	SHUTDOWN.HARDSD_LAT.LATCH1	SUMMARY HARD SD (FUEL CHOP)
1:0501	SHUTDOWN.HARDSD_LAT.SEL_1	
1:0502	SHUTDOWN.HARDSD_LAT.SEL_2	
1:0503	SHUTDOWN.HARDSD_LAT.SEL_3	

1:0504	SHUTDOWN.HARDSD_LAT.SEL_4
1:0505	SHUTDOWN.HARDSD_LAT.SEL_5
1:0506	SHUTDOWN.HARDSD_LAT.SEL_6
1:0507	SHUTDOWN.HARDSD_LAT.SEL_7
1:0508	SHUTDOWN.HARDSD_LAT.SEL_8
1:0509	SHUTDOWN.HARDSD_LAT.SEL_9
1:0510	SHUTDOWN.HARDSD_LAT.SEL_10
1:0511	SHUTDOWN.HARDSD_LAT.SEL_11
1:0512	SHUTDOWN.HARDSD_LAT.SEL_12
1:0513	SHUTDOWN.HARDSD_LAT.SEL_13
1:0514	SHUTDOWN.HARDSD_LAT.SEL_14
1:0515	SHUTDOWN.HARDSD_LAT.SEL_15
1:0516	SHUTDOWN.HARDSD_LAT.SEL_16
1:0517	SHUTDOWN.HARDSD_LAT.SEL_17
1:0518	SHUTDOWN.HARDSD_LAT.SEL_18
1:0519	SHUTDOWN.HARDSD_LAT.SEL_19
1:0520	SHUTDOWN.HARDSD_LAT.SEL_20
1:0521	SHUTDOWN.HARDSD_LAT.SEL_21
1:0522	SHUTDOWN.HARDSD_LAT.SEL_22
1:0523	SHUTDOWN.HARDSD_LAT.SEL_23
1:0524	SHUTDOWN.HARDSD_LAT.SEL_24
1:0525	SHUTDOWN.HARDSD_LAT.SEL_25
1:0526	SHUTDOWN.HARDSD_LAT.SEL_26
1:0527	SHUTDOWN.HARDSD_LAT.SEL_27
1:0528	SHUTDOWN.HARDSD_LAT.SEL_28
1:0529	SHUTDOWN.HARDSD_LAT.SEL_29
1:0530	SHUTDOWN.HARDSD_LAT.SEL_30
1:0531	SHUTDOWN.HARDSD_LAT.SEL_31
1:0532	SHUTDOWN.HARDSD_LAT.SEL_32
1:0533	SHUTDOWN.HARDSD_LAT.SEL_33
1:0534	SHUTDOWN.HARDSD_LAT.SEL_34
1:0535	SHUTDOWN.HARDSD_LAT.SEL_35
1:0536	SHUTDOWN.HARDSD_LAT.SEL_36
1:0537	SHUTDOWN.HARDSD_LAT.SEL_37
1:0538	SHUTDOWN.HARDSD_LAT.SEL_38
1:0539	SHUTDOWN.HARDSD_LAT.SEL_39
1:0540	SHUTDOWN.HARDSD_LAT.SEL_40
1:0541	SHUTDOWN.HARDSD_LAT.SEL_41
1:0542	SHUTDOWN.HARDSD_LAT.SEL_42
1:0543	SHUTDOWN.HARDSD_LAT.SEL_43
1:0544	SHUTDOWN.HARDSD_LAT.SEL_44
1:0545	SHUTDOWN.HARDSD_LAT.SEL_45
1:0546	SHUTDOWN.HARDSD_LAT.SEL_46
1:0547	SHUTDOWN.HARDSD_LAT.SEL_47
1:0548	SHUTDOWN.HARDSD_LAT.SEL_48
1:0549	SHUTDOWN.HARDSD_LAT.SEL_49
1:0550	SHUTDOWN.HARDSD_LAT.SEL_50
1:0551	SHUTDOWN.HARDSD_LAT.SEL_51
1:0552	SHUTDOWN.HARDSD_LAT.SEL_52

1:0553	SHUTDOWN.HARDSD_LAT.SEL_53
1:0554	SHUTDOWN.HARDSD_LAT.SEL_54
1:0555	SHUTDOWN.HARDSD_LAT.SEL_55
1:0556	SHUTDOWN.HARDSD_LAT.SEL_56
1:0557	SHUTDOWN.HARDSD_LAT.SEL_57
1:0558	SHUTDOWN.HARDSD_LAT.SEL_58
1:0559	SHUTDOWN.HARDSD_LAT.SEL_59
1:0560	SHUTDOWN.HARDSD_LAT.SEL_60
1:0561	SHUTDOWN.HARDSD_LAT.SEL_61
1:0562	SHUTDOWN.HARDSD_LAT.SEL_62
1:0563	SHUTDOWN.HARDSD_LAT.SEL_63
1:0564	SHUTDOWN.HARDSD_LAT.SEL_64
1:0565	SHUTDOWN.HARDSD_LAT.SEL_65
1:0566	SHUTDOWN.HARDSD_LAT.SEL_66
1:0567	SHUTDOWN.HARDSD_LAT.SEL_67
1:0568	SHUTDOWN.HARDSD_LAT.SEL_68
1:0569	SHUTDOWN.HARDSD_LAT.SEL_69
1:0570	SHUTDOWN.HARDSD_LAT.SEL_70
1:0571	SHUTDOWN.HARDSD_LAT.SEL_71
1:0572	SHUTDOWN.HARDSD_LAT.SEL_72
1:0573	SHUTDOWN.HARDSD_LAT.SEL_73
1:0574	SHUTDOWN.HARDSD_LAT.SEL_74
1:0575	SHUTDOWN.HARDSD_LAT.SEL_75
1:0576	SHUTDOWN.HARDSD_LAT.SEL_76
1:0577	SHUTDOWN.HARDSD_LAT.SEL_77
1:0578	SHUTDOWN.HARDSD_LAT.SEL_78
1:0579	SHUTDOWN.HARDSD_LAT.SEL_79
1:0580	SHUTDOWN.HARDSD_LAT.SEL_80
1:0581	SHUTDOWN.HARDSD_LAT.SEL_81
1:0582	SHUTDOWN.HARDSD_LAT.SEL_82
1:0583	SHUTDOWN.HARDSD_LAT.SEL_83
1:0584	SHUTDOWN.HARDSD_LAT.SEL_84
1:0585	SHUTDOWN.HARDSD_LAT.SEL_85
1:0586	SHUTDOWN.HARDSD_LAT.SEL_86
1:0587	SHUTDOWN.HARDSD_LAT.SEL_87
1:0588	SHUTDOWN.HARDSD_LAT.SEL_88
1:0589	SHUTDOWN.HARDSD_LAT.SEL_89
1:0590	SHUTDOWN.HARDSD_LAT.SEL_90
1:0591	SHUTDOWN.HARDSD_LAT.SEL_91
1:0592	SHUTDOWN.HARDSD_LAT.SEL_92
1:0593	SHUTDOWN.HARDSD_LAT.SEL_93
1:0594	SHUTDOWN.HARDSD_LAT.SEL_94
1:0595	SHUTDOWN.HARDSD_LAT.SEL_95
1:0596	SHUTDOWN.HARDSD_LAT.SEL_96
1:0597	SHUTDOWN.HARDSD_LAT.SEL_97
1:0598	SHUTDOWN.HARDSD_LAT.SEL_98
1:0599	SHUTDOWN.HARDSD_LAT.SEL_99
1:0600	SHUTDOWN.HARDSD_LAT.SEL_100
1:0601	SHUTDOWN.HARDSD_LAT.SEL_101

1:0602	SHUTDOWN.HARDSD_LAT.SEL_102
1:0603	SHUTDOWN.HARDSD_LAT.SEL_103
1:0604	SHUTDOWN.HARDSD_LAT.SEL_104
1:0605	SHUTDOWN.HARDSD_LAT.SEL_105
1:0606	SHUTDOWN.HARDSD_LAT.SEL_106
1:0607	SHUTDOWN.HARDSD_LAT.SEL_107
1:0608	SHUTDOWN.HARDSD_LAT.SEL_108
1:0609	SHUTDOWN.HARDSD_LAT.SEL_109
1:0610	SHUTDOWN.HARDSD_LAT.SEL_110
1:0611	SHUTDOWN.HARDSD_LAT.SEL_111
1:0612	SHUTDOWN.HARDSD_LAT.SEL_112
1:0613	SHUTDOWN.HARDSD_LAT.SEL_113
1:0614	SHUTDOWN.HARDSD_LAT.SEL_114
1:0615	SHUTDOWN.HARDSD_LAT.SEL_115
1:0616	SHUTDOWN.HARDSD_LAT.SEL_116
1:0617	SHUTDOWN.HARDSD_LAT.SEL_117
1:0618	SHUTDOWN.HARDSD_LAT.SEL_118
1:0619	SHUTDOWN.HARDSD_LAT.SEL_119
1:0620	SHUTDOWN.HARDSD_LAT.SEL_120
1:0621	SHUTDOWN.HARDSD_LAT.SEL_121
1:0622	SHUTDOWN.HARDSD_LAT.SEL_122
1:0623	SHUTDOWN.HARDSD_LAT.SEL_123
1:0624	SHUTDOWN.HARDSD_LAT.SEL_124
1:0625	SHUTDOWN.HARDSD_LAT.SEL_125
1:0626	SHUTDOWN.HARDSD_LAT.SEL_126
1:0627	SHUTDOWN.HARDSD_LAT.SEL_127
1:0628	SHUTDOWN.HARDSD_LAT.SEL_128
1:0629	SHUTDOWN.HARDSD_LAT.SEL_129
1:0630	SHUTDOWN.HARDSD_LAT.SEL_130
1:0631	SHUTDOWN.HARDSD_LAT.SEL_131
1:0632	SHUTDOWN.HARDSD_LAT.SEL_132
1:0633	SHUTDOWN.HARDSD_LAT.SEL_133
1:0634	SHUTDOWN.HARDSD_LAT.SEL_134
1:0635	SHUTDOWN.HARDSD_LAT.SEL_135
1:0636	SHUTDOWN.HARDSD_LAT.SEL_136
1:0637	SHUTDOWN.HARDSD_LAT.SEL_137
1:0638	SHUTDOWN.HARDSD_LAT.SEL_138
1:0639	SHUTDOWN.HARDSD_LAT.SEL_139
1:0640	SHUTDOWN.HARDSD_LAT.SEL_140
1:0641	SHUTDOWN.HARDSD_LAT.SEL_141
1:0642	SHUTDOWN.HARDSD_LAT.SEL_142
1:0643	SHUTDOWN.HARDSD_LAT.SEL_143
1:0644	SHUTDOWN.HARDSD_LAT.SEL_144
1:0645	SHUTDOWN.HARDSD_LAT.SEL_145
1:0646	SHUTDOWN.HARDSD_LAT.SEL_146
1:0647	SHUTDOWN.HARDSD_LAT.SEL_147
1:0648	SHUTDOWN.HARDSD_LAT.SEL_148
1:0649	SHUTDOWN.HARDSD_LAT.SEL_149
1:0650	SHUTDOWN.HARDSD_LAT.SEL_150

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1:0678		
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 Kilovolts
1:0682	A2_PS_OUTG.CTUNITINFO.LT	GEN CT Units are Amps
1:0683	A2_PS_OUTG.CTUNITINFO.EQ	GEN CT Units are Kiloamps
1:0684	A2_PS_OUTG.PWRUNITS.LT	GEN Power Units are Watts
1:0685	A2_PS_OUTG.PWRUNITS.EQ	GEN Power Units are Kilowatts
1:0686	A2_PS_OUTG.PWRUNITS.GT	GEN Power Units are Megawatts
1:0687	A2_PS_OUTB.PTUNITINFO.LT	BUS PT Units are Volts
1:0688	A2_PS_OUTB.PTUNITINFO.EQ	BUS PT Units are Kilovolts
1:0689	A2_PS_OUTB.CTUNITINFO.LT	BUS CT Units are Amps
1:0690	A2_PS_OUTB.CTUNITINFO.EQ	BUS CT Units are Kiloamps
1:0691	A2_PS_OUTB.PWRUNITS.LT	BUS Power Units are Watts
1:0692	A2_PS_OUTB.PWRUNITS.EQ	BUS Power Units are Kilowatts
1:0693	A2_PS_OUTB.PWRUNITS.GT	BUS Power Units are Megawatts
1:0694		
1:0695		
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1:0698		
1:0699		

1:0700

Analog Reads (RPTar)

Addr	Input	Description	Multiplier
3:0001	ACCEL_DEC.ACCEL_OUT.A_NAME	ACCEL CONTROL	100
3:0002	ACCEL_DEC.DECEL_OUT.A_NAME	DECEL CONTROL	100
3:0003	START_MODE.START_CTRL.A_NAME	START RAMP CONTROL	100
3:0004	CDP.CDP_HSS.A_NAME	CDP HIGH SIGNAL SELECT	
3:0005	DRIVER.GAS_DMD.A_NAME	GAS VALVE DEMAND	
3:0006	DRIVER.LIQ_DMD.A_NAME	LIQUID VALVE DEMAND	
3:0007	DRIVER.VLV_DMND.A_NAME	VALVE DEMAND	
3:0008	EGT.EGT_AVG.A_NAME	EGT AVERAGE	
3:0009	EGT.EGT_PID.A_NAME	EGT CONTROL	100
3:0010	0		
3:0011	ACCEL_DEC.CORR_CURV.MULTIPLY	CDP vs FUEL MAX LIMIT	
3:0012	CDP.CDPPID.PID_2	CDP TOPPING CONTROL	100
3:0013	A2_PS_OUTG.GEN_KWATTS.A_NAME	GEN Kilowatt Output	
3:0014	A2_PS_OUTG.GEN_KVA.A_NAME	GEN KVA Output	1
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	0	spare	
3:0020	0	spare	
3:0021	0	spare	
3:0022	PT_CNTRL.PT_HSS.A_NAME	PT SPEED HIGH SIGNAL SELECT	
3:0023	PT_CNTRL.PT_PID.A_NAME	PT SPEED CONTROL	100
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 Info	
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	NV_MEM.LOG.OUT_1	Number of Fired Starts	
3:0036	NV_MEM.LOG.OUT_2	Number of Starts Attempted	
3:0037	NV_MEM.LOG.OUT_3	Number of Shutdowns	
3:0038	NV_MEM.LOG.OUT_4	Number of Turbine Run Hours	
3:0039	DISPLAY.EGT_AVG.A_SW	EGT Temperature IO	
3:0040	A2_PS_OUTG.GEN_FREQ.A_NAME	Generator Frequency	10
3:0041	A2_PS_OUTB.BUS_FREQ.A_NAME	Bus Frequency	10
3:0042	SYNC.SYNCSCOPE.A_NAME	Synchronoscope Output	
3:0043			
3:0044			

3:0045		
3:0046		
3:0047		
3:0048		
3:0049		*** Atlas H/W Analog Signals ***
3:0050	A01_TC.DSS_01.TSS_ATL	PT SPEED PROBE A
3:0051	A01_TC.DSS_02.TSS_ATL	PT SPEED PROBE B
3:0052	A01_TC.AI_01.AI_ATL	Analog Input #1
3:0053	A01_TC.AI_02.AI_ATL	Analog Input #2
3:0054	DISPLAY.CDPHSS.A_SW	Analog Input #3
3:0055	A01_TC.AI_04.AI_ATL	Analog Input #4
3:0056	A01_TC.AI_05.AI_ATL	Analog Input #5
3:0057	A01_TC.AI_06.AI_ATL	Analog Input #6
3:0058	A01_TC.AO_01.DISPLAY	PT ACTUAL SPEED READOUT
3:0059	A01_TC.AO_02.DISPLAY	PT REFERENCE SPEED READOUT
3:0060	A01_TC.AO_03.DISPLAY	FUEL VALVE DEMAND READOUT
3:0061	A01_TC.AO_04.DISPLAY	EXHAUST GAS TEMP READOUT
3:0062	A01_TC.AO_05.DISPLAY	CDP READOUT
3:0063	A01_TC.AO_06.DISPLAY	CUSTOMER AO
3:0064	A01_TC.ACT_01.ACT_ATL	GAS FUEL VALVE DEMAND
3:0065	A01_TC.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 SETPOINT
3:0068	0	
3:0069	0	
3:0070	0	
3:0071	DISPLAY.AI01_OUT.A_SW	Config 1 = Process Signal
3:0072	CNFG_ANIN.AI.OUT_2	Config 2 = Remote PT Ref
3:0073	DISPLAY.AMB_TEMP.A_SW	Config 3 = Amb Inlet Temp
3:0074	CNFG_ANIN.AI.OUT_4	Config 4 = Remote KW Ref
3:0075	CNFG_ANIN.AI.OUT_5	Config 5 = Remote VAR/PF Ref
3:0076	DISPLAY.AI06_OUT.A_SW	Config 6 = Remote Process Ref
3:0077	CNFG_ANIN.AI.OUT_7	Config 7 = Gas Fuel Vlv Fdbk
3:0078	CNFG_ANIN.AI.OUT_8	Config 8 = Liq Fuel Vlv Fdbk
3:0079	CNFG_ANIN.AI.OUT_9	Config 9 = Customer Signal
3:0080	0	
3:0081	0	
3:0082	0	
3:0083	0	
3:0084	0	
3:0085		
3:0086		
3:0087	0	spare
3:0088	0	spare
3:0089		
3:0090		
3:0091		
3:0092	0	spare
3:0093	0	spare

3:0094	0	spare
3:0095	0	spare
3:0096	0	spare
3:0097	0	spare
3:0098	0	spare
3:0099	0	spare
3:0100	0	*** 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_VA.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_VAR.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 POWER FACTOR
3:0124		
3:0125		
3:0126		
3:0127		
3:0128		
3:0129		
3:0130	A2_PS_OUTB.PT_A_BUS.A_NAME	BUS PT A Voltage
3:0131	A2_PS_OUTB.PT_B_BUS.A_NAME	BUS PT B Voltage
3:0132	A2_PS_OUTB.PT_C_BUS.A_NAME	BUS PT C Voltage
3:0133	A2_PS_OUTB.PT_BUS_AVG.A_NAME	BUS PT Average Voltage
3:0134	A2_PS_OUTB.CT_A_BUS.A_NAME	BUS CT A Current
3:0135	A2_PS_OUTB.CT_B_BUS.A_NAME	BUS CT B Current
3:0136	A2_PS_OUTB.CT_C_BUS.A_NAME	BUS CT C Current
3:0137	A2_PS_OUTB.CT_BUS_AVG.A_NAME	BUS CT Average Current
3:0138	A2_PS_OUTB.BUS_PWR_A.A_NAME	BUS Power from Phase A
3:0139	A2_PS_OUTB.BUS_PWR_B.A_NAME	BUS Power from Phase B
3:0140	A2_PS_OUTB.BUS_PWR_C.A_NAME	BUS Power from Phase C
3:0141	A2_PS_OUTB.BUS_WATTS.A_NAME	BUS Total Power
3:0142	A2_PS_OUTB.BUS_VA_A.A_NAME	BUS VA from Phase A

3:0143	A2_PS_OUTB.BUS_VA_B.A_NAME	BUS VA from Phase B
3:0144	A2_PS_OUTB.BUS_VA_C.A_NAME	BUS VA from Phase C
3:0145	A2_PS_OUTB.BUS_VA.A_NAME	BUS Total VA
3:0146	A2_PS_OUTB.BUS_VAR_A.A_NAME	BUS VAR from Phase A
3:0147	A2_PS_OUTB.BUS_VAR_B.A_NAME	BUS VAR from Phase B
3:0148	A2_PS_OUTB.BUS_VAR_C.A_NAME	BUS VAR from Phase C
3:0149	A2_PS_OUTB.BUS_VAR.A_NAME	BUS Total VAR
3:0150	A2_PS_OUTB.BUS_NPHV.A_NAME	BUS Negative Phase Voltage
3:0151	A2_PS_OUTB.BUS_NPHA.A_NAME	BUS Negative Phase Current
3:0152		
3:0153		
3:0154		
3:0155		
3:0156		
3:0157		
3:0158		
3:0159		
3:0160		

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	spare	
4:0010	spare	
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 Setpoint	
4:0017	VAR Control Setpoint	
4:0018	PF Control Setpoint	0.01
4:0019	Process Control Setpoint	
4:0020		

Appendix C. Alarm/Shutdown Event List

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 programmed as Hard Shutdowns and are not tunable, 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	Distributed IO Fault	Disabled	
AL_008	Speed Signal #1 Failed	ALARM	
AL_009	Speed Signal #2 Failed	ALARM	
AL_010	Analog Input # 1 Failed	ALARM	
AL_011	Analog Input # 2 Failed	ALARM	
AL_012	Analog Input # 3 Failed	ALARM	
AL_013	Analog Input # 4 Failed	ALARM	
AL_014	Analog Input # 5 Failed	ALARM	
AL_015	Analog Input # 6 Failed	HARD SHUTDOWN	
AL_016	Discrete Input # 01 triggered event	HARD SHUTDOWN	
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	Disabled	
AL_041	Not Used	Disabled	
AL_042	Not Used	Disabled	
AL_043	Not Used	Disabled	
AL_044	Not Used	Disabled	
AL_045	Not Used	Disabled	
AL_046	Not Used	Disabled	
AL_047	Not Used	Disabled	
AL_048	Not Used	Disabled	
AL_049	Start Overtemp Level (SD)	HARD SHUTDOWN	
AL_050	PT Overspeed ALM level	ALARM	
AL_051	PT Speed Signal Difference	ALARM	
AL_052	PT Overspeed SD Level	HARD SHUTDOWN	
AL_053	All PT Speed Sig Failed	HARD SHUTDOWN	
AL_054	PT Overspeed Test Enabled	ALARM	
AL_055	EGT Overtemp 1 Level (SD)	HARD SHUTDOWN	
AL_056	EGT Signal Low after OVRD	ALARM	
AL_057	Turbine Overtemp 2 Level (ALM)	ALARM	
AL_058	CDP Over High Press Level	HARD SHUTDOWN	
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	ALARM	
AL_065	GT Failed to Lite_off	HARD SHUTDOWN	
AL_066	Loss of Flame in Combustor	HARD SHUTDOWN	
AL_067	Unit Failed to Reach PT Idle	HARD SHUTDOWN	
AL_068	Unit Failed to Reach PT Rated	HARD SHUTDOWN	
AL_069	Start Command Lost While Running	HARD SHUTDOWN	
AL_070	Normal Stop Complete - Turn Off Starter	ALARM	
AL_071	Alternate Temp Signal (TIT) Failed	Disabled	
AL_072	Running OVERTEMP ALM (CTIT)	Disabled	
AL_073	Starting OVERTEMP ALM (CTIT)	Disabled	
AL_074	Runnng OVERTEMP SD (CTIT)	Disabled	
AL_075	Starting OVERTEMP SD (CTIT)	Disabled	
AL_076	Not Used	Disabled	

AL_077	Not Used	Disabled	
AL_078	Not Used	Disabled	
AL_079	Not Used	Disabled	
AL_080	Not Used	Disabled	
AL_081	Not Used	Disabled	
AL_082	Not Used	Disabled	
AL_083	Not Used	Disabled	
AL_084	Not Used	Disabled	
AL_085	Not Used	Disabled	
AL_086	Not Used	Disabled	
AL_087	Not Used	Disabled	
AL_088	Not Used	Disabled	
AL_089	Not Used	Disabled	
AL_090	Not Used	Disabled	
AL_091	Not Used	Disabled	
AL_092	Not Used	Disabled	
AL_093	Not Used	Disabled	
AL_094	Not Used	Disabled	
AL_095	Not Used	Disabled	
AL_096	Not Used	Disabled	
AL_097	Not Used	Disabled	
AL_098	Not Used	Disabled	
AL_099	Not Used	Disabled	
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 * There is no protection for 3 phase ground faults	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	ALARM	
AL_131	Process Value Low Alarm	ALARM	
AL_132	Unit Failed to Sync	ALARM	
AL_133	Voltage Bias Range Alarm	ALARM	
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	Customer Event on AI 01	Disabled	
AL_142	Customer Event on AI 02	Disabled	
AL_143	Customer Event on AI 03	Disabled	
AL_144	Customer Event on AI 04	Disabled	
AL_145	Customer Event on AI 05	Disabled	
AL_146	Customer Event on AI 06	Disabled	
AL_147	Not Used	Disabled	
AL_148	Not Used	Disabled	
AL_149	Not Used	Disabled	
AL_150	Not Used	Disabled	

Appendix D. Configuration and Service Tunables Worksheet

Control Part Number ____________________

Software Number & Revision Letter ____________________

Control Serial Number ____________________

I/O CONFIGURATION NOTES

MPUs:
PT MPUs: Maximum frequency sensing = 25000 Hz
Single or Redundant Sensors

TEMPERATURE INPUT (summary input):
EGT: input in Deg. F, 4-20mA – Required on Analog Input Channel # 6

COMPRESSOR DISCHARGE PRESSURE INPUT:
CDP: input in psia, 4-20mA – If used must be on Analog Input Channel # 3

SERVICE & CONFIGURATION HEADER NOTES:
Below is a list of the Quickservice Inspector File that is used to configure the control. Each Tab sheet is listed below with a column available for the user to record the correct value for their unit.
The column identify by the T * indicates that rows value as tunable.

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

****
** LIST OF CONFIGURE SHEET TAB HEADERS **
****
** CONFIGURE: C1- A - SYSTEM **
** CONFIGURE: C2- B - Psense SETTINGS**
** CONFIGURE: C3- C - SPEED SENSOR SETTINGS**
** CONFIGURE: C4- D - ANALOG IN OPTS (4=MAX)**
** CONFIGURE: C5- E - EGT SETTINGS**

Configure: A - SYSTEM

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Use Gas Fuel Valve *True is unit is to run on Gas Fuel*	*	TRUE			
Configure	02 Gas Valve Reverse Act? *True inverts the output to the gas fuel valve so that 0% = max fuel*	*	FALSE			
Configure	03 Use Liq Fuel Valve *True is unit is to run on Liquid Fuel*	*	TRUE			
Configure	04 Liq Valve Reverse Act? *True inverts the output to the liquid fuel valve so that 0% = max fuel*	*	FALSE			
Configure	05 PT Idle Speed Ref (Min) *Turbine idle speed (min speed control setpoint)*	*	2250	100	20000	
Configure	06 PT Rated Speed *Rated/Synchronous turbine speed*	*	3600	100	20000	
Configure	07 PT Max Spd Ref Setpoint *Max speed setpoint – for 5% droop this typically = rated speed + 5% of rated speed*	*	3780	1000	30000	
Configure	08 PT Speed for SD Reset *Speed below which the turbine speed must reach before a shutdown condition can be reset*	*	500	100	30000	
Configure	09 Flame Detect Options Available options for combustor flame detection – *1 = EGT temp > 400 deg F* *2= Use DI Flame detectors* *3= Use both of these options*	*	1	1	3	
Configure	10 Flame Detect Option Fdbk *Confirms selection above*		EGT > 400 Deg F			
Configure	11 Disable CDP Sensor *True if the fuel valve has a built-in CDP limiter function*	*	FALSE			
Configure	12 Fuel Transfer Rate from Liquid to Gas (sec) *Time for unit to ramp from Liquid fuel to gas fuel*	*	60	1	120	
Configure	13 Fuel Transfer Rate from Gas to Liquid (sec) *Time for unit to ramp from Gas fuel to Liquid fuel*	*	60	1	120	
Configure	14 Gen Freq (1=50, 2=60) HZ *Selection of generator frequency*	*	2	1	2	
Configure	15 Use Sync/Breaker Cmds? *True enables the use of the breaker commands & synchronization logic*	*	TRUE			
Configure	16 Init Mode at Brkr Close *Selection of control action upon closure of the generator breaker* *0 = Manual / goes to min load point* *1= Ramp to Base load setpoint* *2= Go to Isoch Loadsharing*	*	0	0	2	
Configure	17 Initial Mode Selected *Confirms the selection above*		Manual Loading			
Configure	18 Use Load Sharing by LON? *True = Load sharing logic available*	*	FALSE			
Configure	19 Use Reactive Load Cntrl? *True= Reactive load (VAR or PF) control available*	*	TRUE			
Configure	20 Display Temps in Deg C *True = temp display outputs will be in degrees C*	*	FALSE			
Configure	21 SD BO True=SD True = Relay output #1 is energized when unit is shutdown *False = Relay output #1 is energized when no shutdowns present*	*	TRUE			

Configure	22 ALM Out Summary or Horn True = Alarm relay output #2 is energized whenever a new event happens – cleared by an acknldg *False = Alarm relay output #2 is energized whenever an alarm condition exists – cleared by a reset*	*	FALSE			
Configure	23 Use Reset as Acknowlge *This will tie the Reset input to trigger an Acknowledge command – if Reset is pressed for less than 2 seconds it will = an ACK command, if held for longer than 2 seconds it will = a Reset command*	*	FALSE			
Configure	24 Reset Clears DIO1 SD *Tune True if it is desired to have the GTC clear its SD output during a Reset if the only cause of the SD is the External Trip on DI1*	*	FALSE			
Configure	25 Tune True= CNFGComplete *User must tune this value TRUE once the initial configuration is complete – False = unit shutdown*	*	TRUE			

Configure: B - PSense SETTINGS

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 GEN CT Ratio *Generator Current Transformer (CT) Ratio*	*	150	5	30000	
Configure	02 GEN PT Ratio *Generator Potential Transformer (PT) Ratio*	*	5	1	1000	
Configure	03 GEN Sensing Type T=3 Phz *Generator Sensing Type Single or 3 Phase - False = 1 phase, True = 3 phase*	*	TRUE			
Configure	04 GEN H/W Volt(70/120/240) *Generator Hardware Voltage Range - 1=70Vac (100 max), 2=120Vac (150 max), 3=240Vac (300 max)*	*	2	1	3	
Configure	05 Mains CT Ratio *Mains Current Transformer (CT) Ratio*	*	150	5	30000	
Configure	06 Mains PT Ratio *Mains Potential Transformer (PT) Ratio*	*	5	1	1000	
Configure	07 Mains Sensing Type (T=3) *Mains Sensing Type Single or 3 Phase - False = 1 phase, True = 3 phase*	*	TRUE			
Configure	08 Mains H/W Vlt 70/120/240 *Mains Hardware Voltage Range - 1=70Vac (100 max, <27Vac DeadBusDetect), 2=120Vac (150 max, <40Vac DeadBusDetect), 3=240Vac (300 max, <80Vac DeadBusDetect)*	*	2	1	3	
Configure	09 Num of Poles in GEN *Number of Poles on the Generator*	*	2	2	18	
Configure	10 Rated GEN KVA *Rated Generator Volt-Ampere (in KVA)*	*	12500	10	30000	
Configure	11 Rated GEN KVAR *Rated Generator Volt-Ampere-Reactive (in KVAR)*	*	2500	0.001	30000	
Configure	12 Rated GEN KW *Rated Generator Kilowatts*	*	10000	0.001	30000	
Configure	13 Rated GEN Volt *Rated Generator Voltage*	*	13800	0.001	30000	
Configure	14 GEN Line Config 1=Delta *Generator PT Configuration - 1 = Wye, Star, or Line-to-Neutral 2 = Delta or Line-to-Line*	*	2	1	2	
Configure	15 GEN Rotation (T=ABC) *Generator Phase Rotation Direction - True = Clockwise or ABC False = Counter Clockwise or ACB*	*	TRUE			
Configure	16 Rated Mains KVA *Rated Mains Volt-Ampere (in KVA)*	*	1000	10	30000	

Configure	17 Rated Mains KVAR *Rated Mains Volt-Ampere-Reactive (in KVAR)*	*	1000	0.001	30000	
Configure	18 Rated Mains KW *Rated Mains Kilowatts*	*	10000	0.001	30000	
Configure	19 Rated Mains Volts *Rated Mains Voltage*	*	480	0.001	30000	
Configure	20 Mains Line Config (2=Y) *Mains PT Configuration - 1 = Wye, Star, or Line-to-Neutral 2 = Delta or Line-to-Line*	*	1	1	2	
Configure	21 Voltage Bias Type *Voltage Bias Output Type - 1 = 4-20 mA, 2 = +/-9 Vdc, 3 = +/-3 Vdc, 4 = +/-1 Vdc, 5 = Raise/Lower Discrete Cmds*	*	3	1	5	
Configure	22 Voltage Bias Selected *Feedback of Voltage Bias Selection*		+/- 3 Volt			
Configure	23 LON Unit Number *LON network address for this unit*	*	1	1	16	

Configure: C - SPEED SENSOR SETTINGS

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Use Two PT Sensors *True if using redundant speed sensors*	*	TRUE			
	*NOTE: The maximum frequency is clamped at 25,000 Hz. This means that the MAX_SPEED * (NUM_TEETH/60) * GEAR_RATIO must be less than 25,000*					
Configure	02 PT Max Speed *Max speed the block will output*	*	5000	0	30000	
Configure	03 PT Gear Ratio *The relationship of the speed of the gear on which the speed sensing device is mounted to the turbines shaft speed*	*	1	0.01	100	
Configure	04 PT Number of Gear Teeth *Number of teeth on the gear to which the speed sensing device is mounted*	*	83	1	1000	
Configure	05 PT Failed High Setpoint *Speed above this value triggers a sensor failed alarm*	*	5000	0	30000	
Configure	06 PT Failed Low Setpoint *Speed below this value triggers a sensor failed alarm*	*	300	0	30000	
Configure	07 PT Spread Alarm Level *Difference value to trigger alarm if 2 sensors are used*	*	1000	0	30000	
Configure	08 PT Hi Speed Alarm Setpnt *High speed alarm setpoint*	*	4000	100	10000	
Configure	09 PT Overspeed SD Setpoint *Overspeed trip speed setpoint*	*	4000	100	10000	

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

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 Process Control Signal *True if Process control functions are to be used on this unit*	*	FALSE			
Configure	02 Remote PT Speed REF *True if a remote speed reference signal is to be used on this unit*	*	TRUE			
Configure	03 Amb Inlet Air Temp *True if an ambient inlet air temp sensor is present on this unit*	*	TRUE			
Configure	04 Remote KW Reference *True if a remote KW setpoint signal is to be used on this unit*	*	FALSE			
Configure	05 Remote VAR/PF REF *True if VAR/PF control functions are be used on this unit*	*	TRUE			

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	06 Remote Process Setpoint *True if a remote process setpoint signal is to be used on this unit*	*	FALSE			
Configure	07 Gas Fuel Valve Pos Fdbk *True if the valve position feedback signal is to be used on this unit*	*	TRUE			
Configure	08 Liq Fuel Valve Pos Fdbk *True if the valve position feedback signal is to be used on this unit*	*	FALSE			

Configure: E - EGT SETTINGS

Category	Field Name	T	Initial Value	Low	High	User Value
Configure	01 EGT Low Temp Setpnt *EGT below this temp will trigger low temp alarm*	*	500	-100	2500	
Configure	02 Use Speed Switch OVRD *Tune TRUE to use a speed switch to Override EGT Overtemp (1 and 2) until a certain speed (set below) – this does not override the Start Overtemp event*	*	TRUE	False	True	
Configure	03 Speed Override Setpoint *This is the speed at which the Temp Override will be removed*	*	2000	50	10000	
Configure	04 Overtemp 1 Setpnt (SD) *EGT above this temp will trigger a high temp Shutdown (Event 55)*	*	2000	0	2500	
Configure	05 Overtemp 2 Setpnt (ALM) *EGT or Turbine temp above this temp will trigger a high temp alarm (Event 57)*	*	1650	0	2500	
Configure	06 Start Overtemp Setpnt *EGT or Turbine temp above this temp will trigger a high temp shutdown (Event 49)*	*	1650	0	2500	
Configure	07 EGT Temp Switch 1 Setpnt *Temp switch # 1 will go True when the EGT exceeds this temp*	*	400	0	2500	
Configure	08 EGT Temp Switch 2 Setpnt *Temp switch # 2 will go True when the EGT exceeds this temp*	*	1000	0	2500	
Configure	09 EGT Temp Switch 3 Setpnt *Temp switch # 3 will go True when the EGT exceeds this temp*	*	1500	0	2500	
Configure	10 Control Alternate Temp (TIT) *Tune this TRUE to have the Control PID control a temperature other than EGT, for example some units have combustor temperatures or calculated temps*	*	TRUE	False	True	
Configure	11 Use Curve for TIT Setpoint - *Use CIT_SPD curve forTIT reference setpoint (Curve at EGT_REF.CIT_SPD)*	*	FALSE	False	True	
Configure	12 Use CTIT (no EGT or TIT Signal) *Use the calculated turbine inlet temp algorithm as process variable – no direct EGT or TIT signal available*	*	FALSE	False	True	

SERVICE SHEETS

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

****

** LIST OF SERVICE SHEET TAB HEADERS **

****

** 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 AO 1-4 Setup**
** SERVICE: S08 AO 5-8 Setup **
** SERVICE: S09 DI 1-6 Setup **
** SERVICE: S10 DI 7-11 Setup **
** SERVICE: S11 DI 12-16 Setup **
** SERVICE: S12 DI 17-21 Setup **
** SERVICE: S13 DI 22-24 Setup **
** SERVICE: S14 DO 3-7 Setup **
** SERVICE: S15 DO 8-12 Setup **
** SERVICE: S16 Relay Output Forcing **
** SERVICE: S17 Analog Output Forcing **
** SERVICE: S18 Serial Port #1 Setup **
** SERVICE: S19 Serial Port #2 Setup **
** SERVICE: S20 Ambient Temp Setup **
** SERVICE: S21 Remote Speed Reference Setup **
** SERVICE: S22 Start / Lite-off Setup **
** SERVICE: S23 Valve Calibration & Stroke **
** SERVICE: S24 PT Speed Control Setup **
** SERVICE: S25 CDP to Fuel Limit Curve **
** SERVICE: S26 Accel PID Setup **
** SERVICE: S27 Decel Curve (CDP) Setup **
** SERVICE: S28 CDP Control PID Setup **
** SERVICE: S29 EGT Control PID Setup **
** SERVICE: S30 Real Load Control Setup **
** SERVICE: S31 PowerSense Module Setup **
** SERVICE: S32 Synchronizer Setup **
** SERVICE: S33 Reactive Load Setup **
** SERVICE: S34 Process Control Setup **
** SERVICE: S35 Generator Protection 1 **
** SERVICE: S36 Generator Protection 2 **
** SERVICE: S37 ALM/SD Events **
** SERVICE: S38 ALM/SD Events **
** SERVICE: S39 ALM/SD Events **
** SERVICE: S40 ALM/SD Events **
** SERVICE: S41 ALM/SD Events **
** SERVICE: S42 ALM/SD Events **
** SERVICE: S43 START/STOP SEQUENCE **
** SERVICE: S44 Turbine Parameters **

Service: S01 AI 1 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI01 *Selection from available options found in Chapter 5*	*	1	0	10	
Service	02 Mode = *Feedback of option selected above*		Process Control Input Signal			
Service	03 1=4-20mA 2=0-5V *Type of analog signal used, 1 = 4-20 mA current sensor, 2 = 0-5 Vdc voltage sensor*	*	1	1	2	
Service	04 Mode = *Feedback of option selected above*		Channel configured as 4-20 mA			
Service	05 Analog 1 Value @ 4 mA = *Lower range of input signal when current = 4mA or voltage = 0 Vdc*	*	0	-20000	20000	
Service	06 Analog 1 Value @ 20 mA = *Upper range of input signal when current = 20mA or voltage = 5 Vdc*	*	100	-32768	32768	
Service	07 Analog 1 Value *Readback of value currently being read at this input position*		-24.8			
Service	08 Analog 1 Offset *Offset adder to this signal (for calib)*	*	0	-10000	10000	
Service	09 Analog 1 Gain *Gain multiplier to this signal (for calibration)*	*	1	0	2	
Service	10 Failed sensor delay time *Delay time (sec) before triggering alarm for this sensor being out of range, which is set at 2 and 22 mA*	*	0.1	0	5	
Service	11 Configurd for Custom Sig *Status – True is this input is configured for a user custom signal*		FALSE			
Service	12 Custom Use Event Level *Value at which this signal will trigger an event*	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F *If True - this event will trigger when the signal drops below this value*	*	FALSE			
Service	14 Mode = *Feedback of event mode selected*		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD *Selection of the desired action for this event, 1=Not used, 2=Alarm, 3=Shutdown*	*	1	1	4	
Service	16 Mode = *Feedback of action mode selected*		Disabled			
Service	17 Alarm delay time *Delay time (sec) before triggering this event*	*	0.1	0	500	
Service	18 Action on Failed Signal *Select the action desired if this input signal fails*	*	2	1	5	
Service	19 Mode = *Feedback of action mode selected*		Alarm			

Service: S02 AI 2 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI02 *Selection from available options found in Chapter 5*	*	2	0	10	
Service	02 Mode = *Feedback of option selected above*		Remote PT Speed Ref			
Service	03 1=4-20mA 2=0-5V *Type of analog signal used, 1 = 4-20 mA current sensor, 2 = 0-5 Vdc voltage sensor*	*	1	1	2	
Service	04 Mode = *Type of analog signal used, 1 = 4-20 mA current sensor, 2 = 0-5 Vdc voltage sensor*		Channel configured as 4-20 mA			

Service	05 Analog 2 Value @ 4 mA = *Lower range of input signal when current = 4mA or voltage = 0 Vdc*	*	100	-20000	20000	
Service	06 Analog 2 Value @ 20 mA = *Upper range of input signal when current = 20mA or voltage = 5 Vdc*	*	100	-30000	30000	
Service	07 Analog 2 Value *Readback of value currently being read at this input position*		100			
Service	08 Analog 2 Offset *Offset adder to this signal (for calibration)*	*	0	-10000	10000	
Service	09 Analog 2 Gain *Gain multiplier to this signal (for calibration)*	*	1	0	2	
Service	10 Failed sensor delay time *Delay time (sec) before triggering alarm for this sensor being out of range, which is set at 2 and 22 mA*	*	0.1	0	5	
Service	11 Configurd for Custom Sig *Status – True is this input is configured for a user custom signal*		FALSE			
Service	12 Custom Use Event Level *Value at which this signal will trigger an event*	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F *If True - this event will trigger when the signal drops below this value*	*	FALSE			
Service	14 Mode = *Feedback of action mode selected*		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD *Selection of the desired action for this event, 1=Not used, 2=Alarm, 3=Shutdown*	*	1	1	4	
Service	16 Mode = *Feedback of action mode selected*		Disabled			
Service	17 Alarm delay time *Delay time (sec) before triggering this event*	*	0.1	0	500	
Service	18 Action on Failed Signal *Select the action desired if this input signal fails*	*	2	1	5	
Service	19 Mode = *Feedback of action mode selected*		Alarm			

Service: S03 AI 3 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI03 *1 = CDP Sensor, 2= Customer use, 3= Not Used*	*	1	1	3	
Service	02 Mode = *Feedback of option selected above*		GTC Use = CDP Sensor			
Service	03 1=4-20mA 2=0-5V *Type of analog signal used, 1 = 4-20 mA current sensor, 2 = 0-5 Vdc voltage sensor*	*	1	1	2	
Service	04 Mode = *Feedback of option selected above*		Channel configured as 4-20 mA			
Service	05 Analog 3 Value @ 4 mA = *Lower range of input signal when current = 4mA or voltage = 0 Vdc*	*	0	-20000	20000	
Service	06 Analog 3 Value @ 20 mA = *Upper range of input signal when current = 20mA or voltage = 5 Vdc*	*	100	-30000	30000	
Service	07 Analog 3 Value *Readback of value currently being read at this input position*		-0.003			
Service	08 Analog 3 Offset *Offset adder to this signal (for calib)*	*	0	-10000	10000	
Service	09 Analog 3 Gain *Gain multiplier to this signal (for calibration)*	*	1	0	2	
Service	10 Failed sensor delay time *Delay time (sec) before triggering alarm for this sensor being out of range, which is set at 2 and 22 mA*	*	0.1	0	5	

Service	11 Configurd for Custom Sig *Status – True is this input is configured for a user custom signal*		FALSE			
Service	12 Custom Use Event Level *Value at which this signal will trigger an event*	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F *If True - this event will trigger when the signal drops below this value*	*	FALSE			
Service	14 Mode = *Feedback of event mode selected*		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD *Selection of the desired action for this event, 1=Not used, 2=Alarm, 3=Shutdown*	*	1	1	4	
Service	16 Mode = *Feedback of action mode selected*		Disabled			
Service	17 Alarm delay time *Delay time (sec) before triggering this event*	*	0.1	0	500	
Service	18 Action on Failed Signal *Select the action desired if this input signal fails*	*	4	1	5	
Service	19 Mode = *Feedback of action mode selected*		Hard Shutdown			

Service: S04 AI 4 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI04 *Selection from available options found in Chapter 5*	*	3	0	10	
Service	02 Mode = *Feedback of option selected above*		Ambient Inlet Air Temp			
Service	03 1=4-20mA 2=0-5V *Type of analog signal used, 1 = 4-20 mA current sensor, 2 = 0-5 Vdc voltage sensor*	*	1	1	2	
Service	04 Mode = *Feedback of option selected above*		Channel configured as 4-20 mA			
Service	05 Analog 4 Value @ 4 mA = *Lower range of input signal when current = 4mA or voltage = 0 Vdc*	*	0	-20000	20000	
Service	06 Analog 4 Value @ 20 mA = *Upper range of input signal when current = 20mA or voltage = 5 Vdc*	*	100	-30000	30000	
Service	07 Analog 4 Value *Readback of value currently being read at this input position*		-0.003			
Service	08 Analog 4 Offset *Offset adder to this signal (for calib)*	*	0	-10000	10000	
Service	09 Analog 4 Gain *Gain multiplier to this signal (for calibration)*	*	1	0	2	
Service	10 Failed sensor delay time *Delay time (sec) before triggering alarm for this sensor being out of range, which is set at 2 and 22 mA*	*	0.1	0	5	
Service	11 Configurd for Custom Sig *Status – True is this input is configured for a user custom signal*		FALSE			
Service	12 Custom Use Event Level *Value at which this signal will trigger an event*	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F *If True - this event will trigger when the signal drops below this value*	*	FALSE			
Service	14 Mode = *Feedback of event mode selected*		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD *Selection of the desired action for this event, 1=Not used, 2=Alarm, 3=Shutdown*	*	1	1	4	
Service	16 Mode = *Feedback of action mode selected*		Disabled			
Service	17 Alarm delay time *Delay time (sec) before triggering this event*	*	0.1	0	500	

Service	18 Action on Failed Signal *Select the action desired if this input signal fails*	*	2	1	5	
Service	19 Mode = *Feedback of action mode selected*		Alarm			

Service: S05 AI 5 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI05 *Selection from available options found in Chapter 5*	*	5	0	10	
Service	02 Mode = *Feedback of option selected above*		Remote VAR/PF Reference			
Service	03 1=4-20mA 2=0-5V *Type of analog signal used, 1 = 4-20 mA current sensor, 2 = 0-5 Vdc voltage sensor*	*	1	1	2	
Service	04 Mode = *Feedback of option selected above*		Channel configured as 4-20 mA			
Service	05 Analog 5 Value @ 4 mA = *Lower range of input signal when current = 4mA or voltage = 0 Vdc*	*	0	-20000	20000	
Service	06 Analog 5 Value @ 20 mA = *Upper range of input signal when current = 20mA or voltage = 5 Vdc*	*	100	-30000	30000	
Service	07 Analog 5 Value *Readback of value currently being read at this input position*		-0.003			
Service	08 Analog 5 Offset *Offset adder to this signal (for calib)*	*	0	-10000	10000	
Service	09 Analog 5 Gain *Gain multiplier to this signal (for calibration)*	*	1	0	2	
Service	10 Failed sensor delay time *Delay time (sec) before triggering alarm for this sensor being out of range, which is set at 2 and 22 mA*	*	0.1	0	5	
Service	11 Configurd for Custom Sig *Status – True is this input is configured for a user custom signal*		FALSE			
Service	12 Custom Use Event Level *Value at which this signal will trigger an event*	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F *If True - this event will trigger when the signal drops below this value*	*	FALSE			
Service	14 Mode = *Feedback of event mode selected*		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD *Selection of the desired action for this event, 1=Not used, 2=Alarm, 3=Shutdown*	*	1	1	4	
Service	16 Mode = *Feedback of action mode selected*		Disabled			
Service	17 Alarm delay time *Delay time (sec) before triggering this event*	*	0.1	0	500	
Service	18 Action on Failed Signal *Select the action desired if this input signal fails*	*	2	1	5	
Service	19 Mode = *Feedback of action mode selected*		Alarm			

Service: S06 AI 6 setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select Function for AI06 *1= EGT Temp, 2=Customer use, 3= Not Used*	*	1	1	3	
Service	02 Mode = *Feedback of option selected above*		GTC Use = Analog EGT Signal			

Service	03 1=4-20mA 2=0-5V *Type of analog signal used, 1 = 4-20 mA current sensor, 2 = 0-5 Vdc voltage sensor*	*	1	1	2	
Service	04 Mode = *Feedback of option selected above*		Channel configured as 4-20 mA			
Service	05 Analog 6 Value @ 4 mA = *Lower range of input signal when current = 4mA or voltage = 0 Vdc*	*	0	-20000	20000	
Service	06 Analog 6 Value @ 20 mA = *Upper range of input signal when current = 20mA or voltage = 5 Vdc*	*	2000	-30000	30000	
Service	07 Analog 6 Value *Readback of value currently being read at this input position*		-499.16			
Service	08 Analog 6 Offset *Offset adder to this signal (for calib)*	*	0	-10000	10000	
Service	09 Analog 6 Gain *Gain multiplier to this signal (for calibration)*	*	1	0	2	
Service	10 Failed sensor delay time *Delay time (sec) before triggering alarm for this sensor being out of range, which is set at 2 and 22 mA*	*	0.1	0	5	
Service	11 Configurd for Custom Sig *Status – True is this input is configured for a user custom signal*		FALSE			
Service	12 Custom Use Event Level *Value at which this signal will trigger an event*	*	1000	-15000	15000	
Service	13 Alarm Low=T Hi=F *If True - this event will trigger when the signal drops below this value*	*	FALSE			
Service	14 Mode = *Feedback of event mode selected*		Alarm on rising signal (High)			
Service	15 1=N_Used 2=Alrm 3=SD *Selection of the desired action for this event, 1=Not used, 2=Alarm, 3=Shutdown*	*	1	1	4	
Service	16 Mode = *Feedback of action mode selected*		Disabled			
Service	17 Alarm delay time *Delay time (sec) before triggering this event*	*	0.1	0	500	
Service	18 Action on Failed Signal *Select the action desired if this input signal fails*	*	4	1	5	
Service	19 Mode = *Feedback of action mode selected*		Hard Shutdown			

Service: S07 AO 1-4 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select function for AO01 *Selection from available options found in Chapter 5*	*	1	1	21	
Service	02 Mode = *Feedback of mode selected*		PT actual speed readout			
Service	03 Analog Out1 Val at 4 mA *Lower range of output signal when current = 4mA*	*	0	-20000	20000	
Service	04 Analog Out1 Val at 20 mA *Upper range of output signal when current = 20mA*	*	5000	-30000	30000	
Service	05 Present AO_01 dmd value *Readback of value currently being output on this channel*		0			
Service	06 Select function for AO02 *Selection from available options found in Chapter 5*	*	2	1	21	
Service	07 Mode = *Feedback of mode selected*		PT reference speed readout			
Service	08 Analog Out2 Val at 4 mA *Lower range of output signal when current = 4mA*	*	0	-20000	20000	

Service	09 Analog Out2 Val at 20 mA *Upper range of output signal when current = 20mA*	*	5000	-20000	20000	
Service	10 Present AO_02 dmd value *Readback of value currently being output on this channel*		2250			
Service	11 Select function for AO03 *Selection from available options found in Chapter 5*	*	3	1	16	
Service	12 Mode = *Feedback of mode selected*		Exh gas temp readout			
Service	13 Analog Out3 Val at 4 mA *Lower range of output signal when current = 4mA*	*	0	-20000	20000	
Service	14 Analog Out3 Val at 20 mA *Upper range of output signal when current = 20mA*	*	2000	-30000	30000	
Service	15 Present AO_03 dmd value *Readback of value currently being output on this channel*		-499.16			
Service	16 Select function for AO04 *Selection from available options found in Chapter 5*	*	4	1	16	
Service	17 Mode = *Feedback of mode selected*		Comp disch press readout (psia)			
Service	18 Analog Out4 Val at 4 mA *Lower range of output signal when current = 4mA*	*	0	-20000	20000	
Service	19 Analog Out4 Val at 20 mA *Upper range of output signal when current = 20mA*	*	300	-30000	30000	
Service	20 Present AO_04 dmd value *Readback of value currently being output on this channel*		-74.72			

Service: S08 AO 5-6 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select function for AO05 *Selection from available options found in Chapter 5*	*	5	1	16	
Service	02 Mode = *Feedback of mode selected*		Fuel valve readout (%)			
Service	03 Analog Out5 Val at 4 mA *Lower range of output signal when current = 4mA*	*	0	-20000	20000	
Service	04 Analog Out5 Val at 20 mA *Upper range of output signal when current = 20mA*	*	100	-30000	30000	
Service	05 Present AO_05 dmd value *Readback of value currently being output on this channel*		0			
Service	06 Select function for AO06 *Selection from available options found in Chapter 5*	*	6	1	16	
Service	07 Mode = *Feedback of mode selected*		Gen KWatts Output			
Service	08 Analog Out6 Val at 4 mA *Lower range of output signal when current = 4mA*	*	0	-20000	20000	
Service	09 Analog Out6 Val at 20 mA *Upper range of output signal when current = 20mA*	*	10	-30000	30000	
Service	10 Present AO_06 dmd value *Readback of value currently being output on this channel*		0			

Service: S09 DI 1-6 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI01 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	02 Mode = *Feedback of mode selected*		Normally closed switch			
Service	03 DI02 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	04 Mode = *Feedback of mode selected*		Normally closed switch			
Service	05 DI03 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	06 Mode = *Feedback of mode selected*		Normally closed switch			
Service	07 DI04 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	08 Mode = *Feedback of mode selected*		System Acknowledge (ALM & SD)			
Service	09 DI04 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	10 Mode = *Feedback of mode selected*		Normally closed switch			
Service	11 DI05 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	12 Mode = *Feedback of mode selected*		PT Reference Lower Command			
Service	13 DI05 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	14 Mode = *Feedback of mode selected*		Normally closed switch			
Service	15 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	16 DI06 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	17 Mode = *Feedback of mode selected*		PT Reference Raise Command			
Service	18 DI06 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	19 Mode = *Feedback of mode selected*		Normally closed switch			
Service	20 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	

Service: S10 DI 7-11 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI07 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	02 Mode = *Feedback of mode selected*		PT Reference Select Fast Rate			
Service	03 DI07 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	04 Mode = *Feedback of mode selected*		Normally closed switch			

Service	05 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	06 DI08 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	07 Mode = *Feedback of mode selected*		PT Speed Signal Failed Override			
Service	08 DI08 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	09 Mode = *Feedback of mode selected*		Normally closed switch			
Service	10 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	11 DI09 F=GTC T=Customer	*	FALSE			
Service	12 Mode = *Feedback of mode selected*		Initiate a Normal Stop			
Service	13 DI09 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	14 Mode = *Feedback of mode selected*		Normally closed switch			
Service	15 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	16 DI10 F=GTC T=Customer	*	FALSE			
Service	17 Mode = *Feedback of mode selected*		Combustor Flame Detector			
Service	18 DI10 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	19 Mode = *Feedback of mode selected*		Normally closed switch			
Service	20 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	21 DI11 F=GTC T=Customer	*	FALSE			
Service	22 Mode = *Feedback of mode selected*		Fuel Selection / Transfer TRUE=Liquid			
Service	23 DI11 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	24 Mode = *Feedback of mode selected*		Normally closed switch			
Service	25 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	

Service: S11 DI 12-16 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI12 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	02 Mode = *Feedback of mode selected*		Enable Remote PT Reference			
Service	03 DI12 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	04 Mode = *Feedback of mode selected*		Normally closed switch			

Service	05 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0			
Service	06 DI13 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	07 Mode = *Feedback of mode selected*		Enable Synchronizer			
Service	08 DI13 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	TRUE			
Service	09 Mode = *Feedback of mode selected*		Normally open switch			
Service	10 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0			
Service	11 DI14 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	12 Mode = *Feedback of mode selected*		Generator Breaker AUX (52)			
Service	13 DI14 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	14 Mode = *Feedback of mode selected*		Normally closed switch			
Service	15 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0			
Service	16 DI15 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	17 Mode = *Feedback of mode selected*		Enable Load Share / Util Breaker Open			
Service	18 DI15 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
	19 Mode = *Feedback of mode selected*		Normally closed switch			
	20 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0			
	21 DI16 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
	22 Mode = *Feedback of mode selected*		Enable Reactive Load Control (VAR/PF)			
	23 DI16 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	24 Mode = *Feedback of mode selected*		Normally closed switch			
Service	25 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0			

Service: S12 DI 17-21 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI17 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	02 Mode = *Feedback of mode selected*		VAR/PF/Voltage Lower Command			

Service	03 DI17 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	04 Mode = *Feedback of mode selected*		Normally closed switch			
Service	05 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	06 DI18 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	07 Mode = *Feedback of mode selected*		VAR/PF/Voltage Raise Command			
Service	08 DI18 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	09 Mode = *Feedback of mode selected*		Normally closed switch			
Service	10 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	11 DI19 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	12 Mode = *Feedback of mode selected*		Utility/Mains Breaker AUX			
Service	13 DI19 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	14 Mode = *Feedback of mode selected*		Normally closed switch			
Service	15 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	16 DI20 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	17 Mode = *Feedback of mode selected*		Process Control Setpoint Lower Command			
Service	18 DI20 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	19 Mode = *Feedback of mode selected*		Normally closed switch			
Service	20 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	21 DI21 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	22 Mode = *Feedback of mode selected*		Process Control Setpoint Raise Command			
Service	23 DI21 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	24 Mode = *Feedback of mode selected*		Normally closed switch			
Service	25 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	

Service: S13 DI 22-24 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 DI22 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	02 Mode = *Feedback of mode selected*		Go to PT Rated Speed			
Service	03 DI22 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	04 Mode = *Feedback of mode selected*		Normally closed switch			
Service	05 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	06 DI23 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	07 Mode = *Feedback of mode selected*		Input Not Used			
Service	08 DI23 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	09 Mode = *Feedback of mode selected*		Normally closed switch			
Service	10 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	
Service	11 DI24 F=GTC T=Customer *Select function, False= GTC defined, True= Customer defined*	*	FALSE			
Service	12 Mode = *Feedback of mode selected*		Input Not Used			
Service	13 DI24 T=NO F=NC *Active state of this input channel True= Normally Open, False = Normally Closed*	*	FALSE			
Service	14 Mode = *Feedback of mode selected*		Normally closed switch			
Service	15 Use PERM, ALM, SD? *Custom use for this input, 0=Not Used, 1=Start Permissive, 2= Alarm, 3=Soft Shutdown, 4=Hard Shutdown*	*	0	0	4	

Service: S14 DO 3-7 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select DO_03 function *Selection from available options found in Chapter 5*	*	3	1	30	
Service	02 Mode = *Feedback of mode selected*		OPEN BREAKER COMMAND			
Service	03 DO_03 State = *Feedback of current relay state*		De-energized			
Service	04 Select DO_04 function *Selection from available options found in Chapter 5*	*	4	1	30	
Service	05 Mode = *Feedback of mode selected*		OPEN GAS FUEL SHUTOFF VALVES			
Service	06 DO_04 State = *Feedback of current relay state*		De-energized			
Service	07 Select DO_05 function *Selection from available options found in Chapter 5*	*	5	1	30	
Service	08 Mode = *Feedback of mode selected*		OPEN LIQUID FUEL SHUTOFF VALVES			

Service	09 DO_05 State = *Feedback of current relay state*		De-energized			
Service	10 Select DO_06 function *Selection from available options found in Chapter 5*	*	6	1	30	
Service	11 Mode = *Feedback of mode selected*		IGNITORS ON			
Service	12 DO_06 State = *Feedback of current relay state*		De-energized			
Service	13 Select DO_07 function *Selection from available options found in Chapter 5*	*	7	1	30	
Service	14 Mode = *Feedback of mode selected*		STARTER ENGAGED			
Service	15 DO_07 State = *Feedback of current relay state*		De-energized			

Service: S15 DO 8-12 Setup

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select DO_08 function *Selection from available options found in Chapter 5*	*	8	1	30	
Service	02 Mode = *Feedback of mode selected*		ALARM/HORN OUTPUT			
Service	03 DO_08 State = *Feedback of current relay state*		De-energized			
Service	04 Select DO_09 function *Selection from available options found in Chapter 5*	*	9	1	30	
Service	05 Mode = *Feedback of mode selected*		PT SPEED SWITCH #1			
Service	06 DO_09 State = *Feedback of current relay state*		Energized			
Service	07 Select DO_10 function *Selection from available options found in Chapter 5*	*	10	1	30	
Service	08 Mode = *Feedback of mode selected*		PT SPEED SWITCH #2			
Service	09 DO_10 State = *Feedback of current relay state*		De-energized			
Service	10 Select DO_11 function *Selection from available options found in Chapter 5*	*	13	1	30	
Service	11 Mode = *Feedback of mode selected*		PT SPEED REF AT LOWER LIM			
Service	12 DO_11 State = *Feedback of current relay state*		De-energized			
Service	13 Select DO_12 function *Selection from available options found in Chapter 5*	*	18	1	30	
Service	14 Mode = *Feedback of mode selected*		SPEED IN CONTROL			
Service	15 DO_12 State = *Feedback of current relay state*		De-energized			

Service: S16 RELAY OUTPUT FORCING

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 OK to Enter Cal Mode? *Unit safe to enter calibration mode*		TRUE			
Service	02 Enable Calibration Mode *Tune True to enter Calib. mode*	*	FALSE			
Service	03 Relay Out 01 Dmd State *True = Energize relay coil* *False = De-energize the relay coil* *(this is the same for each below)*	*	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: S17 ANALOG OUTPUT FORCING

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Analog Out 01 Demand Val *Display current output value*	*	0	-20000	20000	
Service	02 Analog Out 01 Offset *Analog output adder to this channel*	*	0	-1000	1000	
Service	03 Analog Out 01 Gain *Analog output multiplier to this channel*	*	1	0	2	
Service	04 Analog Out 02 Demand Val *Display current output value*	*	0	-20000	20000	
Service	05 Analog Out 02 Offset *Analog output adder to this channel*	*	0	-1000	1000	
Service	06 Analog Out 02 Gain *Analog output multiplier to this channel*	*	1	0	2	
Service	07 Analog Out 03 Demand Val *Display current output value*	*	0	-20000	20000	
Service	08 Analog Out 03 Offset *Analog output adder to this channel*	*	0	-1000	1000	
Service	09 Analog Out 03 Gain *Analog output multiplier to this channel*	*	1	0	2	
Service	10 Analog Out 04 Demand Val *Display current output value*	*	0	-20000	20000	
Service	11 Analog Out 04 Offset *Analog output adder to this channel*	*	0	-1000	1000	
Service	12 Analog Out 04 Gain *Analog output multiplier to this channel*	*	1	0	2	
Service	13 Analog Out 05 Demand Val *Display current output value*	*	0	-20000	20000	
Service	14 Analog Out 05 Offset *Analog output adder to this channel*	*	0	-1000	1000	
Service	15 Analog Out 05 Gain *Analog output multiplier to this channel*	*	1	0	2	
Service	16 Analog Out 06 Demand Val *Display current output value*	*	0	-20000	20000	
Service	17 Analog Out 06 Offset *Analog output adder to this channel*	*	0	-1000	1000	
Service	18 Analog Out 06 Gain *Analog output multiplier to this channel*	*	1	0	2	
Service	19 Analog Out 06 Demand Val *Display current output value*		0			
Service	20 Voltage Bias Out Offset *Analog output adder to this channel*	*	0	-50	50	
Service	21 Voltage Bias Out Gain *Analog output multiplier to this channel*	*	1	0.20	1.5	

Service: S18 SERIAL PORT 1 SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Serial Port # 1? *Tune True if using this port, False will disable all alarms of this port*	*	TRUE			
Service	02 Port 1 Set Baud Rate *Set the comm. Baud rate, 12=115200, 11= 57600, 10=38400, 9=19200, 8=9600, 7=4800, 6=2400*	*	10	1	12	

Service	03 Port 1 Baud Rate Fdbk *Feedback of selection made*		38,400			
Service	04 Port 1 Set Data Bits *Set number of data bits 1=7, 2=8*	*	2	1	2	
Service	05 Port 1 - Data Bits Fdbk *Feedback of selection made*		8 Data Bits			
Service	06 Port 1 Set Stop Bits *Set number of stop bits 1=1, 2=2, 3=1.5*	*	1	1	3	
Service	07 Port 1 Stop Bits Fdbk *Feedback of selection made*		1 Stop Bit			
Service	08 Port 1 Set Parity *Set number of stop bits 1=off, 2=odd, 3=even*	*	1	1	3	
Service	09 Port 1 Parity Fdbk *Feedback of selection made*		OFF			
Service	10 Port 1 Set Driver Type *Set type of driver signal 1=RS-232, 2= RS-422, 3=RS-485*	*	1	1	3	
Service	11 Port 1 Driver Type Fdbk *Feedback of selection made*		RS-232			
Service	12 Modbus 1=ASCII, 2=RTU *Select ASCII or RTU Modbus protocol*	*	1	1	2	
Service	13 Modbus Net Address *Specify Modbus slave address*	*	1	1	247	
Service	14 Modbus Time Out (sec) *Delay on the Modbus comm. timeout*	*	3	1	30	
Service	15 Disable Modbus Writes *Tune True to disable Modbus writes from this device*	*	FALSE			

Service: S19 SERIAL PORT 2 SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Serial Port # 2? *Select the use for this port 2=Modbus port, 3=Modbus port, 4=Control assistant port, 5=Not used*	*	3	2	5	
Service	02 Port 2 Choice Feedback *Feedback of selection made*		Modbus Port 2			
Service	03 Port 2 Set Baud Rate *Set the comm. Baud rate, 12=115200, 11= 57600, 10=38400, 9=19200, 8=9600, 7=4800, 6=2400*	*	10	1	12	
Service	04 Port 2 Baud Rate Fdbk *Feedback of selection made*		38,400			
Service	05 Port 2 Set Data Bits *Set number of data bits 1=7, 2=8*	*	2	1	2	
Service	06 Port 2 - Data Bits Fdbk *Feedback of selection made*		8 Data Bits			
Service	07 Port 2 Set Stop Bits *Set number of stop bits 1=1, 2=2, 3=1.5*	*	1	1	3	
Service	08 Port 2 Stop Bits Fdbk *Feedback of selection made*		1 Stop Bit			
Service	09 Port 2 Set Parity *Set number of stop bits 1=off, 2=odd, 3=even*	*	1	1	3	
Service	10 Port 2 Parity Fdbk *Feedback of selection made*		OFF			
Service	11 Port 2 Set Mode *Select communication mode 1=Line, 2=Character*	*	1	1	2	
Service	12 Port 2 Mode Fdbk *Feedback of selection made*		Line			
Service	13 Port 2 Set Flow Control *Select Flow control setting 1=Off, 2=XON-XOFF, 3=CTS-RTS*	*	1	1	3	
Service	14 Port 2 Flow Fdbk *Feedback of selection made*		ON			
Service	15 Port 2 Set Echo *Set Auto echo 1=Off, 2=On*	*	1	1	2	
Service	16 Port 2 Echo Fdbk *Feedback of selection made*		OFF			

Service	17 Port 2 End of Line *Set end of line character 1=LF, 2=CR, 3=CRLF*	*	3	1	3	
Service	18 Port 2 Endline Fdbk *Feedback of selection made*		CRLF			
Service	19 Port 2 Set IGNCR *Ignore Carriage Return 1=Off, 2=On*	*	2	1	2	
Service	20 Port 2 IGNCR Fdbk *Feedback of selection made*		Ignore CR ON			
Service	21 Port 2 Set Driver Type *Set type of driver signal 1=RS-232, 2= RS-422, 3=RS-485*	*	1	1	3	
Service	22 Port 2 Driver Type Fdbk *Feedback of selection made*		RS-232			

Service: S20 AMBIENT TEMP SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Using Amb Temp Snsr? *Status of if an ambient temp sensor exists in the system*		TRUE			
Service	02 Ambient Sensor Default *Value used as ambient temp if the sensor fails*	*	60	20	200	
	The curve below can be used to bias the EGT setpoint based on inlet temp, the default curve has no effect, the X values are inlet temp setpoints while the Y values are a gain multiplier on the EGT setpoint					
Service	03 Amb Bias EGT Curve X1	*	-50	-300	300	
Service	04 Amb Bias EGT Curve Y1	*	1	0	10	
Service	05 Amb Bias EGT Curve X2	*	0	-300	300	
Service	06 Amb Bias EGT Curve Y2	*	1	0	10	
Service	07 Amb Bias EGT Curve X3	*	59	-300	300	
Service	08 Amb Bias EGT Curve Y3	*	1	0	10	
Service	09 Amb Bias EGT Curve X4	*	140	-300	300	
Service	10 Amb Bias EGT Curve Y4	*	1	0	10	

Service: S21 REMOTE SPEED REF SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Remote PT Ref? *Status of if a Remote PT reference sensor exists in the system*		TRUE			
Service	02 Remote Ref Low Limit *Feedback of the lower limit of the sensor configured for this function*		100			
Service	03 Remote Ref High Limit *Feedback of the upper limit of the sensor configured for this function*		100			
Service	04 Remot Ref Lrg Error Rate *Rate in rpm/sec that the PT ref. Ramp will move when a large error exists between the remote setpoint versus the actual setpoint*	*	4	0	100	
Service	05 Remote Ref Small Window *When Remote Ref and current ref. differ by +/- this rpm amount the current ref will move to the remote ref at the default rate*	*	0.4	0	10	
Service	06 Remote Ref Large Window *When Remote Ref and current ref. differ by +/- this rpm amount the current ref will move at the Large Error rate.*	*	5	0	100	
Service	07 Always Enable Remote Ref *If True the control will always follow the remote reference setpoint*	*	FALSE			

Service: S22 START / LITEOFF SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Electric Liteoff? *Setting of the fuel metering valve for turbine lite-off, True=Electrical position (use min fuel setpoint below), False=Mechanical lite-off*	*	FALSE			
Service	02 Start Ramp Rate *Rate in percent/sec that the start ramp will increase the fuel valve demand between lite-off and speed control*	*	0.3	0.100006	100	
Service	03 Start Ramp Gas Min Fuel *Gas fuel valve % opening position for achieving turbine lite-off*	*	0	0	100	
Service	04 Start Ramp Liq Min Fuel *Liquid fuel valve % opening position for achieving turbine lite-off*	*	0	0	100	
Service	05 Manual Crank/Starter ON *Tune True to manually engage starter on turbine*	*	FALSE			

Service: S23 VALVE CALIB & STROKE

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 OK to Enter Cal Mode? *Is it safe to enter Calibration mode – No SD's, No start/run input AND either no speed or EGT is < 400 deg*		TRUE			
Service	02 Enable Calibration Mode *Tune True to enter Cal mode*	*	FALSE			
Service	03 Gas Fuel Metr VLV Stroke *Manual stroke of gas fuel valve*	*	0	0	100	
Service	04 Gas Fuel Act 1 Output *Actual Act 1 demand*		0			
Service	05 Act1 Type 0-20 / 0-200mA *Select type of Driver current range, 0=0-20 mA, 1= 0-200mA*	*	0	0	1	
Service	06 Act1 Type Chosen *Feedback of mode selected*		Current Output 0-20 mA			
Service	07 Act1 mA at 0% Dmnd *Setting of current mA value at min output demand*	*	4	-200	200	
Service	08 Readback of Min mA value for Act 1		4			
Service	09 Act1 mA at 100% Dmnd *Setting of current mA value at max output demand*	*	20	-200	200	
Service	10 Readback of Max mA value for Act 1		20			
Service	11 Act1 Offset *Output value adder to this output channel*	*	0	-200	200	
Service	12 Act1 Gain *Output value multiplier to this output channel*	*	1	0	2	
Service	13 Act1 Dither *Value of dither amplitude in mA. Dither is a +/- value superimposed over the demand signal to prevent valve sticking*	*	0	0	3	
Service	14 Liq Fuel Metr VLV Stroke *Manual stroke of liquid fuel valve*	*	0	0	100	
Service	15 Liquid Fuel Act 2 Output *Actual Act 2 demand*		0			
Service	16 Act2 Type 0-20 / 0-200mA *Select type of Driver current range, 0=0-20 mA, 1= 0-200mA*	*	0	0	1	
Service	17 Act2 Type Chosen *Feedback of mode selected*		Current Output 0-20 mA			
Service	18 Act2 mA at 0% Dmnd *Setting of current mA value at min output demand*	*	4	-200	200	
Service	19 Readback of Min mA value for Act 2		4			

Service	20 Act2 mA at 100% Dmnd *Setting of current mA value at max output demand*	*	20	-200	200	
Service	21 Readback of Max mA value for Act 2		20			
Service	22 Act2 Offset *Output value adder to this output channel*	*	0	-200	200	
Service	23 Act2 Gain *Output value multiplier to this output channel*	*	1	0	2	
Service	24 Act2 Dither *Value of dither amplitude in mA. Dither is a +/- value superimposed over the demand signal to prevent valve sticking*	*	0	0	3	
Service	25 Initiate Fuel XFER T=Liq Initiate a Fuel Transfer T=Go to Liquid, F=Go to Gas	*	FALSE			

Service: S24 PT SPEED CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 PT Prop Gain 1 *Proportional gain of PT speed PID – first dynamic setting*	*	0.2	0	100	
Service	02 PT Integral Gain 1 *Integral gain of PT speed PID – first dynamic setting*	*	1.5	0.01	50	
Service	03 PT SDR 1 *Speed Derivative ratio of PT speed PID – first dynamic setting*	*	0.2	0.01	100	
Service	04 Use Dual Dynamics *Tune True if different dynamic settings are required while unit is in Droop*	*	TRUE			
Service	05 PT Prop Gain 2 *Proportional gain of PT speed PID – second dynamic setting*	*	0.2	0	100	
Service	06 PT Integral Gain 2 *Integral gain of PT speed PID – second dynamic setting*	*	1.5	0.01	50	
Service	07 PT SDR 2 *Speed Derivative ratio of PT speed PID – second dynamic setting*	*	0.2	0.01	100	
Service	08 PT Low Limit *Feedback of PT lower limit – set in configure mode*		2250			
Service	09 PT High Limit *Feedback of PT upper limit – set in configure mode*		3780			
Service	10 PT Reference Default Rate *Default setting for PT reference ramp rate in rpm/sec*	*	2	0	1000	
Service	11 PT Reference Fast Rate *Fast rate setting for PT reference ramp rate in rpm/sec*	*	10	1	1000	
Service	12 Use PT Auto Override *Tune True to automatically override the low latch when no speed should be detected (use if GTC is controlling starter & start sequence)*	*	TRUE			
Service	13 Time to wait for Speed *Max time to wait for speed after starter has been engaged*		20			
Service	14 PT Speed Switch 1 *Speed switch value, switch output goes True when speed is > this*	*	1000	50	32768	
Service	15 PT Speed Switch 2 *Speed switch value, switch output goes True when speed is > this*	*	2000	50	32768	
Service	16 PT Speed Switch 3 *Speed switch value, switch output goes True when speed is > this*	*	3600	50	32768	

Service	17 PT Overspeed Test Enable *Tune True to enable an overspeed test – max time for testing is 5 min.* *This will allow the configured overspeed trip setpoint to be adjusted and PT ref upper limit will equal this value*	*	FALSE			
Service	18 PT OVRSPD bias (+/-100) *Value to be added to the configured overspeed trip setpoint*	*	0	-100	100	
Service	19 PT Speed Value *Feedback of current turbine speed*		100			
Service	20 PT Speed Setpoint *Feedback of current turbine speed setpoint*		2250			
Service	21 PT Control PID Output *Feedback of current PT speed PID output*		110			
Service	22 Raise PT Reference *Tune True to raise the PT reference*	*	FALSE			
Service	23 Lower PT Reference *Tune True to lower the PT reference*	*	FALSE			

Service: S25 CDP to Fuel Limit Curve

Category	Field Name	T	Initial Value	Low	High	User Value
	This curve must be set to protect the turbine from over acceleration / over fueling. The X inputs are to be set at CDP values (in psia) and the Y values should be fuel valve demand (in %) that corresponds to these points. Gas and Liquid curves exist					
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 =	*	100	0	1000	
Service	06 Gas CDP/WF CURVE Y3 =	*	25	0	100	
Service	07 Gas CDP/WF CURVE X4 =	*	200	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) *Feedback of current curve output*		-47.96			
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 =	*	100	0	1000	
Service	17 Liq CDP/WF CURVE Y3 =	*	25	0	100	
Service	18 Liq CDP/WF CURVE X4 =	*	200	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) *Feedback of current curve output*		-47.96			

Service: S26 ACCEL PID SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Accel PID? *Tune True to utilize the Acceleration PID limiter. The X inputs are PT Speed values in (rpm) and the Y output values is the max rate of PT speed increase (in rpm/sec)*	*	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 =	*	3000	1000	20000	
Service	08 Accel Ref Curv Y2 =	*	75	10	2000	
Service	09 Accel Ref Curv X3 =	*	3200	1000	20000	
Service	10 Accel Ref Curv Y3 =	*	500	10	2000	
Service	11 Accel Ref Curv X4 =	*	3600	1000	20000	
Service	12 Accel Ref Curv Y4 =		500	100	2000	
Service	13 Accel Ref Curv X5 =	*	3650	1000	20000	
Service	14 Accel Ref Curv Y5 =	*	750	100	2000	
Service	15 Accel Ref Curv X6 =	*	3650	1000	20000	
Service	16 Accel Ref Curv Y6 =	*	750	100	2000	
Service	17 SPD ACCEL Value		0			
Service	18 SPD ACCEL Setpoint		75			
Service	19 ACCEL Control PID Output		-47.975			
Service	20 ACCEL Prop Gain Sub-Idle	*	0.044	0.001	1	

Service: S27 DECEL Curve (CDP) SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Decel (CDP) Curve? *Tune True to utilize the Deceleration curve limiter. The X inputs are CDP values in (psia) and the Y output values are the fuel valve % demand*	*	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 =	*	0	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)		0			
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 =	*	0	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)		0			

Service: S28 CDP CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 CDP Control Setpoint *CDP control setpoint for PID in psia*	*	180	20	500	
Service	02 CDP PID Proportional Gn *Proportional gain of CDP PID*	*	0.25	0.001	100	
Service	03 CDP PID Integral Gain *Integral gain of CDP PID*	*	2	0	50	
Service	04 CDP PID SDR term *Speed derivative ratio of CDP PID*	*	100	0.01	100	
Service	05 Use Corrected CDP Setpt *Tune True to bias the CDP setpoint based on the ambient inlet temp*	*	FALSE			
Service	06 Turbine CDP (psia) *Feedback of current CDP value*		-74.69			
Service	07 CDP Control PID *Feedback of current CDP PID output*		110			
Service	08 CDP Overpressur Setpoint *CDP setpoint (in psia) for a CDP overpressure alarm or shutdown*	*	190	50	500	

Service: S29 EGT CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 EGT Contrl Base Setpoint *EGT control setpoint for PID (deg F)*	*	1400	100	2500	
Service	02 EGT Control Peak Setpoint *EGT control setpoint for PID (deg F)*	*	1400	100	2500	
Service	03 EGT PID Proportional Gn *Proportional gain of EGT PID*	*	0.1	0.001	100	
Service	04 EGT PID Integral Gain *Integral gain of EGT PID*	*	2	0	50	
Service	05 EGT PID SDR term *Speed derivative ratio of EGT PID*	*	100	0.01	100	
Service	06 Use Temp Start Ramp *Tune True to use Temp limiter during a start*	*	FALSE			
Service	07 Temp Ramp Lo Temp *Initial (low) value of EGT temp start ramp in deg F*	*	1575	100	2000	
Service	08 Temp Ramp Hi Temp *Final (high) value of EGT temp start ramp in deg F*	*	1575	100	2000	
Service	09 Temp Ramp Rise Rate *Rate at which the EGT setpoint will increase between these 2 points*	*	10	1	100	
Service	10 EGT Average Temp *Feedback of current EGT temp*		-499.07			
Service	11 EGT Control Setpoint *Displays current EGT Setpoint (Base or Peak)*					
Service	12 EGT Control PID Output *Current output value of EGT PID*		110			

Service: S30 REAL LOAD CONTROL SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Confirm KW Sensr Range *Feedback of rated KW value set in configure mode*		10000			
Service	02 Droop Percent *Percent of Droop when running against a load grid*	*	5	0.01	8	
Service	03 Min Load KW Setpoint *Minimum load setpoint (in KW) – value unit goes to upon bus breaker closure*	*	500	10	30000	
Service	04 Base Load KW Setpoint *Load setpoint to ramp to when base load is selected*	*	9000	10	30000	
Service	05 Use Remote KW Setpoint *Tune True to use a remote KW setpoint*	*	FALSE			

Service	06 Auto Loading Rate (sec) *Time (sec) to load from min load level to base load level – calculates a rate that goes to PT Ref ramp*	*	60	1	7200	
Service	07 Normal Unload Rate *Time (sec) to unload from base load level to min load level – calculates a rate that goes to PT Ref ramp*	*	60	1	7200	
Service	08 Low Load / Open Brkr Lvl *Open Breaker load point on normal stop – feedback of min load setpoint*		500			
Service	09 Low Load Alarm Level *Setpoint for a low load event trigger (in kw)*	*	5	0	30000	
Service	10 High Load Alarm Level *Setpoint for a high load event trigger (in kW)*	*	300	0	30000	
Service	11 Use Load Limiter (=2) *Tune to 2 to enable Load limiter PID*	*	1	1	2	
Service	12 Load PID Prop Gain *Proportional gain of KWLIM PID*	*	0.1	0.001	100	
Service	13 Load PID Integral Gain *Integral gain of KWLIM PID*	*	2	0	50	
Service	14 Load PID Output Value *Current output value of KWLIM PID*		9.36			
Service	15 Enable LS Functions *Tune True to enable load sharing functions (done via the LON link)*	*	TRUE			
Service	16 Utility Breaker Open? *Feedback of utility breaker status*		FALSE			
Service	17 XFER Rate IN/OUT of LS *Rate at which unit will ramp into or out of load sharing mode*	*	10	0.10	60	
Service	18 Number of Network Nodes *Feedback of number of nodes the LON comm. Link sees on network*		1			
Service	19 Number of Nodes in LS *Feedback of number of nodes the LON comm. Link sees actively sharing load on network*		0			

Service: S31 PowerSense SETUP

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 GEN Phase A Cur Gain *Gain multiplier on generator phase A current*	*	1	0.5	1.5	
Service	02 GEN Phase B Cur Gain *Gain multiplier on generator phase B current*	*	1	0.5	1.5	
Service	03 GEN Phase C Cur Gain *Gain multiplier on generator phase C current*	*	1	0.5	1.5	
Service	04 GEN Phase A Volt Gain *Gain multiplier on generator phase A voltage*	*	1	0.5	1.5	
Service	05 GEN Phase B Volt Gain *Gain multiplier on generator phase B voltage*	*	1	0.5	1.5	
Service	06 GEN Phase C Volt Gain *Gain multiplier on generator phase C voltage*	*	1	0.5	1.5	
Service	07 GEN PT Avg Volts *Feedback of generator average PT voltage signal (all phases)*		0			
Service	08 Voltage Units *Units for above value (V or KV)*		VOLTS			
Service	09 GEN CT Avg Amps *Feedback of generator average CT current signal (all phases)*		0			
Service	10 Current Units *Units for above value*		AMPS			
Service	11 Mains Phase A Cur Gain *Gain multiplier on mains phase A current*	*	1	0.5	1.5	
Service	12 Mains Phase B Cur Gain *Gain multiplier on mains phase B current*	*	1	0.5	1.5	
Service	13 Mains Phase C Cur Gain *Gain multiplier on mains phase C current*	*	1	0.5	1.5	

Service	14 Mains Phase A Volt Gain *Gain multiplier on mains phase A voltage*	*	1	0.5	1.5	
Service	15 Mains Phase B Volt Gain *Gain multiplier on mains phase B voltage*	*	1	0.5	1.5	
Service	16 Mains Phase C Volt Gain *Gain multiplier on mains phase C voltage*	*	1	0.5	1.5	
Service	17 BUS PT Avg Volts *Feedback of mains average PT voltage signal (all phases)*		0			
Service	18 Voltage Units *Units for above value (V or KV)*		VOLTS			
Service	19 BUS CT Avg Amps *Feedback of mains average CT current signal (all phases)*		0			
Service	20 Current Units *Units for above value*		AMPS			

Service: S32 SYNCHRONIZER

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 SYNC MODE *Synchronizer mode 1=Off, 2=Check, 3=Permissive, 4=Run/Auto*	*	4	1	4	
Service	02 SYNC MODE *Feedback of mode selected*		RUN/AUTO			
Service	03 SYNC GAIN *Value of the proportional gain in the P-I sync controller*	*	0.15	0.001	100	
Service	04 SYNC INTEGRAL *Value of the integral gain in the P-I sync controller*	*	0.56	0.01	100	
Service	05 VOLTAGE RAMP TIME *Time (sec) for the voltage bias output to ramp from min to max*	*	300	1	600	
Service	06 SYNCHROSCOPE *Feedback of the Synchroscope output value*		180			
Service	07 VOLTAGE MATCHING *Tune True to enable voltage matching function*	*	TRUE			
Service	08 VOLTAGE MATCHING *Feedback of mode selected*		ENABLED			
Service	09 VOLTAGE WINDOW *Value (in %) of the allowable deviation (+/-) of the gen voltage compared to the bus voltage to allow a breaker closure at sync time*	*	1	0.1	10	
Service	10 SYNC TYPE *Selects the type of synchronization 1=Phase Matching, 2=Slip Frequency, 3=Off/None*	*	TRUE			
Service	11 SYNC TYPE *Feedback of mode selected*		PHASE CONTROL			
Service	12 PHASE WINDOW *Value is the max allowable electrical phase angle between the bus and generator when the synchronizer initiates breaker closure (in deg)*	*	10	2	20	
Service	13 SLIP WINDOW *Value is the max allowed frequency difference (slip) from the slip frequency reference when initiating breaker closure*	*	0.1	-0.3	0.30	
Service	14 SLIP FREQUENCY *Value (Hz) that the gen freq will be above the bus freq at time of sync*	*	0.1	-0.3	0.30	
Service	15 CLOSE ATTEMPTS *Number of attempts synchronizer will make at closing the breaker. If this is exceeded, sync=off and alarm is triggered*	*	3	0	20	
Service	16 RECLOSE DELAY *Delay (sec) between attempts to close the breaker*	*	5	1	1200	
Service	17 AUTO RESYNCHRONIZE *True to allow sync to automatically switch to mode selected when the breaker opens*	*	TRUE			

Service	18 AUTO RESYNCHRONIZE *Feedback of mode selected*		ENABLED			
Service	19 CIRCUIT BREAKER TYPE *True if device is a breaker, closed command will go true for the Breaker Hold Time, tune False for a contact device, closed command is held true until a breaker open cmd is issued*	*	TRUE			
Service	20 CIRCUIT BREAKER TYPE *Feedback of mode selected*		BREAKER			
Service	21 SYNCH TIMEOUT *Time (sec) during which the unit will attempt to get synchronization (value of 0 disables this function)*	*	0	0	1200	
Service	22 DEADBUS CLOSURE *True allows the unit to close the breaker to a dead bus (voltage<min)*	*	TRUE			
Service	23 DEADBUS CLOSURE *Feedback of mode selected*		ENABLED			
Service	24 BREAKER HOLD TIME *Time (sec) duration for the breaker close command to be issued*	*	1	0	5	
Service	25 BKR CLOSE DLY TIME *Time (sec) for the breaker contacts to engage after closure*	*	0.1	0.01	2	
Service	26 ENABLE SYNC TEST *True enables 'check' mode with phase and voltages verified, but no breaker commands will be issued*	*	FALSE			
Service	27 ENABLE SYNC TEST *Feedback of mode selected*		DISABLED			
Service	28 SLIP WITHIN LIMITS *Status feedback*		FALSE			
Service	29 PHASE WITHIN LIMITS *Status feedback*		FALSE			
Service	30 VOLTAGE WITHIN LIMITS *Status feedback*		FALSE			
Service	31 RECLOSE ATTEMPTS *Status feedback*		0			
Service	32 SYNC TIMEOUT REMAINING *Status feedback*		0			
Service	33 SYNC STATE *Status feedback*		DISABLED			
Service	34 SYNC MODE *Status feedback of mode selected*		DISABLED			
Service	35 GEN STABILIZE TIME DELAY *Time (sec) for unit to stabilize at rated speed prior to attempting breaker closure*	*	30	1	30000	
Service	36 OPEN GEN BREAKER CMD *Tune True to issue a Manual Open Breaker Command*	*	FALSE			

Service: S33 REACTIVE LOAD CONTROL

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Select VAR/PF Mode *Select mode, 0=Disabled, 1=VAR control, 2= Power Factor mode*	*	0	0	2	
Service	02 Mode Selected *Status feedback of mode selected*		Disabled			
Service	03 VARPF GAIN *Voltage control proportional gain*	*	0.2	0.01	20	
Service	04 VOLTAGE RAMP TIME *Time (sec) for voltage reference ramp to go from min to max value*	*	20	0	1000	
Service	05 PF SHARE GAIN *Power factor proportional gain*	*	0.2	0.001	20	
Service	06 VARPF INTEGRAL GN *VAR or PF integral gain*	*	0.1	0	20	
Service	07 VAR/PF PID Output *Feedback of PID output value*		0			

Service	08 INITIAL VAR REFERENCE *Initial VAR reference setpoint*	*	10	-30000	30000	
Service	09 VAR REFERENCE *Status feedback*		0			
Service	10 GEN TOTAL VAR *Status feedback*		0			
Service	11 INITIAL PF REFERENCE *Initial PF reference setpoint*	*	0	-0.5	0.5	
Service	12 PF REFERENCE *Status feedback*		1			
Service	13 PF REF DIRECTION *Status feedback*		Lag			
Service	14 PF DEADBAND *Value of error window around the setpoint (+/-) in which the PF control will not adjust the voltage regulator*	*	0.02	0	1	
Service	15 GEN AVERAGE PF *Status feedback*		1			
Service	16 PF ACTUAL DIRECTION *Status feedback*		Lag			
Service	17 OPERATING VOLTAGE *Value of the units rated voltage, the voltage trim feature will use this as the target value in isolated mode*	*	480	0.001	30000	
Service	18 ENABLE VAR/PF CNTRL *Tune True to enable VAR/PF control mode (use this OR discrete input)*	*	FALSE			
Service	19 VAR/PF CNTRL STATUS *Status feedback*		VAR/PF Disabled			
Service	20 LOWER SETPT *Manually lower the VAR/PF setpoint*	*	FALSE			
Service	21 RAISE SETPT *Manually raise the VAR/PF setpoint*	*	FALSE			
Service	22 VOLTAGE BIAS OUTPUT *Status feedback*		0			
Service	23 KVA Switch Hi Level *Value (kVA) for high KVA alarm*	*	30	0	30000	
Service	24 KVA Switch Lo Level *Value (kVA) for low KVA alarm*	*	5	0	30000	
Service	25 Use Voltage Trim? *True to enable voltage trim feature*	*	FALSE			

Service: S34 PROCESS CONTROL

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 PROCESS GAIN *Proportional gain for process PID*	*	0.05	0.001	20	
Service	02 PROCESS INTEGRAL GN *Integral gain for process PID*	*	0.3	0	20	
Service	03 PROCESS DERIVATIVE *Derivative gain for process PID*	*	100	0.01	100	
Service	04 PROCESS PID OUTPUT *Actual Process PID output value*		0			
Service	05 PROCESS DEADBAND *Error window (+/-) around the setpoint within which the PID will not respond to*	*	0	-30000	30000	
Service	06 PROCESS DROOP *Value of droop desired for process signal, only use on very slow signals*	*	0	0	50	
Service	07 PROCESS FILTER *Value (Hz) of the bandwidth of low pass filter for process controller. Higher settings = faster response but less immunity to noise*	*	1	0.01	10	
Service	08 PROCESS SETPOINT *Process control setpoint*	*	0	-30000	30000	
Service	09 ENABLE MODBUS SETPT *True enables the process setpoint to be entered via a Modbus*	*	FALSE			
Service	10 MODBUS REF VALUE *Status feedback*		0			

Service	11 ENABLE REM ANALOG SET *True to enable process setpoint to come in via an analog input*	*	FALSE			
Service	12 PROCESS REF VALUE *Status feedback*		0			
Service	13 PROCESS INPUT VALUE *Status feedback*		-24.8			
Service	14 ENABLE PROC CNTRL *True to enable process control – this is OR with discrete input*	*	FALSE			
Service	15 PROCESS PERMS MET? *Status feedback*		FALSE			
Service	16 PROCESS CNTRL ON? *Status feedback*		FALSE			
Service	17 ENABLE DISCRETE INS *True enables discrete inputs to raise/lower setpoint, False lets analog value to control setpoint*	*	FALSE			
Service	18 LOWER PROCESS SETPT *Lowers the process setpoint*	*	FALSE			
Service	19 RAISE PROCESS SETPT *Raises the process setpoint*	*	FALSE			
Service	20 Direct Proc (F=Indirect) *True = direct relation between load and process (raising load = raising process value)*	*	TRUE			
Service	21 Process Load Rate *Value of process reference rate of change – picking up load (%/sec)*	*	0.5	0	10	
Service	22 Process Unload Rate *Value of process reference rate of change – shedding load (%/sec)*	*	0.5	0	10	
Service	23 This Unit is Proc Master *True to declare this unit as the master in a multi-unit system (LON)*	*	TRUE			

Service: S35 GENERATOR PROTECTION 1

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 GEN Over Volt Alm Level *Gen over voltage alarm level*	*	700	0	30000	
Service	02 GEN Under Volt Alm Level *Gen under voltage alarm level*	*	300	0	30000	
Service	03 GEN Over/Under Vlt Delay *Delay (sec) that unit must be over or under voltage to trigger the alarm*	*	10	0.10	120	
Service	04 GEN Phas OverCur AlmLvl *Gen phase over current alarm level*	*	1500	0	3000	
Service	05 GENPhas OverCur CurvShft *This value level shifts the inverse time curve defined by IEEE and IEC*	*	1	0.01	10	
Service	06 GEN Over Freq Alm Level *Gen over frequency alarm level*	*	70	40	70	
Service	07 GEN Under Freq Alm Level *Gen under frequency alarm level*	*	40	40	70	
Service	08 GEN Over/Undr Freq Delay *Delay (sec) that unit must be over or under frequency to trigger the alarm*	*	10	0.10	120	
Service	09 GEN Over Power Alm Level *Gen over power alarm level*	*	11000	-30000	30000	
Service	10 GEN Reverse Powr Alm Lvl *Gen under (reverse) power alarm level*	*	-50	-30000	30000	
Service	11 GEN Direct Pwr Curv Shft *This value level shifts the inverse time curve defined by IEEE and IEC*	*	1	0.01	10	
Service	12 GEN Over VAR Alm Level *Gen over VAR alarm level*	*	1500	-30000	30000	
Service	13 GEN Reverse VAR Alm Lvl *Gen under VAR alarm level*	*	-50	-30000	30000	
Service	14 GEN Direct VAR Alm Delay *Delay (sec) that unit must be over or under VARs to trigger the alarm*	*	10	0.10	120	

Service	15 GEN NegPhzSeq OvrVlt Lvl *Value (volts) of negative phase sequence over voltage alarm level*	*	150	0	30000	
Service	16 GEN NegPhzSeq OvrVlt Dly *Delay (sec) that the unit must be over the negative phase seq voltage level to trigger the alarm*	*	10	0.10	120	
Service	17 GEN NegPhzSeq OvrCur Lvl *Value (amps) of negative phase sequence over current alarm level*	*	150	0	30000	
Service	18 GEN NegPhzSeq OvrCur Dly *Delay (sec) that the unit must be over the negative phase seq current level to trigger the alarm*	*	10	0.10	120	
Service	19 GEN PhasCur Diff Alm Lvl *Value (amps) of phase current differential current alarm level*	*	150	0	30000	
Service	20 GEN PhasCurDiff CurvShft *This value level shifts the inverse time curve defined by IEEE and IEC*	*	1	0.01	10	

Service: S36 GENERATOR PROTECTION 2

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 GEN Over Volt Warn Level *Gen over voltage warning level*	*	700	0	30000	
Service	02 GEN Under Volt Warn Levl *Gen under voltage warning level*	*	300	0	30000	
Service	03 GEN Over/Under Vlt Delay *Delay (sec) that unit must be over or under voltage to trigger the warning*	*	10	0.10	120	
Service	04 GEN Phas OverCur WarnLvl *Gen phase over current warning level*	*	1500	0	3000	
Service	05 GEN Over Freq Warn Level *Gen over frequency warning level*	*	70	40	70	
Service	06 GEN Under Freq Warn Levl *Gen under frequency warning level*	*	40	40	70	
Service	07 GEN Over/Undr Freq Delay *Delay (sec) that unit must be over or under frequency to trigger warning*	*	10	0.10	120	
Service	08 GEN Over Power Warn Levl *Gen over power warning level*	*	11000	-30000	30000	
Service	09 GEN Revers Powr Warn Lvl *Gen under power warning level*	*	-50	-30000	30000	
Service	10 GEN Over VAR Warn Level *Gen over VAR warning level*	*	1500	-30000	30000	
Service	11 GEN Reverse VAR Warn Lvl *Gen under VAR warning level*	*	-50	-30000	30000	
Service	12 GEN Direct VAR Warn Dely *Delay (sec) that unit must be over or under VAR to trigger warning*	*	10	0.10	120	
Service	13 GEN NegPhzSeq OvrVlt Lvl *Value (volts) of negative phase sequence over voltage warning level*	*	150	0	30000	
Service	14 GEN NegPhzSeq OvrVlt Dly *Delay (sec) that unit must be over neg. phase seq voltage to trigger warning*	*	10	0.10	120	
Service	15 GEN NegPhzSeq OvrCur Lvl *Value (volts) of negative phase sequence over voltage warning level*	*	150	0	30000	
Service	16 GEN NegPhzSeq OvrCur Dly *Delay (sec) that unit must be over neg. phase seq current to trigger warning*	*	10	0.10	120	
Service	17 GEN PhasCur Dif Warn Lvl *Value (amps) of phase current differential current warning level*	*	150	0	30000	

Service: S37 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
	Each of the events programmed are listed below with their corresponding alarm # - each can be set to trigger the following actions: = *Disabled* = *Alarm Condition* = *Soft Shutdown (open Brkr)* = *Hard Shutdown (Fuel off)* = *Reserved TBD (no action)*					
Service	01 Atlas HW/OpSys Fault	*	4	1	5	
Service	02 Atlas Input Power Alm	*	2	1	5	
Service	03 Atlas H/W High Temp	*	2	1	5	
Service	04 Control is NOT Configured	*	4	1	5	
Service	05 Serial Port #1 Fault	*	2	1	5	
Service	06 Serial Port #2 Fault	*	1	1	5	
Service	07 Distributed I/O Fault	*	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		2			
Service	11 Analog Input #2 Failed		2			
Service	12 Analog Input #3 Failed		4			
Service	13 Analog Input #4 Failed		2			
Service	14 Analog Input #5 Failed		2			
Service	15 Analog Input #6 Failed		4			
Service	16 Alms 16-39 are Configured		in DI Setup Menus			
Service	40 AI Configuration Error	*	2	1	5	

Service: S38 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
Service	41 Not Used	*	1	1	5	
Service	42 Not Used	*	1	1	5	
Service	43 Not Used	*	1	1	5	
Service	44 Not Used	*	1	1	5	
Service	45 Not Used	*	1	1	5	
Service	46 Not Used	*	1	1	5	
Service	47 Not Used	*	1	1	5	
Service	48 Not Used	*	1	1	5	
Service	49 Not Used	*	1	1	5	
Service	50 PT Overspeed Alm Level	*	2	1	5	
Service	51 PT Spd Signal Diff	*	2	1	5	
Service	52 PT Overspeed SD Level		4			
Service	53 All PT Spd Sig Failed		4			
Service	54 PT Overspeed Test Enabld	*	2	1	5	
Service	55 EGT Overtemp SD Level		4			
Service	56 EGT Signl Low -post OVRD	*	1	1	5	
Service	57 EGT Overtemp ALM Level	*	2	1	5	
Service	58 CDP Over High Press Levl	*	4	1	5	
Service	59 Gas Fuel Drivr Flt (Alt)	*	2	1	5	
Service	60 Liq Fuel Drivr Flt (Alt)	*	2	1	5	

Service: S39 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 PT Idle	*	4	1	5	
Service	68 Fail to Reach PT Rated	*	4	1	5	
Service	69 Start Cmd Lost whil Run	*	4	1	5	
Service	60 NStop Cmplt-Turnoff Strt	*	2	1	5	
Service	71 Alternate Temp (TIT) Signal Failed	*	1	1	5	
Service	72 Running OTEMP Alarm (CTIT)	*	1	1	5	
Service	73 Starting OTEMP Alarm (CTIT)	*	1	1	5	
Service	74 Running OTEMP Shutdown (CTIT)	*	1	1	5	
Service	75 Starting OTEMP Shutdown (CTIT)	*	1	1	5	
Service	76 Not Used	*	1	1	5	
Service	77 Not Used	*	1	1	5	
Service	78 Not Used	*	1	1	5	
Service	79 Not Used	*	1	1	5	
Service	80 Not Used	*	1	1	5	
Service	81 Not Used	*	1	1	5	
Service	82 Not Used	*	1	1	5	
Service	83 Not Used	*	1	1	5	
Service	84 Not Used	*	1	1	5	
Service	85 Not Used	*	1	1	5	

Service: S40 ALM/SD Events

Category	Field Name	T	Initial Value	Low	High	User Value
Service	86 Not Used	*	1	1	5	
Service	87 Not Used	*	1	1	5	
Service	88 Not Used	*	1	1	5	
Service	89 Not Used	*	1	1	5	
Service	90 Not Used	*	1	1	5	
Service	91 Not Used	*	1	1	5	
Service	92 Not Used	*	1	1	5	
Service	93 Not Used	*	1	1	5	
Service	94 Not Used	*	1	1	5	
Service	95 Not Used	*	1	1	5	
Service	96 Not Used	*	1	1	5	
Service	97 Not Used	*	1	1	5	
Service	98 Not Used	*	1	1	5	
Service	99 Not Used	*	1	1	5	
Service	100 Following Alarm 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: S41 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	*	2	1	5	
Service	131 Process Value Low Alm	*	1	1	5	
Service	132 Unit Fail to Synchronize	*	1	1	5	
Service	133 Voltage Bias Range Alm	*	2	1	5	
Service	134 High Load Alarm Level	*	1	1	5	
Service	135 Low Load Alarm Level	*	2	1	5	

Service: S42 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 Customer Event on AI 01	*	1	1	5	
Service	142 Customer Event on AI 02	*	1	1	5	
Service	143 Customer Event on AI 03	*	1	1	5	
Service	144 Customer Event on AI 04	*	1	1	5	
Service	145 Customer Event on AI 05	*	1	1	5	
Service	146 Customer Event on AI 06	*	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: S43 START/STOP SEQUENCE

Category	Field Name	T	Initial Value	Low	High	User Value
Service	01 Use Auto Start/Stop SEQ? *True to use the programmed start sequence, False = done externally*	*	TRUE			
Service	02 Use Fuel SOV/IGN Output? *True to use GTC outputs for the fuel shutoff valves & ignitors, False = done externally*	*	TRUE			
Service	03 Min Starter Crank Speed *Speed (rpm)that control must see to acknowledge that the starter is running*	*	1000	100	2000	
Service	04 Time to wait for Speed *Delay (sec) to wait for this speed before triggering an alarm*	*	20	0	120	
Service	05 Purge Timer/Crank Time? *Time (sec) to run on the starter at crank speed before attempting to 'lite-off' the turbine*	*	30	0	3000	
Service	06 Wait for Liteoff Tmr Gas *Time (sec) to wait for lite-off indication after ignition – on gas fuel*	*	10	2	30	
Service	07 Wait for Liteoff Tmr Liq *Time (sec) to wait for lite-off indication after ignition – on liq fuel*	*	15	2	30	
Service	08 Starter Cutout Speed *Speed at which to disengage starter*	*	2000	100	5000	
Service	09 Ignitor OFF Speed *Speed at which Ignitors turn OFF*	*	2400	100	10000	
Service	10 Max Time to PT Idle *Max time (sec) it should take for turbine to reach PT Idle speed*	*	60	5	600	
Service	11 Warmup Time at Idle *Time (sec) to stay at Idle speed before ramping to rated speed*	*	30	2	600	
Service	12 Raise PTRef at FastRate? *True to ramp from Idle to Rated at the fast rate, False = default rate*	*	TRUE			
Service	13 Fast Rate to PT Rated *Value (rpm/sec) of ramp rate from Idle speed to rated speed*	*	50	2	1000	
Service	14 Max Time to PT Rated *Max time (sec) it should take for turbine to reach PT Rated speed from PT Idle speed*	*	60	5	600	
Service	15 Cooldown Time/Idle *Time (sec) to stay at Idle speed before chopping fuel after normal stop command has been issued*	*	10	0	1800	

Service: S44 TURBINE PARAMETERS

Category	Field Name	T	Initial Value	Low	High	User Value
	This is a status list of the current value of many turbine parameters. The last 2 fields provide one shot acknowledge/reset inputs					
Service	01 Alarm Latch Status		TRUE			
Service	02 Alarm Condition #		5			
Service	03 Shutdown Latch Status		TRUE			
Service	04 Shutdown Condition #		12			
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)		2250			
Service	11 EGT Temp (deg F)		-499.16			
Service	12 Amb Inlet Temp (deg F)		-84.78			
Service	13 CDP (psia)		-74.73			
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 high or low
- Relay outputs – NO or NC, contact load ratings
- MPU Speed sensor specifications (# of teeth, gear ratio, hi/lo fail spds)
- PowerSense module info PT/CT ratios, rated voltage, frequency
- Fuel Actuator/Valve drivers – mA range (need SPC?), PPH flow vs. Valve Pos.
- Operator Interface – size, location, desired functionality
- Communication Links to other devices – signal type, protocols
- Termination wiring details (existing & upgrades)

Control Limits

- EGT topping temperature limit
- CDP topping pressure limit
- PT Speed – upper limit (Alm & SD), Ref limits (high & low)
- Any Required Acceleration or Deceleration Schedules
- Load Control functions utilized (or desired in the upgrade)

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
- Fuel Flow information
- Any EGT Start overtemp limit
- Time from Lite-off to PT Idle Speed
- Time from PT Idle to PT Rated speed

Running Information

- How do they typically operate the unit (Peak, Baseload, Process…)
- Gathering the following info will greatly simplify GTC control configuration

Data Point	CDP (psia)	EGT (deg F)	PT Speed Ref.	Fuel Valve (%)	Fuel Flow
@ PT Idle					
@ PT Rated					
@ 10% Load					
@ 25% Load					
@ 50% Load					
@ 75% Load					
@ 100% Load					

We appreciate your comments about the content of our publications.

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