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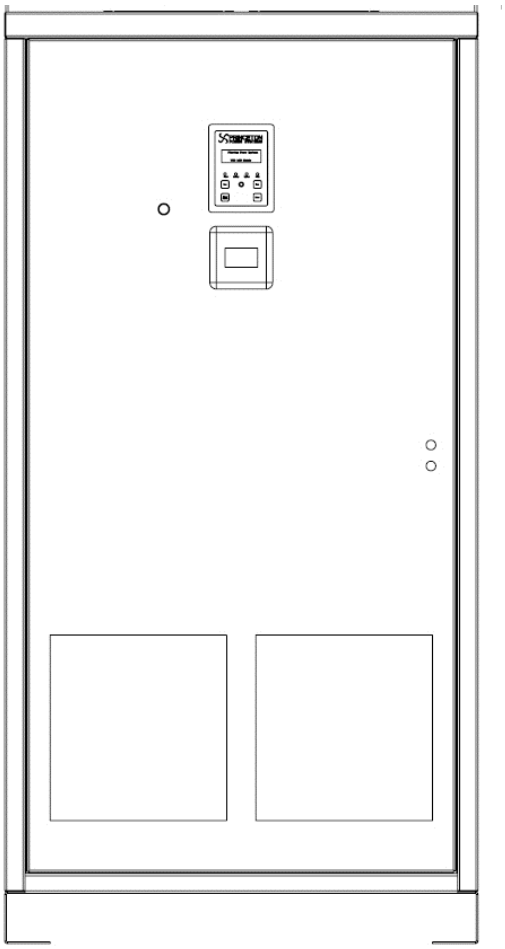

GTIB 480-100 Grid-Tied Inverter for Solar, Wind, Battery Backup

480VAC Output

User Reference Manual

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Utilization for Intended Purpose Only:

The Princeton Power GTIB 480-100 may only be used for jobs as defined by the “intended purpose”. Utilization for any other purpose, or in any other manner, shall be deemed "not in accordance with the intended purpose". The manufacturer shall not be liable for any damage resulting from such improper use.

Utilization in accordance with the “intended purpose” also comprises

- Thorough reading of and compliance with all the instructions, safety instructions and warnings given in this manual
- Performing all stipulated inspection and servicing work
- Installation in accordance with the instruction manual

Where appropriate, the following guidelines should also be applied:

- Regulations of the power supply company for input to the grid
- Information provided by the manufacturer of the solar modules or batteries

0 Introduction

Congratulations on purchasing one of the most advanced inverters in the world, from one of the leading power electronics companies in the world. The GTIB 480-100 Grid-Tied Inverter meets Underwriter's Labs' standard 1741 to allow power export to the North American electric grid. It can also power loads directly in "off-grid" mode, and automatically transfer to off-grid mode when the electric grid goes down. It can even power variable loads like large motors to maximize efficiency and control. It is compatible with multiple input sources, including solar arrays with advanced maximum power point tracking (MPPT), battery banks, and DC generators including wind turbines.

The GTIB 480-100 is highly reliable, efficient, and flexible. It is backed by a world-class team of engineers at Princeton Power Systems that can ensure the technical and financial success of your application.

0.1 PPS Company Info

Princeton Power Systems designs and manufactures advanced power conversion products and systems to provide customers with cost-effective, reliable, smart distributed generation. Our patented technologies, including AC-link™, produce clean electric power simply and efficiently, and our capable and flexible engineering team works closely with our customers to solve their problems. Customer solutions include grid-integrated distributed generation, renewable energy, energy storage, and military power supplies for Navy and Army applications.

0.2 About this manual

0.2.1 Purpose:

The purpose of this manual is to provide explanations and guidance for the installation, operation, and maintenance of the GTIB 480-100 Grid-Tied Inverter.

0.2.2 How to Use This Manual:

Consult the main table of contents to determine which section contains the desired information. Navigate to the appropriate section and consult the section index to find the particular topic you are seeking. The Manual provides important safety information and procedures for installing and operating the Inverter. This manual does not provide detailed instructions about the photovoltaic (PV), battery, or other systems

that may be connected to the Inverter. Consult the equipment manufacturer for information on these components. This manual must be kept at the inverter location at all times. In addition, it is important to comply with both the generally applicable and local accident prevention and environmental protection regulations.

0.2.3 Audience:

This Manual is intended for a professional electrician or technician for the purposes of installing, commissioning, and operating the GTIB 480-100 Grid-tied Inverter. All personnel using this manual should be trained and certified and be familiar with all local and national electrical and construction codes relating to the installation of this equipment.
All persons involved in any way with starting up, servicing and maintaining the equipment must:

- Read this instruction manual thoroughly and follow the instructions to the letter
- Be suitably qualified, and
- Have good knowledge of dealing with electrical installations

This equipment has been manufactured in accordance with the state of the art and general safety-engineering principles. Nevertheless, incorrect operation or misuse may still endanger:

- The life and well-being of the operator or of third parties,
- The equipment and other tangible assets belonging to the owner/operator,
- Working efficiency of the equipment.

All the safety instructions and warning signs on the machine itself:

- must be kept in a legible condition
- must not be damaged
- must not be removed or moved such that they alter the intent of the warning
- must not be covered, pasted or painted over

Any malfunctions that might impair the safe operation of the inverter must be remedied immediately, before the equipment is switched on.

1 Important Safety Instructions

SAVE THESE INSTRUCTIONS– This manual contains important instructions for the GTIB 480-100 that shall be followed during installation and maintenance of the inverter.

1.1 Important User Information

1.1.1 Symbols

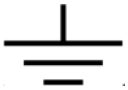
The following is a list of symbols used in this manual and on labels in the GTIB 480-100:


DC circuit


AC circuit


Phase indicator


Protective earth ground.


Other grounding conductor

1.1.2 Abbreviations and Definitions

GFDI	Ground Fault Detector and Interrupter
NEC	National Electric Code
ESD	Electro-Static Discharge
MPPT	Maximum Power Point Tracking
WebUI	Web-based user interface
PV	Photovoltaic
THD	Total Harmonic Distortion

1.1.3 Model Number Explanation

The GTIB 480-100 has five optional features that may be included in the system. The system model number contains a letter indicating system that indicates which optional features are installed on a particular unit.

The model number has the following format:

GTIB 480-100- XPGF

Up to five letter indicators can be appended in the five spaces shown, each letter indicating that a particular option is installed.

The 5 possible system options and their associated letter indicators are the following:

X	Configured for installation with isolation transformer
P	Configured for multiple parallel unit installation
G	Ground fault detector/interrupter module installed*
M	Integrated revenue-grade power meter installed
F	Integrated 350A DC circuit protection fuse installed**
D	VDC Power Supply for Dark Start (280DC MIN)

* The GFDI option can only be installed when the system is installed with an isolation transformer.
** DC port circuit protection is required for non-solar DC inputs, the integrated 350A fuse may serve as this protection or external circuit protection with a maximum rating of 350A may be installed. If the DC source requires circuit protection, the user is responsible for installing appropriate circuit protection. The 350A fuse option is for the protection of the GTIB 480-100, and may not provide appropriate protection for the DC source.

Model # examples:

Model #	Explanation
GTIB 480-100	Baseline system with no options – system is intended for single-unit use without an isolation transformer, without a GFDI, without an integrated power meter, and will require external DC circuit protection to be installed if used with a battery.
GTIB 480-100- XGM	System is configured for installation with an isolation transformer and it includes an integrated GFDI and revenue-grade power meter. It will require external DC protection to be installed if used with a battery. This configuration is typical for solar power installations. (external DC circuit protection is not required for solar installations)
GTIB 480-100- PF	System is configured for parallel installation alongside one or more units. Each system in the parallel group would have the "P" letter indicator in the model number. This system also has the 350A fuse option installed. This configuration is typical for battery installation systems over 100kW in capacity.

Note: The above are only three examples, other option combinations are possible.

1.2 Warning Symbols used in this manual

Attention: This symbol identifies information about circumstances or practices that could lead to personal injury, death, internal component damage, reduced product life, equipment damage, economic loss, or other adverse effects.

Shock Hazard: This symbol identifies information about a condition or procedure that could be potentially lethal or harmful to personnel or damaging to components due to live voltages within the system, components holding stored energy, or electrostatic discharge (ESD).

1.3 General Precautions

Maintenance by Qualified Personnel: Only personnel familiar with the Princeton Power GTIB 480-100 Inverter and associated machinery should attempt installation, commissioning, or maintenance of the system. Untrained or unauthorized personnel run the risk of grave personal injury, death, or equipment damage.

These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operating instructions unless you are qualified to do so.

High Voltage Electric Shock Hazard: The Princeton Power GTIB 480-100 Inverter contains electrical components carrying potentially lethal voltages and currents. Extreme caution should be exercised around the system, especially when the cabinet door is open. Before opening the cabinet, all supply power should be disconnected using a standard physical lock-

out procedure
and the service personnel should wait 5 minutes prior to opening the enclosure door.

Installation to Code: The following instructions are merely a guide for proper installation. The National Electric Codes (NEC), local codes, and similar standards outline detailed requirements for safe installation of electrical equipment. Installation must comply with specifications for wire types, conductor sizes, electrical and thermal insulation, branch circuit protection, grounding, and disconnect devices. Princeton Power Systems cannot assume responsibility for compliance or noncompliance to any national or local code. Princeton Power cannot assume responsibility for personal injury and/or equipment damage exists if codes are ignored or misapplied during installation.

CAUTION: To reduce the risk of fire, connect each AC circuit of the inverter only to a circuit provided with 200 amperes maximum branch-circuit over-current protection in accordance with the National Electrical Code, ANSI/NFPA 70.

Improper Use: Princeton Power cannot assume responsibility for personal injury and/or equipment damage as a result of improper installation, use, maintenance, reconfiguration, reprogramming, or other improper actions. An incorrectly serviced or operated Inverter system can cause personal injury, component damage, or reduced product life. Malfunction may result from wiring errors, an incorrect or inadequate DC supply or AC grid connection, excessive ambient temperatures or obstructed ventilation, or incorrect software configuration.

Heat Hazard: The cabinet should not be mounted on a combustible surface nor should combustible materials be placed on or against the cabinet. The system should not be installed in a confined space that prevents proper ventilation or allows the build-up of excessive heat. A minimum of 12 inches of spacing clearance must exist for proper cooling airflow into and out of ventilation openings.

ESD Sensitive Components: The inverter contains Electrostatic Discharge (ESD) sensitive components. Standard ESD control precautions must be followed when installing, commissioning, testing, servicing, or repairing the system. Component damage, component degradation, or an interruption in control system operation may occur upon an electrostatic discharge event.

- Unit suitable for INDOOR installation only
- Keep vents and air outlets clear of debris and provide proper airflow. Do not place or store any objects on the enclosure roof
- Wear protective clothing (gloves, apron, etc.) approved for the materials and tools being used
- Use approved safety equipment (explosion-proof lights, blowers, etc.) when using cleaners. Be sure that fire-fighting equipment is readily available
- Keep cleaners and solvents in special polyethylene bottles or in safety cans in minimum quantities. Discard soiled cleaning rags into safety cans
- Use only authorized replacement parts or hardware when servicing the unit
- There are no user serviceable parts in the Inverter. All maintenance must be done by trained and certified Electricians or Technicians.

Door Locked Closed

- Keep the door closed at all times when operating the system. Additionally, keep all guards, screens, and electrical enclosures in place when the system is operating
- Close the inverter enclosure before energizing the unit
- Unit must remain locked at all times – Door latch is equipped with a provision that allows for locking door in the closed position

1.4 Safety Check

Performing a routine safety check before energizing the Inverter will minimize the risk of injury to the operator and minimize the potential for damaging the unit.

Before operating the unit, check for obvious signs of damage or concern. The following is a list of suggested items to be checked before operating the unit:

- Check the enclosure for obvious signs of damage.
- Verify that all inlet and outlet vents are clear of debris.
- Check external wires and cables for signs of damage, such as fraying or cracked insulation.
- Check room for potential hazards, such as standing water on the floor or on the GTIB 480-100 Inverter.

NOTE: Additional safety checks may be necessary depending on the particular installation of the unit. The safety checklist above is not intended to be all-inclusive.

Resolve all issues before operating the inverter. Contact Princeton Power Systems if necessary.

1.5 High Voltage Electrical Equipment Maintenance

- The inverter has high-energy charged capacitors that will hold a deadly electrical charge for up to five (5) minutes after the unit has been isolated from the PV array (or other DC source) and disconnected from the AC power grid. Wait for at least five (5) minutes before opening the door to prevent the risk of shock
- The system is powered by multiple power sources. Disconnect ALL sources and use proper Lock-Out/Tag-Out procedures before opening the doors, or before working on the power converter or transformer
- Disconnect the PV array before servicing the unit, as the PV array may hold a residual charge even in low light conditions.
- Unit must remain locked at all times - There are no door interlocks on the unit
- The external AC and DC disconnects need to be in the off position before the door to the power converter is opened. This isolates the AC and DC power from the unit.
- Remove jewelry, watches, rings, and metal objects that can cause short circuits.
- Use anti-static wristbands when servicing electronic components.
- Observe proper Lock-Out/Tag-Out procedures when working on the inverter system, the AC isolation transformer, and associated electrical controls.
- Remove all tools, paperwork, and all foreign objects not designed for use in the Inverter, from the enclosure prior to closing the door and re-energizing the equipment.
- Be sure that all electrical connections and connectors are properly installed and connected with proper torque (See Section 5).
- For continued protection against risk of fire, only use replacement fuses of the same type and rating as the original fuse.
- Avoid hazardous voltage situations that could result from unsafe conditions such as, but not limited to, the following:
    - Back-feed from the utility

- Improper grounding
- Handling electrical leads or devices with wet hands or on wet ground
- Frayed electrical leads
- Working with or on an electrically hot system or component, or when connected to an energized load
- An ungrounded battery pack
- Improper connection or re-connection of the terminal leads
- Short circuits
- Energized normal and emergency power sources

1.6 Terms of Use

Because of the wide variety of uses for power electronics equipment, this manual does not describe every possible application or configuration. All technicians responsible for installing, commissioning, and operating this equipment must satisfy themselves of the suitability and proper implementation of the intended application of this power conversion product.

In no event will Princeton Power Systems, Inc., its subsidiaries, partners, employees, or affiliates be responsible or liable for any damages, indirect or direct, resulting from the misuse or incorrect application of this equipment.

The examples and diagrams in this manual are for illustrative purposes only. Because of the wide variety of uses, applications, peripheral equipment, and facility configurations particular to each installation, Princeton Power Systems, Inc. cannot assume responsibility or liability for actual use based on the information provided herein.

1.7 External GFDI Requirement

The GTIB 480-100 has an optional internal Ground Fault Detector and Interrupter (GFDI) that grounds the negative DC input terminal of the system and detects and interrupts any ground fault current. This option is only available in inverters having the optional internal configuration that requires the installation of an external isolation transformer as described in Section 5.5.2.

Inverters with the internal GFDI option installed will have a G in the model number that is displayed on the label, which is affixed to the inside of the inverter door, as shown:

Model #: GTIB 480-100-xxGxx

WARNING: This option may only be installed if each individual inverter in the system is installed with an isolation transformer as described in Section 5.5.2. Installation of the internal GFDI. Installing an inverter that has the optional GFDI installed without an isolation transformer may result in damage to the inverter and in a condition that is potentially lethal or harmful to personnel.

WARNING: If the inverter used does not have the GFDI installed, then it is not provided with a GFDI device. This inverter must be used with an external GFDI device as required by the Article 690 of the National Electrical Code for the installation location.

1.8 Battery Information

This system is designed to be operated with a variety of battery types and voltage. Installer must determine if the charging methods outlined in Section 7.10 are compatible with the type of battery used. Battery voltage and current ratings must comply with the DC port ratings outlined in Table 3.1 – Electrical Specifications.

WARNING: The battery charge control function has adjustable battery charging settings. The user must confirm that the charge control profile used in this inverter is appropriate and safe for the type of battery used and that all battery charging settings are set correctly for the battery voltage, current, and temperature ratings. Setting these settings incorrectly may damage the battery and the inverter and may cause a hazardous condition that puts personnel at risk of grave injury or death.

WARNING: Programming temperature compensation parameters (See Section 7.10) that are not suitable for the type of battery being used may damage the battery and the inverter and may cause a hazardous condition that puts personnel at risk of grave injury or death. The user must ensure that the battery temperature compensation parameters are appropriate and safe for the type and voltage rating of the battery used.

2 System Description

2.1 System Overview

The GTIB 480-100 Grid-tied Inverter is a bi-directional DC-AC inverter that facilitates the interconnection of a variety of DC power sources or energy storage systems with a 3-phase utility power connection. Supported DC sources include PV arrays, wind turbine generators, and battery systems.

2.1.1 Utility Grid Interface

The GTIB 480-100 inverter operates on a 480VAC 3-phase utility grid voltage. The inverter is certified to UL standard 1741 and IEEE standard 1547 for grid-tied inverters and includes Unintentional Islanding Protection and field-adjustable utility voltage and frequency trip points. See Section 3.1 for more detailed specifications.

2.1.2 PV and Max Power Tracking

The GTIB 480-100 inverter is designed for use with high-voltage photovoltaic arrays, including single crystalline, poly crystalline, and thin film. The inverter max power tracking range is 280VDC – 580VDC.

Princeton Power has incorporated a new, advanced proprietary Maximum Power Point Tracking (MPPT) algorithm into the GTIB 480-100. This new algorithm is designed to have high performance under fluctuating irradiance conditions without sacrificing accuracy in steady conditions. This feature ensures that the inverter collects the maximum amount of power from a solar array at all times.

The GTIB 480-100 inverter is most efficient when operated at the highest allowable DC voltage, so PV arrays should be designed with the highest possible open-circuit voltage without exceeding 600VDC. See Section 3.1 for more detailed specifications.

2.1.3 Battery System Compatibility

The GTIB 480-100 is designed to operate with battery systems to facilitate bi-directional grid power flow control and backup power. The inverter can export power from the battery to the grid on command, and manages battery charging automatically. The battery charging profile and settings are adjustable for compatibility with a variety of battery types, chemistries, and voltages.

2.1.4 Critical Load Support

The GTIB 480-100 provides a secondary 3-phase AC power port for the support of critical loads. When utility power is available, this port is connected to and fed by the utility voltage. When utility power fails, the AC Load Port is automatically disconnected from the utility and fed directly by the inverter, drawing power from the DC source as long as sufficient DC power is available. The port is automatically transferred back to the utility connection when utility power becomes available again.

2.1.5 Variable Speed Motor Load Control

The AC Load Port can be configured for use with a single induction motor load, in which case, when utility power is unavailable, the inverter can power the motor, adjusting the operating speed in order to draw as much power as is available from the DC source, and not more. This feature is designed to allow the inverter to operate motors that drive pumps and fans directly off a PV array, operating the motor as fast as possible depending on the available PV power.

2.1.6 Backup Generator (Micro-grid) Support

The GTIB 480-100 inverter is designed for installation in conjunction with a backup power generator. When a measured system load signal is fed to the inverter, the inverter can operate feeding power into a local micro-grid supported by a backup generator. This feature allows all available PV array power to be used before generator power is used, minimizing the amount of fuel consumed by the backup generator.

2.1.7 Expandability

Multiple GTIB inverters can be installed in parallel to create inverter systems with higher power capability. Up to 20 units can be installed in parallel for a total power capacity of 2,000kW. Such paralleled systems operate as one inverter, and have all of the same features as a single inverter, including backup power for critical loads and motor control. See Section 5.6 for more details on parallel inverter installation.

2.1.8 Control Features

The front panel of the inverter includes a control panel with keypad and 4-line display for configuration, monitoring, and control of the inverter. The inverter also includes a Web-based User Interface (WebUI) for computer-based control. Software diagnostics and adjustable parameters are included, as detailed in this manual.

2.2 Operational Mode Descriptions

The GTIB 480-100 Grid-Tied Inverter is utility-interactive, for use in several configurations:

Mode Summary Table	On-Grid		Off-Grid	
	Standard	Micro-grid/ Generator support	Standard	Motor Operation
PV array	✓	✓	✓	✓
Battery	✓	✓	✓	✓

2.2.1 On-grid Solar (Photovoltaic (PV)) Array Application

When connected to a PV array and an electric grid, the inverter will track the PV array and export maximum available power from sunrise to sunset. As soon as there is enough solar power available, the inverter will automatically supply current and power into the grid. As soon as available power falls below the required threshold, the inverter stops exporting power and de-energizes to avoid wasting power.

The inverter will transfer the maximum power possible from the PV array to the AC grid via a maximum power point tracking function (MPPT). If the installation includes an isolation transformer (for grounded PV arrays), the inverter will disconnect the isolation transformer from the grid when it is not exporting power, in order to minimize tare losses. Exporting power to the grid is always done according to UL 1741 requirements.

Circuits connected to the inverter's critical load port will be fed with utility power whenever it is available. If grid power becomes unavailable, the critical load port will be powered from the solar array as long as sufficient solar power is available. Power will be supplied from the grid again automatically when it becomes available.

If a motor load is connected to the critical load port, such as a fan or a water pump, the system can control the speed of the motor to use as much power as is available from the solar array.

2.2.2 On-grid Battery Bank Application

When connected to a bank of batteries, the inverter will charge and discharge power to and from the electric grid according to an external control signal. This allows a user to draw energy from the grid and store it at times of day when electricity rates are low, and export power (sell power back to the utility) when rates are higher. When charging, the inverter follows a pre-programmed algorithm for maximizing the efficiency and lifetime of the batteries.

When grid power is unavailable, circuits connected to the critical load port are fed with power from the battery for as long as the battery can supply power. Power will be supplied from the grid again automatically when the grid becomes available.

2.2.3 Off-grid "Standalone" Mode

With either PV or another DC power source, the inverter can be connected in a "standalone" mode where it will directly power one or more loads with no electric grid. The grid connection is not used, and all loads are connected to the critical load port. The inverter will supply power to the loads whenever there is sufficient power from the DC sources.

2.2.4 Off-grid Mode with AC Motor Control

When the only loads connected to the system are AC motor loads, the inverter can run the motors at variable speed, adjusting the power draw of the load to match the available DC power. This can even be done when the DC power source is intermittent, such as a solar array. As the available sunlight is reduced, the speed of the motor will automatically be reduced, and vice versa.

2.2.5 Off-grid Mode with Line-interactive 60Hz AC Generator

With the installation of a power measurement signal to the inverter (see Section 7.7 "Inverter Control" for details), the inverter can be programmed to interact with a 60Hz AC generator that is outputting power

into a “microgrid”. The inverter does not require any control over the generator and can minimize fuel use by feeding power from other DC sources, including solar arrays, into the microgrid. This configuration will also work in systems where a backup generator normally supplies power when the grid is unavailable. The inverter will automatically operate with the generator when the grid is unavailable, and operate with the grid when it is available.

3 Technical Specifications

3.1 Electrical specifications

General Specifications	
Inverter Technology	Pulse width modulation
Size	inches: 36 W x 18 D x 75 H
DC Port Specifications	
DC Voltage Range	280 – 600 VDC
DC Maximum Power Voltage Range	330 - 600 VDC
PV MPPT Range	280 – 580 VDC
Maximum Input Current	320 ADC
Maximum Input Power (current limited below 330VDC)	105 kW (> 330 VDC input)
Maximum Output Current	285 ADC (or lower – user adjustable limit)
Maximum Output Power	95 kW
Maximum DC Source Short-Circuit Current	10,000 ADC
Maximum DC Back-Feed Current	600 ADC
DC Source Configuration	Monopole negative grounded Bipolar neutral grounded Ungrounded
Max Power Point Tracking	Proprietary current-source MPPT algorithms, User-controlled power-limiting function
Grid Port Specifications	
Rated Output Voltage	480 VAC ±10%, 3-phase (88-110% per IEEE 1547 4.2.3)
Continuous Output Current	133 A AC
Maximum Output Current	133 A AC
Continuous Output Power	100 kW
Maximum Input Current (At maximum AC load, zero DC input power)	150 A AC
Maximum Input Power	137 kW continuous (150A combined critical load and battery charging current at 528VAC grid voltage)
Power Factor	> 0.95 above 20% rated power, input and output (plus critical load power factor) [a]
Nominal Line Frequency	60 Hz
Maximum Line Frequency	60.5 Hz (per IEEE1547 4.2.4)
Minimum Line Frequency	57.0 – 59.8 Hz – Field Adjustable (per IEEE1547 4.2.4)
Harmonics	IEEE 1547 compliant, <5% Current THD
Maximum AC Fault Current and Duration	1700A for 3ms
Maximum AC Circuit Protection	External 200A branch circuit breaker required, with1500A max instantaneous trip setting
Grid Tied	Yes
AC Load Port Specifications (Standard Output Mode)	
Rated Output Voltage	480 VAC ±10%, 3-phase
Maximum Load Power	100 kW[c]
Allowable Load Power	1.00 – 0.85 (Lagging)

Factor	
Maximum Load current rating	142A
Nominal Line Frequency (Grid-tied and Stand-alone)	60 Hz[b]
Maximum Line Frequency (Grid-tied)	60.5 Hz[b]
Minimum Line Frequency (Grid-tied)	57.0 – 59.8 Hz – Field Adjustable
Frequency Range (Stand-alone)	60 Hz, +/- .02 Hz[b]
Maximum AC Circuit Protection	Maximum of 200A branch circuit breaker required, with1500A max instantaneous trip setting
AC Load Port Specifications (Motor Control Mode)	
Rated Output Voltage	0 - 480 VAC ±10%, 3-phase
Maximum Load Power	100 kW[c]
Rated Output Current	142A
Minimum Power Factor	0.85
Frequency Range (Stand-alone)	0 - 60 Hz[b] +/- .02 Hz.
Maximum Line Frequency (Grid-tied)	60.5 Hz[b]
Minimum Line Frequency (Grid-tied)	57.0 – 59.8 Hz – Field Adjustable
Maximum AC Circuit Protection	External 200A branch circuit breaker required, with1500A instantaneous trip
Safety Features	
Faults	Over/Under Voltage, Over Current, Over/Under Frequency, Ground Fault, Internal
Standards Compliance	UL 1741, IEEE 1547, CEC
Safety Features	Anti-islanding (grid fault detection, isolation, & auto-reconnect), Fused ground fault interrupter, UL-compliant trip points (factory adjustable), Password-protected parameters
User Interface Features	
Front-Panel Interface	4x20 LCD, Keypad, Running/Fault/Ground Fault LEDs,
Communications	Modbus RTU over RS-485 Ethernet, TCP/IP Java User Interface
Performance Monitoring & Data Logging	Real-time & historical, web-based performance data Ethernet-compatible (LAN, Wireless)
Analog & Digital I/O ports	Analog: (3) inputs, (1) output; 0-10 V or 4-20 mA Digital: (3) inputs 0-24V, (2) output relays
Analog & Digital I/O Maximum ratings	Digital Inputs Max Voltage 30VDC Output relays Max Voltage 30VDC Output relays Max Current 1A Analog Inputs Max Voltage(voltage mode) 12V Analog Inputs Max Current(current mode) 25mA Analog Output Max Current(voltage mode) 15mA Analog Output Max Load(current mode) 1kOhm
Efficiency	
Peak Efficiency	96.5%
CEC Efficiency	96.0%
Night time TARE Losses	25 W
Energy-Saving Features	Automatic internal subsystems power-down, Nighttime output auto-disconnect

a – Grid terminal power factor is the resulting power factor of the sum of the inverter current and the critical load current. The inverter current power factor is >.95 for power levels above 20kW input or output power. The critical load power factor is allowed to be as low as .85 (lagging).
b – The critical load port is powered directly of the grid when grid power is available, so the frequency range is the same as the grid port. In stand-alone mode, the critical load port frequency is 60Hz +/- .02 Hz.
c – The critical load port is powered directly of the grid when grid power is available, so the frequency range is the same as the grid port. In stand-alone motor control mode, the critical load port frequency is 0 - 60Hz +/- .02 Hz.

Table 3.1 – Electrical Specifications

3.2 **Mechanical specifications**

Enclosure Specifications	
Enclosure	NEMA 1 (indoor)
Size	inches: 36 W x 18 D x 75 H
Environmental Specifications	
Temperature	Operating: 0 to 50°C Storage: -20 to 60°C
Humidity	5 – 95% (non-condensing)
Cooling	Forced-air cooled – adjustable speed blowers optimize cooling power for maximized system efficiency
Rated Max Elevation	6,000 feet

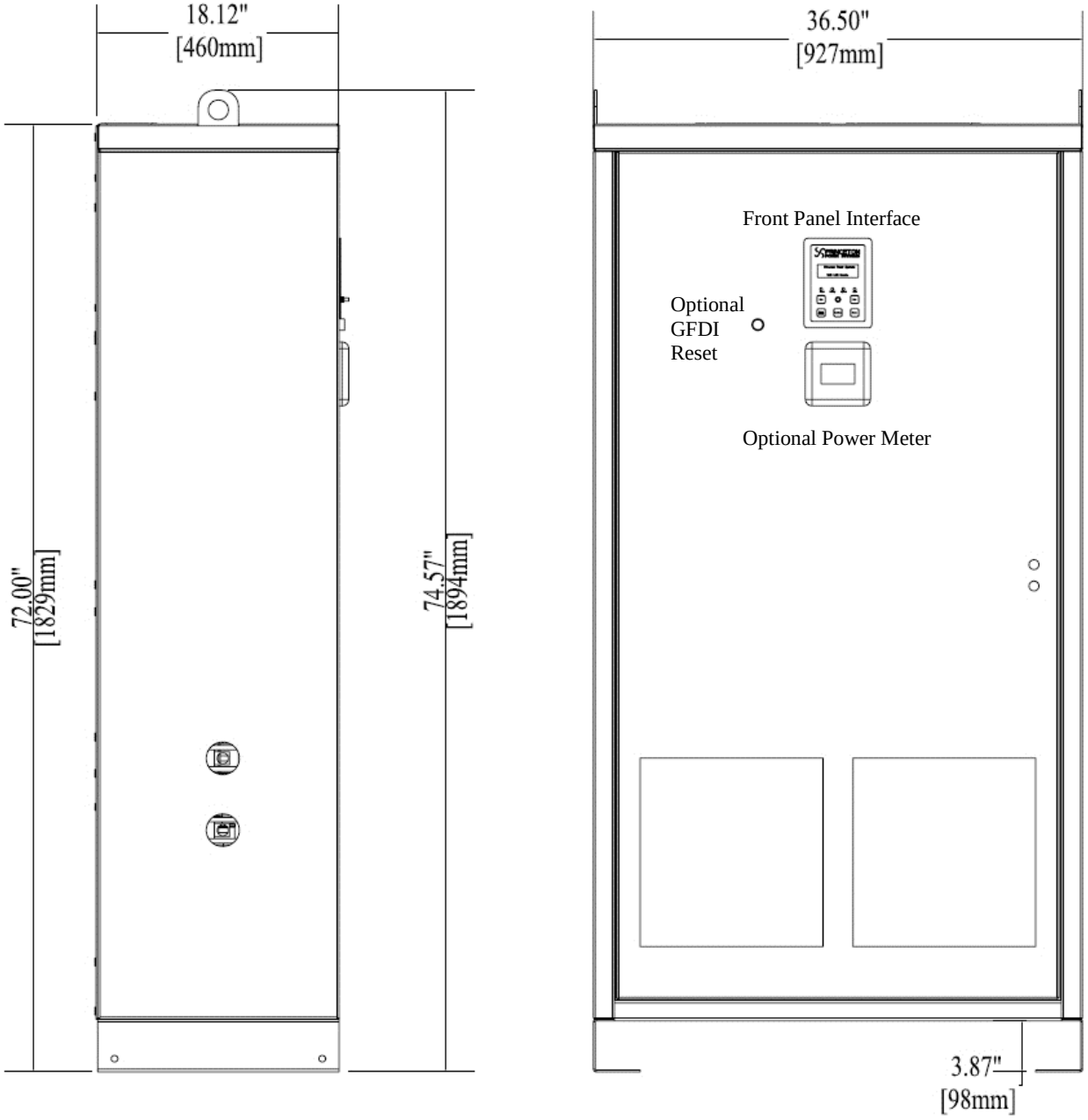


Figure 3.1 – Mechanical Diagram and Dimensions

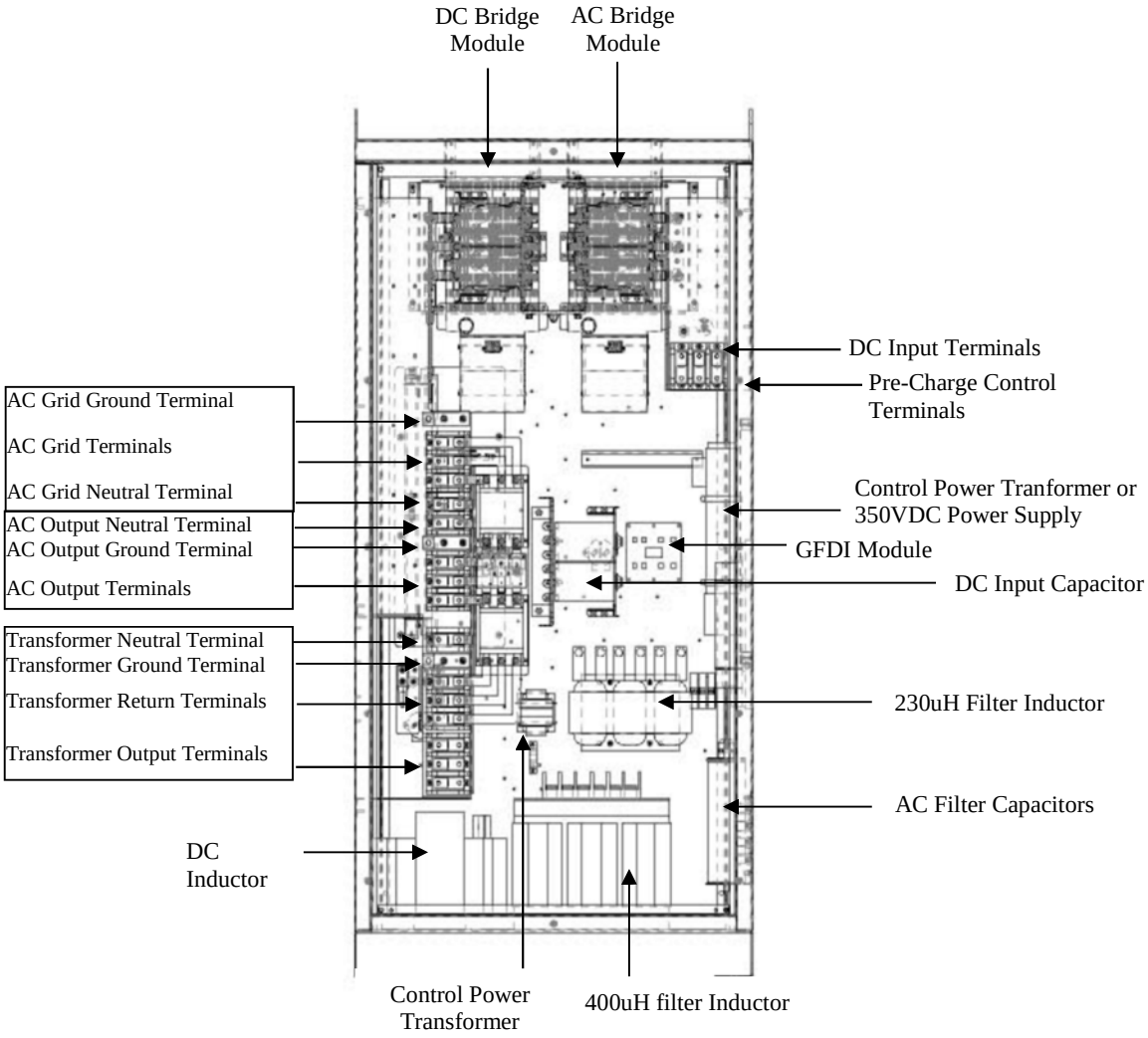


Figure 3.2 – Internal Mechanical Components

4 Installation Instructions

Important: Before installing the Inverter, make sure to read all instructions and cautionary markings included in this manual and the documentation included with all other equipment installed with the inverter.

4.1 Unpacking, Inspection, and Storage

Upon receiving the unit, inspect for signs of damage that may have been caused during shipping. If damage is found, immediately contact Princeton Power Systems and the Shipping Company.

Together, the inverter and output isolation transformer weigh approximately 2,000 lbs. Use a pallet jack or forklift to move the units. Do NOT attempt to lift and/or move either the inverter or transformer by hand. They are extremely heavy. Attempting to move the unit by hand may lead to serious injury.

4.2 Transporting by crane

WARNING! Falling equipment can cause serious or even fatal injury. When moving the inverter by crane it is essential that these instructions are followed.

The inverter weights approximately 1000lbs. To lift the inverter using a crane, both lifting tabs must be lifted simultaneously and equally. Each lifting tab must be lifted vertically as shown in Figure 4.1. Tabs must NOT be lifted with angled chains. When setting the inverter down on the ground, do so gently to avoid damaging the mounting feet.

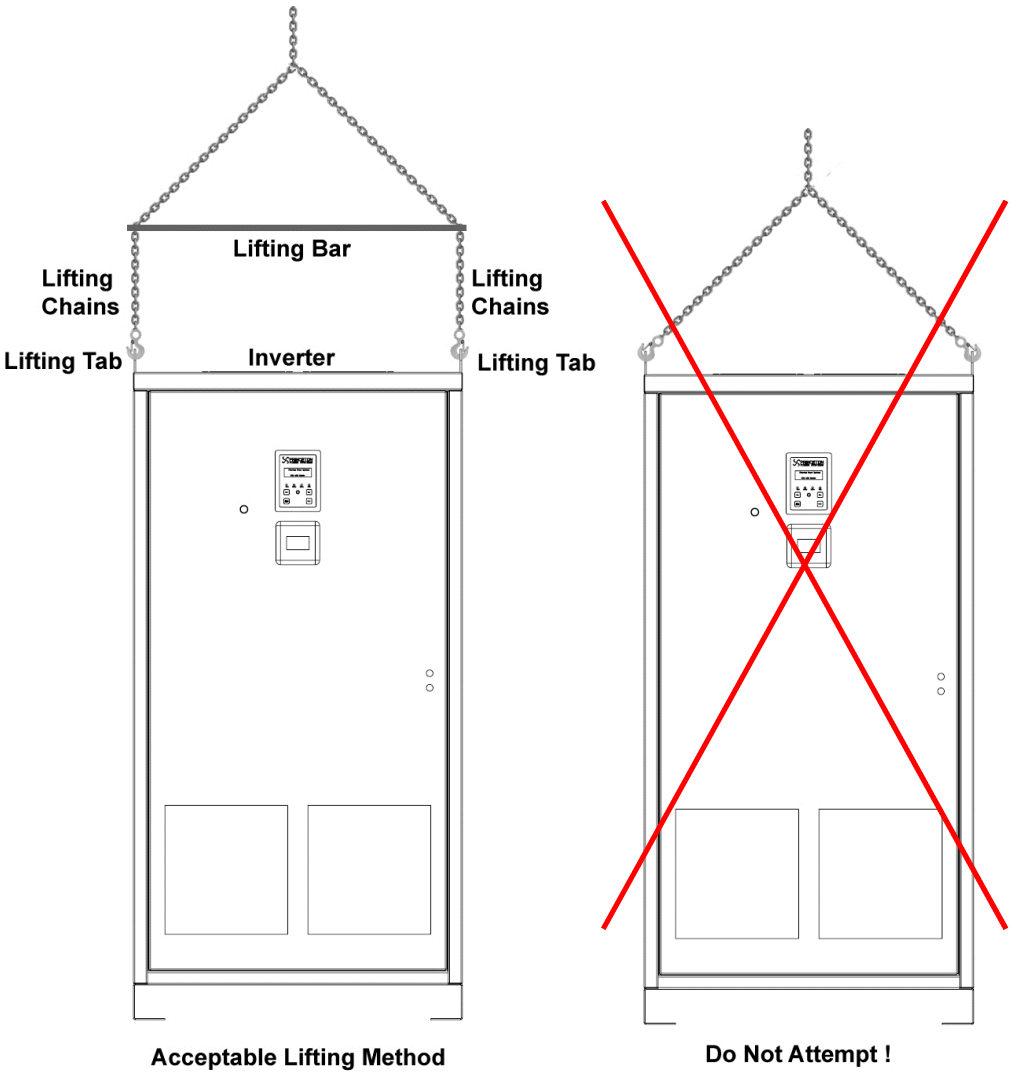
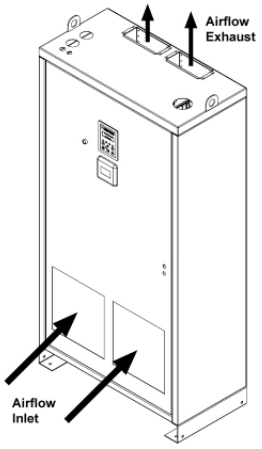


Figure 4.1 – Lifting the inverter with a crane

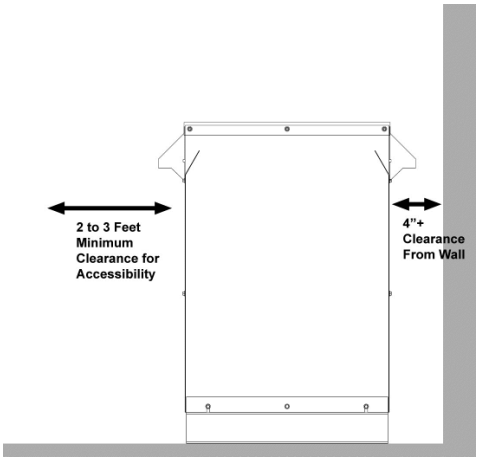
4.3 Location considerations

Choosing a location:
To make the most of the benefits provided by the inverter, please comply with the following requirements:

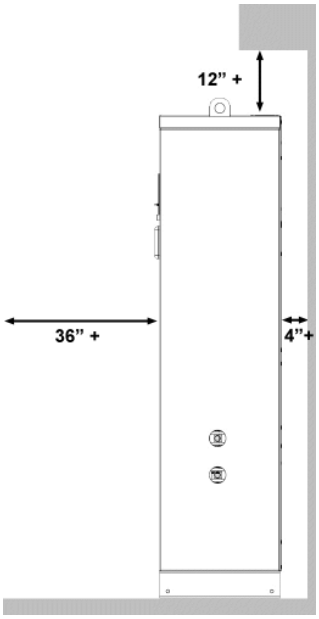
- The inverter is for indoor use only.
- Install the inverter in an accessible location following NEC codes for enclosure and disconnect door clearances and proximity to other equipment.
- The maximum life of the inverter can be achieved by mounting the unit in a clean, dry and cool location
- For optimal inverter life and performance, do not mount the inverter in direct sunlight, especially in hot climates. If the unit must be mounted in direct sunlight, a metal sun-shield is recommended but not required.
- The inverter is forced-air-cooled. Cold air drawn in through vents at the bottom of the front door, exhaust air emitted vertically from vents at the rear of the roof, as shown. The air inlet and outlet must not be blocked, and the installation location should be sufficiently ventilated to prevent the inverter heat output from increasing the ambient temperature beyond the inverter's rating.



- Under certain operating conditions, the inverter will emit audible noise; it is not advisable to install in the immediate vicinity of living quarters.
- The inverter should not be installed in an area that is excessively dusty, as this may decrease the performance of the air cooling system.
- The inverter must not be installed in areas in which dust containing conductive particles (e.g. iron filings) may form.
- When installing the inverter, care should be taken to ensure that the display unit remains at or below eye level.



- Be sure that the optional high-efficiency isolation transformer is mounted on a clear floor that allows free flow of air. Always allow 2-3 feet of clearance in front of the transformer to provide space for operating/working. All local codes that pertain to the installation of the isolation transformer must be followed



4.4 Mounting & Ventilation

- The inverter weighs about 1000 lbs. Be sure to verify load capacity of floor, roof or concrete pad mounting area (recommended).
- Provisions should be made and/or procedures should be in place to ensure that nothing is placed or stored on the enclosure roof where it could block the exhaust vents.
- Similar precautions should be taken regarding the air inlet vents on the front of the unit
- A minimum distance of 12 inches (300mm) must be clear above the inverter for ventilation.

- A minimum distance of 36 inches (900mm) must be clear in front of the inverter to allow for opening of the main door.
- The inverter must be mounted with at least a 4” open space behind it.
- Correct mounting position for the inverter is vertical with the mounting feet on the floor. The enclosure should be mechanically fastened to a rigid structure to prevent the possibility of tipping.

4.5 Conduit Installation Locations

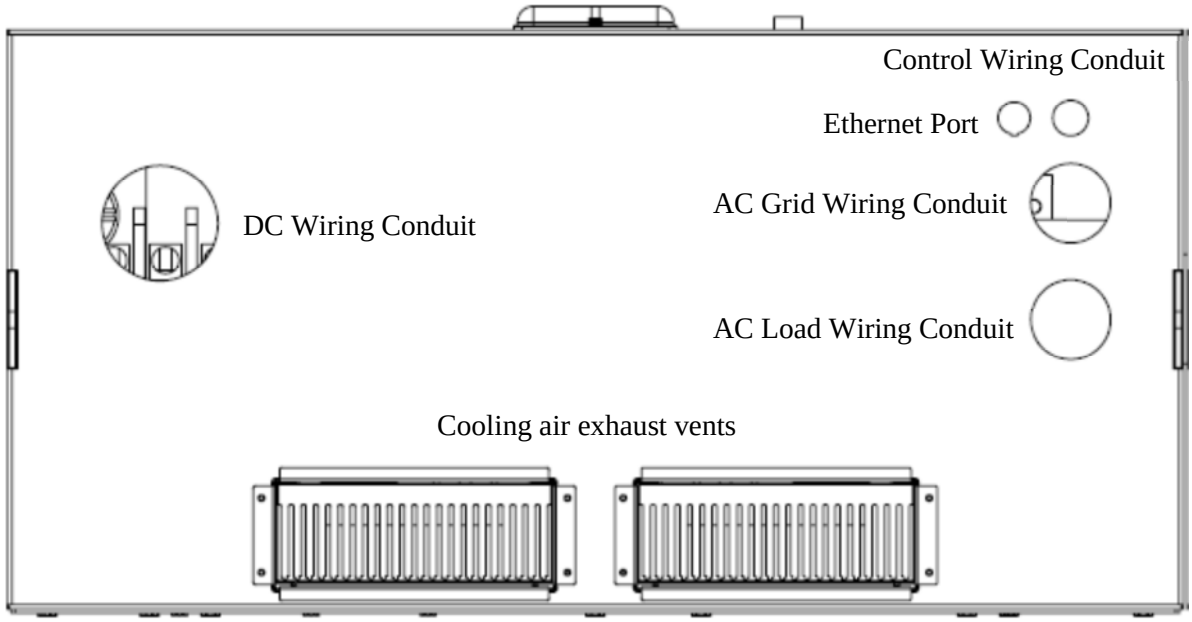


Figure 4.2 – Conduit Hole locations, Inverter top view

4.6 Preparing for the Installation

Installation Tools and Materials Tools Required:

- Wire strippers
- Assorted open-end wrenches or socket wrench set and fittings
- Torque wrench
- Electrical tape
- Multi-meter (AC/DC Voltage, frequency)
- Assorted Phillips screw drivers
- Allen/Hex head driver set (through 1/2")
- Slotted screw driver
- Level
- Pencil
- Utility knife

The following materials may be required for completing this installation:

- Conduits (flexible conduit is recommended), bushings, wire nuts, and appropriate fittings for wire runs
- Electrical wire of appropriate size and length

- Breaker panels (if used)
- Additional circuit breakers (if required)
- Ground busses, bars, and/or rods

WARNING: Shock Hazard

Ensure that no DC voltage is being supplied to the inverter and that no AC voltage is present on the AC wiring. Failure to do so could cause serious injury or death. A warning label is provided to inform all personnel that multiple sources of power are available inside. This label is installed on the outside of the door and should remain clearly visible. Ensure all sources are OFF or disconnected before servicing.

Before connecting the solar panels, check that the voltage specified by the manufacturer corresponds to the actual measured voltage. At an outside temperature of -10°C, the open-circuit voltage for the solar panels should never rise above 600 V. When the temperature is lower, the open-circuit voltage generated will be higher than normal. The temperature coefficients for calculating the open-circuit voltage at -10°C can be found in the data sheet for the solar panels. If the open-circuit voltage for the solar panels rises above 600 V, this may result in damage to the inverter and all warranty rights shall be declared null and void.

5 Wiring Instructions

5.1 Wire Sizing and Ratings

5.1.1 AC Wire Sizing and Ratings

All AC power wiring, including AC grid port, AC load port, and transformer installation terminals, should meet the following specifications:

Voltage Rating	600 Volts	
Temperature Class	75°C or greater	
Gauge	Copper:	3/0 AWG
	Aluminum:	250 MCM

Note on phase rotation: Grid Port Power wiring must be installed with a positive phase rotation: 123 or ABC. All AC power terminals are labeled by phase number; follow these labels when installing AC power wiring.

5.1.2 DC Wire Sizing and Ratings

DC power wiring should meet the following specifications:

Voltage Rating	600 Volts	
Temperature Class	75°C or greater	
Gauge	Copper:	500 MCM

5.1.3 Control Wire Sizing and Ratings

Class 1 wiring methods must be used for wiring of class 2 circuits (Control or sensor circuit)

All wiring installed in the system must be rated for 600VAC, including control and signal wiring.

5.1.3.1 Analog or Digital I/O wiring

Also see Sections 0 through 0

Voltage Rating	600 Volts
Temperature Class	75°C or greater
Gauge	Copper Stranded: 22 - 18AWG
Cable type	Shielded twisted pair recommended

5.1.3.2 Remote contactor feedback wiring

Also see Section 5.6.3.3

Voltage Rating	600 Volts
Temperature Class	75°C or greater
Gauge	Copper Stranded: 18 – 12AWG

5.1.3.3 Remote grid voltage sensing wiring

Also see Section 5.6.4

Voltage Rating	600 Volts
Temperature Class	75°C or greater
Gauge	Copper Stranded: 18 - 12AWG

5.1.3.4 Remote contactor control wiring

Also see Section 5.6.3.4

Voltage Rating	600 Volts
Temperature Class	75°C or greater
Gauge	Copper Stranded: 18AWG

5.1.3.5 Synchronization signal wiring

Also see Section 5.6.5

Voltage Rating	600 Volts
Temperature Class	75°C or greater
Gauge	Copper Stranded: 22-18AWG
Cable type	Shielded twisted pair recommended

5.2 Hookup Requirements

5.2.1 DC Circuit Protection

If the DC power source connected to the DC port of the inverter is not a PV array, then DC circuit protection is required. This protection is already provided in systems with the integrated 350A DC fuse option (option "F") installed (see section 1.1.3), and no additional circuit protection is required for the safety of the inverter. An externally-installed DC circuit breaker with a DC current rating of 380A or less may also be used as DC circuit protection.

Table 5.1 DC Circuit Breaker Required Ratings

Minimum rated DC voltage	600V DC
Maximum allowable rated current	380A DC
Minimum interrupt rating	Source Dependent [a]

a – The DC circuit breaker must be rated to interrupt the short circuit current supplied by the installed DC source.

WARNING: The DC circuit protection described in this section is required for the safe operation of the inverter system, and does not necessarily adequately protect the DC source connected to the DC port of the inverter. The installer must ensure that any DC circuit protection required for the safe operation of the DC source is provided if necessary.

5.2.2 AC Circuit Protection

5.2.2.1 Grid Port Circuit Breaker

The grid connection port of each GTIB inverter must be fed with a dedicated 3-phase (multi-pole) circuit breaker. The circuit breaker shall open all ungrounded conductors of the AC circuit and shall be a common trip type. This breaker must have a maximum rating of 200A at 480VAC or greater. Magnetic trip settings must be set between 1200 and 1500 amps.

5.2.2.2 AC Load Port Circuit Breaker

The AC load port must feed an AC branch circuit with a dedicated 3-phase (multi-pole) circuit breaker. The circuit breaker shall open all ungrounded conductors of the AC circuit and shall be a common trip type. This breaker must have at least a maximum rating of 200A at 480VAC or greater. Magnetic trip settings must be set less than 1500A.

5.2.3 DC Disconnects

Each individual inverter must be installed with a dedicated DC disconnect on its DC circuit having the following characteristics:

1. The DC disconnect must open all ungrounded conductors of the circuit to which it is connected,
2. Consist of a manually operated switch or a circuit breaker,
3. Employ an operating handle that is accessible or located behind a hinged cover not requiring a tool for opening
4. Be marked or otherwise clearly identified as the DC disconnect switch for the inverter, and
5. Be rated for 600VDC and the lesser of
    a. The maximum current of the connected DC source, or
    b. 320ADC (the maximum DC ratings of the inverter)

5.2.4 AC Disconnects

For each inverter installation, which may be comprised of a number of parallel inverters, a single AC disconnect switch must be installed, and must have the following characteristics:

1. The AC disconnect must open all ungrounded conductors of the circuit to which it is connected,
2. Consist of a manually operated switch or a circuit breaker,
3. Employ an operating handle that is accessible or located behind a hinged cover not requiring a tool for opening
4. Be marked or otherwise clearly identified as the AC disconnect switch for the system, and
5. Be rated for at least 480VAC and for the total combined current capacity of all of the inverters and loads in parallel.

Since a circuit breaker may serve as a disconnect switch, for single-inverter installations it may be acceptable to use the required 200A circuit breaker to server also the role of the disconnect switch. In this case the above disconnect requirements would apply to the circuit breaker. All local electrical codes must be followed.

5.3 Grounding

All input and output circuits are isolated from the enclosure. System grounding, when required by Sections 690.41, 690.42, and 690.43 of the National Electric Code, ANSI/NFPA 70, is the responsibility of the installer.

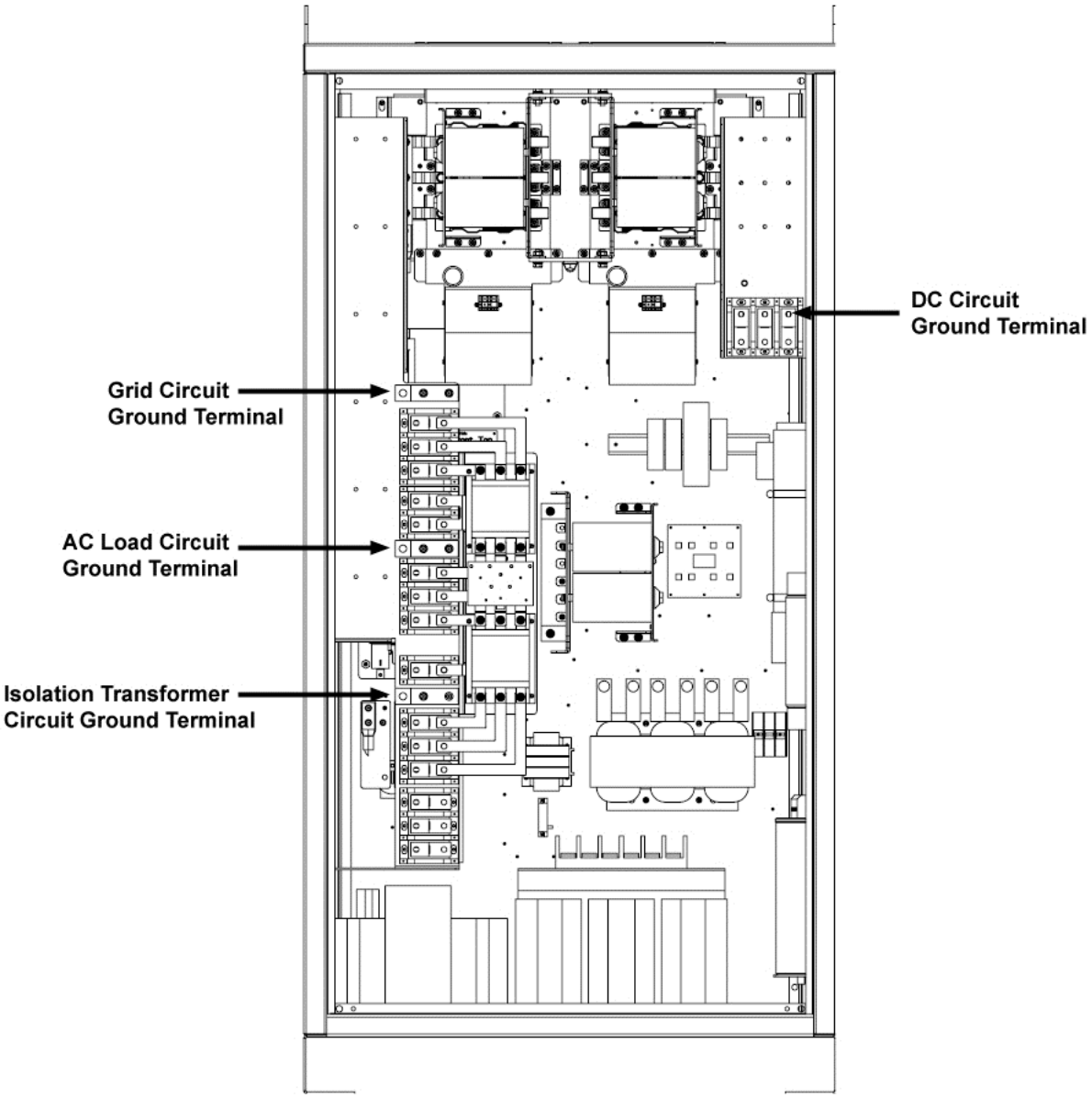


Figure 5.1 – Ground terminal locations

5.3.1 Torque Specifications

All grounding terminal set screws should be tightened to 230 lb-in.

5.3.2 Ground wire sizing

5.3.2.1 AC circuits and non-PV DC circuits

For an AC circuits or a non-PV DC circuit, a ground wire will be sized according to Table 5.2, based on the size of the over-current device protecting that circuit.

Column 1	Column 2			
	Minimum size of equipment-grounding or bonding conductor AWG or kcmil (mm²)			
Maximum current rating,[a] amperes	Copper		Aluminum or copper-clad aluminum	
15	14	(2.1)	12	(3.3)
20	12	(3.3)	10	(5.3)
30	10	(5.3)	8	(8.4)
40	10	(5.3)	8	(8.4)
60	10	(5.3)	8	(8.4)
90	8	(8.4)	6	(13.3)
100	8	(8.4)	6	(13.3)
150	6	(13.3)	4	(21.2)
200	6	(13.3)	4	(21.2)
300	4	(21.2)	2	(33.6)
400	3	(26.7)	1	(42.4)

Table 5.2 Ground wire size chart

5.3.2.2 PV DC input

For installations with PV arrays installed on the DC input port, a ground wire for the DC circuit will be rated for at least 1.25 times the rated short-circuit current of the installed PV array.

5.3.3 Ground Wiring Instructions

At least one of the grounding terminals needs to be solidly grounded to earth ground. The ground supplied with the AC grid circuit typically can serve as this ground connection. Verify local wiring and local codes before using the AC grid circuit ground as the system earth ground.

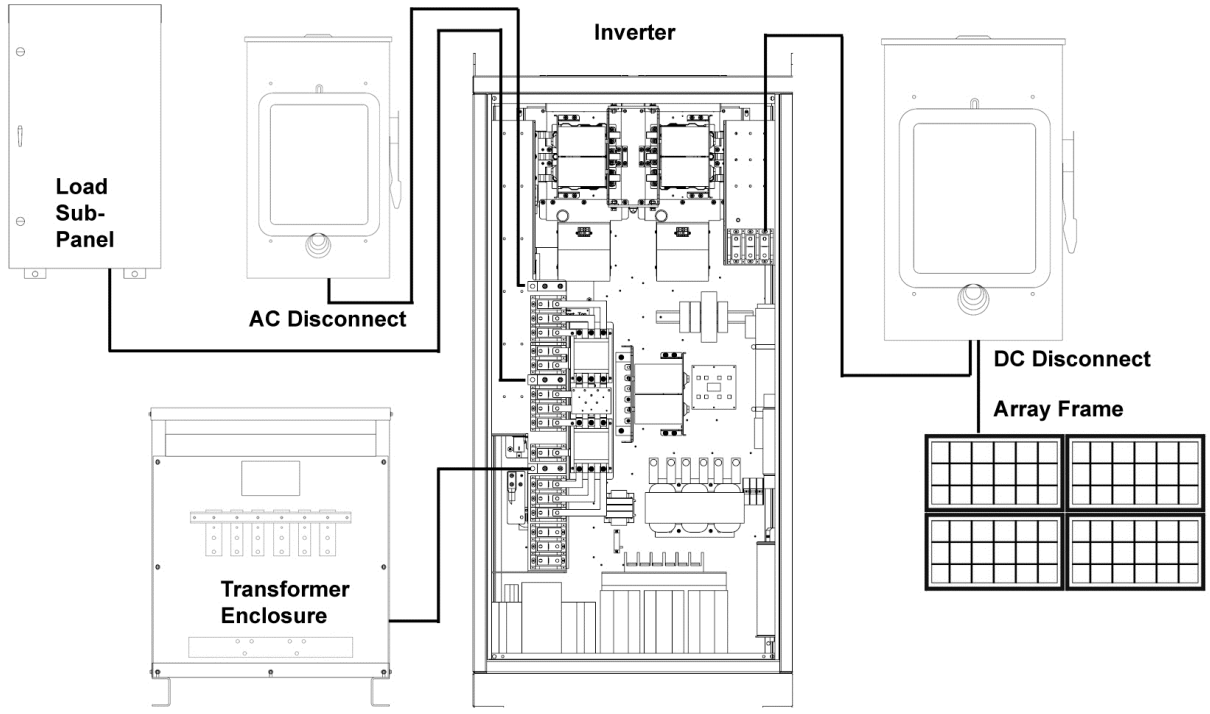


Figure 5.2 - Example ground wiring diagram

5.3.3.1 Grid circuit ground connection

This ground is associated with the AC circuit connected to the grid port. If the Grid port is used, connect the utility-supplied ground here. The utility supplied ground may serve as the system earth ground if it is earth grounded.

5.3.3.2 AC load circuit ground connection

This ground is associated with the AC circuit connected to the AC load port. This ground may be used to ground any hardware or equipment associated with that circuit. If no other earth ground connection is provided, this terminal also may be used to connect a solid earth ground connection to the system.

5.3.3.3 Isolation transformer ground connection

This ground is associated with the isolation transformer circuit. This ground may be used to ground any hardware or equipment associated with that circuit. If no other earth ground connection is provided, this terminal may also be used to connect a solid earth ground connection to the system.

5.3.3.4 DC circuit ground connection

This ground is associated with the DC input circuit. This ground may be used to ground any hardware or equipment associated with that circuit. If no other earth ground connection is provided, this terminal may also be used to connect a solid earth ground connection to the system.

WARNING: For systems equipped with an integrated GFDI (see section 1.1.3) the DC circuit ground must NOT be used to ground either the positive or negative nodes of the input DC circuit. The GFDI circuit grounds the negative DC terminal to earth ground, and no other ground may be used to ground either the positive or negative nodes.

WARNING: If the system is not equipped with an integrated GFDI (see section 1.1.3) then this inverter must be used with an external GFDI device as required by the Article 690 of the National Electrical Code for the installation location.

5.4 DC Connection

5.4.1 Torque Specifications

The DC terminal block compression screws must be tightened with a torque of 230 in-lbs.

5.4.2 Installation

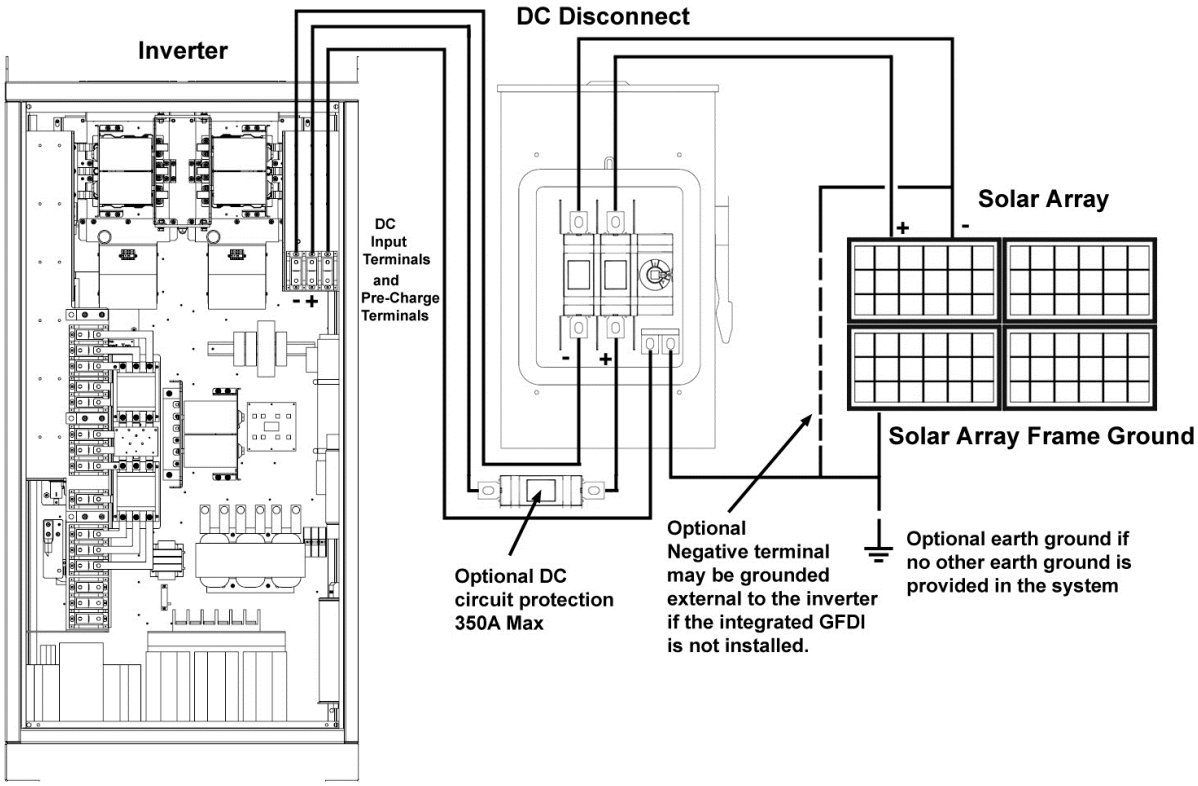


Figure 5.3 - DC Wiring Diagram

5.4.3 Pre-Charge Control Connections

An optional DC Pre-Charge circuit is provided with the GTIB 480-100 inverter system with control input terminal points located adjacent to the main DC Input Terminals. This Pre-Charge Control Input allows a customer to limit the initial inrush current when first energizing the inverter DC input. When used, the Pre-Charge input will initially connect DC power to the Inverter input stage through a resistive network for a short time before power to the main DC Input Terminals is applied by the customer.

High inrush currents are not typically a problem with PV systems but systems using batteries as the DC Source could experience significant inrush currents when first energizing the system due to the presence of a large filter capacitance on the inverter DC input. This high inrush current is not a problem for the GTIB 480-100 Inverter hardware but it can be problematic for external controls or cause nuisance trips of external DC Over-current protection devices (DC Breakers or Fuses). By initially applying the input DC power to the Pre-Charge Control Input the DC input capacitance is charged up at a controlled rate to allow Main DC Power to be applied with minimal transients.

To use the optional Pre-Charge controls the input DC Power is applied through a control relay or breaker to the Pre-Charge Control terminals located adjacent to the main DC Input Terminals. After a delay of 20 seconds the DC Power can be applied to Main DC Input Terminals and the system can be operated normally. **Note: The power supply to the Pre-Charge Control Input should be de-energized after the Main DC Power has been applied.**

Shock Hazard: For Inverter system installations making use of the Pre-Charge Control functionality, the external Pre-Charge DC power source must be de-energized along with the main DC Input Terminals to fully de-energize the system to allow access for any reason.

5.5 AC Utility and Load Connections

Important: The AC neutral connection in this system is NOT bonded to ground

5.5.1 Torque Specifications

All AC terminal blocks in the GTIB 480-100 are the same size, and the compression screws must be tightened with a torque of 230 in-lbs.

5.5.2 Installation with Isolation Transformer and Neutral Connection

5.5.2.1 Systems that require an isolation transformer:

If a system has any of the following characteristics, an isolation transformer must be installed with the inverter:

- The DC source is grounded, either at the negative terminal, positive terminal, or in a bi-polar configuration. This includes systems with the integrated GFDI option, because this option internally grounds the negative DC terminal.
- The DC source is derived from rectifying an AC source with a grounded neutral.
- The load(s) connected to the AC load port requires a neutral connection. I.e. single-phase loads

5.5.2.2 Transformer Requirements

If an isolation transformer is installed with the inverter as described in this section, it must have the following characteristics.

Power Rating	112.5 kVA or greater
Frequency	60Hz
Primary Winding	3-phase WYE configuration
Primary Voltage Rating	480/277 VAC
Secondary Winding	3-phase DELTA configuration
Secondary Voltage	480 VAC
% Impedance	1% < Impedance <10%
% Efficiency	Any
The transformer shall comply with the Standard for Dry-Type General Purpose and Power Transformers, UL 1561, or the Standard for Transformers, Distribution, Dry-Type B Over 600 Volts, UL 1562, whichever applies.	

5.5.2.3 AC Wiring Diagram with Transformer.

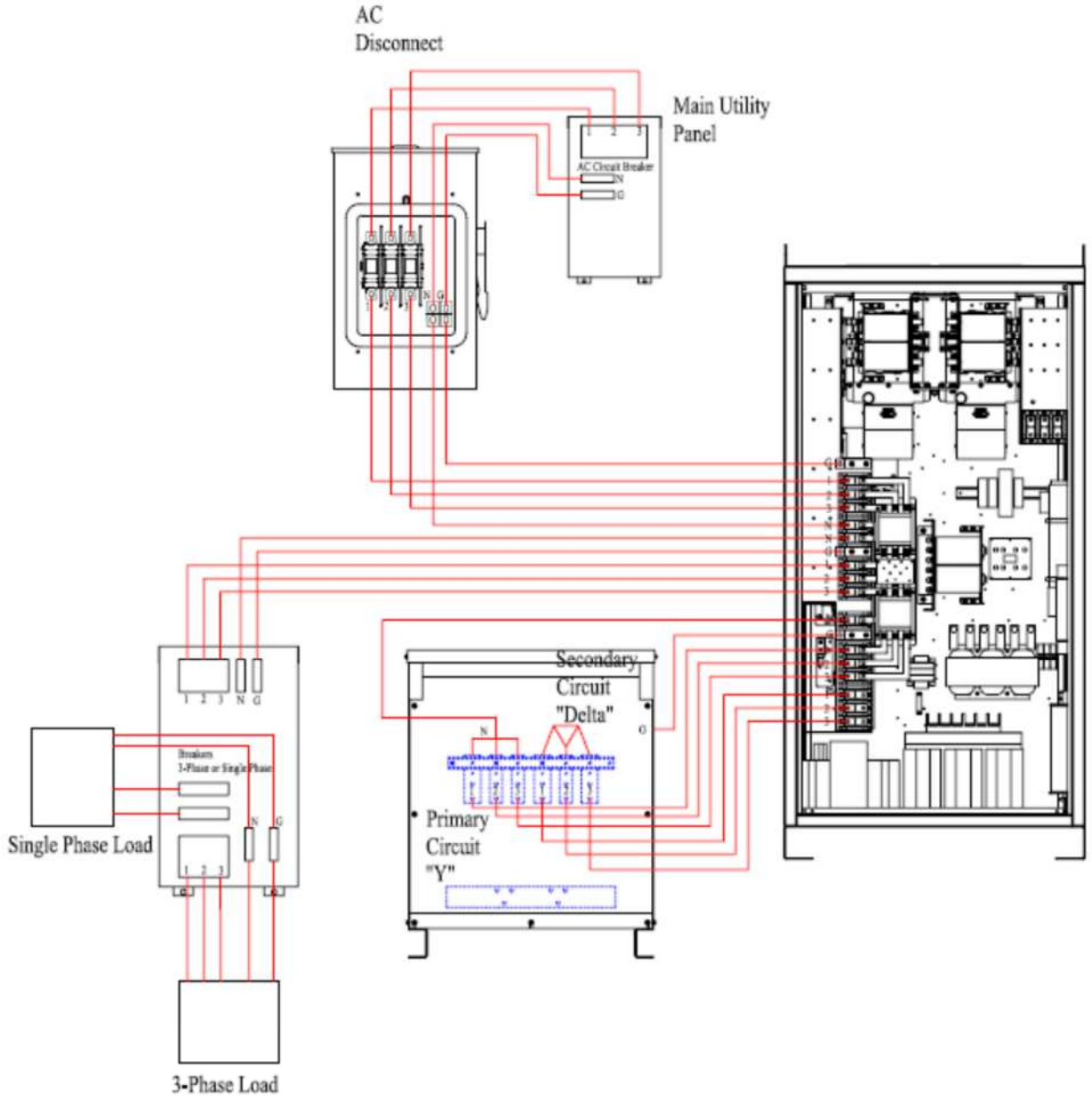


Figure 5.4 - AC Wiring diagram with transformer and neutral connections

5.5.3 Installation with No Isolation Transformer and Without Neutral Connection

CAUTION: When the inverter is installed without an isolation transformer, the DC source may not be grounded. Attempting to ground the DC source when no isolation transformer is installed may damage the battery and the inverter and may cause a hazardous condition that puts personnel at risk of grave injury or death.

CAUTION: In systems without an isolation transformer, the DC source negative terminal will not be grounded. It will carry a high voltage relative to ground and must be treated as a live conductor.

IMPORTANT: The AC load port neutral connection must not be used in a system without an isolation transformer. If a load that is to be connected to the AC load port requires a neutral connection, an isolation transformer must be installed.

5.5.3.1 Systems that do not require an isolation transformer:

If a system has all of the following characteristics, the inverter may be installed without an isolation transformer.

- The DC source is floating with respect to ground: Neither the negative terminal, nor the positive terminal, nor any center point in a bi-polar configuration is grounded, nor does any other reference to ground exist that would result in a ground fault if any part of the DC source were grounded.
- The loads connected to the AC load port do not require a neutral connection.

Exception:
An inverter that will be installed in a stand-alone configuration only, and will not ever be connected to a utility source, may be installed with a grounded DC source without an isolation transformer if the following conditions are true:

- No connection is made to the AC grid port of the inverter.
- The inverter will be providing power to AC loads that do not require a neutral connection
- The AC loads have ground isolation rated for 600V. (The 3-phase output voltage of the inverter will not be a grounded 3-phase system.

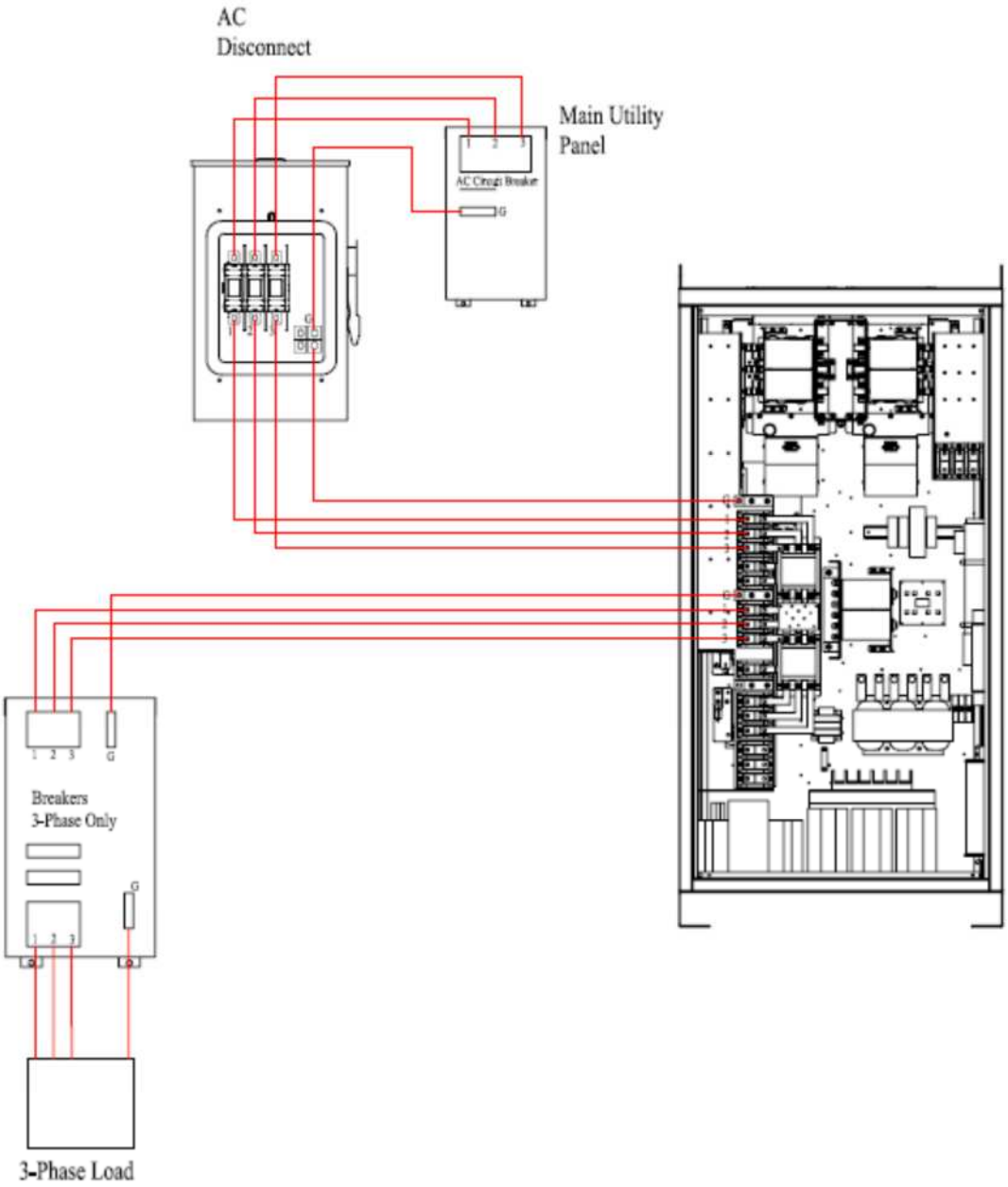


Figure 5.5 - AC wiring with no transformer and no neutral connections

5.6 Wiring for systems with multiple inverters

The GTIB 480-100 is designed to be stackable to build systems that support power levels up to 2MW. By combining multiple inverters in parallel, a system is created with the same functionality as a single inverter, but rated for higher power levels. The following sections outline the installation details for installing systems with multiple parallel inverters.

Regarding whether or not a system requires isolation transformers, see Section 0 “

Systems that require an isolation transformer:” and Section 5.5.3.1 “Systems that do not require an isolation transformer:” The same criteria apply for a system with multiple parallel inverters as for a single inverter.

For parallel inverters to act as one when in backup/stand-alone mode, a remote grid contactor must be installed that can isolate the entire group of inverters and the critical load from the grid. See sections 5.6.1 and 5.6.2 for detailed system wiring instructions.

5.6.1 With isolation transformers and neutral connection

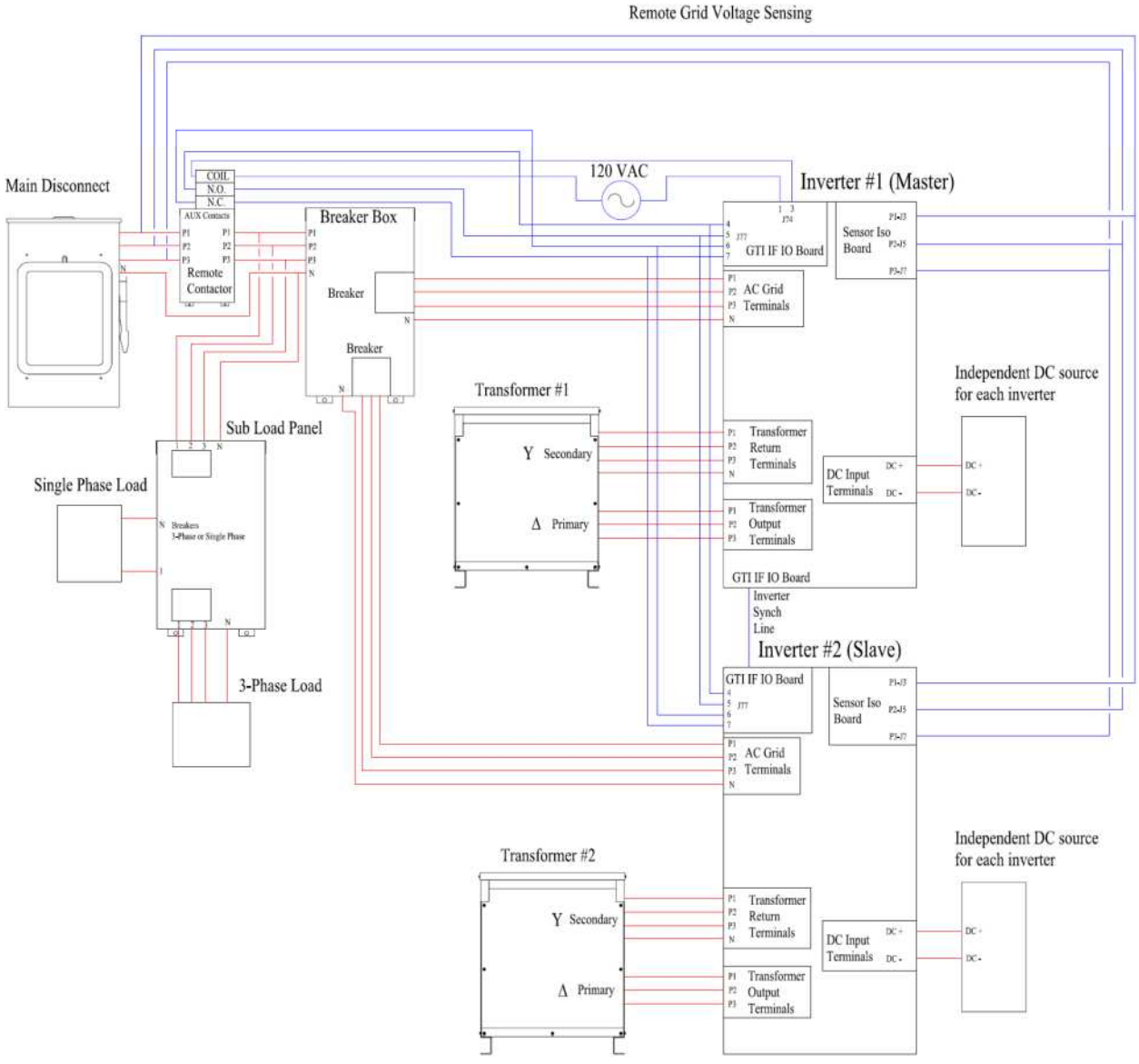


Figure 5.6 – Multiple parallel inverter installation diagram – with isolation transformers

Figure 5.6 shows the wiring connections for installing two inverters in parallel. The same pattern would be followed for multiple inverters. It is important to point out a couple of key points illustrated in the figure:

1. Each inverter is always fed with its own independent DC source. A single DC source can not be used to supply multiple parallel inverters at the same time.
2. Each inverter has its own isolation transformer. A single transformer can not be used for multiple inverters.

3. Each inverter must have its own set of remote grid voltage sensing lines installed, enabling each inverter to measure the grid voltage. See Section 5.6.4 for details on installing the remote voltage sensing lines.
4. Each inverter must be wired to two auxiliary contacts installed on the remote grid contactor, one normally open, and one normally closed. See Section 5.6.3.3 for details on installing these contactor feedback signals.
5. Each inverter is protected by its own independent circuit breaker.
6. A synchronization line must be installed between the master and the slaves. The synch line is designed to be "daisy-chained" from one slave to the next. See Section 5.6.5 for details on installation of the synchronization lines.
7. A contactor control signal is installed to a control relay in the master unit. See section 5.6.3.4 for installation details.

5.6.2 Without isolation transformers and neutral connection

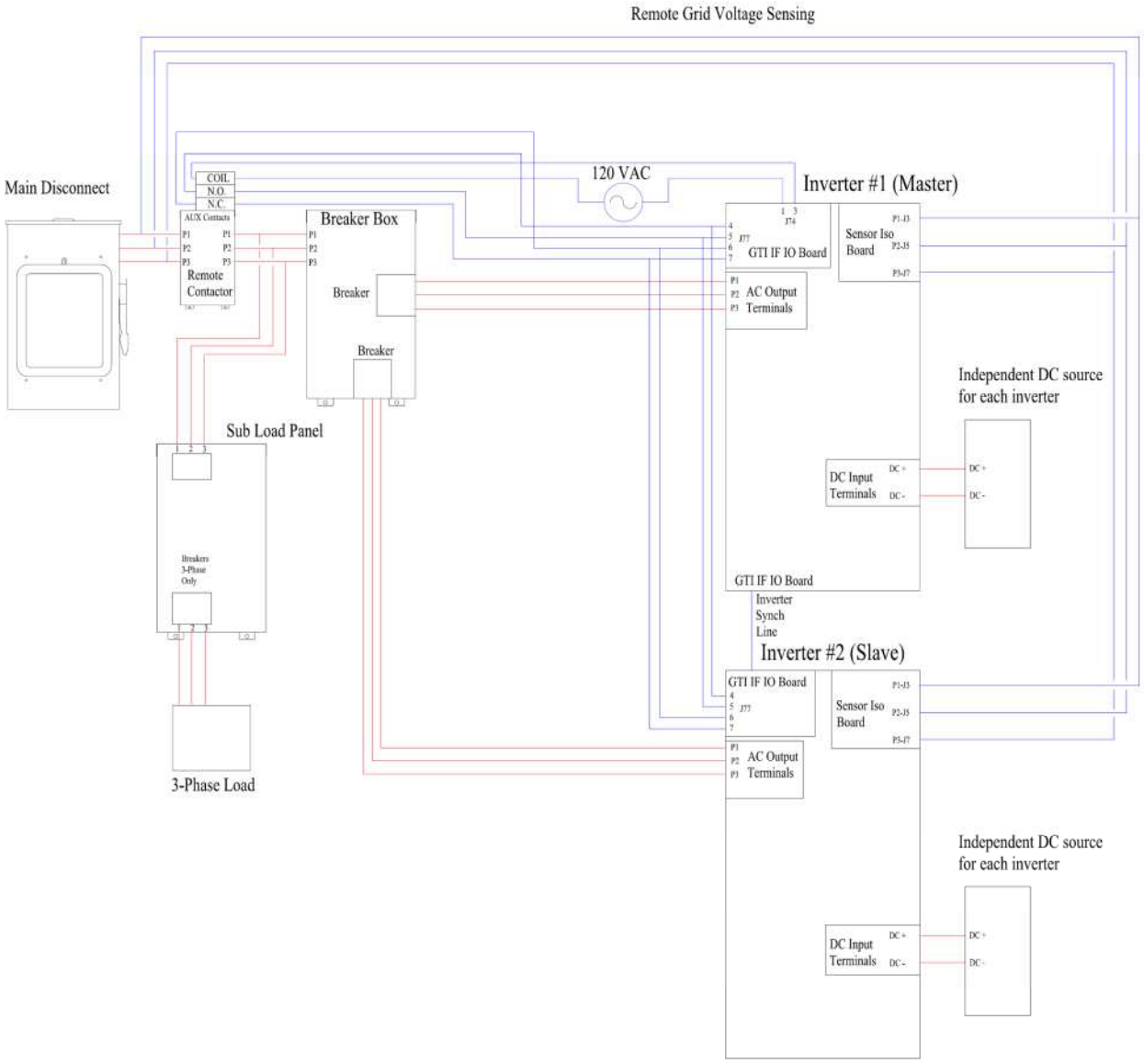


Figure 5.7 – Multiple parallel inverter installation diagram – without isolation transformer

Figure 5.7 shows the wiring connections for installing two inverters in parallel. The same pattern would be followed for multiple inverters. It is important to point out a couple of key points illustrated in the figure:

1. Each inverter is always fed with its own independent DC source. A single DC source can not be used to supply multiple parallel inverters at the same time.
2. Each inverter must have its own set of remote grid voltage sensing lines installed, enabling each inverter to measure the grid voltage. See Section 5.6.4 for details on installing the remote voltage sensing lines.
3. Each inverter must be wired to two auxiliary contacts installed on the remote grid contactor, one normally open, and one normally closed. See Section 5.6.3.3 for details on installing these contactor feedback signals.
4. Each inverter is protected by its own independent circuit breaker.
5. A synchronization line must be installed between the master and the slaves. The synch line is designed to be "daisy-chained" from one slave to the next. See Section 5.6.5 for details on installation of the synchronization lines.
6. A contactor control signal is installed to a control relay in the master unit. See section 5.6.3.4 for installation details.

5.6.3 Remote Contactor Requirements

5.6.3.1 Voltage Rating

The remote grid contactor should be rated for 480VAC or higher.

5.6.3.2 Current Rating

As is evident from Figure 5.6 and Figure 5.7, the remote grid contactor must be rated for the combined power of the AC loads connected to the system and the maximum charging current to be drawn by the inverters. The highest current experienced by the contactor will be during grid-tied operation when the loads are drawing their maximum current and the inverters are drawing their maximum charging power to charge batteries. For PV systems, this charging power is zero and can be neglected.

For systems with batteries installed, in order to calculate the maximum power that will be drawn by the inverters, multiply the maximum battery charging current by the maximum battery charging voltage. (See Section 7.10 for battery charging settings). Each inverter will never draw more than 95kW for battery charging.

5.6.3.3 Auxiliary Contacts Feedback

The remote grid contactor must have a normally-open AND a normally-closed auxiliary contact pairs for providing feedback to the inverters. Any inverter that fails to have both feedback signals installed and working properly will not operate and export power to the grid.

As shown in Figure 5.6 and Figure 5.7, the auxiliary contacts get wired to terminals 4-7 on header number J77 on the GTI interface I/O board located on the inside of the door of the inverter, in each inverter in the system. The normally-open contact should be wired between terminals 4 and 5, and the normally-closed contact should be wired between terminals 6 and 7, as shown in Figure 5.8.

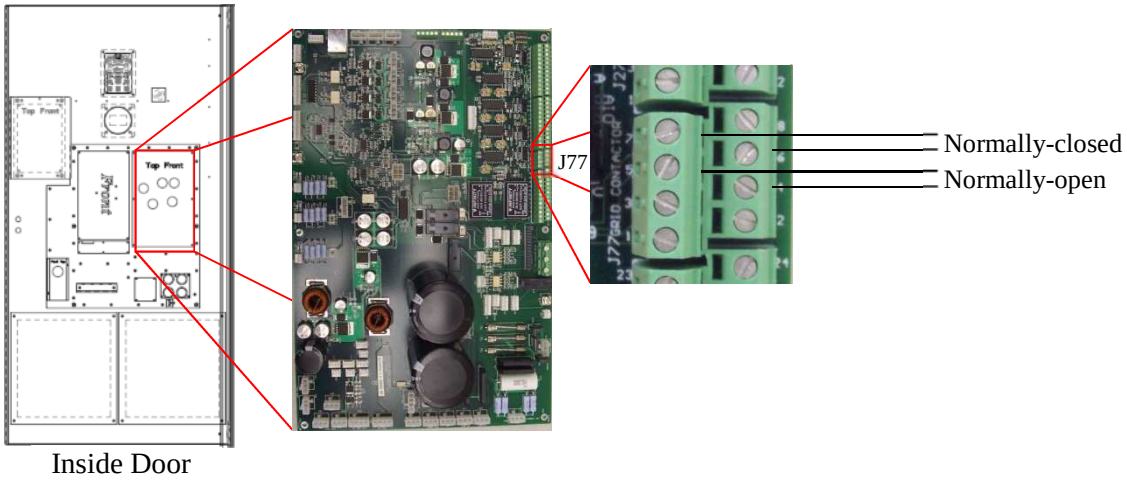


Figure 5.8 – Remote contactor feedback signal installation

5.6.3.4 Contactor Control Signal

As shown in Figure 5.6 and Figure 5.7, the remote contactor control signal is wired to the master inverter on terminals 1 and 3 of header J74 on the GTI interface I/O board located on the inside of the door of the inverter, as shown in Figure 5.9.

The remote contactor control circuit on the GTI interface I/O board is a dry contact relay rated for 8A at 250VAC. This circuit can be used either to close a control circuit that directly powers the closing coil of the remote contactor, or it can be used to close a control circuit that controls a remote relay which closes the remote contactor coil circuit.

Wire sizing:
Wiring for this circuit should be sized appropriately to handle the current required for the chosen implementation, taking into consideration the distance from the master inverter to the remote contactor.

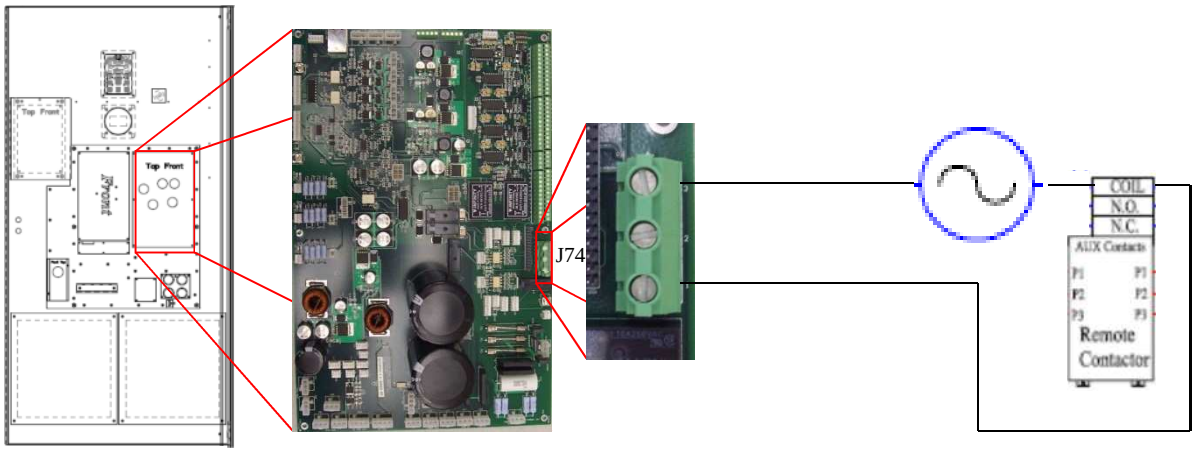
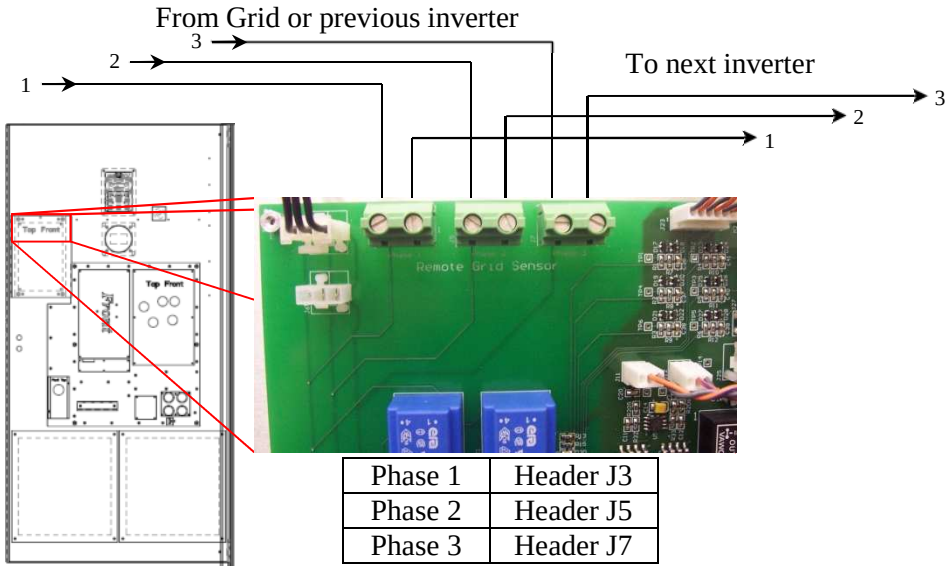


Figure 5.9 – Remote contactor control signal installation

5.6.4 Remote grid voltage sensing

As shown in Figure 5.6 and Figure 5.7, connections must be made from each grid phase, on the utility side of the remote grid contactor, to the 3 terminal blocks at the top of the Voltage Isolation Board, J3, J5,

and J7. The Voltage Isolation Board is located on the inside of the main inverter door as shown in Figure 5.10. The terminal blocks all have two poles so that the grid voltage lines can be "daisy-chained" from one inverter to another.



Phase 1	Header J3
Phase 2	Header J5
Phase 3	Header J7

Figure 5.10

Wire sizing:
Wiring used for grid voltage sensing carries < 100mA of current. It is not necessary to use large gauge wire for this circuit. See Section 5.1.3.3 for wire sizing recommendations.

5.6.5 Inverter synchronization signals

As shown in Figure 5.6 and Figure 5.7, a pair of synchronization signals must be installed that link all of the inverters in the system. This allows the inverters to operate in unison as one higher-power inverter in backup modes. Figure 5.11 shows the installation of these synchronization signals. As with the voltage sensing wiring, the synchronization signals are designed to be "daisy-chained" from one unit to the next until all units are connected.

The synchronization signal outputs are terminals 2-5 and terminals 14-17on header J76 on the GTI interface I/O board which is located on the inside of the door of the inverter. Terminals 2 and 14 are the same electrical connection, as are terminals 3 and 15, etc. The "Master" unit does not have to be physically at the end of the daisy chain. The chain can be set up with the inverters in any order.

Sync Signal 1	Signal 1	Terminals 2 and 14	J76
	Return 1	Terminals 3 and 15	
Sync Signal 2	Signal 2	Terminals 4 and 16	
	Return 2	Terminals 5 and 17	

Table 5.3 – Synchronization Signal Connections

Selecting the "Master" unit:
The master unit is selected by installing the master jumper cable, shown in Figure 5.11, between J40 and J46 on the GTI interface I/O board in the unit that is to be master.

Important: Make sure that only one inverter has the master jumper cable installed. All other inverters in the system are “Slave” units and should have this jumper removed.

To change which unit is the master two things must be done, with the entire system powered down.

1. Move the master jumper from the old master unit to the new master unit.
2. Un-install the remote contactor control circuit from the old master and install it in the new master

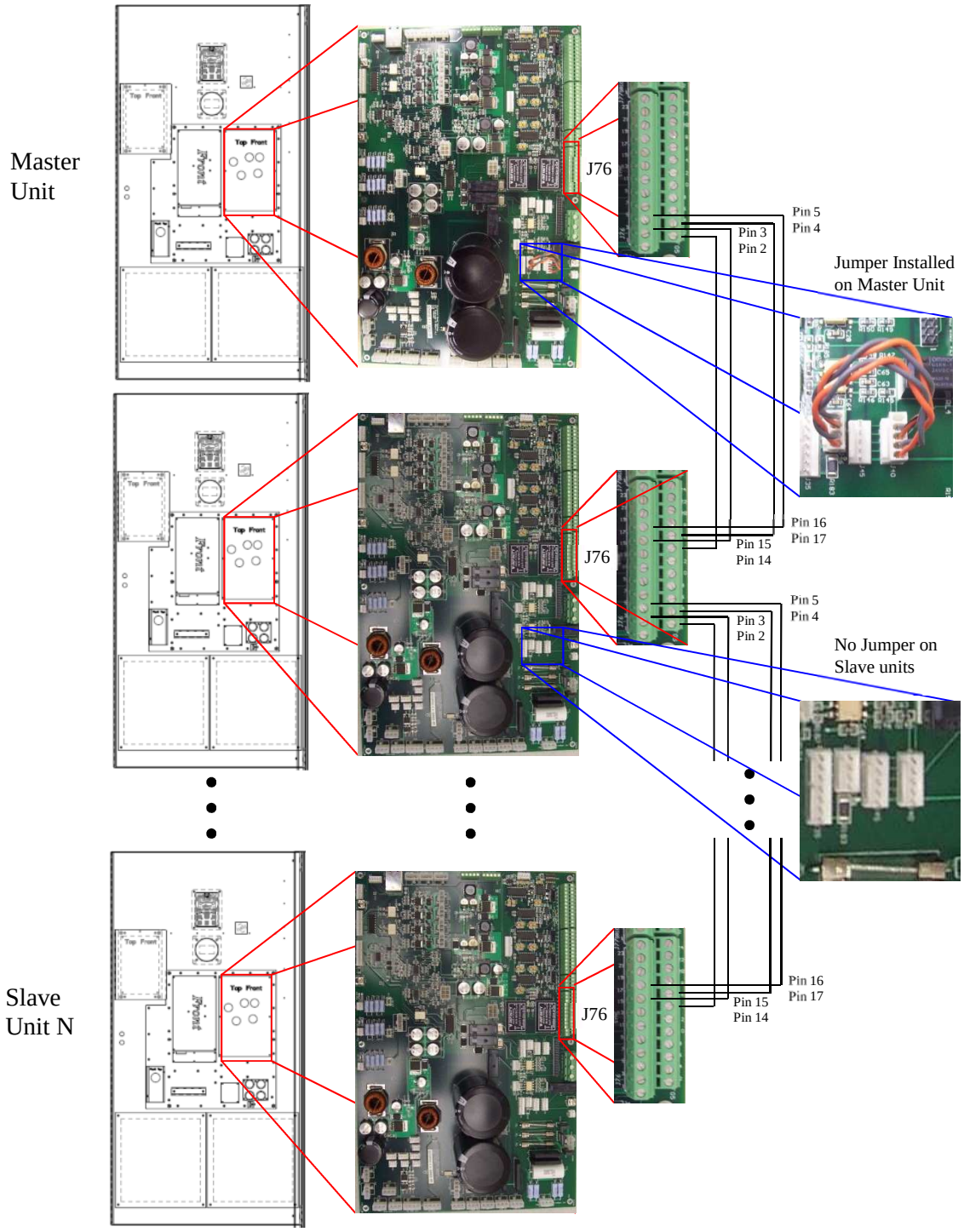


Figure 5.11 – Synchronization signal wire installation

5.7 **Wire Routing**

Cable tie mounting locations are provided along the pathways shown. Pathways provided for control wiring are shown in blue; pathways for power wiring are shown in red. When installing any wiring, use cable ties to hold wires and wire bundles firmly along the illustrated pathways.

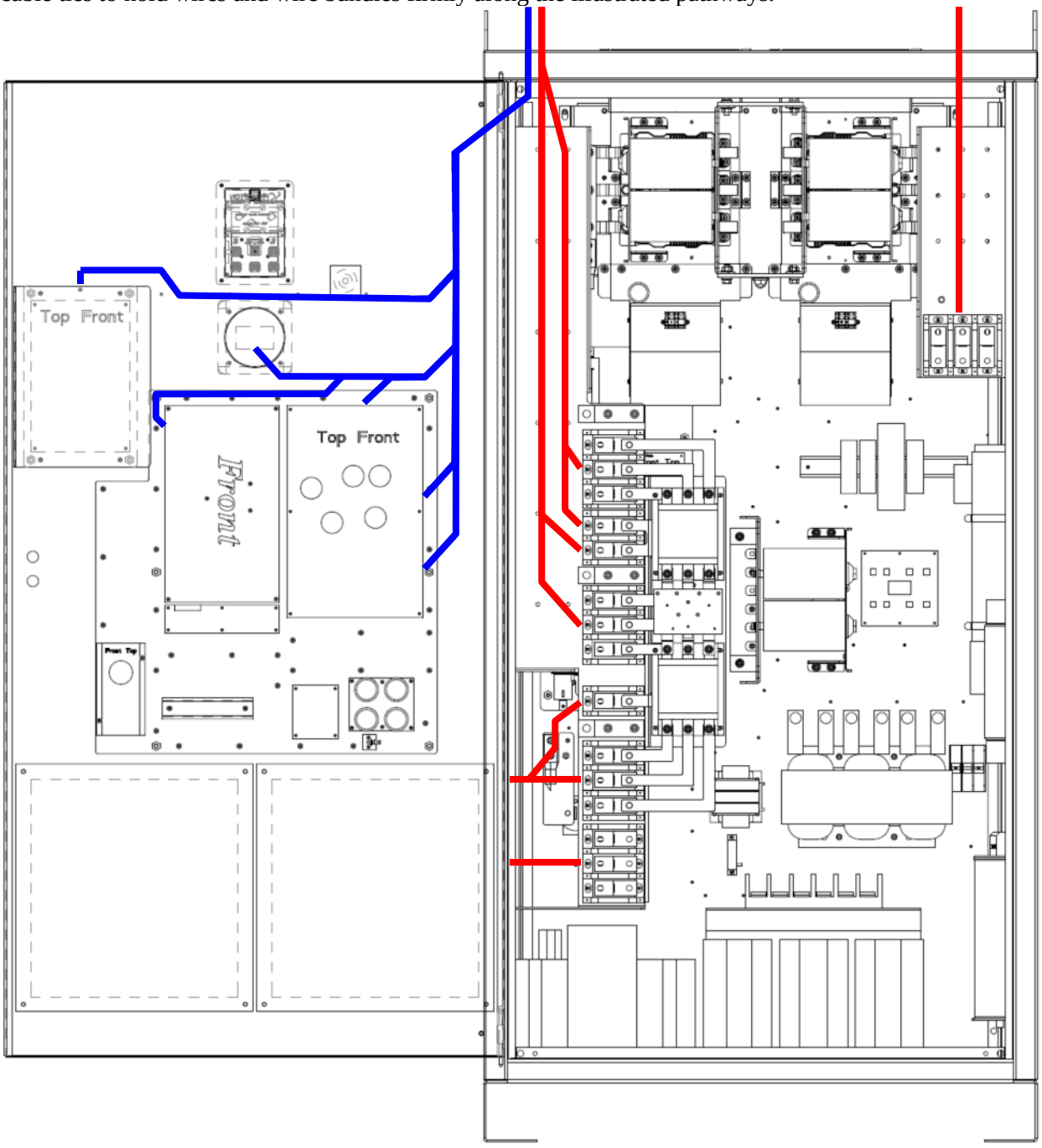


Figure 5.12 – Power and control wire routing

6 Commissioning Sequence

Important: See Section 7.11 for instructions relating to adjusting UL-1741 anti-islanding parameters

6.1 Single Grid-Connected Systems

6.1.1 Wiring checklist

√	Item	Info
℃	System ground (Grid port ground terminal or other ground terminal)	Required
℃	AC Grid disconnect/circuit breaker	Required
℃	AC Grid Port wiring (3 or 4-wire) (abc phase sequence required)	Required
℃	DC circuit disconnect	Required
℃	DC port wiring	Required
℃	DC circuit equipment ground	Required
℃	DC circuit protection	Optional
℃	DC Pre-Charge circuit	Optional
℃	Load Port wiring (3 or 4-wire)	Required for backup loads
℃	Load circuit equipment ground	Required for backup loads
℃	Transformer wiring (4-wire grid side, 3-wire inverter side)	Required for Transformer
℃	Transformer enclosure ground	Required for Transformer
℃	Analog/Digital I/O wiring	Optional
℃	Modbus Communication wiring	Optional

6.1.2 Commissioning Checklist

√		Item	Info
All Systems			
℃		Open AC Disconnect	
℃		Open DC Disconnect	
℃		Open Load Disconnect or Main Breaker (if installed)	
℃		Close AC Disconnect and/or circuit breaker, applying AC power to the inverter.	*The sounds of internal contactors closing may follow seconds after applying power. This is normal.*
℃		Verify proper LCD display	confirms proper control system power-up
℃		Verify web user interface connectivity (if used)	
℃		Verify Modbus communication connectivity (if used)	
℃		Verify Analog input control signal functionality (if used)	*Verify that analog input voltages read properly in the corresponding* **[AIx Signal Val]** *parameters. See Section* 0 *for details.*
℃		Verify AC grid voltage is within anti-islanding parameters (See Section 7.11.) by viewing the grid voltage monitoring parameters (See Section 7.8)	
℃		Close Load Disconnect and Main Breaker (if load installed)	

☐		Verify proper load operation (if load installed)	
☐		Close Pre-Charge DC Source Breaker/Relay (if Pre-Charge Control circuit used) – Wait a minimum of 20 seconds prior to applying Main DC power to the inverter (next step)	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power to the Pre-Charge Control Input*
☐		Close DC Disconnect and/or circuit breaker, applying DC power to the inverter.	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power (if Pre-Charge circuit not used in previous step)*
☐		Verify proper DC voltage by viewing the DC voltage monitoring parameter (See Section 7.8).	*If voltage reads zero, the DC polarity may be reversed.*
Battery Systems (For PV systems, skip to "PV Systems")			
☐		Use control method of choice to set **[Power Command]** to 0. (See Section 7.10)	*This commands the system to charge the battery.*
☐		Review battery charging settings in Section 7.10 carefully. Ensure that charging voltages, charging current limits, temperature settings and other settings are safe for the battery in use.	
☐		Start the inverter by pressing the "Start" button on the front panel interface or in the web UI.	*Depending on the state of charge of the battery and the battery charging settings, the inverter will typically start operating at this point, confirmed by an audible sound. If the battery is fully charged, the inverter may simply enter the Idle charge state, which will be evidenced by the system status on the LCD display changing to "Checking". No sound will be heard.*
☐		Confirm proper battery charging voltages and currents through the monitoring parameters. (Section 7.8).	
☐		Confirm power export to grid by changing **[Power Command]** to a positive number.	*Inverter will stop charging the battery and begin exporting power to the grid.*
PV Systems (For battery systems, skip to "Backup Systems"			
☐		Once DC power is applied to the inverter, it will begin operating automatically.	*If there is sufficient power to operate, the inverter will export power to the grid. If not, the inverter will wait for sufficient power to be available.*
☐		Monitor DC voltage and current and verify proper power export based on present irradiance.	
Backup Systems (For systems with no backup loads installed, checklist complete)			
☐		While inverter is operating, open AC disconnect and/or circuit breaker, disconnecting the inverter from the grid. This will cause the inverter to switch to backup mode.	*There will be the sound of contactors operating, a brief pause in the sound of the inverter operating, and then operation will continue. The inverter sound may change due to a change in power throughput.*
☐		Confirm proper load operation.	*The loads are now being powered by the DC source, through the inverter. They should operate normally. If there is insufficient DC power to feed the loads, the inverter will shut down, and try to operate again in 5 minutes. If this happens in a battery system, the cause*

			is that the battery is being drawn down to the minimum discharge voltage programmed by the user.
℃		Re-close the AC Disconnect and/or circuit breaker, re-applying AC power to the inverter.	
℃		Confirm inverter switches loads back to grid power after 5 seconds. (Inverter will stop operating at this point)	*The sound of contactors operating will confirm the switch-over from off-grid mode to on-grid mode.*
℃		Confirm the inverter begins operating again in 5 minutes.	*Due to UL-1741 regulations, the inverter may not interface with the grid until the grid voltage is within programmed specifications for 5 minutes.*

6.2 Single Stand-Alone Systems (Not Grid Connected)

6.2.1 Wiring checklist

√	Item	Info
℃	System ground (DC port ground terminal or other ground terminal)	Required
℃	DC circuit disconnect	Required
℃	DC port wiring	Required
℃	DC circuit equipment ground	Required
℃	DC circuit protection	Optional
℃	DC Pre-Charge circuit	Optional
℃	Load Port wiring (3 or 4-wire)	Required
℃	Load circuit equipment ground	Required
℃	Transformer wiring (4-wire grid side, 3-wire inverter side)	Required for Transformer
℃	Transformer enclosure ground	Required for Transformer
℃	Analog/Digital I/O wiring	Optional
℃	Modbus Communication wiring	Optional

6.2.2 Commissioning Checklist

√		Item	Info
All Systems			
℃		Open DC Disconnect	
℃		Open Load Disconnect or Main Breaker (if installed)	
℃		Close Pre-Charge DC Source Breaker/Relay (if Pre-Charge Control circuit used) – Wait a minimum of 20 seconds prior to applying Main DC power to the inverter (next step)	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power to the Pre-Charge Control Input*
℃		Close DC Disconnect	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power (if Pre-Charge circuit not used in previous step)*
℃		Verify proper LCD display once control system completes startup sequence.	*Once the DC voltage remains solidly above 350VDC, the control system will complete its startup sequence.*
℃		Verify proper DC voltage by viewing the DC voltage monitoring parameter (See	*If voltage reads zero, the DC polarity may be reversed.*

		Section 7.8).	
☐		Verify web user interface (Web UI) connectivity (if used)	
☐		Verify Modbus communication connectivity (if used)	
☐		Verify Analog input control signal functionality (if used)	*Verify that analog input voltages read properly in the corresponding* **[AIx Signal Val]** *parameters. See Section* 0 *for details.*
☐		Close Load Disconnect and Main Breaker	
		Start the inverter by pressing the "Start" button on the front panel interface or in the Web UI.	
☐		Verify proper load operation.	*The loads are now being powered by the DC source, through the inverter. They should operate normally. If there is insufficient DC power to feed the loads, the inverter will shut down, and try to operate again in 5 minutes. If this happens in a battery system, the cause is that the battery is being drawn down to the minimum discharge voltage programmed by the user.*

6.3 Grid-Connected Systems with Multiple Parallel Inverters.

6.3.1 Wiring checklist

√	Item	Info
☐	System ground (Grid port ground terminal or other ground terminal)	Required
☐	Main AC grid disconnect	Required
☐	Remote grid contactor	Required
☐	Inverter synchronization signals to all inverters	Required
☐	Master unit wire jumper installed on master unit only	Required
☐	Remote grid contactor control circuit to master inverter	Required
☐	Remote grid contactor feedback circuits to all inverters	Required
☐	Remote grid sensing wires installed on all inverters	Required
☐	Dedicated AC circuit breaker for each inverter	Required
☐	AC Load Port wiring (3 or 4-wire) to all inverters (identical abc phase sequence required for all inverters)	Required
☐	DC circuit disconnect for each DC source (1 per inverter)	Required
☐	DC port wiring for each inverter	Required
☐	DC circuit equipment grounds	Required
☐	DC circuit protection for each inverter	Optional
☐	DC Pre-Charge circuit for each inverter	Optional
☐	Load sub-panel wiring (3 or 4-wire)	Required for backup loads
☐	Load circuit equipment ground	Required for backup loads
☐	Transformer wiring (4-wire grid side, 3-wire inverter side) for each inverter	Required for Transformers
☐	Transformer enclosure grounds	Required for Transformers
☐	Analog/Digital I/O wiring	Optional
☐	Modbus Communication wiring	Optional

6.3.2 Commissioning Checklist

√		Item	Info
All Systems			
℃		Open main AC Disconnect	
℃		Open DC Disconnects	
℃		Open Load Disconnect or Main Breaker (if installed)	
℃		Open all individual AC circuit breakers	
℃		Close main AC Disconnect and/or circuit breaker, applying AC power to the inverters.	*The remote grid contactor may close seconds after AC power is applied.*
℃		Verify proper LCD display on each inverter.	*Although each individual inverter's AC circuit breaker is open, control power is supplied through the remote grid sensing wiring.*
℃		Verify web user interface connectivity (if used) with the master unit	
℃		Verify Modbus communication connectivity (if used) with the master unit.	
℃		Verify Analog input control signal functionality (if used) on the master unit	*Verify that analog input voltages read properly in the corresponding* **[AIx Signal Val]** *parameters. See Section* 0 *for details.*
℃		Verify AC grid voltage is within anti-islanding parameters (See Section 7.11.) by viewing the grid voltage monitoring parameters (See Section 7.8)	
℃		Close Load Disconnect and Main Breaker (if load installed)	
℃		Verify proper load operation (if load installed)	
℃ A		Close AC circuit breaker for master inverter (On subsequent passes through this checklist, these steps will be performed on the next inverter in the system, not on the master inverter. I.e. inverter #2, then #3 and so on.)	*This is the first of a set of repeated steps, performed once for each inverter in the system. Each time through these steps, one more inverter will be brought online, until all inverters in the system are online.*
℃		Close Pre-Charge DC Source Breaker/Relay (if Pre-Charge Control circuit used) – Wait a minimum of 20 seconds prior to applying Main DC power to the inverter (next step)	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power to the Pre-Charge Control Input*
℃		Close DC Disconnect and/or circuit breaker, applying DC power to the master inverter. (Or on inverter #2, #3, etc for subsequent passes through this checklist)	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power (if Pre-Charge circuit not used in previous step)*
℃		Verify proper DC voltage by viewing the DC voltage monitoring parameter (See Section 7.8).	*If voltage reads zero, the DC polarity may be reversed.*
Battery Systems (For PV systems, skip to "PV Systems")			

℃		Use control method of choice to set **[Power Command]** to 0 in the master unit. (See Section 7.10) The command is always issued to the master unit, regardless of which inverter is being tested. Always set the **[Power Command]** parameter on the master unit on every pass through these steps.	*This commands the system to charge the battery.*
℃		Review battery charging settings in Section 7.10 carefully. Ensure that charging voltages, charging current limits, temperature settings and other settings are safe for the battery in use.	
℃		Start the inverter by pressing the "Start" button on the front panel interface on the master inverter or in the web UI (which is connected to the master unit). The start button is always pressed on the master unit, regardless of which inverter is being tested.	*Depending on the state of charge of the battery and the battery charging settings, the inverter will typically start operating at this point, confirmed by an audible sound. If the battery is fully charged, the inverter may simply enter the Idle charge state, which will be evidenced by the system status on the LCD display changing to "Checking". No sound will be heard.* *When multiple inverters are online, all of them will charge their own batteries independently at this time.*
℃		Confirm proper battery charging voltages and currents through the monitoring parameters. (Section 7.8).	
℃		Confirm power export to grid by changing **[Power Command]** to a positive number that can be supported by as many inverters as are present active. *** The first time through these steps, only the master is active, each additional time through the steps, an additional inverter will be online, and will share the power capacity equally with the other inverters in the system.	*Inverter will stop charging the battery and begin exporting power to the grid. When more than one inverter is online, all the inverters will export an equal portion of power to the grid.*
℃		Press the Stop/Reset button on the master unit, stopping the inverter(s). Go back to the highlighted step in the check list, marked with the letter A and repeat, activating an additional inverter each time, until all inverters in the system have been tested.	
PV Systems (For battery systems, skip to "Backup Systems"			
℃		Once DC power is applied to the inverter, it will begin operating automatically.	*If there is sufficient power to operate, the inverter will export power to the grid. If not, the inverter will wait for sufficient power to be available.*
		Monitor DC voltage and current and verify	

		proper power export based on present irradiance.	
☐		Go back to the highlighted step in the check list, marked with the letter A and repeat, activating an additional inverter each time until all inverters in the system have been tested.	
Backup Systems (For systems with no backup loads installed, checklist complete)			
☐		Once all inverters in the system have been activated, press stop on the master unit to shut down the inverters.	*There will be the sound of contactors operating, a brief pause in the sound of the inverter operating, and then operation will continue. The inverter sound may change due to a change in power throughput.*
☐		Open the main AC Disconnect	
☐		Make sure the Load Disconnect or breaker is open.	
☐		Press start on the master unit to activate the system in backup/stand-alone mode.	
☐		Confirm that all inverters activate by listening to each one in turn and confirming the audible operating sound.	
☐		Press stop on the master unit to turn off the inverters.	
☐		Close the Load Disconnect or breaker.	
☐		Re-start the system by pressing start on the master unit.	
☐		Confirm proper load operation.	*The loads are now being powered by the DC sources, through the inverters. They should operate normally. If there is insufficient DC power to feed the loads, the inverters will shut down, and try to operate again in 5 minutes. If this happens in a battery system, the cause is that the batteries are being drawn down to the minimum discharge voltages programmed by the user..*
☐		Re-close the Main AC Disconnect and/or circuit breaker, re-applying AC power to the inverter system.	
☐		Confirm inverter switches loads back to grid power after 5 seconds by closing the remote grid contactor. (Inverters will stop operating at this point)	
☐		Confirm the inverters begin operating again in 5 minutes.	*Due to UL-1741 regulations, the inverters may not interface with the grid until the grid voltage is within programmed specification for 5 minutes.*
☐		While the inverters are running, open the Main AC Disconnect. Confirm the remote contactor opens, switching the system into backup/standalone mode.	
☐		Confirm proper load operation.	

6.4 Stand-Alone Systems with Multiple Parallel Inverters.

6.4.1 Wiring checklist

√	Item	Info
℃	System ground (Grid port ground terminal or other ground terminal)	Required
℃	Inverter synchronization signals to all inverters	Required
℃	Master unit wire jumper installed on master unit only	Required
℃	Dedicated AC circuit breaker for each inverter	Required
℃	AC Load Port wiring (3 or 4-wire) to all inverters	Required
℃	DC circuit disconnect for each DC source (1 per inverter)	Required
℃	DC port wiring for each inverter	Required
℃	DC circuit equipment grounds	Required
℃	DC circuit protection for each inverter	Optional
℃	DC Pre-Charge circuit for each inverter	Optional
℃	Load sub-panel wiring (3 or 4-wire)	Required
℃	Load circuit equipment ground	Required
℃	Transformer wiring (4-wire grid side, 3-wire inverter side) for each inverter	Required for Transformers
℃	Transformer enclosure grounds	Required for Transformers
℃	Analog/Digital I/O wiring	Optional
℃	MODBUS Communication wiring	Optional

6.4.2 Commissioning Checklist

√		Item	Info
All Systems			
℃		Open main AC Disconnect	
℃		Open DC Disconnects	
℃		Open Load Disconnect or Main Breaker (if installed)	
℃		Open all individual AC circuit breakers	
℃		Close main AC Disconnect and/or circuit breaker, applying AC power to the inverters.	*The remote grid contactor may close seconds after AC power is applied.*
℃		Verify proper LCD display on each inverter.	*Although each individual inverter's AC circuit breaker is open, control power is supplied through the remote grid sensing wiring.*
℃		Verify web user interface (Web UI) connectivity (if used) with the master unit	
℃		Verify MODBUS communication connectivity (if used) with the master unit.	
℃		Verify Analog input control signal functionality (if used) on the master unit	*Verify that analog input voltages read properly in the corresponding* **[AIx Signal Val]** *parameters. See Section* 0 *for details.*
℃		Verify AC grid voltage is within anti-islanding parameters (See Section 7.11.) by viewing the grid voltage monitoring parameters (See Section 7.8)	

☐C		Close Load Disconnect and Main Breaker (if load installed)	
☐C		Verify proper load operation (if load installed)	
☐C A		Close AC circuit breaker for master inverter (On subsequent passes through this checklist, these steps will be performed on the next inverter in the system, not on the master inverter. I.e. inverter #2, then #3 and so on.)	*This is the first of a set of repeated steps, performed once for each inverter in the system. Each time through these steps, one more inverter will be brought online, until all inverters in the system are online.*
☐C		Close Pre-Charge DC Source Breaker/Relay (if Pre-Charge Control circuit used) – Wait a minimum of 20 seconds prior to applying Main DC power to the inverter (next step)	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power to the Pre-Charge Control Input*
☐C		Close DC Disconnect and/or circuit breaker, applying DC power to the master inverter. (Or on inverter #2, #3, etc for subsequent passes through this checklist)	*The sounds of DC Pre-charge contactor operating may follow momentarily after applying DC power (if Pre-Charge circuit not used in previous step)*
☐C		Verify proper DC voltage by viewing the DC voltage monitoring parameter (See Section 7.8).	*If voltage reads zero, the DC polarity may be reversed.*
Battery Systems (For PV systems, skip to "PV Systems")			
☐C		Use control method of choice to set **[Power Command]** to 0 in the master unit. (See Section 7.10) The command is always issued to the master unit, regardless of which inverter is being tested. Always set the **[Power Command]** parameter on the master unit on every pass through these steps.	*This commands the system to charge the battery.*
☐C		Review battery charging settings in Section 7.10 carefully. Ensure that charging voltages, charging current limits, temperature settings and other settings are safe for the battery in use.	
☐C		Start the inverter by pressing the "Start" button on the front panel interface on the master inverter or in the web UI (which is connected to the master unit). The start button is always pressed on the master unit, regardless of which inverter is being tested.	*Depending on the state of charge of the battery and the battery charging settings, the inverter will typically start operating at this point, confirmed by an audible sound. If the battery is fully charged, the inverter may simply enter the Idle charge state, which will be evidenced by the system status on the LCD display changing to "Checking". No sound will be heard.* *When multiple inverters are online, all of them will charge their own batteries independently at this time.*
☐C		Confirm proper battery charging voltages and currents through the monitoring	

		parameters. (Section 7.8).	
☐		Confirm power export to grid by changing **[Power Command]** to a positive number that can be supported by as many inverters as are present active. *** The first time through these steps, only the master is active, each additional time through the steps, an additional inverter will be online, and will share the power capacity equally with the other inverters in the system.	*Inverter will stop charging the battery and begin exporting power to the grid. When more than one inverter is online, all the inverters will export an equal portion of power to the grid.*
☐		Press the Stop/Reset button on the master unit, stopping the inverter(s). Go back to the highlighted step in the check list, marked with the letter A and repeat, activating an additional inverter each time, until all inverters in the system have been tested.	
PV Systems (For battery systems, skip to "Backup Systems"			
☐		Once DC power is applied to the inverter, it will begin operating automatically.	*If there is sufficient power to operate, the inverter will export power to the grid. If not, the inverter will wait for sufficient power to be available.*
		Monitor DC voltage and current and verify proper power export based on present irradiance.	
☐		Go back to the highlighted step in the check list, marked with the letter A and repeat, activating an additional inverter each time until all inverters in the system have been tested.	
Backup Systems (For systems with no backup loads installed, checklist complete)			
☐		Once all inverters in the system have been activated, press stop on the master unit to shut down the inverters.	*There will be the sound of contactors operating, a brief pause in the sound of the inverter operating, and then operation will continue. The inverter sound may change due to a change in power throughput.*
☐		Open the main AC Disconnect	
☐		Make sure the Load Disconnect or breaker is open.	
☐		Press start on the master unit to activate the system in backup/stand-alone mode.	
☐		Confirm that all inverters activate by listening to each one in turn and confirming the audible operating sound.	
☐		Press stop on the master unit to turn off the inverters.	
☐		Close the Load Disconnect or breaker.	
☐		Re-start the system by pressing start on the master unit.	
☐		Confirm proper load operation.	*The loads are now being powered by the DC sources,*

			through the inverters. They should operate normally. If there is insufficient DC power to feed the loads, the inverters will shut down, and try to operate again in 5 minutes. If this happens in a battery system, the cause is that the batteries are being drawn down to the minimum discharge voltages programmed by the user..
° C		Re-close the Main AC Disconnect and/or circuit breaker, re-applying AC power to the inverter system.	
° C		Confirm inverter switches loads back to grid power after 5 seconds by closing the remote grid contactor. (Inverters will stop operating at this point)	
° C		Confirm the inverters begin operating again in 5 minutes.	*Due to UL-1741 regulations, the inverters may not interface with the grid until the grid voltage is within programmed specification for 5 minutes.*
° C		While the inverters are running, open the Main AC Disconnect. Confirm the remote contactor opens, switching the system into backup/standalone mode.	
° C		Confirm proper load operation.	

7 System Operation and Parameters

To help differentiate parameter names and display text from other text, this manual uses certain formatting conventions:

- Parameter names will appear **[Bold and In Brackets]**.
- Front Panel Interface text will appear in `Courier Font`.

The following symbols will be used to describe system parameters

Parameter Symbol	Description
Write-OPEN	Open Access Writeable Parameter. Operational parameter modifiable by all users.
Write-USER	User Access Writeable Parameter. Parameter configurable by the facility manager.
Write-FACTORY	Factory Access Writeable Parameter. Parameter accessible by Princeton Power's installation and field service technicians.
Read Only	Read-Only Parameter. Parameter cannot be modified by the user; it is updated internally.
Read	Not Readable. The system will always display this parameter as 0. Used for password parameters.
BIN	Binary parameter. Displayed as a string of 16 digits, each of which is a 0 or a 1. These parameters are edited one digit at a time.
CWR	Changeable While Running. This parameter value can be modified while the system is running.
AIn	Analog Input Mappable. Parameter can be mapped to a user analog input channel.
AOut	Analog Output Mappable. Parameter can be mapped to a user analog output channel.
DIn	Digital Input Mappable. Parameter can be mapped to a user digital input channel.
DOut	Digital Output Mappable. Parameter can be mapped to a user digital output channel.

7.1 Software Status

The following parameters contain version and setup information on the various pieces of software:

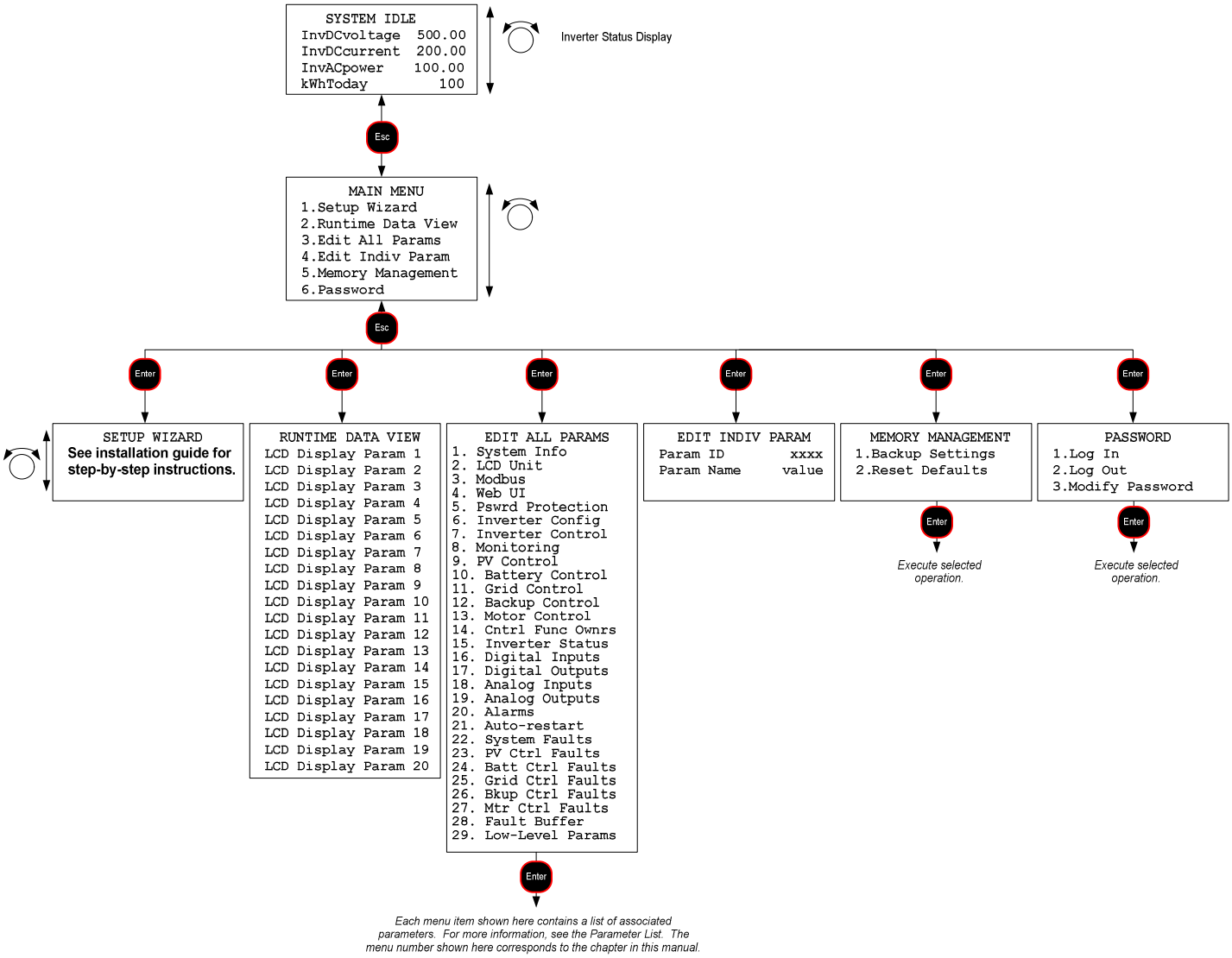
Parameter Name	Parameter #	Description
[FPGA Firmware V#]	101	Logic Firmware Version #
[DSP Firmware V#]	102	Processor Firmware Version #
[DSP Product Type]	103	Factory Product Code
[DSP kW Macro]	104	Firmware Build Kilowatt Level
[WebUI Driver V#]	105	Web User Interface Driver Version #
[WebUI Applet V#]	106	Web User Interface Java Applet Version #
[LCD Menu V#]	107	Front Panel User Interface Menu List Version #
[LCD Product Type]	108	Factory Product Code

[LCD Driver V#]	109	Front Panel User Interface Firmware Version #
[Setup Wizard Done]	110	= 1 if user has completed Setup Wizard

7.2 Front-Panel Interface

[LCD Display Param ID1] . . . [LCD Display Param ID20]

7.2.1 Menu Structure



7.2.2 Basic Operation

7.2.2.1 Navigation

The front panel interface shown here is used to view and change all system parameters. This interface can be used to configure the inverter and to control the inverter while it is running. The LCD screen displays either a list of menu options or a list of parameters at all times. Menu options or parameters are selected by scrolling to the desired item using the navigation knob and then pressing the "Enter" button. Pressing the "Esc" button will bring you back to the previous menu page or cancel the parameter change.

The parameters are organized into groups in a way that mirrors their organization in Section 7 in the user manual. For example, if a particular parameter is described in Section 0 of the manual, then that parameter will be found under menu selection 18 under the `View/Change Params` option on the front panel interface.

7.2.2.2 Inverter Status Screen/Home Screen

When the inverter is first powered-on, the LCD screen will display the Home Screen. This screen displays the present inverter status at the top, and the following four parameters:

1) **[Inverter DC Voltage]**
2) **[Inverter DC Current]**
3) **[Inverter AC Power]**
4) **[PV kWh Today]**

The display will always return to this home screen after 5 minutes of inactivity on the Front Panel Interface. The Home Screen can be accessed at any time by pressing "Esc" from the Main Menu.

7.2.2.3 Main Menu

The Main Menu is accessed by pressing "Esc" from the Home Screen. The Main Menu can also be accessed from any part of the menu structure by repeatedly pressing "Esc" until the Main Menu is reached again. Reminder: Pressing "Esc" while viewing the Main Menu will take you to the Home Screen and pressing "Esc" from the Home Screen will bring you back to the Main Menu.

The Main Menu contains a list of options. Scroll to the desired option using the navigation knob and press "Enter".

7.2.2.4 Editing Parameters

To edit any parameter, navigate to that parameter within the menu structure until the cursor arrow is next to the parameter you want, and press "Enter". If you have permission to edit that parameter at that time, the parameter value will begin blinking. Use the navigation knob to scroll the value of the parameter up or down to the desired value and then press "Enter" to save the new value. The message "`Parameter Downloaded`" will appear briefly if the new value is saved successfully. You can press "Esc" at any time while editing the value to abort the change, and the parameter will remain at its previous value.

You will not be allowed to edit certain parameters at certain times for a number of possible reasons:
1) The parameter is not allowed to be changed while the inverter is running
2) You have not entered a password appropriate for the level of access associated with that parameter
3) The parameter is read-only
4) The Front Panel Interface does not have "ownership" of the parameter (see section 23)

If you are not allowed to edit a parameter when you attempt to change it, a message will display briefly explaining the reason, and no changes will be made.

Editing Binary Parameters
A small number of system parameters are binary parameters, meaning that they are displayed as a string of 16 digits, each of which is a zero or a one. These parameters are edited one digit at a time. Select the parameter using the navigation knob and press "Enter". The first digit of the parameter that is changeable will begin blinking. Use the navigation knob to scroll the value of that digit to one (up) or zero (down). Then press "Enter" again to move to the next digit. Once you have reached the last digit, pressing "Enter" will save the new parameter value, and the message `Parameter Downloaded` will appear briefly if the new value is saved successfully. Pressing "Esc" at any point before this will abort the changes made to all digits, and the parameter will remain unchanged.

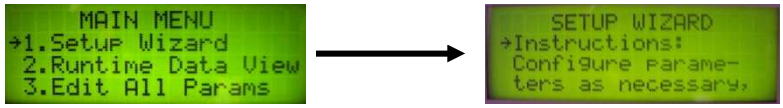
7.2.3 Setup Wizard

The Setup wizard provides the user with a quick way to configure the most commonly used inverter parameters. Most applications will not require further setup after the Setup Wizard is completed. The Setup Wizard can be accessed from both the Front Panel and the Web Interface. The instructions below apply to the Front Panel, though the procedure for the Web Interface is identical in most cases.

Operational Note: The inverter will not run until the Setup Wizard has been completed, unless it is preconfigured at the factory.

7.2.3.1 Navigating the Wizard

Selecting `Setup Wizard` from the `MAIN MENU` will take you to the first page of the Setup Wizard.



At the bottom of each screen is a list of options. Read and follow the instructions on each screen, scrolling up and down using the navigation knob, and choose one of the options at the bottom by pressing the `Enter` key. Pressing the `Esc` key at any time will bring you back to the `MAIN MENU`. Changes up to that point will be retained, so you will not have to redo them if you re-start the Setup Wizard. Scrolling the cursor past the last displayed line on the screen will scroll the contents of the screen.

7.2.4 Runtime Data Page

Selecting `Runtime Data View` from the main menu will take you to the Runtime Data Page, which displays a user-configurable list of system parameters at all times.

[LCD Display Param ID1]	Parameter #	201 . . . 220

	Type	Write-USER CWR
	Range	[0 . . . Maximum Parameter ID]
	Default	0

These parameters determine which parameter values are displayed on the Runtime Data Page. **[LCD Display Param ID1]** contains the parameter ID for the parameter that the user wants to display on the first line of the Runtime Data. **[LCD Display Param ID2]** contains the parameter ID for the parameter on line 2, and so on up to line 20. Any valid parameter ID may be entered into these parameters.

[LCD Indiv Param ID]	Parameter #	221
	Type	Write-USER CWR
	Range	[0 . . . Maximum Parameter ID]
	Default	0

[LCD Operation Timer]	Parameter #	222
	Type	Read Only
	Range	[0 . . . 32767]
	Default	0

7.2.5 Memory Management

Selecting `Memory Management` from the Main Menu will allow you either to save the current parameter settings or reset the parameters to their default settings. This feature is also available through the Web Interface, with the additional ability to save and name individual parameter profiles. Parameter settings will be automatically saved when the VSD starts running.

7.2.6 Password and User Access

Writeable parameters are grouped into three levels of access:

1) Open Access – Operational parameters modifiable by all users.
2) User Access – Parameters configurable by the facility manager.
3) Factory Access – Parameters for system commissioning and testing, accessible by Princeton Power's installation and field service technicians.

To view the password options, choose `Password` from the Main Menu. To unlock access to user- or factory-level parameters, choose `Log In` and enter in the appropriate password. Once user- or factory-level access has been granted, the user can modify the password for that level of access by selecting `Modify Passwords`. To revert back to Open Access, select `Log Out`.

7.3 MODBUS Interface

7.3.1 Introduction

The Modbus RTU protocol is an industrial communications and distributed control system to integrate PLCs, computers, terminals, and other monitoring, sensing, and control devices. Modbus is a Master-Slave communications protocol. The Master controls all serial activity by selectively polling one or more slave devices. The protocol provides for one master device and up to 247 slave devices on a common line.

Each device is assigned an address to distinguish it from all other connected devices. More information on the protocol standard can be found here:

http://www.Modbus.org/docs/Modbus_Application_Protocol_V1_1a.pdf
http://www.Modbus.org/docs/Modbus_over_serial_line_V1.pdf

The inverter allows the user to view and configure all system parameters using the Modbus interface over a serial hardware interface. The system supports three different hardware protocols: RS-232, the standard RS-485 half-duplex multidrop, and the modified RS-485 full-duplex multidrop protocol. The user must configure the communication parameters to match those of the Modbus master controller. The user must also properly configure the hardware connection on the I/O board.
"All Modbus registers are 16-bit signed integers, however most of the parameters are floating point numbers. To obtain the actual floating point value of a parameter, it's Modbus register value needs to be multiplied by the scale coefficient for that parameter. The scale coefficients of all parameters are provided in the Section 7.29 (Parameter List) in the column "Scale". For example, if a user reads a value of 5051 for Parameter 801 (Inverter AC Voltage) using Modbus, the actual value is 5051 x 0.1 = 505.1V."

7.3.2 Setup

7.3.2.1 Parameter Configuration

[Device ID]
[Baud Rate]
[Data Bits]
[Parity]
[Stop Bits]
[RS-232/485 Select]

Both RS-232 and RS-485 (full-duplex or half-duplex) standards are supported. In RS-232 and RS-485 full-duplex, the transmitter is on continuously. In RS-485 half-duplex, the transmitter is only powered when the device being polled is transmitting. After setting the **[RS-232/485 Select]** to choose the protocol being used, the protocols require that you specify four parameters: the **[Baud Rate]** of the transmission, the number of **[Data Bits]** encoding a character, the sense of the optional **[Parity]**, and the number of **[Stop Bits]**. Each transmitted character is packaged in a character frame that consists of a single start bit followed by the data bits, the optional parity bit, and the stop bit or bits.

[Device ID]	Parameter #	301
	Type	Write-USER
	Range	[1 . . . 247]
	Default	1

If the user installs multiple Slave devices in a RS-485 Modbus chain, each Slave will require a unique **[Device ID]** so the Master can communicate with it. Only one Slave is possible using RS-232, so this parameter should be set to 1 when using RS-232.

[Baud Rate]	Parameter #	302
	Type	Write-USER
	Range	[4800. . . 57600]
	Units	10 bps
	Default	38,400

[Baud Rate] is a measure of how fast data is moving between instruments that use serial communication. When setting this parameter, note that the units are 10 bps, not 1 bps, so if Modbus is used, the entered value should be the actual value divided by 10. If this parameter is configured using the keypad or Web Interface, the value should be entered without scaling.

[Data Bits]	Parameter #	303
	Type	Write-USER
	Range	7, 8
	Default	8

This is the number of bits transmitted per packet. Nearly all systems should be configured for 8 data bits.

[Parity]	Parameter #	304
	Type	Write-USER
	Range	0 No Parity 1 Odd Parity 2 Even Parity
	Default	0

An optional parity bit follows the data bits in the character frame. This bit is included as a simple means of error handling. It is typically disabled (no parity).

[Stop Bits]	Parameter #	305
	Type	Write-USER
	Range	1, 2
	Default	1

The last part of a character frame consists of 1 or 2 stop bits. 1.5 stop bits is not supported because this setting is only required if the port is configured for 5 data bits. Nearly all systems should be configured for 1 stop bit.

[RS-232/485 Select]	Parameter #	306
	Type	Write-USER
	Range	0 RS-232 1 RS-485
	Default	0

This parameter allows the user to select between RS-232 or RS-485 communication.

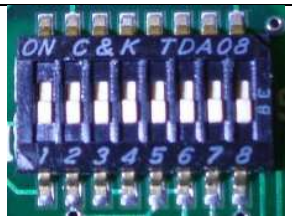
7.3.2.2 RS-232 Hardware Configuration

For RS-232, connect the following signals to J66 of the interface board:

RS-232 Signal Name	Pin #
TXD - Transmit	1
CTS - Clear to Send	2
RXD - Receive	3
RTS - Ready to Send	4
Signal Ground	5

For RS-232, configure the piano switches located on the I/O board as follows:

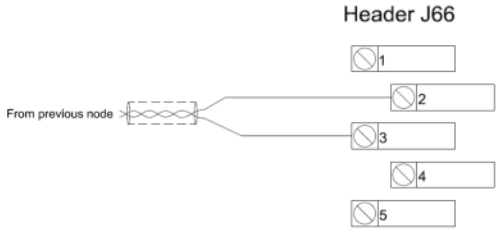
Switch	Position	Comments
1	Down (OFF)	
2	Down (OFF)	
3	Down (OFF)	No termination resistor
4	Down (OFF)	
5	Down (OFF)	No termination resistor
6	Down (OFF)	
7	Down (OFF)	
8	Down (OFF)	



7.3.2.3 Half-Duplex RS-485 Hardware Configuration

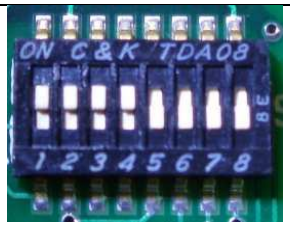
RS-485 is a multidrop protocol, which means more than two systems can be connected. Devices are connected in a daisy chain or "bus", which means that devices in the middle of the chain will have a pair of wires coming from the previous node and a pair of wires going to the next node. The devices at either end of the bus will have only one incoming pair and need to have signal termination installed.

Termination



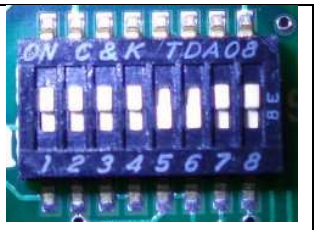
If the inverter is the only slave device on the Modbus communication bus, or if it is physically located at either end of the bus, the communication signals must be terminated. There are two ways to accomplish this.
(1) *Termination without bias:* For basic termination using on-board 120 Ω, the user can configure the piano switches on the I/O board as shown in the table below. The termination capacitor may be removed by setting switch 4 in the Down (OFF) position.

Switch	Position	Comments
1	Up (ON)	Shorts terminals 1 & 3
2	Up (ON)	Shorts terminals 2 & 4
3	Up (ON)	120 ohm termination
4	Up (ON)	Termination capacitor
5	Down (OFF)	
6	Down (OFF)	
7	Down (OFF)	
8	Down (OFF)	



(2) *Termination with bias:* For more robust termination with voltage bias, the user can configure the piano switches on the I/O board as shown in the table below. The termination capacitor may be removed by setting switch 4 in the Down (OFF) position.

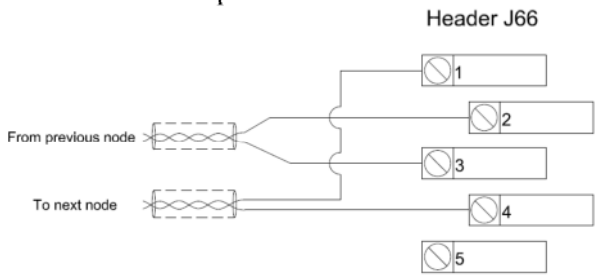
Switch	Position	Comments
1	Up (ON)	Shorts terminals 1 & 3
2	Up (ON)	Shorts terminals 2 & 4
3	Up (ON)	120 ohm termination
4	Up (ON)	Termination capacitor
5	Down (OFF)	
6	Down (OFF)	
7	Up (ON)	Voltage bias
8	Up (ON)	Voltage bias



Multidrop Connection

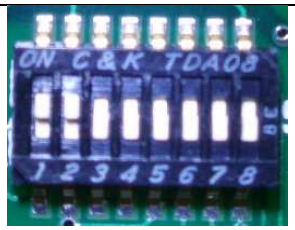
The figure below shows a half-duplex RS-485 connection for a device that is not located at either end of the bus. One differential signal is used for both transmit and receive. This corresponds to two pairs of wires, with each pair consisting of a (+) and (-) wire. One pair comes from the preceding node and one pair goes to the next node in the bus. The following signal connections are required:

Half-Duplex RS-485 Signal Name	Pin #
Negative (-)	1
Positive (+)	2
Negative (-)	3
Positive (+)	4
Signal GND	5



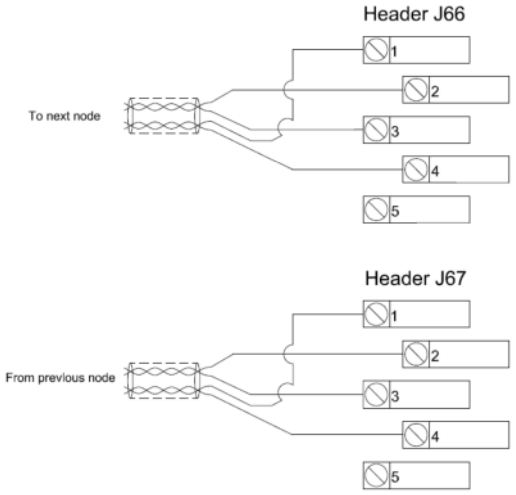
If there are multiple slave devices on the Modbus communication bus and the inverter is not physically located at either end of the bus, then set the switches as follows:

Switch	Position	Comments
1	Up (ON)	Shorts terminals 1 & 3
2	Up (ON)	Shorts terminals 2 & 4
3	Down (OFF)	No termination resistor
4	Down (OFF)	No termination capacitor
5	Down (OFF)	
6	Down (OFF)	
7	Down (OFF)	
8	Down (OFF)	



7.3.2.4 Full-Duplex RS-485 Hardware Configuration

Full-duplex RS-485 uses two differential signals, transmit and receive. This corresponds to four wires (TX+, TX-, RX+, RX-).

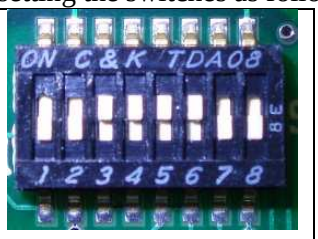


The following signal connections are required:

Full-Duplex RS-485 Signal Name	Pin #
Transmit (-)	1
Transmit (+)	4
Receive (-)	3
Receive (+)	2
Signal Ground	5

If the inverter is the only slave device on the Modbus communication bus, or if it is physically located at either end of the bus, the communication signals must be terminated by setting the switches as follows:

Switch	Position	Comments
1	Down (OFF)	Separates terminals 1 & 3
2	Down (OFF)	Separates terminals 2 & 4
3	Up (ON)	120 ohm termination
4	Up (ON)	Termination capacitor
5	Up (ON)	120 ohm termination
6	Up (ON)	Termination capacitor
7	Down (OFF)	
8	Down (OFF)	



If the inverter is not physically located at either end of the bus, set all switches to Down (OFF) position.

7.3.3 Supported Functions

The following Modbus functions are supported and provide the functionality necessary to monitor and control the inverter remotely.

Function Code	Description
03 (0x03)	Read Holding Registers
04 (0x04)	Read Input Registers
06 (0x06)	Write Single Register
16 (0x10)	Write Multiple Registers
23 (0x17)	Read/Write Multiple Registers

7.3.3.1 Message Format

Address	Function Code	Data	Error Check

The address field of a message frame contains 8 bits. Each slave device is assigned a unique address in the range of 1 – 247. Master can communicate with any slave by inserting the appropriate address into the address field. Also master can broadcast a message to all the slaves connected to the network by placing 0 into the address field. When slave responds, it places its address into the address field of a response message, to indicate which slave responded.

The function code field of a message frame contains eight bits. Valid codes are in the range of 1-255 decimal (0x00 to 0xFF hexadecimal). When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform.

When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to a logic 1.

The data field is constructed using sets of two hexadecimal digits (one RTU character), in the range of 00 to FF hexadecimal. The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

In the inverter, Modbus Register addresses (which start at 0) match Parameter IDs (which start at 1), so Register 0 corresponds to a Parameter ID of 1.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

The message also contains a 16-bit checksum at the end of the packet for error checking.

7.3.3.2 Read Registers - 03 (0x03) & 04 (0x04)

These function codes are used to read the contents of one or more sequential registers. Because the holding and input registers share the same memory space, they can be used interchangeably. The request specifies the starting register address and the number of registers. The response contains the sequential data read from the registers.

Request

Function Code	1 byte	0x03 or 0x04
Starting Address	2 bytes	0x0000 to 0xFFFF
Number of Registers to Read (N)	2 bytes	1 to 125 (0x0001 to 0x007D)

Response

Function Code	1 byte	0x03
Byte Count	1 byte	2 x N
Register Values	N x 2 bytes	[data]

Error

Error Code	1 byte	0x83 or 0x84
Exception Code	1 byte	01, 02, 03, or 04

7.3.3.3 Write Single Register - 06 (0x06)

This function code is used to write a single register. The request specifies the target register address. The normal response is an echo of the request after the register contents have been written.

Request

Function Code	1 byte	0x06
Register Address	2 bytes	0x0000 to 0xFFFF
Register Data	2 bytes	0x0000 to 0xFFFF

Response

Function Code	1 byte	0x06
Register Address	2 bytes	0x0000 to 0xFFFF
Register Data	2 bytes	0x0000 to 0xFFFF

Error

Error Code	1 byte	0x86
Exception Code	1 byte	01, 02, 03, or 04

7.3.3.4 Write Multiple Registers - 16 (0x10)

This function code is used to write to one or more sequential registers, up to 120 registers. The response contains the function code, starting address, and number of registers written.

Request

Function Code	1 byte	0x10
Starting Address	2 bytes	0x0000 to 0xFFFF
Number of Registers to Write (N)	2 bytes	1 to 120 (0x0001 to 0x00078)
Byte Count	1 byte	2 x N
Register Values	N x 2 bytes	[data]

Response

Function Code	1 byte	0x10
Starting Address	2 bytes	0x0000 to 0xFFFF
Number of Registers Written	2 bytes	1 to 120 (0x0001 to 0x00078)

Error

Error Code	1 byte	0x90
Exception Code	1 byte	01, 02, 03, or 04

7.3.3.5 Read/Write Multiple Registers - 23 (0x17)

This function code is used to write to one or more sequential registers and then, in the same function call, read one or more sequential register values. This can be used to automatically confirm the register settings after a write. The request specifies the read starting address, number of registers to be read, write starting address, number of registers to be written, and the data to be written. The byte count specifies the number of bytes in the write data field. The response contains the data from the group of registers that were read. The byte count field specifies the number of bytes in the read data field.

Request

Function Code	1 byte	0x17
Read Starting Address	2 bytes	0x0000 to 0xFFFF
Number of Registers to Read	2 bytes	1 to 118 (0x0001 to 0x0076)
Write Starting Address	2 bytes	0x0000 to 0xFFFF
Number of Registers to Write (N)	2 bytes	1 to 118 (0x0001 to 0x0076)
Write Byte Count	1 byte	2 * N
Register Values	N x 2 bytes	[data]

N = Registers written

Response

Function Code	1 byte	0x10
Read Byte Count	2 bytes	1 to 236 (0x0001 to 0x00EC)
Read Register Values	N x 2 bytes	[data]

N = Registers read

Error

Error Code	1 byte	0x97
Exception Code	1 byte	01, 02, 03, or 04

7.4 Web Interface

[IP Address MSB]. . . [IP Address LSB]
[Subnet Mask MSB]. . . [Subnet Mask LSB]
[Gateway MSB]. . . [Gateway LSB]
[E-mail Trip Data Enable]

7.4.1 Setup

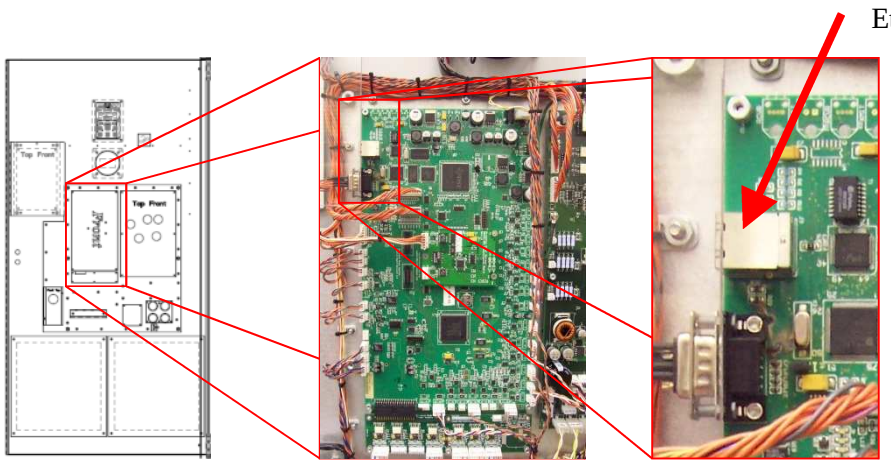
Note: To use the Web Interface, the user must install Java Runtime Environment version 5.0 (or newer) on the computer workstation. This can be done by visiting http://java.com/en/download/index.jsp, for instructions, and for downloading, and installing the Java software.

An external RJ-45 Ethernet jack, with a weather-seal cap, is located on top of the enclosure roof to allow for easy connection to a Local Area Network (LAN). The internal connection of this Ethernet port is routed to an RJ-45 jack on the GTIB 480-100 system Control Board located on the inside of the enclosure door (described below).

RJ-45 port on enclosure

For permanent network installations, an installer has the option to remove this RJ-45 connector in the enclosure roof and permanently route the network cable through conduit to the enclosure and internally to the Control Board Ethernet Jack (RJ-45).

Note: If a user is connecting directly between the RJ-45 jack of a local computer and a GTIB 480-100 inverter RJ-45 jack, without the use of a network connection, router, or switch (etc.), an Ethernet “Crossover” cable may be required for proper communication.



Inside View of Door

The user should verify that an Ethernet cable is plugged into the inverter's control board (shown above) and into an active Ethernet jack. Open up a web browser (e.g. Internet Explorer) after the software has been installed on the computer workstation. Type the inverter's Host Name (the default is **`GTIB1`**) into the web browser's address. If the browser first displays a security warning before displaying the Web Interface page, grant security access. This is usually done by right-clicking the security warning and selecting "Allow Blocked Content. . . ".

It will take the Web Interface's Java applet a few seconds to load before displaying a login page. The default login username is **`user`** and default password is **`user`**. After logging in for the first time, the user should change the username and password from the "Change Password" menu.

If multiple inverters are installed on the same network, the user must take care to not have two inverters on the network with the same Host Name. Doing so will prevent Web Interface access on all inverters with identical Host Names. Make sure to change the Host Name via the Inverter Configuration/WebUI menu on the inverter before plugging additional units into the network.

7.4.2 Features

The Web Interface has the following features:

- Step-by-step **Setup Wizard** for initial installation of the inverter, configuration of the analog & digital inputs/outputs, and setup & auto-tuning of motor parameters.
- Configuration and viewing of all system parameters via the **Inverter Configuration** menu.
- Run/stop control and continuous real-time viewing of system status parameters via the **Inverter Status** menu.
- Continuous real-time graphical plotting of system status parameters via the **Data Plot** menu.
- Back-up/Saving and reloading of parameter profiles via the **Save/Load Profile** menu.
- Access to support and troubleshooting resources via the **Support** menu.

7.4.3 Parameters

[DHCP Enable]	Parameter #	401
	Type	Write-USER
	Range	0 DHCP service disabled 1 DHCP service enabled
	Default	1

If the DHCP service is enabled, the IP Address, Subnet Mask, and Gateway are set automatically and the inverter's Host Name is used to access the Web Interface. If the DHCP service is disabled, the user must configure the IP Address, Subnet Mask, and Gateway based on his network's settings. The Host Name can only be viewed and modified from the Web Interface, not from the Front Panel or Modbus interfaces.

[IP Address MSB] **[IP Address Byte 3]** **[IP Address Byte 2]** **[IP Address LSB]**	Parameter #	402 . . . 405
	Type	Write-USER
	Range	[0 . . . 255]
	Default	192.168.0.200

Only modify this value if **[DHCP Enable]** is 0. The IP address should be chosen such that it is unique on the network. Typically MSB, Byte 3, and Byte 2 are the same as the corresponding Gateway values, but it depends on the network setup. Please consult the network administrator on how to set up these parameters

[Subnet Mask MSB] **[Subnet Mask Byte 3]** **[Subnet Mask Byte 2]** **[Subnet Mask LSB]**	Parameter #	406 . . . 409
	Type	Write-USER
	Range	[0 . . . 255]
	Default	255.255.255.0

Only modify this value if **[DHCP Enable]** is 0. This four-parameter setting should be the same as the Subnet Mask on another PC on the network.

[Gateway MSB] **[Gateway Byte 3]** **[Gateway Byte 2]** **[Gateway LSB]**	Parameter #	410 . . . 413
	Type	Write-USER
	Range	[0 . . . 255]
	Default	192.168.0.1

Only modify this value if **[DHCP Enable]** is 0. This four-parameter setting should be the same as the Gateway on another PC on the network.

[E-mail Trip Data Enable]	Parameter #	414
	Type	Write-USER CWR
	Range	0 Trip data email disabled 1 Trip data email enabled
	Default	0

If the trip data email is enabled, the inverter will send an email message with trip information to the email address configured by the manufacturer. This is used for gathering trip information by the manufacturer to provide fast technical support and to improve the performance of the inverter. The destination email address cannot be changed by a user. Disable this parameter only if the inverter is not connected to the Internet.

7.5 Password Protection

[Password]
[User Set Password]

Some of the system parameters are password protected, and can not be edited unless a password with sufficient access is entered. There are three levels of access:

1) Open Access – Operational parameters modifiable by all users.
2) User Access – Parameters configurable by the facility manager configuration.
3) Factory Access – Parameters used for system commissioning and testing, accessible by authorized installation and field service technicians.

The default user-level password is **000**. Note that this is different than the Web Interface password. For security reasons, the customer should consider changing the **[User Set Password]** from the default value after logging in for the first time. Until the user changes the user-level password to something other than "**000**", all user-level access parameters will be accessible by all users. Write down this new password and store it in a safe place. Lost passwords will require reinitializing the inverter system, which can be done only by a qualified service technician.

In general, once user-level access has been granted, the user can change the user-level password.

[Password]	Parameter #	501
	Type	Write-OPEN ~~Read~~ CWR
	Range	[0 . . . 32767]
	Default	0

In order to gain access to parameters protected by the user-settable password, enter the user password into this parameter. If the entered value matches the stored **[User Set Password]**, you will be granted access to the protected parameters.

[User Set Password]	Parameter #	502
	Type	Write-USER ~~Read~~ CWR
	Range	[0 . . . 32767]
	Default	0

Store a password of your choice in this parameter. After this password is changed from its default, the user must log in by entering the new password in the **[Password]** parameter.

[Factory Set Password]	Parameter #	503
	Type	Write-FACTORY ~~Read~~ CWR
	Range	[0 . . . 32767]
	Default	314

7.6 Inverter Configuration

[DC Source Type]
[Backup Type]

[DC Source Type]	Parameter #	601
	Type	Write-USER
	Range	[0, 1]
	Default	0

This parameter tells the system what type of DC source is connected to the DC input port of the inverter. Setting this parameter to 0 indicates that a battery type source is connected. Setting it to a 1 indicates that a PV array is connected.

[Backup Type]	Parameter #	602
	Type	Write-USER
	Range	[0, 1, 2]
	Default	1

This parameter sets what mode the inverter will run in when it switches to standalone mode when grid power is unavailable. Setting this parameter to 0 indicates "Standard" backup mode. In this mode the inverter will supply a standard 480VAC output to the AC load port. Setting this parameter to a 1 indicates "Motor Control" mode. For this mode, the inverter AC load port must be connected to a single, 3-phase induction motor rated for 440, 460, or 480VAC. In this mode, the inverter will run the motor as fast as is possible based on available power. See sections 2.2 "Operational Mode Descriptions" and 7.13 "Motor Control Settings".

7.7 Inverter Control

[Inverter On]
[Inverter Reset]
[Power Command]
[Power Command Analog Lo]
[Power Command Analog Hi]
[Run On Power Up]

[Inverter On]	Parameter #	701
	Type	Write-OPEN CWR DIn DOut
	Range	[0, 1]
	Default	0

Setting this parameter to 1 will start the inverter as long as **[Inverter Reset]** is not set to 1. Resetting this parameter to 0 will stop the inverter. Changing this parameter from 1 to 0 will act as a system reset, and will clear system faults. Digital inputs can be mapped to this parameter so it may be controlled by a remote system.

[Inverter Reset]	Parameter #	702
	Type	Write-OPEN CWR DIn
	Range	[0, 1]
	Default	0

Changing this parameter from 0 to 1 acts as a system reset, and will clear system faults. A digital input can be mapped to this parameter so it may be controlled by a remote system.

[Power Command]	Parameter #	703
	Type	Write-OPEN CWR AIn AOut
	Range	[-100. . . 100]
	Units	kW
	Default	0

This parameter controls the amount of power that is exported and imported from the inverter on the AC grid port when the inverter is operating with a battery type DC source. If the inverter is configured for PV operation, this parameter has no effect on the operation of the inverter.

When the inverter is configured for operation with a battery type DC source, the inverter will output or import to or from the grid the amount of power indicated by this parameter, drawing this power from or delivering it to the battery. In order to charge the battery, this parameter should be set to a negative value. When this parameter is set to a negative value, the inverter will charge the batteries at that rate up to but not exceeding the limits defined by the battery charging profile described in Section 7.10 “Battery Control Settings”.

[Power Command Analog Lo]	Parameter #	704
	Type	Write-USER
	Range	[-100. . . 100]
	Default	0
[Power Command Analog Hi]	Parameter #	705
	Type	Write-USER
	Range	[-100. . . 100]
	Default	100

These parameters are the analog mapping parameters for **[Power Command]**. See Section 0.

[Run On Power Up]	Parameter #	706
	Type	Write-USER CWR
	Range	0 Disabled 1 Enabled
	Default	0

If this parameter is set to 1, then the inverter will automatically self-initiate a standard start command immediately when power is applied to the input terminals, provided that the right signals are present. In order to start, the **[Inverter On]** parameter must be a 1. **[Inverter Reset]** must be 0.

7.8 Monitoring

The system parameters in this section serve to provide information about the operation of the inverter. Many system measurements are available to be monitored

[Inverter AC Voltage]
[Inverter AC Voltage Analog Lo]
[Inverter AC Voltage Analog Hi]
[Grid AC Voltage AB]
[Grid AC Voltage BC]
[Grid AC Voltage CA]
[Inverter DC Current]
[Inverter DC Current Analog Lo]
[Inverter DC Current Analog Hi]
[Central Cap Voltage]
[Inverter AC Power]
[Inverter AC Power Analog Lo]

[Inverter AC Voltage]	Parameter #	801
	Type	Read Only AOut
	Range	[0. . . 3200]
	Units	V
	Default	0

RMS voltage output of the internal switching stage of the inverter.

[Inverter AC Voltage Analog Lo]	Parameter #	802
	Type	Write-USER
	Range	[0. . . 3200]
	Default	0
[Inverter AC Voltage Analog Hi]	Parameter #	803
	Type	Write-USER
	Range	[0. . . 3200]
	Default	1000

These parameters are the analog mapping parameters for **[Inverter AC Voltage]**. See Section 7.18.

[Grid AC Voltage AB] **[Grid AC Voltage BC]** **[Grid AC Voltage CA]**	Parameter #	804. . . 806
	Type	Read Only AOut
	Range	[0. . . 3200]
	Units	V
	Default	0

3 Individual RMS phase-to-phase voltages on the terminals of the AC grid port.

[Grid AC Voltage Analog Lo]	Parameter #	807
	Type	Write-USER
	Range	[0. . . 3200]
	Default	0
[Grid AC Voltage Analog Hi]	Parameter #	808
	Type	Write-USER
	Range	[0. . . 3200]
	Default	1000

These parameters are the analog mapping parameters for **[Grid AC Voltage AB], [Grid AC Voltage BC]**, and **[Grid AC Voltage CA]**. See Section 7.18.

[Inverter DC Voltage]	Parameter #	809
	Type	Read Only AOut
	Range	[0. . . 3200]
	Units	V
	Default	0

This is the voltage measured at the terminals of the DC Port.

[Inverter DC Voltage Analog Lo]	Parameter #	810
	Type	Write-USER
	Range	[0. . . 3200]
	Default	0
[Inverter DC Voltage Analog Hi]	Parameter #	811
	Type	Write-USER
	Range	[0. . . 3200]
	Default	1000

These parameters are the analog mapping parameters for **[Inverter DC Voltage]**. See Section 7.18.

[Inverter AC Current]	Parameter #	812
	Type	Read Only AOut
	Range	[0. . . 3200]
	Units	Amps
	Default	0

The average of the 3 RMS currents at the three phase terminals of the internal switching stage of the inverter.

[Inverter AC Current Analog Lo]	Parameter #	813
	Type	Write-USER
	Range	[0. . . 3200]
	Default	0
[Inverter AC Current Analog Hi]	Parameter #	814
	Type	Write-USER
	Range	[0. . . 3200]
	Default	200

These parameters are the analog mapping parameters for **[Inverter AC Current]**. See Section 7.18.

[Grid AC Current]	Parameter #	815
	Type	Read Only AOut
	Range	[0. . . 3200]
	Units	Amps
	Default	0

The average of the 3 RMS currents at the three phase terminals of AC grid port.

[Grid AC Current Analog Lo]	Parameter #	816
	Type	Write-USER
	Range	[0. . . 3200]
	Default	0
[Grid AC Current Analog Hi]	Parameter #	817
	Type	Write-USER
	Range	[0. . . 3200]
	Default	200

These parameters are the analog mapping parameters for **[Grid AC Current]**. See Section 7.18.

[Inverter DC Current]	Parameter #	818
	Type	Read Only AOut
	Range	[0. . . 3200]
	Units	Amps
	Default	0

DC current measured at the terminals of the DC port.

[Inverter DC Current Analog Lo]	Parameter #	819
	Type	Write-USER
	Range	[0. . . 3200]
	Default	0
[Inverter DC Current Analog Hi]	Parameter #	820
	Type	Write-USER
	Range	[0. . . 3200]
	Default	300

These parameters are the analog mapping parameters for **[Inverter DC Current]**. See Section 7.18.

[Central Cap Voltage]	Parameter #	821
	Type	Read Only
	Range	[0. . . 3200]
	Units	V
	Default	0

Voltage on the central bus capacitor.

[Inverter AC Power]	Parameter #	822
	Type	Read Only AOut
	Range	[-320. . . 320]
	Units	KW
	Default	0

AC power output of the internal switching stage of the inverter.

[Inverter AC Power Analog Lo]	Parameter #	823
	Type	Write-USER
	Range	[-320. . . 320]
	Default	0
[Inverter AC Power	Parameter #	824

	Type	Write-USER
	Range	[-320. . . 320]
	Default	100

These parameters are the analog mapping parameters for **[Inverter AC Power]**. See Section 7.18.

[Inverter DC Power]	Parameter #	825
	Type	Read Only AOut
	Range	[-320. . . 320]
	Units	KW
	Default	0

DC power input at the DC port.

[Inverter DC Power Analog Lo]	Parameter #	826
	Type	Write-USER
	Range	[-320. . . 320]
	Default	0
[Inverter DC Power Analog Hi]	Parameter #	827
	Type	Write-USER
	Range	[-320. . . 320]
	Default	100

These parameters are the analog mapping parameters for **[Inverter DC Power]**. See Section 7.18.

[Motor Speed]	Parameter #	828
	Type	Read Only AOut
	Range	[0. . . 60]
	Units	Hz
	Default	0

Output frequency of the inverter when operating in the motor control type of backup mode.

[Motor Speed Analog Lo]	Parameter #	829
	Type	Write-USER
	Range	[0. . . 60]
	Default	0
[Motor Speed Analog Hi]	Parameter #	830
	Type	Write-USER
	Range	[0. . . 60]
	Default	60

These parameters are the analog mapping parameters for **[Motor Speed]**. See Section 7.18.

7.9 PV Control Settings

[PV Array Open Circuit Voltage]
[PV kWh Today]
[Reset kWh Today]
[PV Total kWh]
[PV Total MWh]
[Reset Total kWh]
[PV Total kWh]
[PV Total MWh]
[Reset Total kWh]
[Reset Date MMDD]
[Reset Date YY]

[PV Array Open Circuit Voltage]	Parameter #	910
	Type	Write-USER
	Range	[0. . . 3200]
	Units	V
	Default	580

Program the total open circuit voltage of the PV array in this parameter. The open circuit voltage of the array is the sum of the open circuit voltages of each PV module/panel in one of the array strings.

System design note: This inverter is most efficient at higher DC voltages. The array should be designed for the maximum allowable open circuit voltage that is less than or equal to 600VDC.

[PV kWh Today]	Parameter #	911
	Type	Read Only
	Range	[0. . . 32000]
	Units	kWh
	Default	0

Total number of kWh generated by the PV source so far in the present day.

[Reset kWh Today]	Parameter #	912
	Type	Write-USER
	Range	[0,1]
	Default	0

Set this parameter to a 1 in order to reset the accumulated kWh in the **[PV kWh Today]** parameter. [Reset kWh Today] will automatically reset itself back to 0.

[PV Total kWh]	Parameter #	913
	Type	Read Only
	Range	[0. . . 999]
	Units	kWh
	Default	0

Total number of kWh generated by the PV source so far since the last full MWh was produced.

[PV Total MWh]	Parameter #	914
	Type	Read Only
	Range	[0. . . 32000]
	Default	0

Total number of MWh generated by the PV source so far since the last time this counter was reset.

[Reset Total kWh]	Parameter #	915
	Type	Write-USER
	Range	[0,1]
	Default	0

Set this parameter to 1 in order to reset the **[PV Total MWh]** and **[PV Total kWh]** parameters to zero. It will automatically reset itself back to 0.

[Reset Date MMDD]	Parameter #	916
	Type	Read Only
	Range	[0. . . 32000]

	Default	0
[Reset Date YY]	Parameter #	917
	Type	Read Only
	Range	[0. . . 32000]
	Default	0

These parameters document the date of the last time the **[PV Total MWh]** and **[PV Total kWh]** parameters were reset.

7.10 Battery Control Settings

[Bulk Charging Voltage]
[Float Charging Voltage]
[Maximum Charging Current]
[Bulk to Float Transition Current]
[Battery Charged Current]
[Battery Not Charged Voltage]
[Minimum Discharge Voltage]
[Battery Equalization Enable]
[Battery Equalization Voltage]
[Battery Equalization Time Hours]
[Bulk Delay Time Hours]
[Bulk Delay Time Minutes]
[Battery Temperature]
[Battery Temp Analog Lo]
[Battery Temp Analog Hi]
[Temperature Compensation Enable]
[Temperature Compensation Per Cell]
[Number of Cells]
[Bulk Time Out]

[Bulk Charging Voltage]	Parameter #	1001
	Type	Write-USER
	Range	[280. . . 600]
	Units	V
	Default	568

This voltage is maintained in the Bulk charging stage

[Float Charging Voltage]	Parameter #	1002
	Type	Write-USER
	Range	[280. . . 600]
	Units	V
	Default	540

This voltage is maintained in the Float charging stage

[Maximum Charging Current]	Parameter #	1003
	Type	Write-USER
	Range	[0. . . 285]
	Units	A
	Default	40

Charging current limited to this value in all charging stages.

[Bulk to Float Transition Current]	Parameter #	1004
	Type	Write-USER
	Range	[0. . . 285]
	Units	A
	Default	10

Unless ***Bulk Delay Time*** has not been reached yet, when charging current falls below **[Bulk to Float Transition Current]** the charging state changes to Float.

[Battery Charged Current]	Parameter #	1005
	Type	Write-USER
	Range	[0. . . 285]
	Units	A
	Default	3

The charging state will change to Idle when the charging current has fallen below this value.

[Battery Not Charged Voltage]	Parameter #	1006
	Type	Write-USER
	Range	[280. . . 600]
	Units	V
	Default	520

The charging state will return to Float from Idle when the battery voltage has discharged below this value.

[Minimum Discharge Voltage]	Parameter #	1007
	Type	Write-USER
	Range	[200. . . 600]
	Units	V
	Default	400

The system will shut down and stop drawing power from the battery once the battery voltage reaches this value. The system must be switched to charge mode (by setting **[Power Command]** to 0) briefly before it will draw power from the battery again.

[Battery Equalization Enable]	Parameter #	1009
	Type	Write-USER
	Range	[0,1]
	Default	0

Setting this parameter to “1” will initialize the battery equalization function the next time the system is switched to charge mode.

[Battery Equalization Voltage]	Parameter #	1010
	Type	Write-USER
	Range	[280. . . 600]
	Units	V
	Default	576

This voltage is maintained during the equalization time.

[Battery Equalization Time Hours]	Parameter #	1011
	Type	Write-USER
	Range	[0. . . 3600]
	Default	0
[Battery Equalization Time Minutes]	Parameter #	1012
	Type	Write-USER
	Range	[0. . . 60]
	Default	0

The equalization voltage is maintained for **[Battery Equalization Time Minutes]** + **[Battery Equalization Time Hours]** before the system switches to the normal charging profile.

[Bulk Delay Time Hours]	Parameter #	1013
	Type	Write-USER
	Range	[0. . . 3600]
	Default	0
[Bulk Delay Time Minutes]	Parameter #	1014
	Type	Write-USER
	Range	[0. . . 60]
	Default	0

The charging state will remain Bulk, even if the charging current has fallen below **[Bulk to Float Transition Current],** until the system has been in the Bulk charging state for **[Bulk Delay Time Hours]** + **[Bulk Delay Time Minutes]**.

[Battery Temperature]	Parameter #	1015
	Type	Write-USER CWR AIn AOut
	Range	[-273. . . 320]
	Units	Degrees C
	Default	0

The battery temperature must be fed into this parameter in order to control the temperature compensation function. This can be done through an analog input channel, through MODBUS serial communication, or manually through the web-based user-interface or front panel interface.

WARNING: Programming temperature compensation parameters (see Section 7.10 Battery Control Settings) that are not suitable for the type of battery being used may damage the battery and the inverter and may cause a hazardous condition that puts personnel at risk of grave injury or death. The user must ensure that the battery temperature compensation parameters are appropriate and safe for the type and voltage rating of the battery used.

[Battery Temp Analog Lo]	Parameter #	1016
	Type	Write-USER
	Range	[-273. . . 320]
	Default	0
[Battery Temp Analog Hi]	Parameter #	1017
	Type	Write-USER
	Range	[-273. . . 320]
	Default	100

These parameters are the analog mapping parameters for **[Battery Temperature]**. See Section 0.

[Temperature Compensation Enable]	Parameter #	1018
	Type	Write-USER
	Range	[0,1]
	Default	0

Setting this parameter to “1” enables the temperature compensation function.

[Temperature Compensation Per Cell]	Parameter #	1019
	Type	Write-USER

	Range	[0,1]
	Default	0.003
[Number of Cells]	Parameter #	1020
	Type	Write-USER
	Range	[0. . . 32000]
	Default	20

[Temperature Compensation Per Cell] times **[Number of Cells]** is the voltage that is added to **[Bulk Charging Voltage]** and [**Float Charging Voltage]**, per degree Celsius by which **[Battery Temperature]** differs from 25C.

[Bulk Time Out]	Parameter #	1022
	Type	Write-USER
	Range	[0. . . 320]
	Units	Hours
	Default	24

If the inverter has been charging the battery in Bulk mode for the number of hours programmed into **[Bulk Time Out]**, the inverter will turn off. This will occur if the Bulk Delay Time has passed, and the charging current is still above [Bulk to Float Transition Current] when **[Bulk Time Out]** is reached. This may indicate a problem with the batteries and is available for safety reasons.

7.11 Grid Control Settings

[AI Sag Frequency]	Parameter #	1104
	Type	Write-USER
	Range	[57. . . 59.8]
	Units	Hz
	Default	59.3
[AI Frequency Sag Time]	Parameter #	1105
	Type	Write-USER
	Range	[0.16. . . 300]
	Units	Seconds
	Default	0.16
[AI Sag Voltage]	Parameter #	1109
	Type	Write-USER
	Range	[422.4. . . 456]
	Units	V
	Default	422.4
[AI Surge Voltage]	Parameter #	1110
	Type	Write-USER
	Range	[504. . . 528]
	Units	V
	Default	528

If the grid power frequency drops below **[AI Sag Frequency]** for longer than **[AI Frequency Sag Time]**, Or,

If the grid power frequency goes above 60.5Hz for 0.16 seconds
Or,
If the grid power RMS voltage goes outside of the limits defined by **[AI Sag Voltage]** and **[AI Surge Voltage]**,
The inverter will cease exporting power to the grid in order to comply with UL-1741 regulations.

Once the grid power voltage and frequency have returned within these limits continuously for 5 minutes, then the inverter will resume exporting power to the grid.

These parameters are adjustable by the user so that the inverter can be adjusted to meet local utility interconnection regulations while avoiding nuisance tripping due to normal local grid variations. In addition to these conditions, if any of the following occur, the inverter will likewise cease exporting power to the grid in order to comply with UL-1741 regulations:

[On-grid Sag Voltage]	Parameter #	1120
	Type	Write-USER
	Range	[0. . . 3200]
	Default	422.4
[On-grid Surge Voltage]	Parameter #	1121
	Type	Write-USER
	Range	[0. . . 3200]
	Default	528

Regardless of whether or not the inverter is presently outputting power to the grid, the AC load port will be connected directly to the grid power as long as the grid power voltage is within the range defined by these two parameters, and the grid power frequency is between 57.0 and 63.0 Hz. If at any point the grid power does not satisfy these conditions, the inverter will disconnect the AC load port from the grid power, switch to backup/stand-alone mode, and begin feeding the loads from the DC source.

While in backup/standalone mode, once the grid power satisfies the above criteria continuously for 5 seconds, the inverter will switch back to On-Grid mode and re-connect the AC-load port directly to the grid power.

Note that the inverter will not export power to the grid unless the previously mentioned “Anti-islanding” conditions are met, which are not necessarily the same conditions that determine whether the inverter is in backup/stand-alone mode or On-Grid mode.

[On-grid Power Limit]	Parameter #	1130
	Type	Write-USER CWR AIn AOut
	Range	[0. . . 150]
	Default	150

When the inverter is configured with a PV array input, this parameter is used as a power limit. In PV mode, the inverter always outputs as much power as is available from the PV array out to the AC grid port. If it is desired to limit the amount of power that the inverter will output to the grid, this parameter should be set equal to that limit.

Operation with a line-interactive backup generator

In order to operate a PV inverter in a system that is powered only by a backup generator, it is necessary to ensure that the inverter will never back-feed the generator. That is, the inverter must not ever export more

power than is being used by the loads in the system. This inverter enables this mode of operation by means of this **[Power Command]** parameter being usable as a power limit.

To limit the inverter power to prevent back-feeding the generator, a power meter should be installed in the system that measures the total load power. This power measurement should be fed into this **[Power Command]** parameter either by means of an analog signal (see Section 0 for setup instructions), or through MODBUS communication (see Section 7.3 "MODBUS Interface").

If the backup generator system is designed to connect to the main grid when it is available, and shut down the generator, the inverter will operate at all times, whether the system is being fed by the generator or by the grid. In order to prevent unnecessary power limiting when the grid is connected, however, the system should be designed to set the **[Power Command]** parameter to its maximum value when the grid is connected.

[On-grid Power Limit Analog Lo]	Parameter #	1131
	Type	Write-USER
	Range	[0. . . 150]
	Default	0
[On-grid Power Limit Analog Hi]	Parameter #	1132
	Type	Write-USER
	Range	[0. . . 150]
	Default	100

These parameters are the analog mapping parameters for **[On-grid Power Limit].** See Section 0.

7.12 Backup Control Settings

There are no user-adjustable parameters that affect the operation of the inverter in standard backup/standalone mode.

In Backup/Stand-alone mode, the inverter supplies power on its AC Load port fed from the DC source. Whether the source is a PV array or a battery, the inverter operates the same way. If the DC source has sufficient power available to power the loads, the inverter will continue to supply power to the loads. If the loads ever draw more than the DC source can supply, the inverter will shut down and restart in 5 minutes to try again.

7.13 Motor Control Settings

[Motor Nameplate FLA]
[Motor Nameplate Hz]
[Motor Nameplate RPM]
[Motor Nameplate Volts]
[Motor Nameplate HP]
[Motor Min Speed]
[Motor Max Speed]
[Motor Startup Delay]
[Motor Acceleration Rate]
[Motor Deceleration Rate]
[Motor Speed Increment]
[Motor Speed Decrement]
[Motor Speed Interval]
[Insufficient PV Voltage Threshold]
[Motor Phase Shift Adjustment Gain]
[Motor Rsim]

The motor control backup mode is designed to operate a single motor at variable speed in order to use all available power from a PV array to drive the motor as fast as it can go using that power. The parameters

in this section are used to control the behavior of the speed optimization algorithm. The default parameters are designed to work for most applications.

While the inverter is in motor control backup mode, it is normal for the motor to completely stop periodically. If the motor is stopping so frequently that there is excessive down-time, the optimization algorithm parameters may need adjustment for better performance.

The user must enter the appropriate information from the motor nameplate into the following "Nameplate" parameters. If this information is not entered, the motor control functions of the inverter may not operate properly. Contact the motor manufacturer if some of the information is not available.

[Motor Nameplate FLA]	Parameter #	1301
	Type	Write-USER
	Range	[0.1. . . 400]
	Default	115

Enter the nominal RMS current drawn by the motor at full load, in amps.

[Motor Nameplate Hz]	Parameter #	1302
	Type	Write-USER
	Range	[20. . . 60]
	Default	60

Enter the rated electrical frequency of the motor, in Hz.

[Motor Nameplate RPM]	Parameter #	1303
	Type	Write-USER
	Range	[1. . . 3600]
	Default	1775

Enter the full load rated motor speed, in RPM.

[Motor Nameplate Volts]	Parameter #	1304
	Type	Write-USER
	Range	[0.1. . . 500]
	Default	460

Enter the rated motor voltage, in volts.

[Motor Nameplate HP]	Parameter #	1305
	Type	Write-USER
	Range	[0.1. . . 300]
	Default	125

Enter the nominal rated motor power, in horsepower.

The following parameters control the behavior of the motor speed optimization algorithm.

[Motor Min Speed]	Parameter #	1306
	Type	Write-USER
	Range	[20. . . 60]
	Default	40

Minimum speed the motor will run. If there is insufficient power to run at this speed, the motor will stop running, and the inverter will try to run the motor again in 5 minutes.

[Motor Max Speed]	Parameter #	1307
	Type	Write-USER
	Range	[20. . . 60]
	Default	55

The maximum speed the motor will run at in motor control backup mode.

[Motor Startup Delay]	Parameter #	1308
	Type	Write-USER
	Range	[0. . . 32000]
	Default	20

The inverter will try to run the motor at **[Motor Speed Min]** for this amount of time to determine if there is sufficient power to run before adjusting the speed higher to use optimal power.

[Motor Acceleration Rate]	Parameter #	1309
	Type	Write-USER
	Range	[0.001. . . 32]
	Default	1

Rate at which the motor accelerates during speed seeking, in Hz/sec.

[Motor Deceleration Rate]	Parameter #	1310
	Type	Write-USER
	Range	[0.001. . . 32]
	Default	1

Rate at which the motor decelerates during speed seeking, in Hz/sec.

[Motor Speed Increment]	Parameter #	1311
	Type	Write-USER
	Range	[0.01. . . 60]
	Default	0.5

The amount per step by which the motor speed is increased during speed seeking, in Hz.

[Motor Speed Decrement]	Parameter #	1312
	Type	Write-USER
	Range	[0.01. . . 60]
	Default	0.5

The amount per step by which the motor speed is decreased during speed seeking, in Hz.

[Motor Speed Interval]	Parameter #	1313
	Type	Write-USER
	Range	[1. . . 32000]
	Default	600

Time between steps during speed seeking, in Seconds.

[Insufficient PV Voltage Threshold]	Parameter #	1314
	Type	Write-USER
	Range	[01. . . 600]
	Default	360

Enter the PV voltage under which the motor does not run, in Volts. Below some point there is guaranteed not to be sufficient PV power to run the motor at minimum speed.

7.14 Control Function Owners

[X Owner]	Parameter #	1401 - 1406
	Type	Write-USER BIN CWR
	Range	xxx1 Digital/Analog Interface Ownership xx1x Modbus Interface Ownership x1xx Front Panel Interface Ownership 1xxx Web Interface Ownership
	Default	1111 (binary)

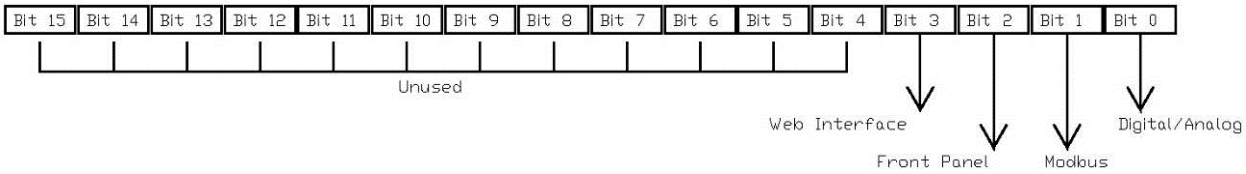
1401 [Inverter On Owner]
1402 [Inverter Reset Owner]
1403 [External Trip Owner]
1404 [Power Command Owner]
1405 [On-grid Power Limit Enable Owner]
1406 [On-grid Power Limit Owner]

System parameters with write-access can be changed from four different interfaces:

1) Analog/Digital Inputs
2) Modbus Interface
3) Front Panel Interface
4) Web Interface

The Control Function Owners feature allows users, for security or process control reasons, to disable write-access to critical parameters from particular interfaces. The default configuration for most parameters is to be writeable from any one of the four interfaces, which means that the parameter has four "owners". However, functionality-critical parameters, such as run/stop/enable control, speed control, and torque and current limits have owner settings that can be changed.

To prevent a certain interface from changing a parameter, change the interface's ownership bit to zero in that parameter's ownership parameter:



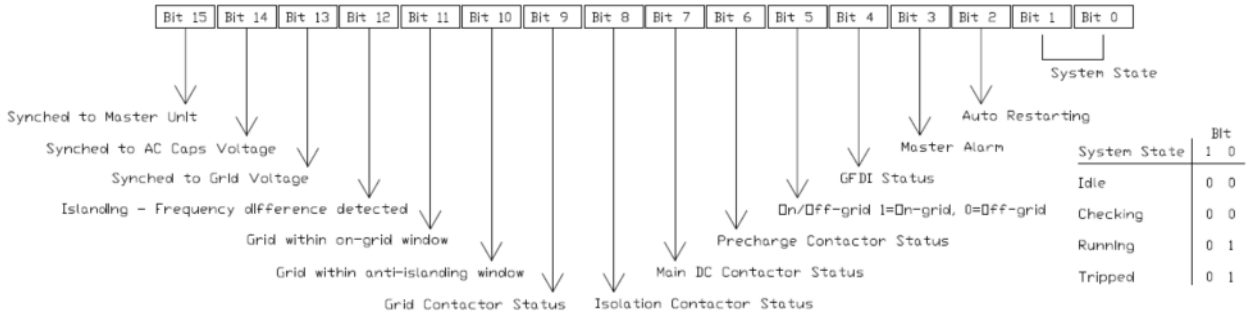
For example, to configure the inverter such that the system cannot be run via the Modbus interface, set the **[Inverter On Owner]** parameter to 1101 (binary). By setting the second bit to zero, the Modbus interface is no longer an owner of the **[Inverter On Owner]** parameter and cannot change that value.

7.15 Inverter Status

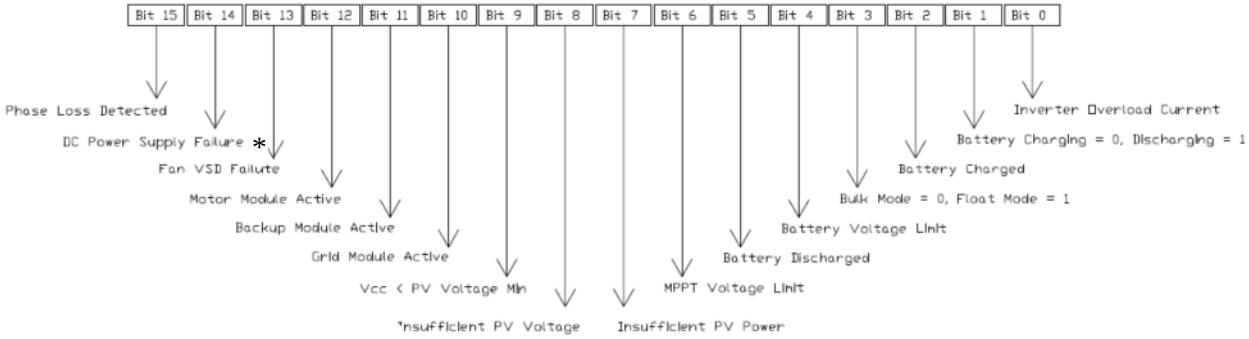
[Inverter Status 1]
[Inverter Status 2]
[System State]

The inverter status registers are binary parameters that contain information about the system state at any given time. Each bit of each status register expresses one piece of information, like whether or not main DC contactor is closed or whether the Battery is charging or discharging. Sometimes multiple bits are grouped together to form a number that can express more complex information, as is the case with bits 0 and 1 of **[Inverter Status 1]**, which represent the four possible system states. Reference the diagrams below to find which information is expressed by each bit in the status registers.

[Inverter Status 1]	Parameter #	1501
	Type	Read Only / BIN
	Range	[0000000000000000 . . . 1111111111111111]
	Default	0



[Inverter Status 2]	Parameter #	1502
	Type	Read Only / BIN
	Range	[0000000000000000 . . . 1111111111111111]
	Default	0



* 350VDC power supply option

[System State]	Parameter #	1503
	Type	Read Only
	Range	16 = Idle 34 = Checking 51 = Running 64 = Tripped
	Default	0

7.16 Digital Inputs

[DI0 Parameter ID], [DI1 Parameter ID]
[Digital Input Invert Mask]
[Digital Input Status]

The inverter is equipped with 2 digital inputs for sending "high/low" signals to the inverter, all of which can be mapped to a number of "digital" parameters within the system. Each digital input has a parameter associated with it (**[DIx Parameter ID]**) that contains the ID number for the parameter to which it is mapped.

For digital inputs, 24VDC signals are used to indicate "high" or "low". When a digital input is mapped to a parameter, then the parameter is set to 1 every time the input goes "high", and is set to 0 every time the input goes "low". Whether 24V means "high" and 0V means "low" or vice-versa is configurable for each channel.

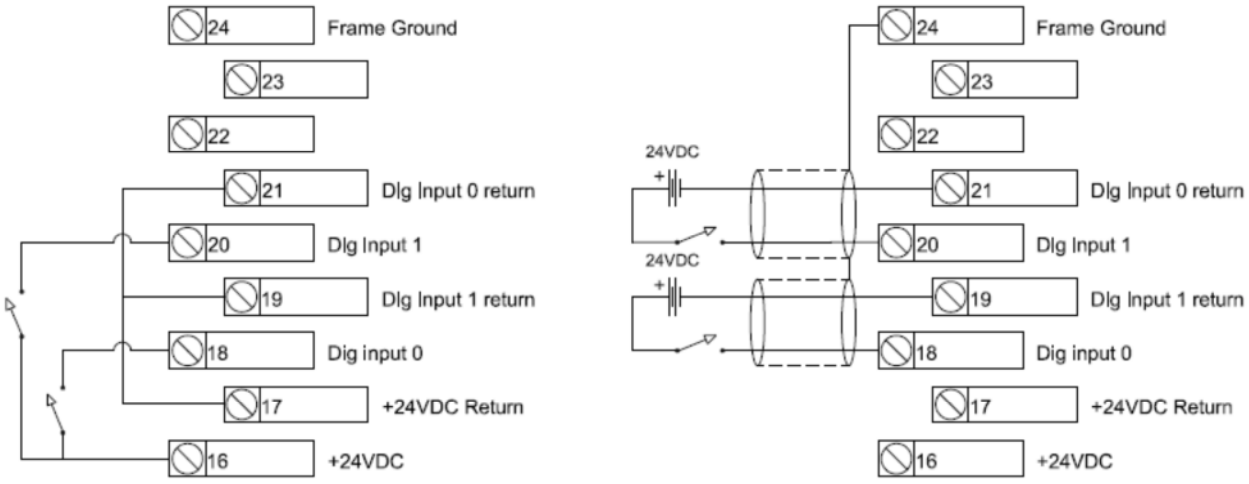


Figure 7.1 – Digital input configuration – Terminals on header J27

24VDC is supplied on the user I/O terminal strip for use in setting up digital input signals. This power supply can be used to convert a relay (contact-closure) input to a 0-24VDC signal, allowing the user to provide input signals to the inverter using relays or other contact-closure systems. The figure at left illustrates how to connect a digital input relay/switch using the on-board 24V power supply. Since the users supply is isolated, a connection must be made between the corresponding digital input return and

the power supply return, as shown. The figure at the right shows a configuration with user supplied 24VDC sources. A cable shield drain is also shown.

[DI0 Parameter ID] **[DI1 Parameter ID]**	Parameter #	1601, 1602
	Type	Write-USER
	Range	[0 . . . Maximum Parameter ID]
	Units	1
	Default	0

These parameters contain the ID numbers for the parameters to which the 2 digital inputs are mapped. The parameters that can be mapped to digital inputs are in the following table. To map a digital input to one of these parameters, enter the parameter ID for that parameter into the **[DIx Parameter ID]** parameter associated with the desired digital input.

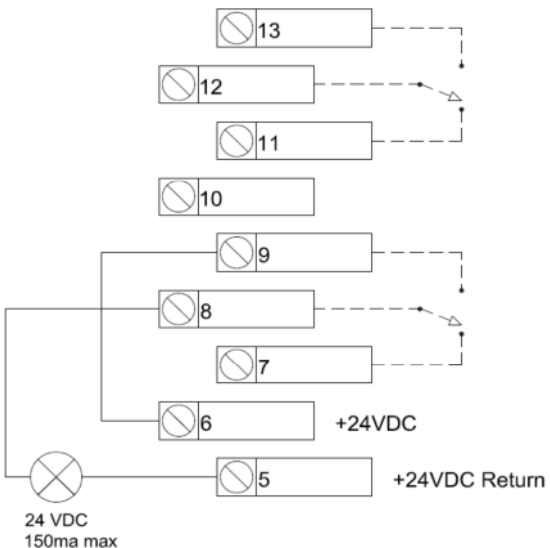
Parameter Name	ID
[Inverter On]	701
[Inverter Reset]	702
[On-grid Power Limit Enable]	1130
[External Trip]	2202

[Digital Input Invert Mask]	Parameter #	1603
	Type	Write-USER BIN
	Range	[0000000000000000 . . . 0000000000000011] bit=0 - Don't invert the detected digital input value bit=1 - Invert the detected digital input value
	Default	0

This parameter controls whether or not each digital input signal is inverted before being mapped to its corresponding parameter. Bits 0 and 1 correspond to digital inputs 1 and 2 respectively, as shown in the diagram under **[Digital Input Status]**. If the invert bit for a given input is 0, then 24V on the input will translate to a "1" in the mapped parameter, and 0V will translate to a "0". If the invert bit is 1, then 24V on the input will translate to a "0", and 0V to "1".

[Digital Input Status]	Parameter #	1604
	Type	Read Only BIN
	Range	[0000000000000000 . . . 0000000000000011] bit=0 - Digital input is inactive bit=1 - Digital input is active
	Default	0

This parameter contains the status of the 2 digital inputs. The first 2 bits represent the status of one of the inputs. Note that this takes the values of **[Digital Input Invert Mask]** into account. **[Digital Input Status]** represents what values would be sent to parameters mapped to the digital inputs.



7.17 Digital Outputs

[DO0 Parameter ID], [DO1 Parameter ID]
[Digital Output Invert Mask]
[Digital Output Status]

The inverter is equipped with 2 digital outputs for sending "high/low" signals from the inverter, all of which can be mapped to a number of "digital" parameters within the system. Each digital output has a parameter associated with it (**[DOx Parameter ID]**) that contains the ID number for the parameter to which it is mapped.

The digital outputs consist of a set of 2 relays that are controlled by the "high/low" status of the digital output signals. As with the digital inputs, the polarity of each digital output relative to its mapped parameter can be configured individually. Each relay also has a "Normally Open" (NO) and a "Normally Closed" (NC) set of contacts, for further flexibility. When the mapped value is logic (0), the NO terminal will be open and the NC terminal will be closed. When the mapped value is logic (1), the NO terminal will be closed and the NO terminal will be open.

24VDC is supplied on the user I/O terminal strip for use in setting up digital output signals. As shown in the figure above, this power supply can be used to turn the relay outputs into 0-24VDC digital voltage signals to power lighted indicators or the inputs of a facility control system. An external power supply could also be used if a different voltage or current limit is required.

Caution: Do not attach a load to the digital outputs that will exceed the 150 mA current rating. Doing so could result in component damage on the I/O board.

[DO0 Parameter ID] **[DO1 Parameter ID]**	Parameter #	1701, 1702
	Type	Write-USER
	Range	[0 . . . Maximum Parameter ID]
	Units	1
	Default	0

These parameters contain the ID numbers for the parameters to which the 2 digital outputs are mapped. The parameters that can be mapped to digital outputs are in the following table. To map a digital output to one of these parameters, enter the parameter ID for that parameter into the **[DOx Parameter ID]** parameter associated with the desired digital output.

Parameter Name	ID
[Inverter On]	701
[On-grid Power Limit Enable]	1130
[Master Alarm]	2001
[User Alarm]	2010
[System Tripped]	2201
[External Trip]	2202

[Digital Output Invert Mask]	Parameter #	1703
	Type	Write-USER BIN
	Range	[000000000000000 . . . 0000000000000011] bit=0 - Digital output equals the mapped parameter bit=1 - Digital output is inverted
	Default	0

This parameter controls whether or not each digital output signal is inverted relative to the parameter to which it is mapped. Bits 0 and 1 correspond to digital outputs 1 and 2 respectively, as shown in the diagram under **[Digital Output Status]**. If the invert bit for a given output is 0, then when the mapped parameter is equal to 1, the relay will activate, and it will deactivate when the mapped parameter equals 0.

If the bit is 1, this will be reversed, and the relay will activate when the mapped parameter equals 0. Note that all relays will deactivate when the system power is off.

[Digital Output Status]	Parameter #	1704
	Type	Read Only BIN
	Range	[0000000000000000 . . . 0000000000000011] bit=0 - Digital output is inactive bit=1 - Digital output is active
	Default	0

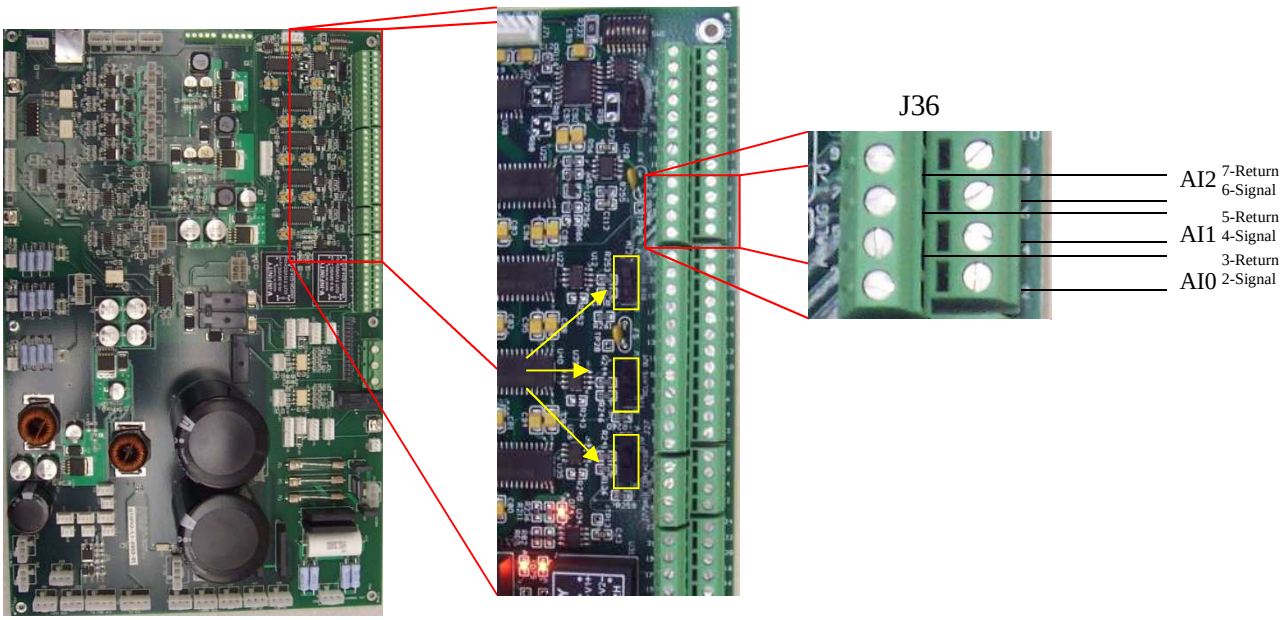
This parameter contains the status of the 2 digital outputs. The first 2 bits represent the status of one of the inputs. Note that this takes the values of **[Digital Output Invert Mask]** into account. The relay for a given output will be active when the bit for that output in this register is 1.

7.18 Analog Inputs

[AI0 Parameter ID] . . . [AI2 Parameter ID]
[AI0 Signal Lo] . . . [AI2 Signal Lo]
[AI0 Signal Hi] . . . [AI2 Signal Hi]
[AI0 Signal Val] . . . [AI2 Signal Val]

The system has 3 analog inputs that can be used to send analog signals to the inverter. Each of the 3 signals can be configured either as a 0-10V voltage input, or a 0-20mA current input. Each of the inputs can be mapped to a number of parameters in the system, and the range and scaling configuration for that mapping is configurable for each input individually.

The analog input signals are connected to J36 on the GTI interface I/O board as shown. The selection of 0-10V input or 0-20mA input is done using the set of 3 analog input selection switches, also on the GTI interface I/O board as shown by the yellow arrows. A switch in the “A” position configures the input as a 0-20mA channel. A switch in the “V” position configures the input as a 0-10V channel.



Caution: Configuring an analog input for 0-20mA operation and driving it instead with a voltage source could cause component damage on the I/O board.

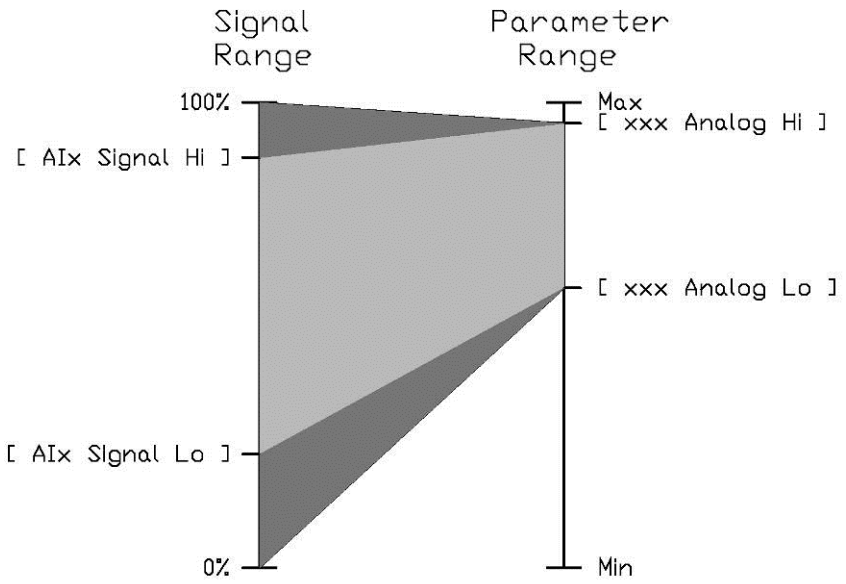
The use of shielded twisted pair wiring is recommended for all analog control signals. Shields should be connected to the FRAME terminal, terminal 1 on J36.

The analog inputs can be driven from a potentiometer (such as a front panel rotary knob) powered by the I/O board itself. A 10V voltage supply is available on terminal 8 of J36, its return is on terminal 9, for facilitating such a circuit.

The analog input can also be driven from an external signal source. In this case, the signal wire is connected to the "signal" terminal and the return wire is connected to the "return" terminal.

Each system parameter that can be mapped to an analog input has two parameters associated with it called **[xxx Analog Hi]**, and **[xxx Analog Lo]**. These parameters are in the same units as their parent parameter (the parameter to be mapped). These define the range that the mapped parameter will traverse when it is mapped to an analog input.

Each analog input channel has two parameters associated with it as well, **[AIx Signal Hi]** and **[AIx Signal Lo]**, that define the part of the range of the input signal that will correspond to the mapped parameter's range defined by **[xxx Analog Hi]** and **[xxx Analog Lo]**. If an input signal goes above or below this range, the parameter will be set to its **[xxx Analog Hi]** or **[xxx Analog Lo]** value respectively. See below diagram.



[AI0 Parameter ID] **[AI1 Parameter ID]** **[AI2 Parameter ID]**	Parameter #	1801, 1806, 1811
	Type	Write-USER
	Range	[0 . . . Maximum Parameter ID]
	Units	1
	Default	0

These parameters contain the ID numbers for the parameters to which the 3 analog inputs are mapped. The parameters that can be mapped to analog inputs are in the following table. To map a analog input to one of these parameters, enter the parameter ID for that parameter into the **[AIx Parameter ID]** parameter associated with the desired digital output.

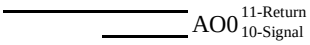
Parameter Name	ID
[Power Command]	703
[Battery Temperature]	1015
[On-grid Power Limit]	1131

[AI0 Signal Lo] **[AI1 Signal Lo]** **[AI2 Signal Lo]**	Parameter #	1802, 1807, 1812
	Type	Write-USER
	Range	[0 . . . 100] %
	Units	.01 %
	Default	0

[AI0 Signal Hi]	Parameter #	1803, 1808, 1813

	Type	Write-USER
	Range	[0 . . . 100] %
	Units	.01 %
	Default	100 %

These parameters define the range of the signal that is to be used. This range will correspond to the range for the mapped parameter defined by that parameter's Analog Lo and Analog Hi parameters (see above diagram). Note: signal loss detection, if used, is triggered by a signal that falls below **[AIx Signal Lo]** – 5%. (See "Loss of Signal Fault").



[AI0 Signal Val] **[AI1 Signal Val]** **[AI2 Signal Val]**	Parameter #	1804, 1809, 1814
	Type	Read Only
	Range	[0 . . . 100] %
	Units	.01 %
	Default	0

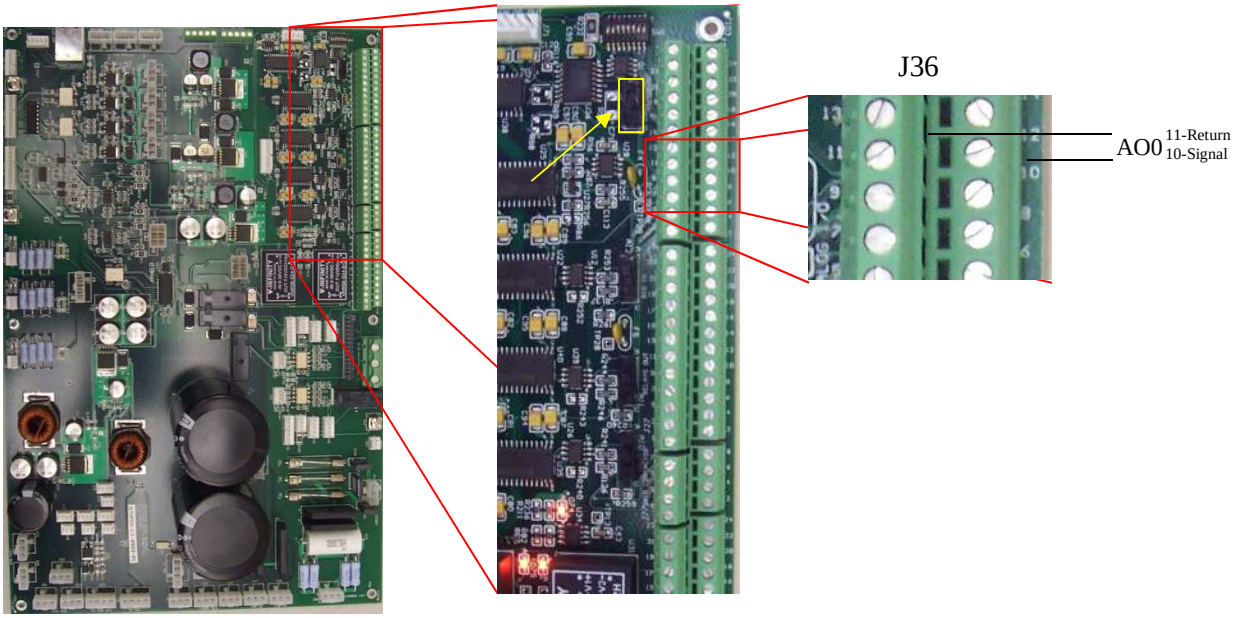
These parameters contain the present raw value of the analog input signal. This value is un-processed, and is expressed as a % of the full range of the analog input, which is either 0-10V or 0-20mA.

7.19 Analog Outputs

[AO0 Parameter ID]
[AO0 Signal Lo]
[AO0 Signal Hi]
[AO0 Signal Val]

The system has 1 analog output that can be used to send analog signals from the inverter. The analog output can be configured either as a 0-10V voltage output, or a 0-20mA current output. The analog output can be mapped to a number of parameters in the system, and the range and scaling configuration for that mapping is configurable for each output individually.

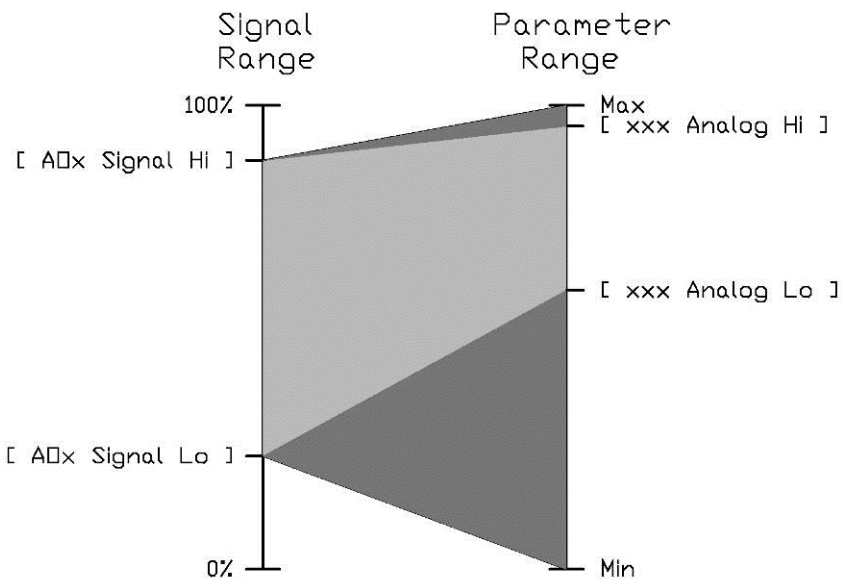
The analog output signal is connected to J36 on the GTI interface I/O board as shown. The selection of 0-10V input or 0-20mA output is done using the analog output selection switch, also on the GTI interface I/O board. The switch in the "A" position configures the output as a 0-20mA channel. The switch in the "V" position configures the output as a 0-10V channel.



Caution: Configuring an analog output to source 0-10V and connecting it to an external current sensor could cause component damage to the external sensor.

Each system parameter that can be mapped to an analog output has two parameters associated with it called **[xxx Analog Hi]**, and **[xxx Analog Lo]**. These parameters are in the same units as their parent parameter (the parameter to be mapped). These define the range of the mapped parameter that will be mapped to the analog output.

The analog output channel has two parameters associated with it as well, **[AO0 Signal Hi]** and **[AO0 Signal Lo]**, that define the part of the range of the output signal that will correspond to the mapped parameter's range defined by **[xxx Analog Hi]** and **[xxx Analog Lo]**. If a mapped parameter goes above or below the range defined by **[xxx Analog Hi]** and **[xxx Analog Lo]** then the analog output will be set to its **[AO0 Signal Hi]** or **[AO0 Signal Lo]** value respectively. See diagram below.



[AO0 Parameter ID]	Parameter #	1901
	Type	Write-USER
	Range	[0 . . . Maximum Parameter ID]
	Units	1
	Default	0

This parameter contains the ID numbers for the parameters to which the analog output is mapped. The parameters that can be mapped to analog outputs are in the following table. To map a parameter to the analog outputs, enter the parameter ID for that parameter into the **[AO0 Parameter ID]** parameter associated with the desired digital output.

Parameter Name	ID	Parameter Name	ID
[Power Command]	703	[Inverter AC Power]	822
[Inverter AC Voltage]	801	[Inverter DC Power]	825
[Grid AC Voltage AB]	804	[Motor Speed]	828
[Grid AC Voltage BC]	805	[Battery Temperature]	1015
[Grid AC Voltage CA]	806	[On-grid Power Limit]	1131
[Inverter DC Voltage]	809	[Input Heatsink Temperature]	2213
[Inverter AC Current]	812	[Output Heatsink Temperature]	2218
[Grid AC Current]	815	[Ambient Temperature]	2223
[Inverter DC Current]	818		

All of the above parameters have an associated pair of Analog hi/lo parameters for analog mapping. **[Input Heatsink Temperature]**, **[Output Heatsink Temperature]**, and **[Ambient Temperature]** all share a common pair, **[Temperature Analog Hi]** and **[Temperature Analog Lo]**.

[AO0 Signal Lo]	Parameter #	1902

	Type	Write-USER
	Range	[0 . . . 100] %
	Units	.01 %
	Default	0

[AO0 Signal Hi]	Parameter #	1903
	Type	Write-USER
	Range	[0 . . . 100] %
	Units	.01 %
	Default	100 %

These parameters define the range of the output signal that is to be used. This range will correspond to the range for the mapped parameter defined by that parameter's Analog Lo and Analog Hi parameters (see above diagram).

[AO0 Signal Val]	Parameter #	1904
	Type	Read Only
	Range	[0 . . . 100] %
	Units	.01 %
	Default	0

These parameters contain the present raw value of the analog output signal. This value is expressed as a % of the full range of the analog input, which is either 0-10V or 0-20mA.

7.20 **Alarms**

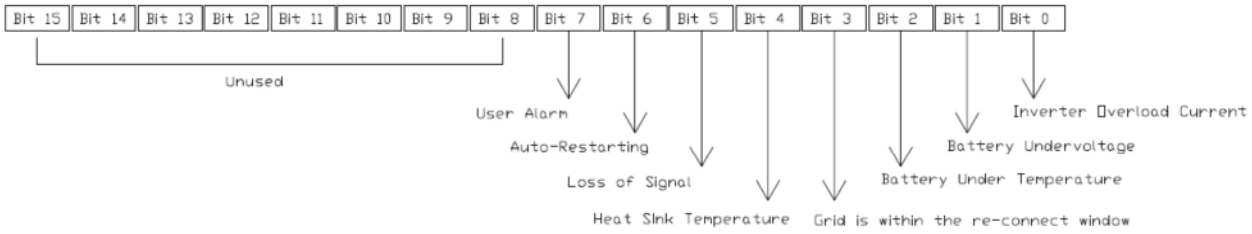
7.20.1 Master Alarm

[Master Alarm]	Parameter #	2001
	Type	Read Only DOut
	Range	0 No alarms active 1 At least 1 alarm active
	Default	0

[Master Alarm] is set equal to 1 whenever any alarm selected in **[Master Alarm Mask]** is active. This parameter is mappable to a digital output so that it may be monitored by a remote system.

[Master Alarm Mask]	Parameter #	2003
	Type	Read Only BIN
	Range	[0000000000000000 . . . 0000000011111111] bit=0 - Alarm will not activate the **[Master Alarm]** bit=1 - Alarm will activate the **[Master Alarm]**
	Default	0

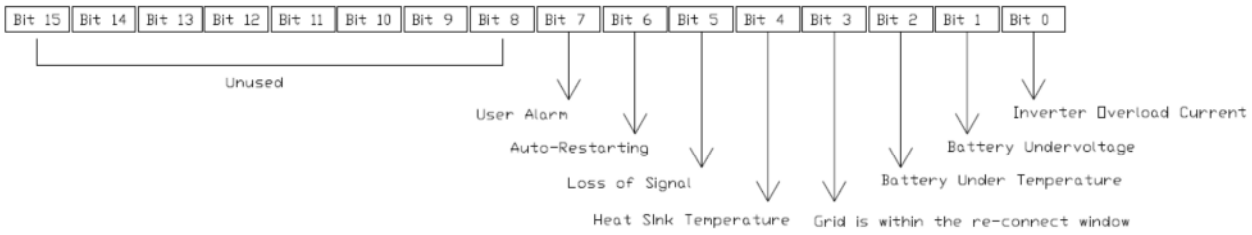
The parameter **[Master Alarm Mask]** determines which alarms are linked to the **[Master Alarm]**. Each bit of the parameter corresponds to one of the alarms, as shown in the below diagram. To link an alarm to the **[Master Alarm]** parameter, set the corresponding bit in **[Master Alarm Mask]** to 1. If an alarm's bit is set to zero, then the master alarm will not be set to 1 when that alarm is active.



7.20.2 Alarm Status

[Alarm Status]	Parameter #	2002
	Type	Read Only BIN
	Range	[0000000000000000 . . . 0000000011111111] bit=0 - Alarm is inactive bit=1 - Alarm is active
	Default	0

The parameter **[Alarm Status]** indicates which alarms are active. Each bit of the parameter corresponds to one of the alarms, as shown in the below diagram. For any alarm that is active, its corresponding bit within this parameter will be equal to 1.



7.20.3 Inverter Overload Current Alarm

This alarm is active when the motor current is above the Inverter Overload Threshold current, which is defined as 137.0A.

7.20.4 Battery Under Voltage Alarm

This alarm is active when the battery voltage is below the [**Battery Under Voltage Alarm Threshold]** parameter.

[Battery Under Voltage Alarm Threshold]	Parameter #	2004
	Type	Write-USER CWR
	Range	[0 . . . 3200] Volts
	Units	.1 Volts
	Default	500 Volts

7.20.5 Battery Under Temperature Alarm

This alarm is active when the battery voltage is below the **[Battery Under Temperature Alarm Threshold]** parameter.

[Battery Under Temperature Alarm Threshold]	Parameter #	2005
	Type	Write-USER CWR
	Range	[-273 . . . 175] C
	Units	.01 C
	Default	-5 C

7.20.6 Grid is Within the Reconnect Window Alarm

This alarm is active when the inverter detects that the abnormal conditions are cleared and the grid voltage and frequency are back within the reconnect window defined by IEEE1547.

7.20.7 Heat Sink Temperature Alarm

Heat sink temperature reached threshold. The alarm threshold should be lower than the trip threshold.

[Temperature Alarm Threshold]	Parameter #	2006
	Type	Write-USER CWR
	Range	[-320 . . . 320] C
	Units	.01 C
	Default	100 C

7.20.8 Loss of Signal Alarm

Signal on any analog inputs goes below trip threshold (See Section 7.22.14, “ Loss of signal fault”). Alarm is enabled even if the trip is disabled.

7.20.9 Auto-Restarting Alarm

If Auto restart is allowable for a fault that occurs, this alarm will activate as soon as the fault occurs, and will remain active until the inverter restarts.

7.20.10 User Configurable Alarm

This alarm is a user-configurable alarm. This alarm is activated when any system parameter of the user’s choice goes above or below a user-settable threshold.

[User Alarm Parameter ID]	Parameter #	2007
	Type	Write-USER CWR
	Range	[0 . . . Maximum Parameter ID]
	Units	1
	Default	0

The user enters the ID for the User Alarm parameter in this parameter. Any parameter ID may be used.

[User Alarm Threshold]	Parameter #	2008
	Type	Write-USER CWR
	Range	[0 . . . 100] %
	Units	.01 %
	Default	70 %

The user defines the User Alarm threshold with this parameter. The threshold is defined as a % of the full range of the User Alarm parameter (defined by **[User Alarm Parameter ID]**. For instance, if the range for the selected parameter is [-50 . . . 150], then to set a threshold of 100, the user would enter 75% in **[Load Loss Alarm Threshold]**, because 100 is 75% of the way from -50 to 150.

[User Alarm Greater/Less]	Parameter #	2009
	Type	Write-USER CWR
	Range	0 Less than 1 Greater than
	Default	1

This parameter determines whether the alarm is activated when the parameter value goes above the user's threshold or when it goes below the threshold. If **[User Alarm Greater/Less]** is set to 1, the alarm will activate when the value of the selected parameter goes above the threshold defined by **[User Alarm Threshold]**. If **[User Alarm Greater/Less]** is set to 0, the alarm will activate when the value of the selected parameter goes below the threshold.

[User Alarm]	Parameter #	2010
	Type	Read Only DOut
	Range	0 User Alarm not active 1 User Alarm Active
	Default	0

This parameter is set to 1 when the User Alarm is active, and is set to 0 when the User Alarm is not active. This parameter is mappable to a digital output so that it may be monitored by a remote system.

7.21 Auto Restart

[Auto Restart Attempts]
[Auto Restart Delay]
[Auto Restart Counter]
[Auto Restart Enable Mask 0]

[Auto Restart Attempts]	Parameter #	2101
	Type	Write-USER CWR
	Range	[0 . . . 20]
	Default	1

This parameter defines the number of times the inverter will automatically reset and restart itself after a trip occurs. Setting this parameter to 0 disables the Auto-restart function. Auto-restarts will only occur after trips for which Auto-restart is authorized. (See Faults Section) Upon restart, the inverter will issue itself a standard run signal, and operate accordingly.

[Auto Restart Delay]	Parameter #	2102
	Type	Write-USER CWR
	Range	[5 . . . 300] seconds
	Units	.01 seconds
	Default	10

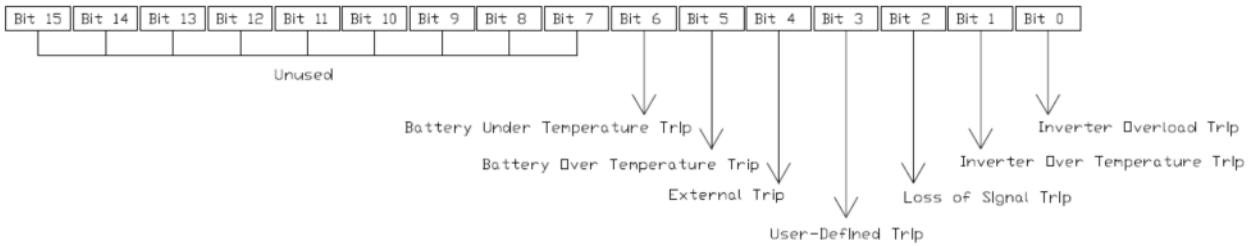
This parameter defines the amount of time the inverter will wait before restarting itself after a trip for which Auto-restart is authorized.

[Auto Restart Counter]	Parameter #	2103
	Type	Read Only
	Range	[0 . . . 20]
	Default	0

This parameter is incremented by 1 every time the inverter auto-restarts itself. If **[Auto Restart Counter]** reaches the value stored in **[Auto Restart Attempts]**, then any further trips will not be followed by a restart. **[Auto Restart Counter]** will be reset to zero whenever the inverter is stopped by the user. The counter will also be set to zero automatically if the inverter runs for 5 minutes without tripping.

[Auto Restart Enable Mask 0]	Parameter #	2104
	Type	Write-USER BIN CWR
	Range	[0000000000000000 . . . 0000000001111111] bit=0 - Auto-restart disabled for the fault bit=1 - Auto-restart enabled for the fault
	Default	0000000000000000

This parameter determines on which faults the inverter will perform an auto-restart. This parameter is a 16-bit binary number, each bit of which corresponds to a fault. If the Auto-Restart Enable bit for a given fault is 1, then the inverter will perform an auto-restart when this fault occurs. If the bit is 0, the inverter will remain stopped after the fault.



7.22 System Faults

This section outlines the various system faults and their associated parameters. If a fault is issued for any reason, the inverter will stop. After the inverter stops, it will enter the "Tripped" state until the fault is cleared. Some faults are self-clearing, and will clear automatically as soon as the corresponding fault conditions are alleviated. For all other faults, after the fault conditions no longer exist, the fault must be cleared by resetting the inverter. The inverter may be reset by issuing a Reset command, or by toggling the **[Inverter On]** signal. Below is a list of all of the inverters Fault IDs and their associated Faults:

Fault Name	Fault ID	Fault Name	Fault ID
Central Cap Over Voltage Fault	1	Calibration Load Fault	85
DC Port Over Voltage Fault	2	TDI Power Supply Failure *	86
DC Port Over Current Fault	3	Grid Contactor Overload Fault	87
AC Port Over Current Fault	4	Master Command Loss Fault	96
AC Caps Over Voltage Fault	5	Synch Signal Loss Fault	97
Grid Over Voltage Fault	6	Grid Contactor Fault	98
Setup Wizard Fault	7	GFDI Error Fault	99
DC Port Reverse Voltage Fault	8	Fan VSD Failure	100
Ground Fault	9	Grid Voltage Synchronization Fault	101
Internal Fault	16	AC Caps Voltage Synchronization Fault	102
Inverter Overload Fault	18	Wrong Phase Order Fault	103
Central Cap Under Voltage Fault	19	Battery Over Voltage Fault	113
Inverter Over Temperature Fault	33	Battery Under Voltage Fault	114
Inverter Temp Sensor Failure	34	Battery Over Temperature Fault	115
Loss of signal fault	53	Battery Over Charge Capacity Fault	116
User-defined Trip	65	Battery Pre-charge Timeout Fault	117
External Trip	66	Battery Under Temperature Fault	118
Internal Fault	67	Synchronization to Master Fault (Backup Mode)	128
Max Retries Fault	68	PV Over Voltage Fault	129
Bootup Fault	70	PV Under Voltage Fault	130
Internal Fault	80	PV Pre-charge Timeout Fault	131
LCD Communication Loss Fault	82	Synchronization to Master Fault (Motor Control Mode)	144

Table 7.1 – Fault Codes

* 350VDC power supply option

[System Tripped]	Parameter #	2201
	Type	Read Only DOut
	Range	0 System not tripped 1 System tripped
	Default	1

This parameter will be equal to 1 when the inverter is in the “Tripped” state. Otherwise it will be equal to 0. This parameter can be mapped to a digital output so it can be monitored by a remote system.

7.22.1 Central Cap Over Voltage Fault

This fault will be issued when the central cap voltage is too high to maintain the proper operation.

7.22.2 DC Port Over Voltage Fault

This fault will be issued when the DC port voltage is too high to maintain the proper operation.

7.22.3 DC Port Over Current Fault

This fault will be issued when the DC port current is too high to maintain the proper operation.

7.22.4 AC Port Over Current Fault

This fault will be issued when the AC port current is too high to maintain the proper operation.

7.22.5 AC Caps Over Voltage Fault

This fault will be issued when the voltage on the AC caps is too high to maintain the proper operation.

7.22.6 Grid Over Voltage Fault

This fault will be issued when the grid voltage is too high to maintain the proper operation.

7.22.7 Setup Wizard Fault

If the user has not completed the setup wizard, the inverter will issue the Setup Wizard Fault when it receives the On signal. The setup wizard must be completed before the inverter can be run.

7.22.8 Ground Fault

This fault will be issued if the ground fault detection circuit measured a ground current of more than 4 amps or determined that the ground fuse is blown.

7.22.9 Internal Faults

Internal faults happen because of a hardware fault. If an internal fault is detected, reset the inverter and restart it. If problem persist, contact technical support.

7.22.10 Inverter Overload Fault

This fault will be issued if the inverter AC current is above 103% of maximum current for enough time that the overload accumulator reaches the overload limit. The overload limit is set such that running at 110% of the maximum current for 1 minute will cause an overload fault. The accumulator is added to by an amount that is proportional to the square of current, so running at 120% of the threshold will trip the inverter in 15 seconds, and so on.

7.22.11 Central Cap Under Voltage Fault

This fault will be issued when the central cap voltage is too low to maintain the proper operation.

7.22.12 Inverter Over Temperature Fault

This fault will be issued if the measured temperature either of the input switching heat sink or of the output switching heat sink exceeds 90C, or the ambient temperature exceeds 70C. The heat sink and ambient temperatures are stored in **[Input Heatsink Temperature], [Output Heatsink Temp]** and **[Ambient Temperature]** respectively.

[Input Heatsink Temperature]	Parameter #	2212
	Type	Read Only AOut
	Range	[-273. . . 175]
	Default	0
[Output Heatsink Temperature]	Parameter #	2217
	Type	Read Only AOut
	Range	[-273 . . . 175]
	Default	0
[Ambient Temperature]	Parameter #	2222
	Type	Read Only AOut
	Range	[-273 . . . 175]
	Default	0

[Temperature Analog Lo]	Parameter #	2210
	Type	Write-USER
	Range	[-273 . . . 175]
	Default	0
[Temperature Analog Hi]	Parameter #	2211
	Type	Write-USER
	Range	[-273 . . . 175]
	Default	120

These parameters define the analog output mapping range for **[Input Heatsink Temperature], [Output Heatsink Temperature],** and **[Ambient Temperature].** See Section 7.19 for details on analog outputs.

7.22.13 Inverter Temp Sensor Failure

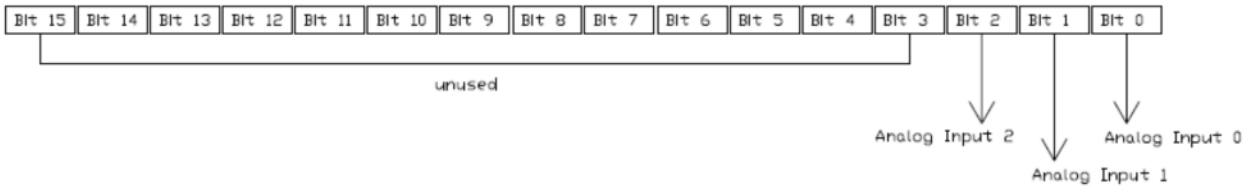
This fault will be issued if the control system detects that one of the temperature sensors is not working properly. This could be caused by damage to the sensor cables or an accidental disconnection at the sensor (located at the heat sink) or at the control board.

7.22.14 Loss of signal fault

If signal loss detection is enabled for a particular analog input, a Loss of Signal Fault will be issued if the measured reference signal on that input goes below **[AIx Signal Lo]**-5%. To enable signal loss detection for an analog input, set the corresponding bit in the **[Signal Loss Enable]** parameter to 1. Note: in order to use signal loss detection, **[AIx Signal Lo]** for the desired analog input must be set greater than 5%. A common configuration for loss detection is to use the range 2-10V or 4-20mA instead of 0-10V and 0-20mA. This configuration uses **[AIx Signal Lo]** = 20% and **[AIx Signal Hi]** = 100%.

[Signal Loss Enable]	Parameter #	2202
	Type	Write-USER BIN CWR
	Range	[000000000000000. . . 000000000000111]
	Default	000000000000000

The first 3 bits of the parameter **[Signal Loss Enable]** each determine whether or not signal loss detection is enabled for one analog input. Signal loss detection is enabled if a bit is 1, and disabled if the bit is 0.



7.22.15 User-defined Trip

This fault is configurable by the user such that the system can trip based on a custom set of conditions. The user is able to choose any system parameter, and set up a threshold such that the inverter will trip if the selected parameter is either above or below that threshold.

[User Trip Parameter ID]	Parameter #	2204
	Type	Write-USER
	Range	[0 . . . 2944]
	Default	0

Enter the parameter ID for the parameter that the User-Defined Trip will be based on.

[User Trip Threshold]	Parameter #	2205
	Type	Write-USER CWR
	Range	[0 . . .100] %
	Units	.01 %
	Default	70%

This parameter defines the threshold to which the User Trip Parameter will be compared. It is defined as a % of the maximum value of this parameter. For example, if the user wants the inverter to trip when the input heat sink temperature reaches 60C, since the maximum for **[Input Heatsink Temperature]** is 175C, **[User Trip Threshold]** should be set to **34.28%**. This is because 60C is 34.28% of 175.

[User Trip Greater/Less]	Parameter #	2206
	Type	Write-USER CWR
	Range	0 Trip when less than threshold 1 Trip when greater than threshold
	Default	1

If the user wants the inverter to trip when the User Trip Parameter is above the threshold defined by **[User Trip Threshold]**, this parameter should be set to 1. If this parameter is set to 0, the inverter will trip when the User Trip Parameter is below the threshold.

[User Trip Enable]	Parameter #	2207
	Type	Write-USER CWR
	Range	0 Disabled 1 Enabled
	Default	0

To enable the User-Defined Trip, set this parameter to 1. To disable it, set it to 0.

7.22.16 External Trip

If **[External Trip]** parameter is set to 1, the inverter will issue an External Trip fault. This parameter can be mapped to a digital input so that it can be controlled by a remote system.

[External Trip]	Parameter #	2202
	Type	Write-OPEN CWR DIn DOut
	Range	0 No Action 1 Trip
	Default	0

7.22.17 Max Retries Fault

This fault will be issued if the inverter has attempted, unsuccessfully, to restart after a fault a number of times equal to **[Auto Restart Attempts].** Inverter will stay tripped until user resets it.

7.22.18 Bootup Fault

If the CRC of stored configuration parameters is not correct, system will indicate a fault and load the default values. This requires re-configuring all inverter parameters, loading the backup parameters from the front panel interface unit, or loading a saved profile via the Web Interface. The inverter must be reset in order to clear this fault.

7.22.19 LCD Communication Loss Fault

This fault is issued if the inverter loses communication with the front panel interface (LCD).

7.22.20 Calibration Load Fault

Unit specific calibration data has been lost due to an error in the control system. Inverter cannot operate without this data. Contact the technical support if this fault occurs.

7.22.21 TDI Power Supply Failure

This fault will be issued if the DC power supply that powers the control system fails. If this fault persists after restarting the system, contact technical support.

7.22.22 Grid Contactor Overload Fault

This fault will be issued if the current going through the grid contactor is above its maximum rated current – 150Amps.

7.22.23 Master Command Loss Fault

This fault will be issued if the inverter stops receiving the command signal sent by the master unit.

7.22.24 Synch Signal Loss

This fault will be issued if the inverter stops receiving the synchronization signal sent by the master unit. If this fault is issued on a stand-alone unit, it may indicate a problem with the jumper cable between J40 and J46 on the GTI interface I/O board on the inside of the door of the inverter.

7.22.25 Grid Contactor Fault

This fault will be issued if the control system detects that the grid contactor failed to operate properly.

7.22.26 GFDI Error Fault

This fault will be issued if the control system detects that the Ground Fault Detector/Interrupter unit is not operating properly.

7.22.27 Fan VSD Failure

This fault will be issued if the control system detects that the VSD that controls the inverter blowers failed to operate properly.

7.23 PV Control Faults

The following faults are only applicable if the inverter configured for PV operation.

7.23.1 PV Over Voltage Fault

This fault will be issued when the PV array voltage is too high to maintain the proper operation.

7.23.2 PV Under Voltage Fault

This fault will be issued when the PV array voltage is too low to maintain the proper operation.

7.23.3 PV Pre-charge Timeout Fault

This fault will be issued if the central cap does not pre-charge within a set time period after the DC disconnect has been closed.

7.24 Battery Control Faults

[Battery Overcharge Fault Enable]
[Battery Total Charge Capacity]
[Battery Overcharge Threshold%]
[Battery Over Temperature Fault Threshold]
[Battery Over Temperature Fault Time]
[Battery Over Temperature Clear Time]
[Battery Under Temperature Fault Threshold]
[Battery Under Temperature Fault Time]
[Battery Under Temperature Clear Threshold]
[Battery Under Temperature Clear Time]

[Battery Over Temperature Clear Threshold]

The following faults are only applicable if the inverter configured for Battery operation.

7.24.1 Battery Over Voltage Fault

This fault will be issued when the battery voltage is too high to maintain the proper operation.

7.24.2 Battery Under Voltage Fault

This fault will be issued when the battery voltage is too low to maintain the proper operation.

7.24.3 Battery Over Temperature Fault

This fault will be issued when the battery temperature exceeds the user set **[Battery Over Temperature Fault Threshold]** parameter for a period of time controlled by **[Battery Over Temperature Fault Time]** parameter. The trip self clears if the battery temperature goes below **[Battery Over Temperature Clear Threshold]** parameter for a period of time controlled by **[Battery Over Temperature Clear Time]** parameter.

[Battery Over Temperature Fault Threshold]	Parameter #	2407
	Type	Write-USER CWR
	Range	[-273 . . . 175]
	Default	70

[Battery Over Temperature Fault Time]	Parameter #	2408
	Type	Write-USER CWR
	Range	[0.01 . . . 10]
	Default	1

[Battery Over Temperature Clear Threshold]	Parameter #	2409
	Type	Write-USER CWR
	Range	[-273 . . . 175]
	Default	60

[Battery Over Temperature Clear Time]	Parameter #	2410
	Type	Write-USER CWR
	Range	[0.01 . . . 10]
	Default	1

7.24.4 Battery Over Charge Capacity Fault

This fault will be issued if the inverter exceeds the battery charge capacity (amp-hours) when in battery charging mode.

[Battery Overcharge Fault Enable]	Parameter #	2415
	Type	Write-USER

	Range	[0, 1]
	Default	0

Set this parameter to 1 to enable the fault, otherwise set it to 0.

[Battery Total Charge Capacity]		
	Parameter #	2416
	Type	Write-USER CWR
	Range	[0 . . . 32000]
	Default	100

Total battery charge capacity in amp-hours.

[Battery Overcharge Threshold%]		
	Parameter #	2417
	Type	Write-USER CWR
	Range	[0 . . . 320]
	Default	1.25

This parameter defines the threshold for the Battery Over Charge Capacity Fault. The inverter will issue the trip if total charge amount will exceed **[Battery Total Charge Capacity]**x**[Battery Overcharge Threshold%].**

7.24.5 Battery Pre-charge Timeout

This fault will be issued if the central cap does not pre-charge within a set time period after the DC disconnect has been closed.

7.24.6 Battery Under Temperature

This fault will be issued when the battery temperature goes bellow the user set **[Battery Under Temperature Fault Threshold]** parameter for a period of time controlled by **[Battery Under Temperature Fault Time]** parameter. The trip self clears if the battery temperature goes above **[Battery Under Temperature Clear Threshold]** parameter for a period of time controlled by **[Battery Under Temperature Clear Time]** parameter.

[Battery Under Temperature Fault Threshold]		
	Parameter #	2411
	Type	Write-USER CWR
	Range	[-273 . . . 175]
	Default	-10

[Battery Under Temperature Fault Time]		
	Parameter #	2412
	Type	Write-USER CWR
	Range	[0.01 . . . 10]
	Default	1

[Battery Under Temperature Clear Threshold]		
	Parameter #	2413
	Type	Write-USER CWR
	Range	[-273 . . . 175]
	Default	0

[Battery Under Temperature Clear Time]		
	Parameter #	2414
	Type	Write-USER CWR

	Range	[0.01 . . . 10]
	Default	1

7.25 Grid Control Faults

The following faults are only applicable if the inverter is operating in on-grid mode.

7.25.1 Grid Voltage Synchronization Fault

This fault will be issued when the inverter loses synchronization with the grid voltage.

7.25.2 AC Caps Voltage Synchronization

This fault will be issued when the inverter loses synchronization with the AC caps voltages.

7.25.3 Wrong Phase Order Fault

This fault will be issued when the inverter detects incorrect phase order at either the grid terminal or the isolation transformer terminals.

7.26 Backup Control Faults

7.26.1 Synchronization to Master Fault (Backup Mode)

This trip will be issued when the inverter is operating in backup mode and loses synchronization with the master unit.

7.27 Motor Control Faults

7.27.1 Synchronization to Master (Motor Control Mode)

This trip will be issued when the inverter is operating in motor control mode and loses synchronization with the master unit.

7.28 Fault Buffer

[Fault Buffer X - Fault ID]	[Fault Buffer X - AC Current Inst]
[Fault Buffer X - Fault Time]	[Fault Buffer X - AC Current Avg]
[Fault Buffer X - Fault Date]	[Fault Buffer X - Central Cap Voltage]
[Fault Buffer X - DC voltage]	[Fault Buffer X - Status Register 1]
[Fault Buffer X - DC current Inst]	[Fault Buffer X - Status Register 2]
[Fault Buffer X - DC current Avg]	[Fault Buffer X - Alarm Status Register]
[Fault Buffer X - AC voltage]	

Every time a Fault is issued, the following 13 system values are stored to memory for later reference. The system stores up to 4 sets of these values. After 4 sets have been stored, when a new Fault is issued, the oldest set is deleted to make room for the newest set.

1. Fault ID
2. Fault Time
3. Fault Date

4. DC Voltage
5. DC Instantaneous Current
6. DC Avergage Current
7. AC Voltage
8. AC Instantaneous Current
9. AC Average Current
10. Central Capacitor Voltage
11. Status Register 1
12. Status Register 2
13. Alarm Status Register

[Fault Buffer 0 - Fault ID] . . . **[Fault Buffer 3 - Fault ID]**	Parameter #	2801, 2814, 2827, 2840
	Type	Read Only
	Range	[-32768 . . . 32767]
	Default	0

[Fault Buffer 0 - Fault Time] . . . **[Fault Buffer 3 - Fault Time]**	Parameter #	2802, 2815, 2828, 2841
	Type	Read Only
	Range	[0 . . . 2359]
	Default	0

[Fault Buffer 0 - Fault Date] . . . **[Fault Buffer 3 - Fault Date]**	Parameter #	2803, 2816, 2829, 2842
	Type	Read Only
	Range	[0 . . . 1231]
	Default	0

[Fault Buffer 0 - DC voltage] . . . **[Fault Buffer 3 - DC voltage]**	Parameter #	2804, 2817, 2830, 2843
	Type	Read Only
	Range	[-3276.8 . . . 3276.7]
	Default	0

[Fault Buffer 0 - DC current Inst] .	Parameter #	2805, 2818, 2831, 2844
	Type	Read Only
	Range	[-3276.8 . . . 3276.7]

. . **[Fault Buffer 3 - DC current Inst]**	Default	0

[Fault Buffer 0 - DC current Avg] . . . **[Fault Buffer 3 - DC current Avg]**	Parameter #	2806, 2819, 2832, 2845
	Type	Read Only
	Range	[-3276.8 . . . 3276.7]
	Default	0

[Fault Buffer 0 - AC voltage] . . . **[Fault Buffer 3 - AC voltage]**	Parameter #	2807, 2820, 2833, 2846
	Type	Read Only
	Range	[-3276.8 . . . 3276.7]
	Default	0

[Fault Buffer 0 - AC Current Inst] . . . **[Fault Buffer 3 - AC Current Inst]**	Parameter #	2808, 2821, 2834, 2847
	Type	Read Only
	Range	[-3276.8 . . . 3276.7]
	Default	0

[Fault Buffer 0 - AC Current Avg] . . . **[Fault Buffer 3 - AC Current Avg]**	Parameter #	2809, 2822, 2835, 2848
	Type	Read Only
	Range	[-3276.8 . . . 3276.7]
	Default	0

[Fault Buffer 0 - Central Cap Voltage] . . . **[Fault Buffer 3 - Central Cap Voltage]**	Parameter #	2810, 2823, 2836, 2849
	Type	Read Only
	Range	[-3276.8 . . . 3276.7]
	Default	0

[Fault Buffer 0 - Status	Parameter #	2811, 2824, 2837, 2850

Register 1] . . . **[Fault Buffer 3 - Status Register 1]**	Type	Read Only
	Range	[-32768 . . . 32767]
	Default	0

[Fault Buffer 0 - Status Register 2] . . . **[Fault Buffer 3 - Status Register 2]**	Parameter #	2812, 2825, 2838, 2851
	Type	Read Only
	Range	[-32768 . . . 32767]
	Default	0

[Fault Buffer 0 - Alarm Status Register] . . . **[Fault Buffer 3 - Alarm Status Register]**	Parameter #	2813, 2826, 2839, 2852
	Type	Read Only
	Range	[-32768 . . . 32767]
	Default	0

The values are stored in the following parameters:

Parameter Name	**ID**
[Fault Buffer 0 - Fault ID]	2801
[Fault Buffer 0 - Fault Time]	2802
[Fault Buffer 0 - Fault Date]	2803
[Fault Buffer 0 - DC voltage]	2804
[Fault Buffer 0 - DC current Inst]	2805
[Fault Buffer 0 - DC current Avg]	2806
[Fault Buffer 0 - AC voltage]	2807
[Fault Buffer 0 - AC Current Inst]	2808
[Fault Buffer 0 - AC Current Avg]	2809
[Fault Buffer 0 - Central Cap Voltage]	2810
[Fault Buffer 0 - Status Register 1]	2811
[Fault Buffer 0 - Status Register 2]	2812
[Fault Buffer 0 - Alarm Status Register]	2813
[Fault Buffer 1 - Fault ID]	2814
[Fault Buffer 1 - Fault Time]	2815
[Fault Buffer 1 - Fault Date]	2816
[Fault Buffer 1 - DC voltage]	2817
[Fault Buffer 1 - DC current Inst]	2818
[Fault Buffer 1 - DC current Avg]	2819
[Fault Buffer 1 - AC voltage]	2820
[Fault Buffer 1 - AC Current Inst]	2821

[Fault Buffer 1 - AC Current Avg]	2822
[Fault Buffer 1 - Central Cap Voltage]	2823
[Fault Buffer 1 - Status Register 1]	2824
[Fault Buffer 1 - Status Register 2]	2825
[Fault Buffer 1 - Alarm Status Register]	2826
[Fault Buffer 2 - Fault ID]	2827
[Fault Buffer 2 - Fault Time]	2828
[Fault Buffer 2 - Fault Date]	2829
[Fault Buffer 2 - DC voltage]	2830
[Fault Buffer 2 - DC current Inst]	2831
[Fault Buffer 2 - DC current Avg]	2832
[Fault Buffer 2 - AC voltage]	2833
[Fault Buffer 2 - AC Current Inst]	2834
[Fault Buffer 2 - AC Current Avg]	2835
[Fault Buffer 2 - Central Cap Voltage]	2836
[Fault Buffer 2 - Status Register 1]	2837
[Fault Buffer 2 - Status Register 2]	2838
[Fault Buffer 2 - Alarm Status Register]	2839
[Fault Buffer 3 - Fault ID]	2840
[Fault Buffer 3 - Fault Time]	2841
[Fault Buffer 3 - Fault Date]	2842
[Fault Buffer 3 - DC voltage]	2843
[Fault Buffer 3 - DC current Inst]	2844
[Fault Buffer 3 - DC current Avg]	2845
[Fault Buffer 3 - AC voltage]	2846
[Fault Buffer 3 - AC Current Inst]	2847
[Fault Buffer 3 - AC Current Avg]	2848
[Fault Buffer 3 - Central Cap Voltage]	2849
[Fault Buffer 3 - Status Register 1]	2850
[Fault Buffer 3 - Status Register 2]	2851
[Fault Buffer 3 - Alarm Status Register]	2852

Table 7.2 – Fault Buffer

7.29 **Parameter List**

The following table contains all of the system parameters, sorted by ID number.

Web Variable Name	ID	Group	Min	Max	Scale	Units
[FPGA Firmware V#]	101	System Info	0	327.67	0.01	
[DSP Firmware V#]	102	System Info	0	327.67	0.01	
[DSP Product Type]	103	System Info	0	32767	1	
[DSP kW Macro]	104	System Info	0	32767	1	
[WebUI Driver V#]	105	System Info	0	327.67	0.01	
[Applet V#]	106	System Info	0	327.67	0.01	
[LCD Menu V#]	107	System Info	0	327.67	0.01	
[LCD Product Type]	108	System Info	0	32767	1	

[LCD Driver V#]	109	System Info	0	327.67	0.01	
[Setup Wizard Done]	110	System Info	0	1	1	
[LCD Display Param ID1]	201	LCD	0	2944	1	
[LCD Display Param ID2]	202	LCD	0	2944	1	
[LCD Display Param ID3]	203	LCD	0	2944	1	
[LCD Display Param ID4]	204	LCD	0	2944	1	
[LCD Display Param ID5]	205	LCD	0	2944	1	
[LCD Display Param ID6]	206	LCD	0	2944	1	
[LCD Display Param ID7]	207	LCD	0	2944	1	
[LCD Display Param ID8]	208	LCD	0	2944	1	
[LCD Display Param ID9]	209	LCD	0	2944	1	
[LCD Display Param ID10]	210	LCD	0	2944	1	
[LCD Display Param ID11]	211	LCD	0	2944	1	
[LCD Display Param ID12]	212	LCD	0	2944	1	
[LCD Display Param ID13]	213	LCD	0	2944	1	
[LCD Display Param ID14]	214	LCD	0	2944	1	
[LCD Display Param ID15]	215	LCD	0	2944	1	
[LCD Display Param ID16]	216	LCD	0	2944	1	
[LCD Display Param ID17]	217	LCD	0	2944	1	
[LCD Display Param ID18]	218	LCD	0	2944	1	
[LCD Display Param ID19]	219	LCD	0	2944	1	
[LCD Display Param ID20]	220	LCD	0	2944	1	
[LCD Indiv Param ID]	221	LCD	0	2944	1	
[LCD Operation Timer]	222	LCD	0	32767	1	sec
[Device ID]	301	Modbus	1	247	1	
[Baud Rate]	302	Modbus	4800	57600	10	bps
[Data bits]	303	Modbus	7	8	1	
[Parity]	304	Modbus	0	2	1	
[Stop bits]	305	Modbus	1	2	1	
[RS-232/485 Select]	306	Modbus	0	1	1	
[DHCP Enable]	401	Web UI	0	1	1	
[IP Address MSB]	402	Web UI	0	255	1	
[IP Address Byte 3]	403	Web UI	0	255	1	
[IP Address Byte 2]	404	Web UI	0	255	1	
[IP Address LSB]	405	Web UI	0	255	1	
[Subnet Mask MSB]	406	Web UI	0	255	1	
[Subnet Mask Byte 3]	407	Web UI	0	255	1	
[Subnet Mask Byte 2]	408	Web UI	0	255	1	
[Subnet Mask LSB]	409	Web UI	0	255	1	
[Gateway MSB]	410	Web UI	0	255	1	
[Gateway Byte 3]	411	Web UI	0	255	1	
[Gateway Byte 2]	412	Web UI	0	255	1	
[Gateway LSB]	413	Web UI	0	255	1	
[E-mail Trip Data Enable]	414	Web UI	0	1	1	
[Password]	501	Password Protection	0	32767	1	
[User Set Password]	502	Password Protection	0	32767	1	

[Factory Set Password]	503	Password Protection	0	32767	1	
[DC Source Type]	601	Inverter Configuration	0	1	1	
[Backup Type]	602	Inverter Configuration	0	2	1	
[Inverter On]	701	Inverter Control	0	1	1	
[Inverter Reset]	702	Inverter Control	0	1	1	
[Power Command]	703	Inverter Control	-100	100	0.01	kW
[Power Command Analog Lo]	704	Inverter Control	-100	100	0.01	kW
[Power Command Analog Hi]	705	Inverter Control	-100	100	0.01	kW
[Run On Power Up]	706	Inverter Control	0	1	1	
[Pulse Limit]	707	Inverter Control	0	9999	1	
[Inverter AC Voltage]	801	Monitoring	0	3200	0.1	V
[Inverter AC Voltage Analog Lo]	802	Monitoring	0	3200	0.1	V
[Inverter AC Voltage Analog Hi]	803	Monitoring	0	3200	0.1	V
[Grid AC Voltage AB]	804	Monitoring	0	3200	0.1	V
[Grid AC Voltage BC]	805	Monitoring	0	3200	0.1	V
[Grid AC Voltage CA]	806	Monitoring	0	3200	0.1	V
[Grid AC Voltage Analog Lo]	807	Monitoring	0	3200	0.1	V
[Grid AC Voltage Analog Hi]	808	Monitoring	0	3200	0.1	V
[Inverter DC Voltage]	809	Monitoring	0	3200	0.1	V
[Inverter DC Voltage Analog Lo]	810	Monitoring	0	3200	0.1	V
[Inverter DC Voltage Analog Hi]	811	Monitoring	0	3200	0.1	V
[Inverter AC Current]	812	Monitoring	0	3200	0.1	Amps
[Inverter AC Current Analog Lo]	813	Monitoring	0	3200	0.1	Amps
[Inverter AC Current Analog Hi]	814	Monitoring	0	3200	0.1	Amps
[Grid AC Current]	815	Monitoring	0	3200	0.1	Amps
[Grid AC Current Analog Lo]	816	Monitoring	0	3200	0.1	Amps
[Grid AC Current Analog Hi]	817	Monitoring	0	3200	0.1	Amps
[Inverter DC Current]	818	Monitoring	0	3200	0.1	Amps
[Inverter DC Current Analog Lo]	819	Monitoring	0	3200	0.1	Amps
[Inverter DC Current Analog Hi]	820	Monitoring	0	3200	0.1	Amps
[Central Cap Voltage]	821	Monitoring	0	3200	0.1	V
[Inverter AC Power]	822	Monitoring	-320	320	0.01	kW
[Inverter AC Power Analog Lo]	823	Monitoring	-320	320	0.01	kW
[Inverter AC Power Analog Hi]	824	Monitoring	-320	320	0.01	kW
[Inverter DC Power]	825	Monitoring	-320	320	0.01	kW
[Inverter DC Power Analog Lo]	826	Monitoring	-320	320	0.01	kW
[Inverter DC Power Analog Hi]	827	Monitoring	-320	320	0.01	kW
[Motor Speed]	828	Monitoring	0	60	0.01	Hz
[Motor Speed Analog Lo]	829	Monitoring	0	60	0.01	Hz
[Motor Speed Analog Hi]	830	Monitoring	0	60	0.01	Hz
[PV Minimum Power]	901	PV Control Settings	0	320	0.01	kW
[PV Minimum Power Time]	902	PV Control Settings	0	32000	1	sec
[PV Restart Time]	903	PV Control Settings	0	32000	1	sec
[PV Minimum Voltage]	904	PV Control Settings	0	3200	0.1	V
[PV MPPT Voltage Limit]	905	PV Control Settings	0	3200	0.1	V
[MPPT Gamma]	906	PV Control Settings	0	1	0.01	

[MPPT Ripple Amplitude]	907	PV Control Settings	0	320	0.01	V
[MPPT Ripple Frequency]	908	PV Control Settings	0	320	0.01	Hz
[DC Damping Rsim]	909	PV Control Settings	0	320	0.01	Ohm
[PV Array Open Circuit Voltage]	910	PV Control Settings	0	3200	0.1	V
[PV kWh Today]	911	PV Control Settings	0	32000	1	kWh
[Reset kWh Today]	912	PV Control Settings	0	1	1	
[PV Total kWh]	913	PV Control Settings	0	32000	1	kWh
[PV Total MWh]	914	PV Control Settings	0	32000	1	MWh
[Reset Total kWh]	915	PV Control Settings	0	1	1	
[Reset Date MMDD]	916	PV Control Settings	0	32000	1	
[Reset Date YY]	917	PV Control Settings	0	32000	1	
[IldcT0NextTarget Cap]	918	PV Control Settings	0	100	0.01	%
[Bulk Charging Voltage]	1001	Battery Control Settings	280	600	0.1	V
[Float Charging Voltage]	1002	Battery Control Settings	280	600	0.1	V
[Maximum Charging Current]	1003	Battery Control Settings	0	285	0.1	Amps
[Bulk to Float Transition Current]	1004	Battery Control Settings	0	285	0.1	Amps
[Battery Charged Current]	1005	Battery Control Settings	0	285	0.1	Amps
[Battery Not Charged Voltage]	1006	Battery Control Settings	280	600	0.1	V
[Minimum Discharge Voltage]	1007	Battery Control Settings	200	600	0.1	V
[Rectifier Used For Testing]	1008	Battery Control Settings	0	1	1	
[Battery Equalization Enable]	1009	Battery Control Settings	0	1	1	
[Battery Equalization Voltage]	1010	Battery Control Settings	280	600	0.1	V
[Battery Equalization Time Hours]	1011	Battery Control Settings	0	3600	1	Hours
[Battery Equalization Time Minutes]	1012	Battery Control Settings	0	60	1	Min
[Bulk Delay Time Hours]	1013	Battery Control Settings	0	3600	1	Hours
[Bulk Delay Time Minutes]	1014	Battery Control Settings	0	60	1	Min
[Battery Temperature]	1015	Battery Control Settings	-273	320	0.01	C
[Battery Temp Analog Lo]	1016	Battery Control Settings	-273	320	0.01	C
[Battery Temp Analog Hi]	1017	Battery Control Settings	-273	320	0.01	C
[Temperature Compensation Enable]	1018	Battery Control Settings	0	1	1	
[Temperature Compensation Per Cell]	1019	Battery Control Settings	0	1	0.0001	V/C
[Number of Cells]	1020	Battery Control Settings	0	32000	1	

[T1 Gain Scale]	1021	Battery Control Settings	0	32	0.001	
[Bulk Time Out]	1022	Battery Control Settings	0	320	0.01	Hours
[IbattT0NextTarget Cap]	1023	Battery Control Settings	0	100	0.01	%
[Battery Minimum Voltage Limit]	1024	Battery Control Settings	0	1000	0.1	V
[Maximum Charging Current Disable]	1025	Battery Control Settings	0	1	1	
[AI Minimum Frequency]	1101	Grid Control Settings	47	63	0.01	Hz
[AI Maximum Frequency]	1102	Grid Control Settings	47	63	0.01	Hz
[AI Outer Frequency Window Time]	1103	Grid Control Settings	0	300	0.01	sec
[AI Sag Frequency]	1104	Grid Control Settings	57	59.8	0.01	Hz
[AI Frequency Sag Time]	1105	Grid Control Settings	0.16	300	0.01	sec
[AI Minimum Voltage]	1106	Grid Control Settings	0	3200	0.1	V
[AI Maximum Voltage]	1107	Grid Control Settings	0	3200	0.1	V
[AI Outer Voltage Window Time]	1108	Grid Control Settings	0	300	0.01	sec
[AI Sag Voltage]	1109	Grid Control Settings	422.4	456	0.1	V
[AI Surge Voltage]	1110	Grid Control Settings	504	528	0.1	V
[AI Voltage Sag Time]	1111	Grid Control Settings	0	300	0.01	sec
[AI Voltage Surge Time]	1112	Grid Control Settings	0	300	0.01	sec
[AI Reconnect Delay]	1113	Grid Control Settings	0	32000	1	sec
[On-grid Minimum Frequency]	1114	Grid Control Settings	0	120	0.01	Hz
[On-grid Maximum Frequency]	1115	Grid Control Settings	0	120	0.01	Hz
[On-grid Outer Frequency Window Time]	1116	Grid Control Settings	0	300	0.01	sec
[On-grid Minimum Voltage]	1117	Grid Control Settings	0	3200	0.1	V
[On-grid Maximum Voltage]	1118	Grid Control Settings	0	3200	0.1	V
[On-grid Outer Voltage Window Time]	1119	Grid Control Settings	0	300	0.01	sec
[On-grid Sag Voltage]	1120	Grid Control Settings	0	3200	0.1	V
[On-grid Surge Voltage]	1121	Grid Control Settings	0	3200	0.1	V
[On-grid Voltage Sag Time]	1122	Grid Control Settings	0	300	0.01	sec
[On-grid Voltage Surge Time]	1123	Grid Control Settings	0	300	0.01	sec
[On-grid Reconnect Delay]	1124	Grid Control Settings	0	32000	1	sec
[Power Factor Shift Time]	1125	Grid Control Settings	0	320	0.01	sec
[Positive Phase Shift]	1126	Grid Control Settings	-180	180	0.1	Deg
[Negative Phase Shift]	1127	Grid Control Settings	-180	180	0.1	Deg
[Anti-islanding Frequency Threshold]	1128	Grid Control Settings	0	320	0.01	Hz
[Grid Contactor Close Delay]	1129	Grid Control Settings	0.01	320	0.01	sec
[On-grid Power Limit Enable]	1130	Grid Control Settings	0	1	1	
[On-grid Power Limit]	1131	Grid Control Settings	0	150	0.01	kW
[On-grid Power Limit Analog Lo]	1132	Grid Control Settings	0	150	0.01	kW
[On-grid Power Limit Analog Hi]	1133	Grid Control Settings	0	150	0.01	kW
[On-grid Power Limit Margin]	1134	Grid Control Settings	0	150	0.01	kW
[Phase Loss Current Threshold]	1135	Grid Control Settings	0	320	0.01	Amps
[Phase Loss Trip Time]	1136	Grid Control Settings	0	320	0.01	sec
[Backup Open Circiut Voltage]	1201	Backup Control Settings	0	3200	0.1	V

[Backup Open Circuit Voltage Min]	1202	Backup Control Settings	0	3200	0.1	V
[Backup Open Circuit Voltage Max]	1203	Backup Control Settings	0	3200	0.1	V
[Backup Regulation Voltage Min]	1204	Backup Control Settings	0	3200	0.1	V
[Backup Regulation Voltage Max]	1205	Backup Control Settings	0	3200	0.1	V
[Backup Voltage I-gain]	1206	Backup Control Settings	1E-05	0.32	0.00001	
[Backup Voltage Ramp Rate]	1207	Backup Control Settings	0	32000	1	V/sec
[Phase Shift Adjustment Gain]	1208	Backup Control Settings	0	10	0.001	
[Backup Rsim]	1209	Backup Control Settings	0	32	0.001	Ohm
[Motor Nameplate FLA]	1301	Motor Control Settings	0.1	400	0.1	Amps
[Motor Nameplate Hz]	1302	Motor Control Settings	20	60	0.01	Hz
[Motor Nameplate RPM]	1303	Motor Control Settings	1	3600	1	RPM
[Motor Nameplate Volts]	1304	Motor Control Settings	0.1	500	0.1	V
[Motor Nameplate HP]	1305	Motor Control Settings	0.1	300	0.1	HP
[Motor Min Speed]	1306	Motor Control Settings	20	60	0.01	Hz
[Motor Max Speed]	1307	Motor Control Settings	20	60	0.01	Hz
[Motor Startup Delay]	1308	Motor Control Settings	0	32000	1	sec
[Motor Acceleration Rate]	1309	Motor Control Settings	0.001	32	0.001	Hz/sec
[Motor Deceleration Rate]	1310	Motor Control Settings	0.001	32	0.001	Hz/sec
[Motor Speed Increment]	1311	Motor Control Settings	0.01	60	0.01	Hz
[Motor Speed Decrement]	1312	Motor Control Settings	0.01	60	0.01	Hz
[Motor Speed Interval]	1313	Motor Control Settings	1	32000	1	sec
[Insufficient PV Voltage Threshold]	1314	Motor Control Settings	0.1	600	0.1	V
[Motor Phase Shift Adjustment Gain]	1315	Motor Control Settings	0	10	0.001	
[Motor Rsim]	1316	Motor Control Settings	0	32	0.001	Ohm
[Inverter On Owner]	1401	Control Function Owners	0	15	1	
[Inverter Reset Owner]	1402	Control Function Owners	0	15	1	
[External Trip Owner]	1403	Control Function Owners	0	15	1	
[Power Command Owner]	1404	Control Function Owners	0	15	1	
[On-grid Power Limit Enable Owner]	1405	Control Function Owners	0	15	1	
[On-grid Power Limit Owner]	1406	Control Function Owners	0	15	1	
[Inverter Status 1]	1501	Inverter Status	-32768	32767	1	
[Inverter Status 2]	1502	Inverter Status	-32768	32767	1	
[System State]	1503	Inverter Status	-32768	32767	1	
[DI0 Parameter ID]	1601	Digital Inputs	0	2944	1	
[DI1 Parameter ID]	1602	Digital Inputs	0	2944	1	
[Digital Input Invert Mask]	1603	Digital Inputs	0	3	1	

[Digital Input Status]	1604	Digital Inputs	0	3	1	
[DO0 Parameter ID]	1701	Digital Outputs	0	2944	1	
[DO1 Parameter ID]	1702	Digital Outputs	0	2944	1	
[Digital Output Invert Mask]	1703	Digital Outputs	0	3	1	
[Digital Output Status]	1704	Digital Outputs	0	3	1	
[AI0 Parameter ID]	1801	Analog Inputs	0	2944	1	
[AI0 Signal Lo]	1802	Analog Inputs	0	100	0.01	%
[AI0 Signal Hi]	1803	Analog Inputs	0	100	0.01	%
[AI0 Signal Val]	1804	Analog Inputs	0	100	0.01	%
[AI0 Digital Val]	1805	Analog Inputs	0	4095	1	
[AI1 Parameter ID]	1806	Analog Inputs	0	2944	1	
[AI1 Signal Lo]	1807	Analog Inputs	0	100	0.01	%
[AI1 Signal Hi]	1808	Analog Inputs	0	100	0.01	%
[AI1 Signal Val]	1809	Analog Inputs	0	100	0.01	%
[AI1 Digital Val]	1810	Analog Inputs	0	4095	1	
[AI2 Parameter ID]	1811	Analog Inputs	0	2944	1	
[AI2 Signal Lo]	1812	Analog Inputs	0	100	0.01	%
[AI2 Signal Hi]	1813	Analog Inputs	0	100	0.01	%
[AI2 Signal Val]	1814	Analog Inputs	0	100	0.01	%
[AI2 Digital Val]	1815	Analog Inputs	0	4095	1	
[AO0 Parameter ID]	1901	Analog Outputs	0	2944	1	
[AO0 Signal Lo]	1902	Analog Outputs	0	100	0.01	%
[AO0 Signal Hi]	1903	Analog Outputs	0	100	0.01	%
[AO0 Signal Val]	1904	Analog Outputs	0	100	0.01	%
[AO0 Digital Val]	1905	Analog Outputs	0	4095	1	
[Master Alarm]	2001	Alarms	0	1	1	
[Alarm Status]	2002	Alarms	-32768	32767	1	
[Master Alarm Mask]	2003	Alarms	0	255	1	
[Battery Under Voltage Alarm Threshold]	2004	Alarms	0	3200	0.1	V
[Battery Under Temperature Alarm Threshold]	2005	Alarms	-273	175	0.01	C
[Temperature Alarm Threshold]	2006	Alarms	-320	320	0.01	C
[User Alarm Parameter ID]	2007	Alarms	0	2944	1	
[User Alarm Threshold]	2008	Alarms	0	100	0.01	%
[User Alarm Greater/Less]	2009	Alarms	0	1	1	
[User Alarm]	2010	Alarms	0	1	1	
[Auto Restart Attempts]	2101	Auto-restart	0	20	1	
[Auto Restart Delay]	2102	Auto-restart	5	300	0.01	sec
[Auto Restart Counter]	2103	Auto-restart	0	255	1	
[Auto Restart Enable Mask 0]	2104	Auto-restart	0	127	1	
[Auto Restart Enable Mask 1]	2105	Auto-restart	-32768	32767	1	
[Auto Restart Enable Mask 2]	2106	Auto-restart	0	63	1	
[System Tripped]	2201	System Faults	0	1	1	
[External Trip]	2202	System Faults	0	1	1	
[Signal Loss Enable]	2203	System Faults	0	15	1	
[LCD Connected Trip Enable]	2204	System Faults	0	1	1	

[User Trip Parameter ID]	2205	System Faults	0	2944	1	
[User Trip Threshold]	2206	System Faults	0	100	0.01	%
[User Trip Greater/Less]	2207	System Faults	0	1	1	
[User Trip Enable]	2208	System Faults	0	1	1	
[Ground Fault Enable]	2209	System Faults	0	1	1	
[Inverter Overload Threshold %]	2210	System Faults	0	150	0.01	%
[Temperature Analog Lo]	2211	System Faults	-273	175	0.01	C
[Temperature Analog Hi]	2212	System Faults	-273	175	0.01	C
[Input Heatsink Temperature]	2213	System Faults	-273	175	0.01	C
[Input Heatsink Temp Fault Threshold]	2214	System Faults	-273	175	0.01	C
[Input Heatsink Temp Fault Time]	2215	System Faults	0	320	0.01	sec
[Input Heatsink Temp Failure Threshold]	2216	System Faults	-273	175	0.01	C
[Input Heatsink Temp Failure Time]	2217	System Faults	0	320	0.01	sec
[Output Heatsink Temperature]	2218	System Faults	-273	175	0.01	C
[Output Heatsink Temp Fault Threshold]	2219	System Faults	-273	175	0.01	C
[Output Heatsink Temp Fault Time]	2220	System Faults	0	320	0.01	sec
[Output Heatsink Temp Failure Threshold]	2221	System Faults	-273	175	0.01	C
[Output Heatsink Temp Failure Time]	2222	System Faults	0	320	0.01	sec
[Ambient Temperature]	2223	System Faults	-273	175	0.01	C
[Ambient Temp Fault Threshold]	2224	System Faults	-273	175	0.01	C
[Ambient Temp Fault Time]	2225	System Faults	0	320	0.01	sec
[Ambient Temp Failure Threshold]	2226	System Faults	-273	175	0.01	C
[Ambient Temp Failure Time]	2227	System Faults	0	320	0.01	sec
[Central Cap Over Voltage Threshold]	2228	System Faults	0	3200	0.1	V
[DC Port Over Voltage Threshold]	2229	System Faults	0	3200	0.1	V
[DC Port Over Current Threshold]	2230	System Faults	0	3200	0.1	Amps
[AC Caps Over Voltage Threshold]	2231	System Faults	0	3200	0.1	V
[AC Port Over Current Threshold]	2232	System Faults	0	3200	0.1	Amps
[Grid Over Voltage Threshold]	2233	System Faults	0	3200	0.1	V
[DC Port Reverse Voltage Threshold]	2234	System Faults	-3200	100	0.1	V
[DC Port Reverse Voltage Clear Threshold]	2235	System Faults	-3200	100	0.1	V
[Central Cap Under Voltage Trip Time]	2236	System Faults	0	320	0.01	sec
[Grid Contactor Overload Trip Enable]	2237	System Faults	0	1	1	
[Grid Contactor Overload Current]	2238	System Faults	0	320	0.01	Amps
[Grid Contactor Overload Time]	2239	System Faults	0	320	0.01	sec
[TDI Supply Failure Time]	2240	System Faults	0	3200	0.1	sec
[PV Over Voltage Fault Threshold]	2301	PV Control Faults	0	3200	0.1	V
[PV Over Voltage Clear Threshold]	2302	PV Control Faults	0	3200	0.1	V
[PV Over Voltage Clear Time]	2303	PV Control Faults	0	3200	0.1	sec
[PV Under Voltage Fault Threshold]	2304	PV Control Faults	0	3200	0.1	V
[PV Under Voltage Clear Threshold]	2305	PV Control Faults	0	3200	0.1	V
[PV Under Voltage Clear Time]	2306	PV Control Faults	0	3200	0.1	sec
[PV Pre-charge Timeout Threshold]	2307	PV Control Faults	0	3200	0.1	sec
[Battery Over Voltage Fault Margin]	2401	Battery Control Faults	0	3200	0.1	V
[Battery Over Voltage Clear Margin]	2402	Battery Control Faults	0	3200	0.1	V
[Battery Over Voltage Clear Time]	2403	Battery Control Faults	0	3200	0.1	sec

[Battery Under Voltage Fault Margin]	2404	Battery Control Faults	0	3200	0.1	V
[Battery Under Voltage Clear Margin]	2405	Battery Control Faults	0	3200	0.1	V
[Battery Under Voltage Clear Time]	2406	Battery Control Faults	0	3200	0.1	sec
[Battery Over Temperature Fault Threshold]	2407	Battery Control Faults	-273	175	0.01	C
[Battery Over Temperature Fault Time]	2408	Battery Control Faults	0.01	10	0.01	sec
[Battery Over Temperature Clear Threshold]	2409	Battery Control Faults	-273	175	0.01	C
[Battery Over Temperature Clear Time]	2410	Battery Control Faults	0.01	10	0.01	sec
[Battery Under Temperature Fault Threshold]	2411	Battery Control Faults	-273	175	0.01	C
[Battery Under Temperature Fault Time]	2412	Battery Control Faults	0.01	10	0.01	sec
[Battery Under Temperature Clear Threshold]	2413	Battery Control Faults	-273	175	0.01	C
[Battery Under Temperature Clear Time]	2414	Battery Control Faults	0.01	10	0.01	sec
[Battery Overchage Fault Enable]	2415	Battery Control Faults	0	1	1	
[Battery Total Charge Capacity]	2416	Battery Control Faults	0	32000	1	Amp-hours
[Battery Overcharge Threshold%]	2417	Battery Control Faults	0	320	0.01	
[Battery Pre-charge Timeout Threshold]	2418	Battery Control Faults	0	100	0.1	sec
[Vgrid Synch Trip Threshold]	2501	Grid Control Faults	-32	32	0.001	rads
[Vgrid Synch Trip Inst Threshold]	2502	Grid Control Faults	-32	32	0.001	rads
[Vgrid Synch Trip Clear Threshold]	2503	Grid Control Faults	-32	32	0.001	rads
[Vgrid Synch Trip Time]	2504	Grid Control Faults	0	3.2	0.0001	sec
[Vgrid Synch Clear Time]	2505	Grid Control Faults	0	3.2	0.0001	sec
[VcapAC Synch Trip Threshold]	2506	Grid Control Faults	-32	32	0.001	rads
[VcapAC Synch Trip Inst Threshold]	2507	Grid Control Faults	-32	32	0.001	rads
[VcapAC Synch Trip Clear Threshold]	2508	Grid Control Faults	-32	32	0.001	rads
[VcapAC Synch Trip Time]	2509	Grid Control Faults	0	3.2	0.0001	sec
[VcapAC Synch Clear Time]	2510	Grid Control Faults	0	3.2	0.0001	sec
[Backup Synch Trip Threshold]	2601	Backup Control Faults	-32	32	0.001	rads
[Backup Synch Trip Inst Threshold]	2602	Backup Control Faults	-32	32	0.001	rads
[Backup Synch Trip Clear Threshold]	2603	Backup Control Faults	-32	32	0.001	rads
[Backup Synch Trip Time]	2604	Backup Control Faults	0	3.2	0.0001	sec
[Backup Synch Clear Time]	2605	Backup Control Faults	0	3.2	0.0001	sec
[Motor Synch Trip Threshold]	2701	Motor Control Faults	-32	32	0.001	rads
[Motor Synch Trip Inst Threshold]	2702	Motor Control Faults	-32	32	0.001	rads
[Motor Synch Trip Clear Threshold]	2703	Motor Control Faults	-32	32	0.001	rads
[Motor Synch Trip Time]	2704	Motor Control Faults	0	3.2	0.0001	sec
[Motor Synch Clear Time]	2705	Motor Control Faults	0	3.2	0.0001	sec
[Fault Buffer 0 - Fault ID]	2801	Fault Buffer	-32768	32767	1	
[Fault Buffer 0 - Fault Time]	2802	Fault Buffer	0	2359	1	hhmm
[Fault Buffer 0 - Fault Date]	2803	Fault Buffer	0	1231	1	MMDD
[Fault Buffer 0 - DC voltage]	2804	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 0 - DC current Inst]	2805	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 0 - DC current Avg]	2806	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 0 - AC voltage]	2807	Fault Buffer	-3276.8	3276.7	0.1	V

[Fault Buffer 0 - AC Current Inst]	2808	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 0 - AC Current Avg]	2809	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 0 - Central Cap Voltage]	2810	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 0 - Status Register 1]	2811	Fault Buffer	-32768	32767	1	
[Fault Buffer 0 - Status Register 2]	2812	Fault Buffer	-32768	32767	1	
[Fault Buffer 0 - Alarm Status Register]	2813	Fault Buffer	-32768	32767	1	
[Fault Buffer 1 - Fault ID]	2814	Fault Buffer	-32768	32767	1	
[Fault Buffer 1 - Fault Time]	2815	Fault Buffer	0	2359	1	hhmm
[Fault Buffer 1 - Fault Date]	2816	Fault Buffer	0	1231	1	MMDD
[Fault Buffer 1 - DC voltage]	2817	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 1 - DC current Inst]	2818	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 1 - DC current Avg]	2819	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 1 - AC voltage]	2820	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 1 - AC Current Inst]	2821	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 1 - AC Current Avg]	2822	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 1 - Central Cap Voltage]	2823	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 1 - Status Register 1]	2824	Fault Buffer	-32768	32767	1	
[Fault Buffer 1 - Status Register 2]	2825	Fault Buffer	-32768	32767	1	
[Fault Buffer 1 - Alarm Status Register]	2826	Fault Buffer	-32768	32767	1	
[Fault Buffer 2 - Fault ID]	2827	Fault Buffer	-32768	32767	1	
[Fault Buffer 2 - Fault Time]	2828	Fault Buffer	0	2359	1	hhmm
[Fault Buffer 2 - Fault Date]	2829	Fault Buffer	0	1231	1	MMDD
[Fault Buffer 2 - DC voltage]	2830	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 2 - DC current Inst]	2831	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 2 - DC current Avg]	2832	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 2 - AC voltage]	2833	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 2 - AC Current Inst]	2834	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 2 - AC Current Avg]	2835	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 2 - Central Cap Voltage]	2836	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 2 - Status Register 1]	2837	Fault Buffer	-32768	32767	1	
[Fault Buffer 2 - Status Register 2]	2838	Fault Buffer	-32768	32767	1	
[Fault Buffer 2 - Alarm Status Register]	2839	Fault Buffer	-32768	32767	1	
[Fault Buffer 3 - Fault ID]	2840	Fault Buffer	-32768	32767	1	
[Fault Buffer 3 - Fault Time]	2841	Fault Buffer	0	2359	1	hhmm
[Fault Buffer 3 - Fault Date]	2842	Fault Buffer	0	1231	1	MMDD
[Fault Buffer 3 - DC voltage]	2843	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 3 - DC current Inst]	2844	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 3 - DC current Avg]	2845	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 3 - AC voltage]	2846	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 3 - AC Current Inst]	2847	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 3 - AC Current Avg]	2848	Fault Buffer	-3276.8	3276.7	0.1	Amps
[Fault Buffer 3 - Central Cap Voltage]	2849	Fault Buffer	-3276.8	3276.7	0.1	V
[Fault Buffer 3 - Status Register 1]	2850	Fault Buffer	-32768	32767	1	
[Fault Buffer 3 - Status Register 2]	2851	Fault Buffer	-32768	32767	1	
[Fault Buffer 3 - Alarm Status Register]	2852	Fault Buffer	-32768	32767	1	
[Vcc Control Pgain]	2901	Low Level Parameters	0.1	1000	0.1	%

[Vcc Target On-grid]	2902	Low Level Parameters	500	1000	0.1	V
[Vcc Target Off-grid]	2903	Low Level Parameters	500	1000	0.1	V
[Vcc Power Margin]	2904	Low Level Parameters	0	320	0.01	kW
[Vcc Voltage Margin]	2905	Low Level Parameters	0	200	0.1	V
[Power Coefficient]	2906	Low Level Parameters	0.9	1.2	0.001	
[Battery Power Limit Min]	2907	Low Level Parameters	-320	320	0.01	kW
[Battery Power Limit Max]	2908	Low Level Parameters	-320	320	0.01	kW
[PV Power Limit Min]	2909	Low Level Parameters	-320	320	0.01	kW
[PV Power Limit Max]	2910	Low Level Parameters	-320	320	0.01	kW
[Grid Power Limit Min]	2911	Low Level Parameters	-320	320	0.01	kW
[Grid Power Limit Max]	2912	Low Level Parameters	-320	320	0.01	kW
[DC Current Limit Min]	2913	Low Level Parameters	-3200	3200	0.1	Amps
[DC Current Limit Max]	2914	Low Level Parameters	-3200	3200	0.1	Amps
[AC Current Limit Max]	2915	Low Level Parameters	-3200	3200	0.1	Amps
[Fan Speed]	2916	Low Level Parameters	0	100	0.01	%
[Max Heatsink Temperature Difference]	2917	Low Level Parameters	0	320	0.01	C
[Fan Control Temperature Adjustment]	2918	Low Level Parameters	0	320	0.01	C
[Fan Min Speed Temp]	2919	Low Level Parameters	0	320	0.01	C
[Fan Max Speed Temp]	2920	Low Level Parameters	0	320	0.01	C
[Fan Turn Off Delay]	2921	Low Level Parameters	0	32000	1	sec
[Grid Current Limit]	2922	Low Level Parameters	0	320	0.01	Amps
[Grid Current Limit I-gain]	2923	Low Level Parameters	0	320	0.01	
[Power Command Slew Rate]	2924	Low Level Parameters	0.1	3200	0.1	W/P
[Logic Analyzer Output Select 0]	2925	Low Level Parameters	-32768	32767	1	
[Logic Analyzer Output Select 1]	2926	Low Level Parameters	-32768	32767	1	
[Logic Analyzer Output Select 2]	2927	Low Level Parameters	-32768	32767	1	
[Logic Analyzer Output Select 3]	2928	Low Level Parameters	-32768	32767	1	
[Logic Analyzer Output Select 4]	2929	Low Level Parameters	-32768	32767	1	
[Logic Analyzer Output Select 5]	2930	Low Level Parameters	-32768	32767	1	
[Logic Analyzer Output Select 6]	2931	Low Level Parameters	-32768	32767	1	
[Logic Analyzer Output Select 7]	2932	Low Level Parameters	-32768	32767	1	
[Test Parameter 0]	2933	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 1]	2934	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 2]	2935	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 3]	2936	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 4]	2937	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 5]	2938	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 6]	2939	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 7]	2940	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 8]	2941	Low Level Parameters	-327.68	327.67	0.01	
[Test Parameter 9]	2942	Low Level Parameters	-327.68	327.67	0.01	
[Test Command]	2943	Low Level Parameters	0	32767	1	
[Test Val]	2944	Low Level Parameters	0	327.67	0.01	

7.30 Contact Info

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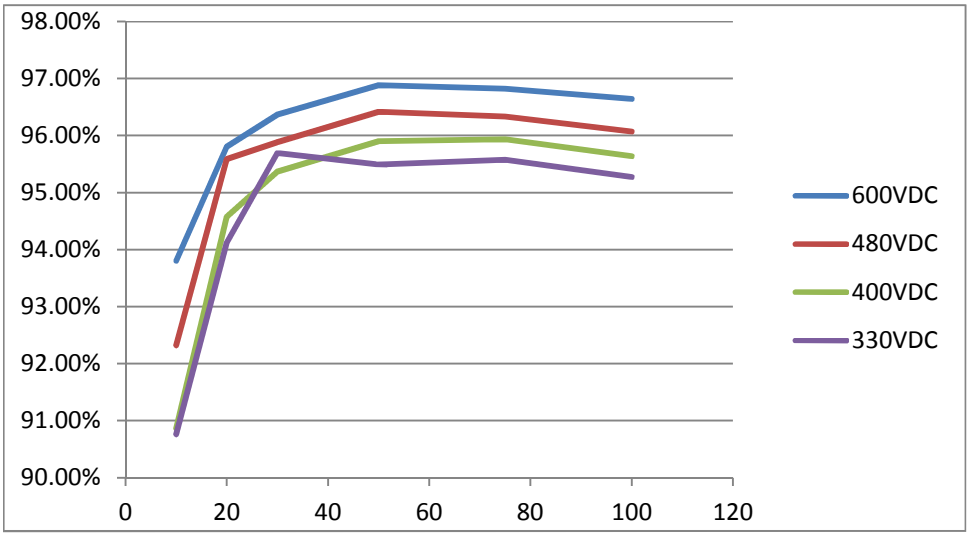
8 CEC Efficiency Curves and Ratings

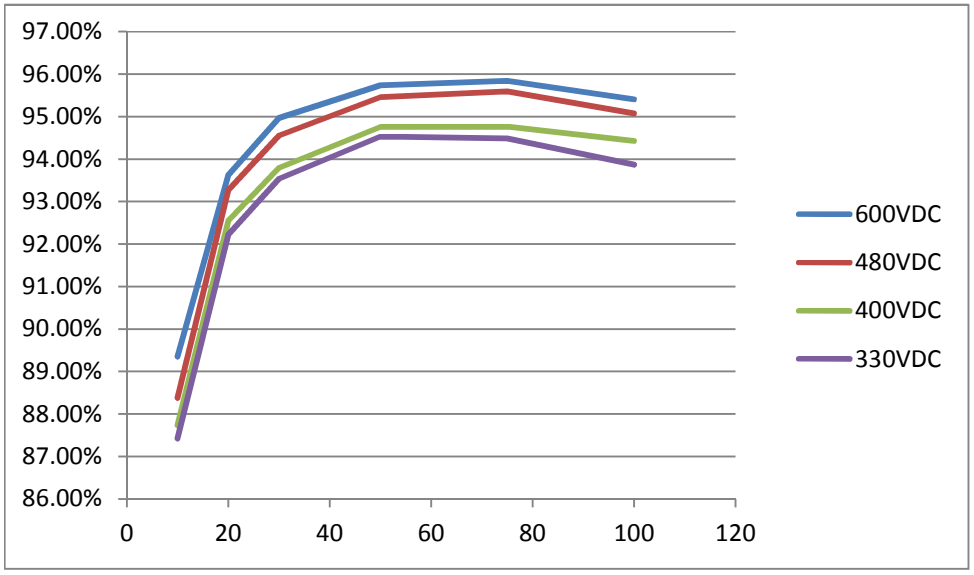
Efficiency Data without Transformer

kW	600VDC	480VDC	400VDC	330VDC
100	96.64%	96.07%	95.64%	95.27%
75	96.82%	96.33%	95.94%	95.57%
50	96.88%	96.42%	95.90%	95.49%
30	96.37%	95.88%	95.37%	95.69%
20	95.81%	95.59%	94.57%	94.12%
10	93.80%	92.32%	90.86%	90.76%
Avg	96.05%	95.44%	94.71%	94.49%
CEC Avg	**96.60%**	**96.09%**	**95.57%**	**95.29%**



Efficiency Data with Transformer

kW	600VDC	480VDC	400VDC	330VDC
100	95.40%	95.07%	94.43%	93.87%
75	95.84%	95.59%	94.76%	94.49%
50	95.74%	95.46%	94.76%	94.53%
30	94.97%	94.56%	93.79%	93.54%
20	93.63%	93.27%	92.55%	92.23%
10	89.35%	88.37%	87.73%	87.42%
Avg	94.16%	93.72%	93.01%	92.68%
CEC Avg	**95.32%**	**95.01%**	**94.24%**	**93.96%**



9 Warranty

Princeton Power Systems System Warranty
What does this warranty cover?
This Limited Warranty is provided by Princeton Power Systems Inc. ("PPS") and covers defects in workmanship and materials in your PPS GTIB 480-100 and Energy Storage System (please refer to Exclusions). This warranty period lasts for ten years from the date of purchase at the point of sale to you, the original end user customer. You require proof of purchase to make warranty claims. This Limited Warranty is transferable to subsequent owners but only for the unexpired portion of the Warranty Period. Subsequent owners also require proof of purchase.

What will PPS do?

PPS will, at its option, repair or replace the defective product free of charge, provided that you notify PPS of the product defect within the Warranty Period, and provided that PPS through inspection establishes the existence of such a defect and that it is covered by this Limited Warranty. PPS will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. PPS reserves the right to use parts or products of original or improved design in the repair or replacement. If PPS repairs or replaces a product, its warranty continues for the remaining portion of the original Warranty Period or 90 days from the date of the return shipment to the customer, whichever is greater. All replaced products and all parts removed from repaired products become the property of PPS. PPS covers both parts and labor necessary to repair the product, and return shipment to the customer via a PPS-selected non-expedited surface freight within the contiguous United States and Canada. Alaska and Hawaii are excluded. Contact PPS Customer Service for details on freight policy for return shipments outside of the contiguous United States and Canada.

How do you get service?

If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact PPS directly at:
(609) 955-5390. Direct returns may be performed according to the PPS Return Material Authorization Policy described in your product manual.

What proof of purchase is required?
In any warranty claim, dated proof of purchase must accompany the product and the product must not have been disassembled or modified without prior written authorization by PPS. Proof of purchase may be in any one of the following forms:

• The dated purchase receipt from the original purchase of the product at point of sale to the end user, or
• The dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status, or
• The dated invoice or purchase receipt showing the product exchanged under warranty

What does this warranty not cover?

This Limited Warranty does not cover normal wear and tear of the product or costs related to the removal, installation, or troubleshooting of the customer's electrical systems. This warranty does not apply to and PPS will not be responsible for any defect in or damage to:

a) the product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment;

b) the product if it has been subjected to fire, water, generalized corrosion, biological infestations, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the PPS product specifications including high input voltage from generators and lightning strikes;
c) The product if repairs have been done to it other than by PPS or its authorized service centers (Hereafter "ASCs");
d) The product if it is used as a component part of a product expressly warranted by another manufacturer;
e) The product if its original identification (trade-mark, serial number) markings have been defaced, altered, or removed.

PPS' LIMITED WARRANTY DOES NOT COVER INTEGRATED DC SOURCES, SUCH AS BATTERIES, IN TURNKEY ENERGY STORAGE SYSTEMS. THE BATTERY WARRANTY AS PROVIDED BY THE BATTERY SUPPLIER WILL BE REMITTED TO THE CUSTOMER AS PART OF A SEPARATE WARRANTY EXCLUSIVE OF PPS' LIMITED 10 YEAR WARRANTY.

Disclaimer

Product
THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY PPS IN CONNECTION
WITH YOUR PPS PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES,
CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED,
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UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD
STIPULATED UNDER THIS LIMITED WARRANTY. IN NO EVENT WILL PPS BE LIABLE FOR ANY SPECIAL,
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ARISING FROM OR AS A RESULT OF MISUSE OR ABUSE, OR THE INCORRECT INSTALLATION, INTEGRATION OR OPERATION OF THE PRODUCT.

Exclusions

If this product is a consumer product, federal law does not allow an exclusion of implied warranties. To the extent you are entitled to implied warranties under federal law, to the extent permitted by applicable law they are limited to the duration of this Limited Warranty. Some states and provinces do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the

limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply to you. This Limited Warranty gives you specific legal rights. You may have other rights which may vary from state to state or province to province.

Warning: Limitations on Use

Please refer to your product manual for limitations on uses of the product.
SPECIFICALLY, PLEASE NOTE THAT THE PPS GTIB 480-100 OR ENERGY STORAGE SYSTEMS SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, PPS MAKES NO REPRESENTATIONS OR WARRANTIES REGARDING THE USE OF THE PPS GTIB 480-100 IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

10 Revision History

Date	Author	Version	Change Reference
8/09	D. Hammell	1.0	Released
5/17/11	S.Mak	1.1	Page 5 – Added 350VDC power supply as option (D) Page 17 – revised figure 3.2 to include CPT Page 83 & 97 – added * to highlight TDI as optional.
5/16/2012	P. Heavener	1.2	Added Section 8 CEC efficiency. Added Section 9 Warranty Added ability to set the power command to a neg. value Pg. 68
10/18/2012	J.Reed	1.3	Ec#2012-026 Add additional Modbus Paragraph Section 7.3.1 Pg.56