890GTB Battery Inverter Product Manual

HA473578U201 Issue *01*

Part Number: 890GTB

Software Version: 5.1

WARRANTY Parker EGT warrants the goods against defects in design, materials and workmanship for the period of 24 months from the date of manufacture, or 12 months from the date of delivery (whichever is the longer period), on the terms detailed in Parker EGT Standard Conditions of Sale IA500504

Parker EGT reserves the right to change the content and product specification without notice.

WARNING: USER RESPONSIBILITY

Failure or improper selection improper use of the products described herein or related items can cause death, personal injury, and property damage. This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

Users, through their own analysis and testing, are solely responsible for making the final selection of the system and components and assuming that all performance, endurance, maintenance, safety, and warning requirements of the application are met. Users must analyze all aspects of the application, follow all applicable industry standards, and follow the information concerning the product in the current catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

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Battery Inverter Manual Table of Contents

Chapter 1 Safety

Please read these important Safety notes before performing maintenance or operating this equipment.

Caution	WARNING
CAUTION notes in the manual warn of danger to equipment.	**WARNING** notes in the manual warn of danger to personnel.

Safety Information

Requirements

IMPORTANT Please read this information BEFORE installing the equipment.

Intended Users

This manual is to be made available to all persons who are required to configure or service equipment described herein, or any other associated operation.

The information given is intended to highlight safety issues, and to enable the user to obtain maximum benefit from the equipment.

Application Area

The equipment described is intended for use as power conversion in an energy storage system.

Personnel

Installation, operation and maintenance of the equipment should be carried out by qualified personnel. A qualified person is someone who is technically competent and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.

Training

Qualified personnel must be trained in Safety-Related Work Practices, Job Hazard Analysis, First Aid and CPR, Arc Flash Hazards, and PPE Requirements (both classroom and on-the-job training are required in accordance with NFPA 70E requirements). **Retraining is required in intervals not to exceed three years.**

Safety Information

Product Warnings

Caution Risk of electric shock	**Caution** Refer to documentation	**Earth/Ground** Protective Conductor Terminal

Hazards

DANGER! – Ignoring the following may result in injury

1. This equipment can endanger life by exposure to high voltages.
2. The equipment must be permanently earthed due to the high earth leakage current, and the supplies and loads must be connected to an appropriate safety earth.
3. Ensure all incoming supplies are isolated before working on the equipment. Be aware that there may be more than one supply connection to the inverter.
4. There may still be dangerous voltages present at power terminals (battery inputs and DC bus) when the inverter is stopped.
5. For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range. CAT I and CAT II meters must not be used on this product.
6. Under normal circumstances the AC and DC Bus should discharge within 10 minutes. Use a meter capable of measuring up to 1500 VDC & 600 VAC RMS to confirm that less than 50V is present on the DC BUS and between all power terminals and earth before working on or near the DC Bus.
7. Unless otherwise stated, this product must NOT be dismantled. In the event of a fault the component must be returned.

Safety Information

WARNING! – Ignoring the following may result in injury or damage to equipment

Safety

Where there is conflict between EMC and Safety requirements, personnel safety shall always take precedence.

- Never perform high voltage resistance checks on the wiring without first disconnecting the inverter from the circuit being tested.
- Whilst ensuring ventilation is sufficient, provide guarding and /or additional safety systems to prevent injury or damage to equipment.
- When replacing a component in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.
- All control and signal terminals are SELV; that is, protected by double insulation. Ensure all external wiring is rated for the highest system voltage.
- All exposed metalwork in the inverter is protected by basic insulation and bonded to a safety earth.
- Residual-current devices (RCDs) are not recommended for use with this product; but where their use is mandatory, only Type B RCDs should be used.

EMC

- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.
- This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.
- This is a product of the restricted sales distribution class according to IEC 61800-3. It is designated as "professional equipment" as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.

Safety Information

CAUTION!

Application Risks

- The specifications, processes and circuitry described herein are for guidance only and may need to be adapted to the user's specific application. We cannot guarantee the suitability of the equipment described in this Manual for individual applications.

Risk Assessment

Under fault conditions, power loss or unintended operating conditions, the inverter may not operate as intended. In particular:

Stored energy might not discharge to safe levels as quickly as suggested and can still be present even though the inverter appears to be switched off.

An inverter is a component within a system that may influence its operation or effects under a fault condition. Consideration must be given to:

- Stored energy
- Supply disconnects
- Sequencing logic
- Unintended operation

Safety Information

WARNING! – Ignoring the following may result in serious injury or damage to equipment

OSHA Electric Power Generation, transmission, and distribution safety standards (29 CFR 1910.269) consideration:
Workers may be exposed to arc flash hazards, electric shocks, and burns that can cause injury and death when making battery or grid connections. Do not work on connections to the battery container or the grid without proper safety considerations.

Safe work practices as proscribed in OSHA's Electric Power Generation, Transmission and Distribution Standard must be implemented and observed. Workers must complete worker training requirements of OSHA's Electric Power Generation, Transmission and Distribution Standard, 29 CFR 1910.269.

Dangerous electrical potentials which can result in electrocution and arc flash hazards are present while the battery container is connected. Workers must pay attention to both battery power conductors and overhead power lines. While fatal electrocution is the main hazard, other hazards include using tools and equipment that can contact power lines.

- **Look for overhead power lines and buried power line indicators.**
- **Stay at least 10 feet away from overhead power lines and assume they are energized.**
- **De-energize and ground lines when working near them.**
- **Use non-conductive wood or fiberglass ladders when working near power lines.**

Safety Information

WARNING! – Ignoring the following may result in serious injury or damage to equipment

Arc Flash and Shock Hazard – Appropriate PPE Required

An Arc Flash Hazard Assessment shall be done to determine the Flash Protection Boundary[1], the incident energy at the working distance[2], and the PPE Requirements.

An Electrical Work Permit is required for any work performed within the Limited Approach Boundary with the exception of non-contact testing or troubleshooting, or voltage measurement using test probes with a minimum rating of CAT III, 1000V if appropriate safe work practices and appropriate personal protective equipment is used.

Category 0 (0-1.2 cal/cm^2) – One layer of non-melting / non-flammable clothing
Category 1 (1.21-4.0 cal/cm^2) – One layer of fire resistant shirt and pants or coveralls
Category 2 (4.1-8.0 cal/cm^2) – 1-2 layers: cotton underwear + fire resistant shirt and pants or coveralls
Category 3 (8.1-25.0 cal/cm^2) – 2-3 layers: cotton underwear + fire resistant shirt and pants + coveralls
Category 4 (25.1-40.0 cal/cm^2) – 3-4 layers: cotton underwear + fire resistant shirt and pants or coveralls + multilayer flash suit

[1] Boundary indicates the minimum working distance of the worker's face and chest
[2] Incident energy measured in calories per square centimetre (cal/cm^2)
Incident Energies exceeding 40 cal/cm^2 are deemed too hazardous for live work.

Example PPE Task Chart:

Table 1-1: Arc Flash and Shock Hazard – Appropriate PPE Required

Tasks Performed on Energized Equipment:	Category[2]	Boundary[1] WD - AFB	Insulated Gloves	Insulated Tools
Perform infrared thermography and non-contact inspections	0		N	N
Circuit Breaker or Fused Switch operation with covers on	0		N	N
Remove bolted Battery Access Covers	2	18" - 45"	N	N
Work on battery connections	2	18" - 45"	Y	Y
Work on energized 480VAC[3] electrical conductors, including voltage testing	2	18" - 45"	Y	Y
Perform infrared thermography and non-contact inspections inside limited approach (cover off)	3	18" - 60"	N	N
Circuit Breaker or Fused Switch operation with covers off	3	18" - 60"	Y	N
Remove bolted covers or hinged covers for access to energized electrical conductors	3	18" - 60"	N	N
Work on energized electrical conductors, including voltage testing	3	18" - 60"	Y	Y
Entry into Enclosure	**Not Allowed while energized**			

[1] **WD indicates Working Distance (the minimum working distance of the worker's face and chest), AFB indicates Arc Flash Boundary**
[2] **OSHA PPE Requirements**
[3] **Voltage source not tied to Inverter Output (Possible RMS value of 1000 Volts if tied to Inverter Output)**

Parker Required PPE:

The following list is the minimum Personal Protection Equipment requirements in accordance with NFPA 70E Article 130.7. When working within the Restricted Approach Boundary, the worker shall wear PPE in accordance with Article 130.4. When working within the Arc Flash Boundary, the worker shall wear PPE in accordance with Article 130.5. All parts of the body inside the Arc Flash Boundary shall be protected. Any person who will be required to use PPE will be required to complete training on the proper use of PPE. NFPA 70E Article 320.3(2) prohibits the wear of conductive objects and jewellery.

Table 1-2: Required PPE Optimum Specifications for HRC2 (8 cal/cm^2)

ITEM	RATING	NOTE
Hard Hat	**Type 1, Class E**	Must be nonconductive – **ANSI/ISEA Z89.1-2009**
Face Shield	**10 cal/cm^2**	**ASTM F 2178-08**
Safety Glasses	**ANSI Z87.1-2010**	Must be rated for Arc Flash
Balaclava	**10.5 cal/cm^2**	When working within the Restricted Approach Boundary or the Arc Flash Boundary **- ASTM F 1506-10a**
Hearing Protection	**22 dB (A)**	Must be Ear Canal Inserts - **OSHA 1910.95**
Undergarments	**Natural Fibers**	**Meltable fibers such as acetate, nylon, polyester, polypropylene and spandex are not permitted**
Shirt*	**10.5 cal/cm^2**	**Daily wear - ASTM F 1506-10a**
Pants**	**10.5 cal/cm^2**	**Daily wear - ASTM F 1506-10a**
Coveralls***	**12.2 cal/cm^2**	When working within the Restricted Approach Boundary or the Arc Flash Boundary **- ASTM F 1506-10a**
Rubber Insulating Gloves	**Class 0**	When Insulated Gloves are required by task **- ASTM D 120-09**
Leather Protectors	**ASTM F 496-06**	When Insulated Gloves are required by task (Minimum thickness .03in, unlined, ATPV value > 10 cal/cm^2)
Cotton Liners	**Cotton**	When Insulated Gloves are required by task (optional)
Steel Toe Boots	**Heavy-duty Leather**	**Daily wear - ASTF 2413-05 (must be non-conductive) NO ESD**
Outer Layers		Garments worn as outer layers over arc-rated clothing must also be made from arc-rated material (Use as Required)
Tools	**1000V-Rated**	When work on live circuits (>50V) is required by task **- ASTM F 1505**

*If a shirt is worn as a top layer, it must be rated at 10.5 cal/cm^2. If it is worn under coveralls rated at 12.2 cal/cm^2, it may be natural fibers and may be short-sleeved.

**If pants are worn as a top layer, they must be rated at 10.5 cal/cm^2. If they are worn under coveralls rated at 12.2 cal/cm^2, they may be natural fibers.

***Coveralls are the preferred method of protection.

For more information please see **Chapter 6 – PPE.**

Safety Information

WARNING! – Ignoring the following may result in serious injury or damage to equipment

Limited Approach Boundary, Restricted Approach Boundary, Prohibited Approach Boundary

Approach Boundaries to Exposed energized Conductors/Parts for qualified employees (NFPA 70E Table 12-1):

- For troubleshooting and testing purposes only, qualified persons using proper test equipment and personal protective equipment must adhere to the boundaries shown below. For adjusting, tightening, calibrating or other work, the circuits must be deenergized, or employees must use voltage-rated gloves and voltage-rated insulated tools.
- For Low Voltage Troubleshooting and Testing only (under 480 volts), a qualified person may penetrate the prohibited approach boundary with instrument probes, leads, CT's, etc. The qualified person must wear Class 00 (500 volt-rated) gloves.
- Supervisors and employees must ensure that an unqualified person can never come closer to any energized line or part than the Limited Approach Boundaries

Table 1-3: Approach Boundaries by Voltage

Approach Boundary[1,2]	< 50 VAC < 100 VDC	50-300 VAC 100-300 VDC	301-750 VAC 301-1k VDC	1.1-5 kVDC	751-15 kVAC 5-15 kVDC
Limited Approach (Exposed movable conductors)	**Not Specified**	**10' – 0"**	**10' – 0"**	**10' – 0"**	**10' – 0"**
Limited Approach (Exposed fixed circuit parts)	**Not Specified**	**3' – 6"**	**3' – 6"**	**5' – 0"**	**5' – 0"**
Restricted Approach **(Shock protection Required + PPE)**	**Not Specified**	**Avoid Contact**	**1' – 0"**	**1' – 5"**	**2' – 2"**
Prohibited Approach **(Equivalent to direct contact)**	**Not Specified**	**Avoid Contact**	**0' – 1"**	**0' – 4"**	**0' – 7"**

[1] **Boundary indicates the minimum working distance of the worker's face and chest**

[2] ***Limited Approach Boundary is 0" with all Access Doors and Panels closed and secured.***

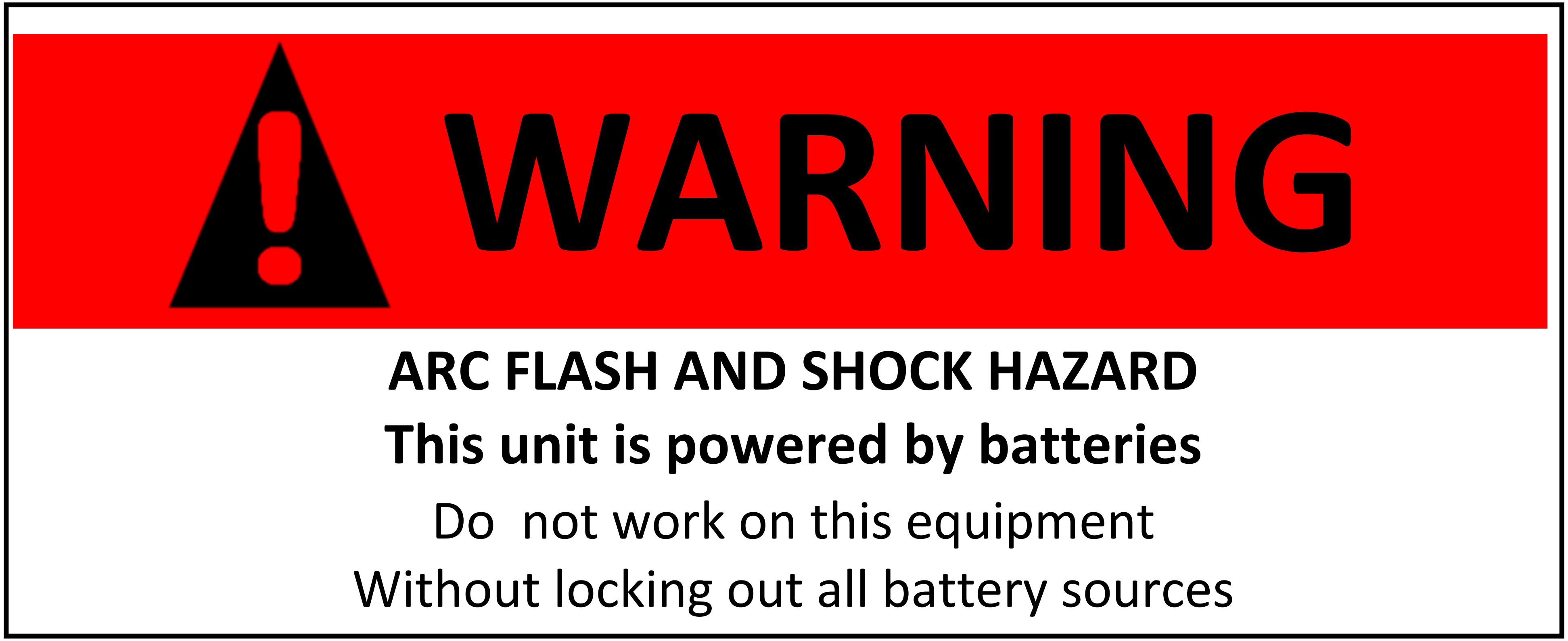


Figure 1-1: Battery Inverter Warning Placard

A variety of battery types may be used in battery enclosures to supply a DC input to the Battery Inverter Enclosure. Each manufacturer can provide specific Cautions and Warnings for work on and around batteries and for battery storage which should be observed.

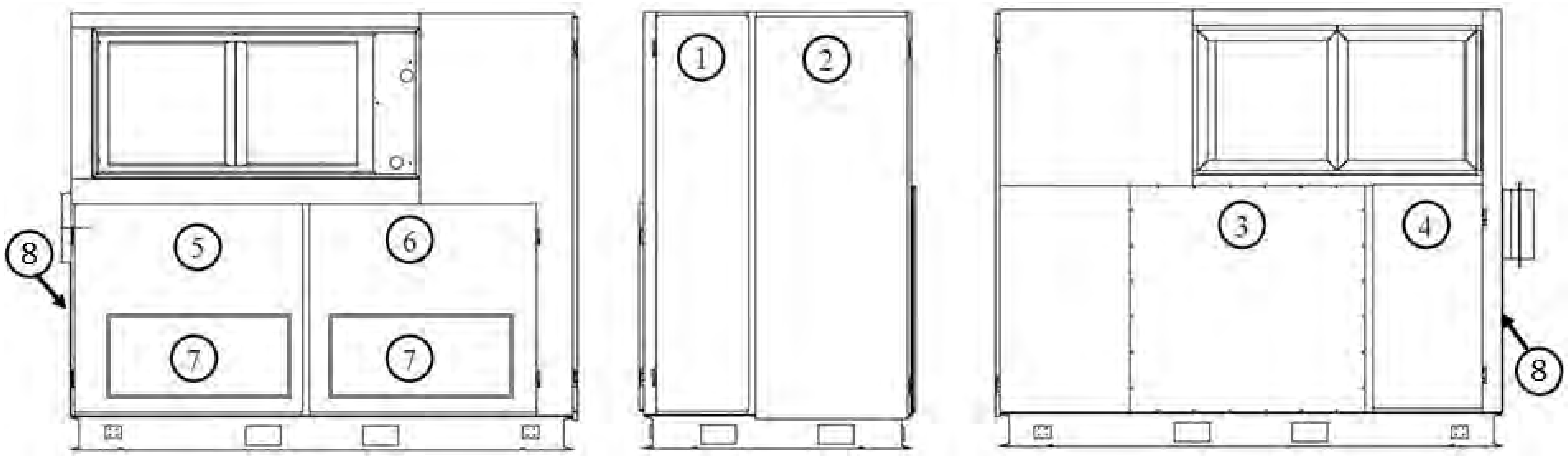


Figure 1-3: Typical Enclosure Access for a 2MW Battery Inverter Enclosure

Table 1-5: Hazard Risk Category with panels open, access to energized circuits:

Enclosure Access		HRC	Boundary WD - AFB	Cal/cm^2 Open
1	HMI Access Door	0		
2	Inverter Access Door	2	18" – 45"	5.91
3	Capacitor / Inductor Access	4	18" – 120"	32.16
4	Breaker Access Door	0		
5	DC Input Access	2	18" – 45"	7.36
6	DC Input Access	2	18" – 45"	7.36
7	Inner DC Input Doors	2	18" – 45"	7.36
8	Breaker Access	4	18" – 120"	32.16

Note: WD indicates Working Distance (the minimum working distance of the worker's face and chest), AFB indicates Arc Flash Boundary
Arc Flash Boundary remains in effect regardless of whether Doors and Access Panels are open or closed.

Lifting Precautions

GTB Inverter Lifting Instructions

The GTB Inverter Enclosure can be positioned using either a fork lift or crane. The fork lift tubes along any side of the enclosure can be used if positioning by a fork lift. The fork lift tubes with a lifting bar and a spreader bar above the container can be used if positioning by a crane.

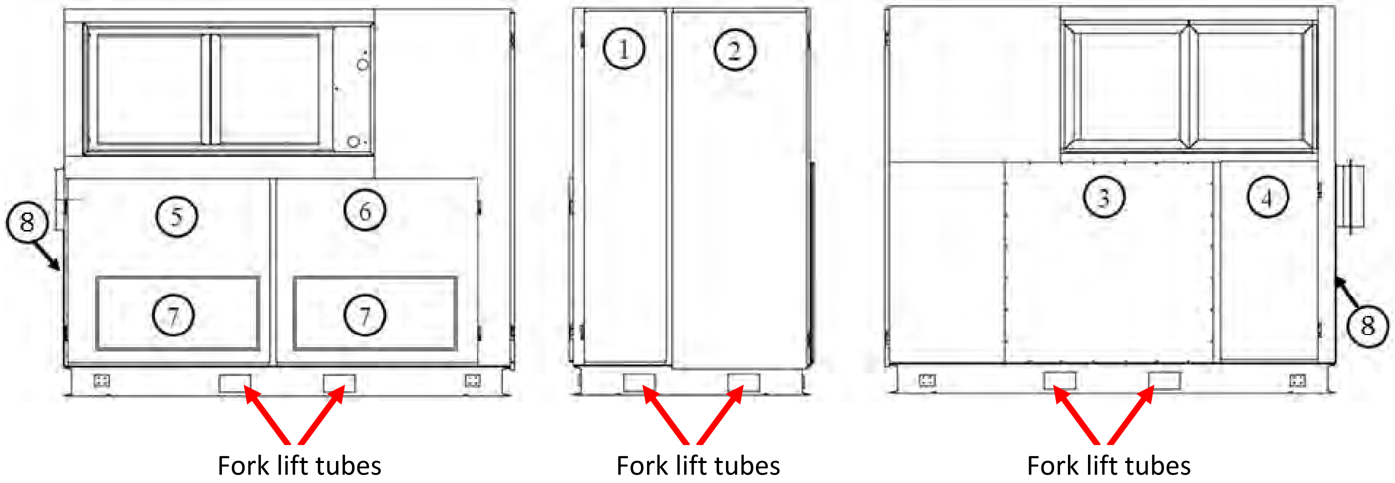


Figure 1-4: Fork Lift Tube location on a 2MW Battery Inverter Enclosure

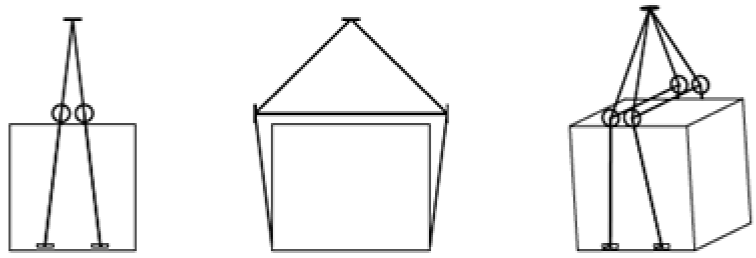


Figure 1-5: Lift Rigging for a 2MW Battery Inverter Enclosure using a crane

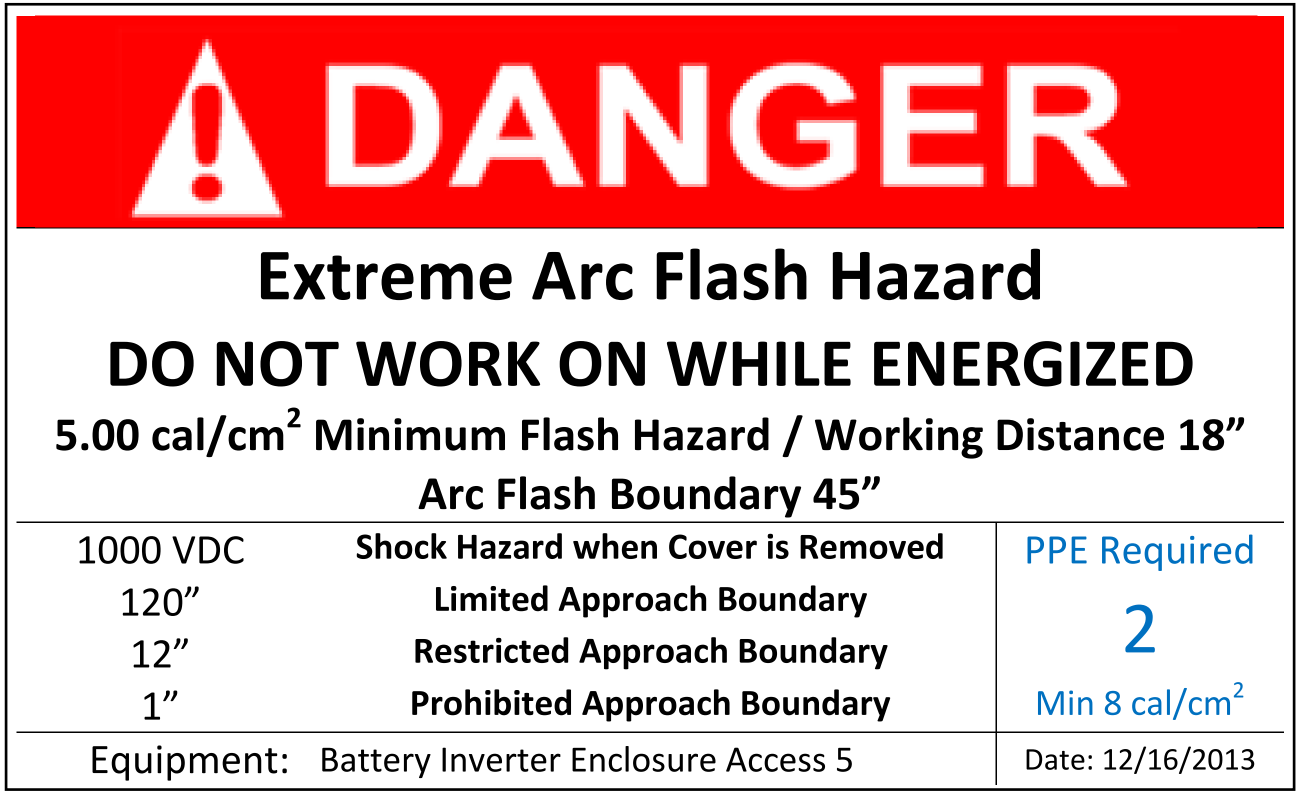


Figure 1-6: Example Arc Flash Label

NFPA 70E 2012 requires warning labels that display the following information: Nominal System Voltage, Arc Flash Boundary, and at least one of the following: Available Incident Energy and the Corresponding Working Distance, Minimum Arc Rating of Clothing, Minimum PPE, or Highest HRC of the Equipment.

Chapter 2 Getting Started

A few things you should know about this manual.

About this Manual

This manual is intended for use by service and maintenance personnel. It assumes reasonable levels of understanding in the disciplines required to service and maintain this equipment.

Note ***Please read all Safety information before proceeding with the service, maintenance and operation of this unit.***
It is important that you pass this manual on to any new user of this unit.

How the Manual is organized

This manual is organized into chapters, indicated by the numbering on the edge of each page.

The manual is focused on servicing and maintaining the Battery Inverter Enclosure. For more detailed information, refer to the relevant manufacturer product manual.

Initial Steps

Use the manual to help you plan the following:

Service and Maintenance

Know your requirements:

Training requirements
OSHA Safety conformance
Compliance with Arc Flash requirements

Typical Related Documentation

Several other documents and manuals listed below describe the operation and maintenance of the system, sub-systems, and Parker EGT components.

These may be referred to throughout this manual.

Battery Inverter Training Guide:	HA473002U201
System Installation Manual:	HG473003U201
Battery Enclosure Manual:	HA473578U211
Firmware Version 5.1 Manual:	HA473746U001
8903/IM, 8903/IP & 8903/PN Ethernet Communications Option	HA500522.pdf
HPC/HPX Series PowerStation User Guide	HPXUG.pdf
IPC-IPX Series PowerStation Series Hardware User Manual	IPX-IPC USER MANUAL.pdf
System Circuit Diagram:	HB473000U002
System One-Line Diagram:	HH473000U002
System Communications Diagram:	HI473000U002
Control Assembly Panel LA473303U002:	HB473303U002

In addition, documentation for key “third party” components is included in **Appendix D** of this manual.

Bender Ground Fault Technical Bulletin	NAE1012020.pdf
National Instrument CompactRIO cRIO-9072/3/4	374639e.pdf
Shark 200 & 200T Power and Energy Meter Manual	E149701_Shark200 User Manual.pdf
Siemens WL Circuit Breaker Manual	Document Order # CBIM-01001-0504
Stride Industrial Ethernet Switches	sesw8uwt.pdf

SunSpec Alliance Specifications

Abbreviations / Definitions

AC	Alternating Current
ANSI	American National Standards Institute
APT	Active Power Tracking
AVR	Automatic Voltage Regulation
Converter	A device that converts one type of energy to another (AC-AC, AC-DC, DC-DC, or DC-AC)
DC	Direct Current
Drive	a generic term for an Adjustable Speed Drive (ASD) or Variable Speed Drive (VSD)
EPO	Emergency Power Off
FR	Flame Resistant
HRC	Hazard Risk Category
HVRT	High Voltage Ride Through
HMI	Human Machine Interface
HOL	High Operating Limit
IGBT	Insulated Gate Bipolar Transistor
Inverter	A converter that changes DC current into AC current
LOL	Low Operating Limit
LOTO	Lock Out Tag Out
LVRT	Low Voltage Ride Through
MPPT	Maximum Power Point Tracking
MPT	Maximum Power Tracking
MVA	Mega-Volt Amperes (Apparent Power)
MW	Megawatts (Real Power)
PCM	Parallel Control Module
PCS	Power Conversion Station (Inverter Transformer Pad)
PF	Power Factor
Plant	Power Plant
PLC	Programmable Logic Controller
PPC	Power Plant Controller
PPE	Personal Protection Equipment
P/S	Power Supply
PV	Photovoltaic
RPI	Requested Packet Interval
SCADA	Supervisory Control and Data Acquisition
SP	Setpoint
System	Power Plant Control System
VAR	Volt Ampere Reactive (Reactive Power)
XML	Extensible Markup Language

Chapter 3 Operations

890GT Communications Topology

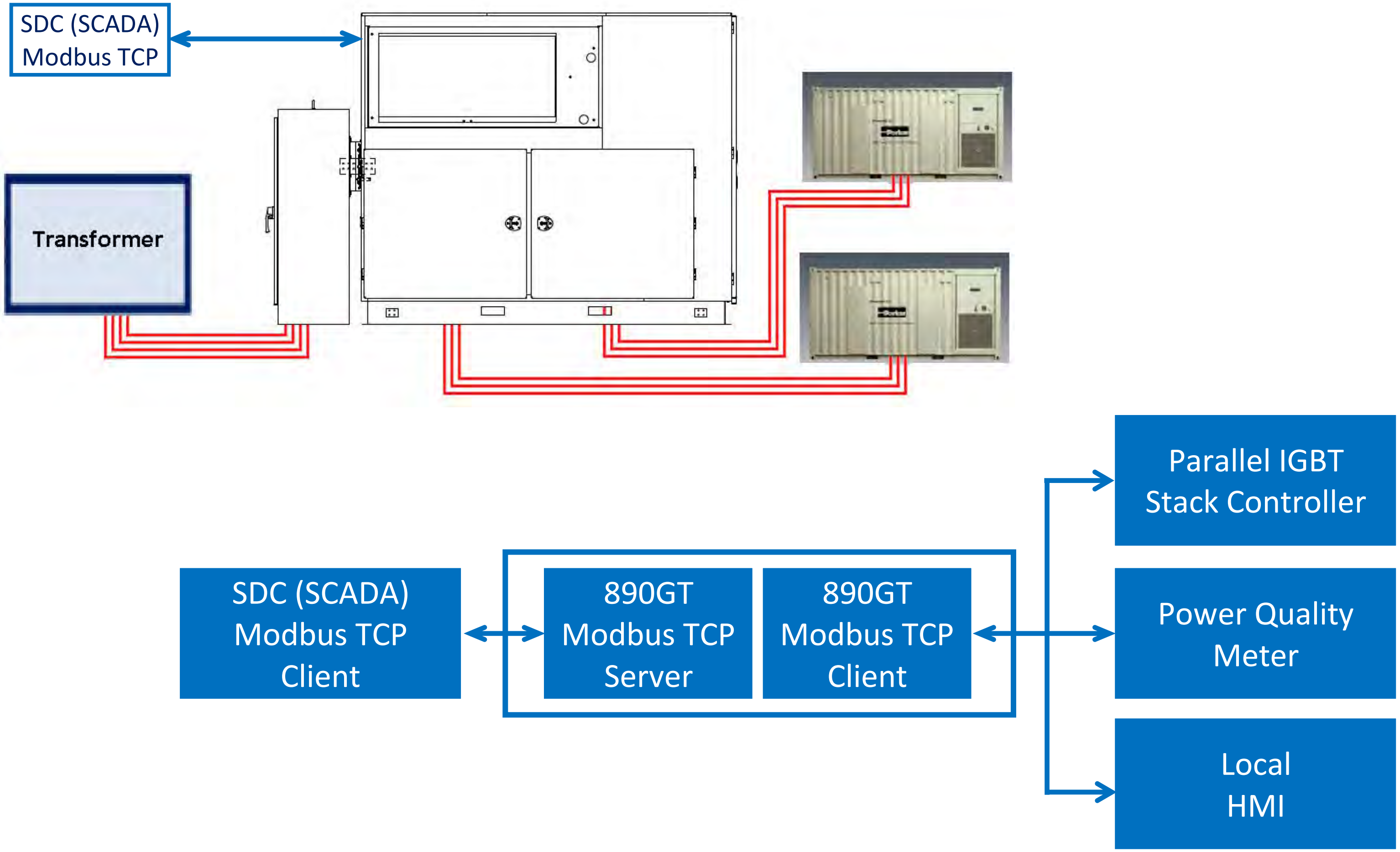


Figure 3-1: Network Communications

The Parker EGT Battery Inverter Enclosure comprises one Grid-Tie Inverter, fed from one or more battery feeds (typically from Battery Enclosure(s)). The maximum input DC current is 3100 A. The rated AC output power is three-phase, three-wire, ungrounded, and protected by a 65 kA Sc and up to 3000A rated AC circuit breaker with electronic trip unit. The enclosure is equipped with access doors, access panels and interior lighting.

Designed as a modular component inverter, the Parker EGT Battery Inverter comprises removable modules housed in a rack with front door and rear panel

- Local control is achieved using the provided selector switch and local HMI.
- Remote control is achieved using the provided selector switch and an external SDC (Site Dispatch Controller) / SCADA system.
- The DSE 890 Configuration Tool provides access to parameters and configuration for in-depth troubleshooting.
- Option Cards can be fitted to the inverter to provide serial communications using several different communication protocols.

The inverter is available in different voltage builds. Each build contains inverters with different power ratings. The following example is for an 890GTB-2206-0CSU0-S400S00, a 2200kVA output Battery Inverter.

Table 3-1: Product Code Structure:

Example Product Code:		**890GT**	**B**	**-**	**220**	**6**	**-**	**0C**	**S**	**U**	**0**	**-**	**S**	**4**	**0**	**0**	**S**	**0**	**0**
Application:	Solar		**S**																
	Energy Storage		**B**																
Power Rating:	2200kVA				**220**														
	2100kVA				**210**														
	1950kVA				**195**														
	1800kVA				**180**														
	1750kVA				**175**														
	1700kVA				**170**														
	1600kVA				**160**														
	1500kVA				**150**														
	1450kVA				**145**														
	1400kVA				**140**														
	1250kVA				**125**														
	1200kVA				**120**														

Example Product Code:		890GT	B	-	220	6	-	0C	S	U	0	-	S	4	0	0	S	0	0
Frequency:	50 Hz					5													
	60 Hz					6													
DC Connection:	Solar 400 A 16 inputs							56											
	Solar 400A 12 inputs							52											
	Solar 350A 16 inputs							46											
	Solar 350A 12 inputs							42											
	Solar 315A 16 inputs							36											
	Solar 315A 12 inputs							32											
	Solar 250A 16 inputs							26											
	Solar 250A 12 inputs							22											
	Solar 200A 16 inputs							16											
	Solar 200A 12 inputs							12											
	Contactor							0C											
	DC Breaker							0B											
AC Connection	Close Coupled								S										
	Bottom Entry								B										
Ground	Negative Bus Grounded									N									
	Positive Bus Grounded									P									
	Ungrounded w/ GF Detector									G									
	Ungrounded w/o GF Detector									U									
Enclosure	White (IP65)										0								
	Gray (IP65)										1								
	White (IP65) - Harsh Environment										2								
	Gray (IP65) - Harsh Environment										3								
	IP21										4								
	Custom										9								
Power Meter	Standard												S						
	With Harmonics												H						
	with Waveform Capture												W						

Example Product Code:	890GT	B	-	220	6	-	0C	S	U	0	-	S	4	0	0	S	0	0

Communications	None	0
	Ethernet IP - Cu	1
	DNP3 - Cu	2
	EtherCAT - Cu	3
	Modbus TCP - Cu	4
	CanOpen	5
	PROFIBUS	6
	Ethernet IP - Optical	A
	DNP3 - Optical	B
	EtherCAT - Optical	C
	Modbus TCP - Optical	D
Aux Power	Internally Generated	0
	External 230V single phase	1
	External 400-460Vac 3 phase	2
	External 120/230V and 400-460Vac	3
Build Standard	UL	0
	IEC	1
	Custom	9
Temperature	Standard (-20C to 55C)	S
	Extended Range (-40 to 55C)	E
Advanced Controls & I/O	Standard	0
	Standard w/analog P/Q	1
	Dynamic controls	2
	Custom	9
Other	Standard	0
	Custom	1

One-Lines

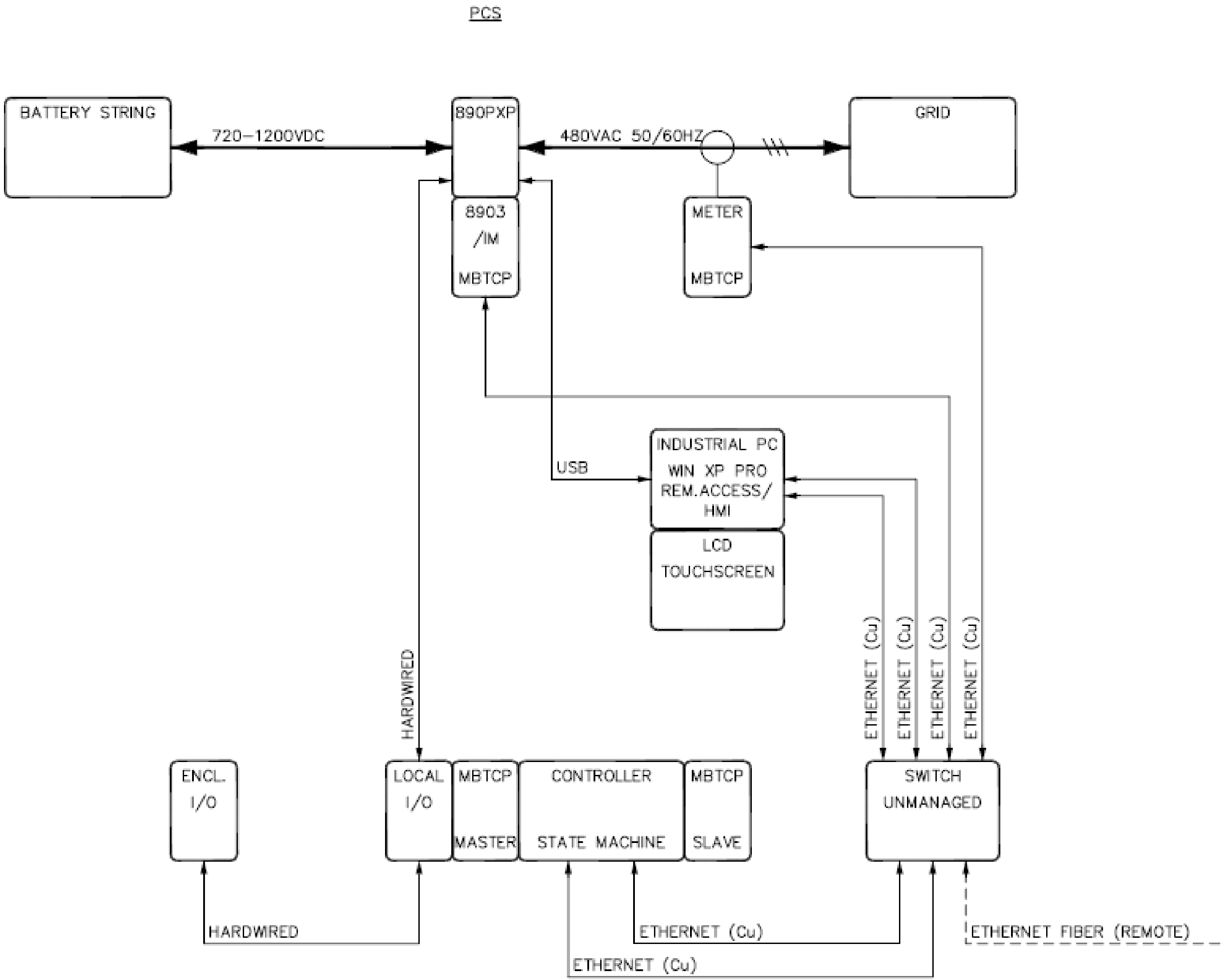


Figure 3-2: Network One Line

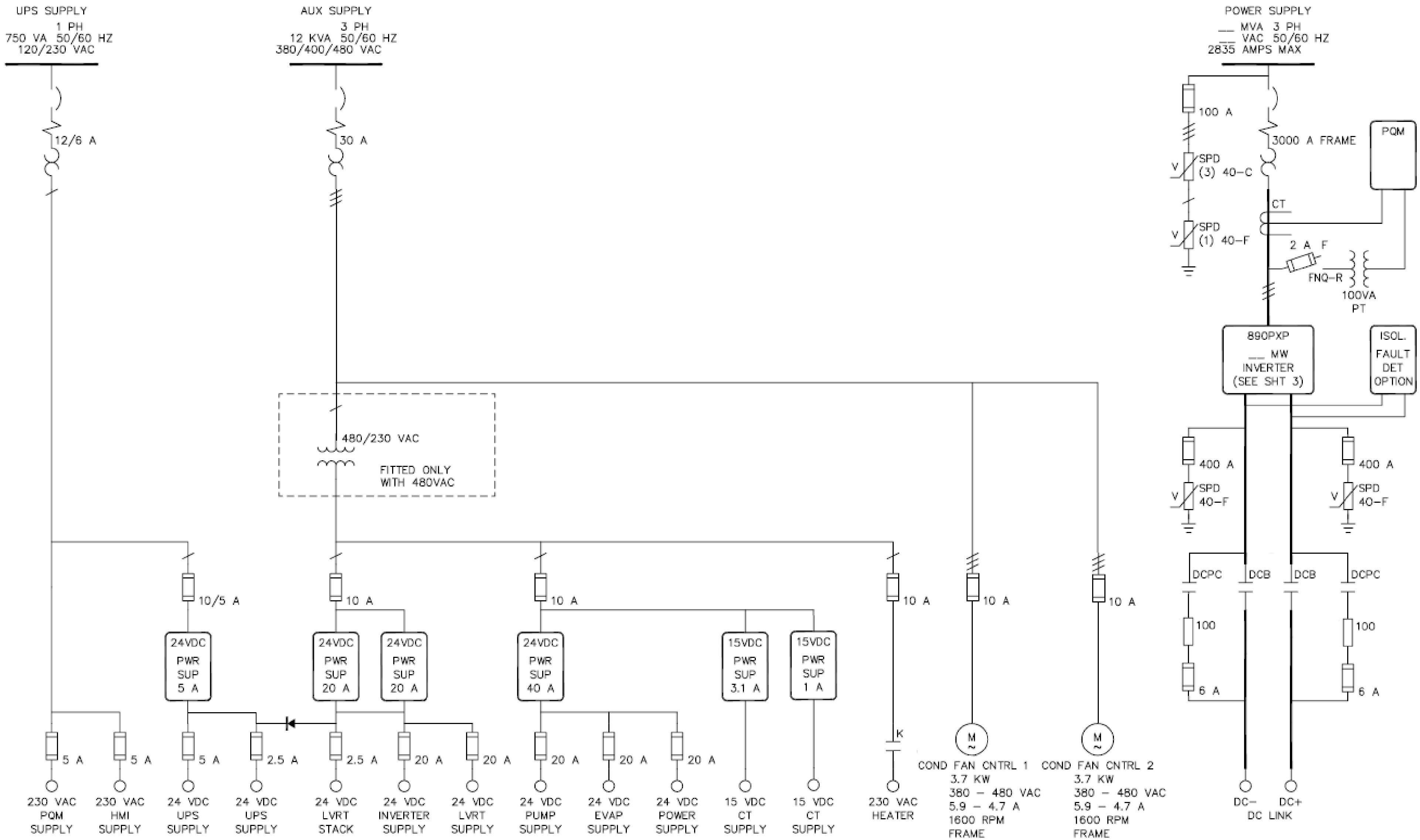


Figure 3-3: Power One Line

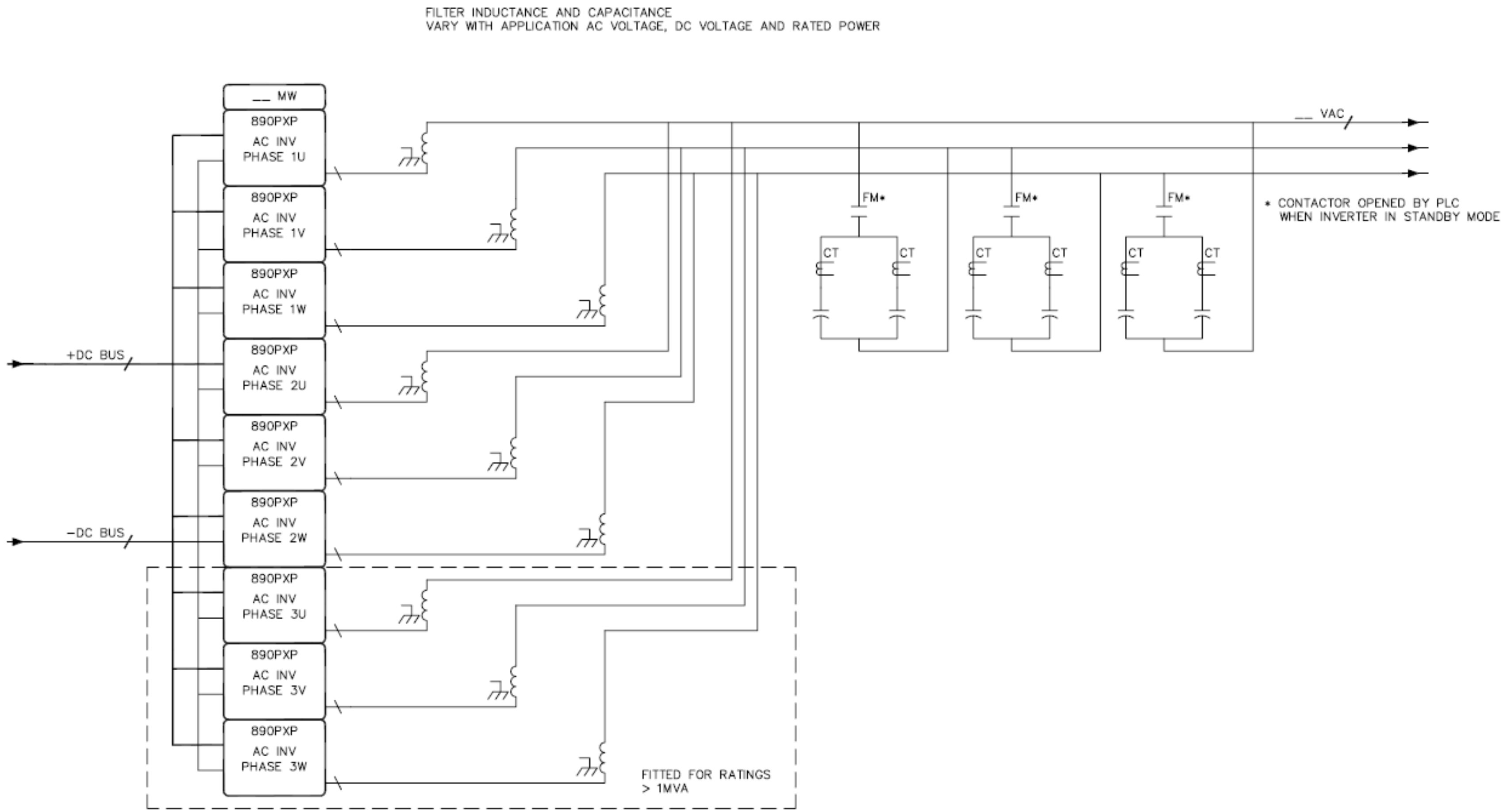


Figure 3-4: AC Power Detail One Line (with filter components)

System Overview

Power Flow – Typical Battery Connection

Incoming DC power is supplied to the DC Bus by a 4000A DC Contactor (See Figure 3-5). A maximum DC input of 3100 A can be accommodated. Both DC connections have an isolation contact. Typical DC bus potential at the DC Bus tie point ranges from 750 to 1150 VDC but can be lower for lower AC connections.

Figure 3-5: Battery Power Connections

Typical Power Conversion

One Parker Grid Tie Inverter (See Figure 3-6) is provided in the Battery Inverter Enclosure. The power stack includes three, six or nine phase modules (also referred to as CD modules) with one to three parallel-connected phase modules per phase which are controlled and coordinated by a Parallel Control Module (PCM). The phase modules are designated by module ("1", "2", and "3") and phase ("U", "V", and "W"). Power connections to the AC output of each phase module are made by bus bars integral to the power stack frame, utilizing high current plug connectors. Its operation, maintenance, and programming details are provided in the Grid-Tie Inverter manual (HA473002U001).

The inverter receives control power (24V DC) from power supplies PS1 (UPS SUPPLY), PS2A and PS2B (denoted as +24VDC LVRT), and DC auxiliary power from power supply PS3 (OTHER +24V). The LVRT power supply has an RC network designed to provide Low-Voltage Ride-Through to critical control functions. PS3 provides +24V for pump, evaporator and non-LVRT functions. PLC Analog inputs, interface board, and the Therminal strings receive +15 VDC from PS4 and -15 VDC from PS5. Power supplies are located on LA473303U002 (See Figure 3-7).

Provided on each PCM is a USB port for programming. Parker "DSE Lite" software is available for programming of the PCM should it ever be necessary to back up or modify the originally provided program. (It is not recommended that any programming changes be made other than by Parker or a Parker designated service provider.)

The power stack includes three parallel connected phase modules per phase, which provide conversion from DC to AC. All modules are easily removed and replaced with minimal manipulation of power wiring. Quick break no-leak connectors eliminate significant loss of refrigerant when a module is removed.

Figure 3-6: Inverter Phase Modules
(3 per phase for a total of 9 modules)
Installed in Power Stack

Power Flow – Grid Feed side

AC power is fed to the grid through the phase modules (See Figure 3-9). The output of each phase module is connected to individual output phase inductors. Inductors are cooled with liquid cooling circuits and monitored by integral temperature sensors.

The three-phase outputs of the phase inductors are connected in parallel (if more than one phase module) with each other, the output capacitor filter and then connected to the low voltage winding of the isolation transformer. The output capacitor filter is provided with contactor control (the contactor is opened by the PLC when the Inverter is in standby mode). Filter current is monitored by a current transducer on each phase. The inverter side connection of the isolation transformer is protected by a 3000 amp three pole circuit breaker. The high voltage windings of an isolation transformer are connected to the grid. The isolation transformer may have temperature, pressure and oil level sensors.

Auxiliary Power

Multiple options are available for auxiliary power supply to the 890GTB. Please consult factory for specific needs. Typical configurations include self-generated auxiliary supply or a single-phase UPS Feed 120/230vac and a 3 phase aux power feed 380-480vac to provide power for operation of the PLC, cooling condenser, blower assemblies, HMI, and other functions within the Battery Inverter Enclosure. The single-phase input is protected by a 6 amp motor overload switch, with branch protection for all sub-circuits.

The 3-phase auxiliary supply is protected by a 30 amp circuit breaker. Branch protection for the UPS and auxiliary power for all sub-circuits is located on the LA473303U002 panel.

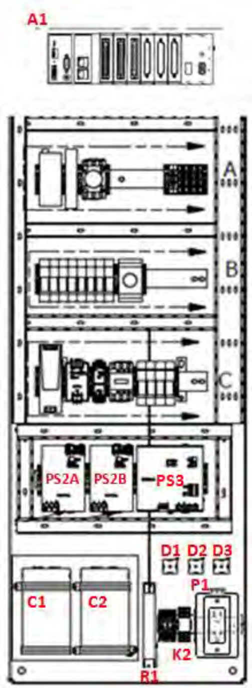


Figure 3-7: LA473303U002

Figure 3-8: Inverter PCM

Figure 3-9: Inverter Phase Modules

Fiaure 3-10: Ethernet Switch

Figure 3-11: Inverter Circuit Breaker

Typical Circuit Breaker Operator

A Siemens 3000-amp WL Circuit Breaker Operator (or equivalent) is powered by 24V DC supplied by PS2. The Circuit Breaker Operator controls CB2 (See Figure 3-10), a 3000-Amp Circuit Breaker that feeds the Isolation Transformer. It receives inputs from the Emergency Power Off (EPO) circuit, and the PLC (Breaker Open, and Breaker Close). The Circuit Breaker Operator provides outputs to the PLC (Breaker Closed, and Breaker Tripped). Optionally the breaker can be tripped by an external source. Wiring terminals for this option are provided in the control enclosure.

Typical Communications

Within the Battery Inverter Enclosure, an Ethernet network coordinates the inverter stacks, PLC, and HMI devices using CAT5 cable. The inverter includes a USB port for programming or it can be programmed over Ethernet. Several communications options are available for integration into a SCADA system.

Cooling

Advanced cooled ratings of the inverter feature a two phase cooling system (See Figure 3-12) which is designed to remove thermal energy losses from the inverter system and reject them to the ambient surroundings outside of the enclosure. The system uses a positive displacement pump module to circulate a vaporizable dielectric fluid, refrigerant R134a, through a closed loop circuit. The fluid is in a sub-cooled liquid state as it enters and exits the pump module.

Liquid out of the pump module flows thru up to 19 parallel paths. Nine of these flow paths each contain three cold plates which are in contact with IGBTs. They are used to transfer heat from the IGBTs to the fluid. Nine more of the parallel flow paths each contain three cooling coils which are in contact with inductor coils. The cooling coils transfer heat from the inductors to the fluid. The last flow path contains an air cooling coil to manage internally generated heat.

Other thermal losses in the inverter system are transferred to the air inside of the enclosure via convection. The air is forced across the evaporator where the heat is transferred to the fluid. As the fluid travels through each flow path it boils as it absorbs heat. The fluid exits each parallel branch and enters a mixed phase manifold. The flow travels from this manifold to an air cooled condenser where the fluid is condensed back to the sub-cooled state before it returns back to the pump module.

High heat transfer coefficients, low flow rates and low thermal gradients are achieved by utilizing the two phase cooling cycle.

Two-phase Cooling System

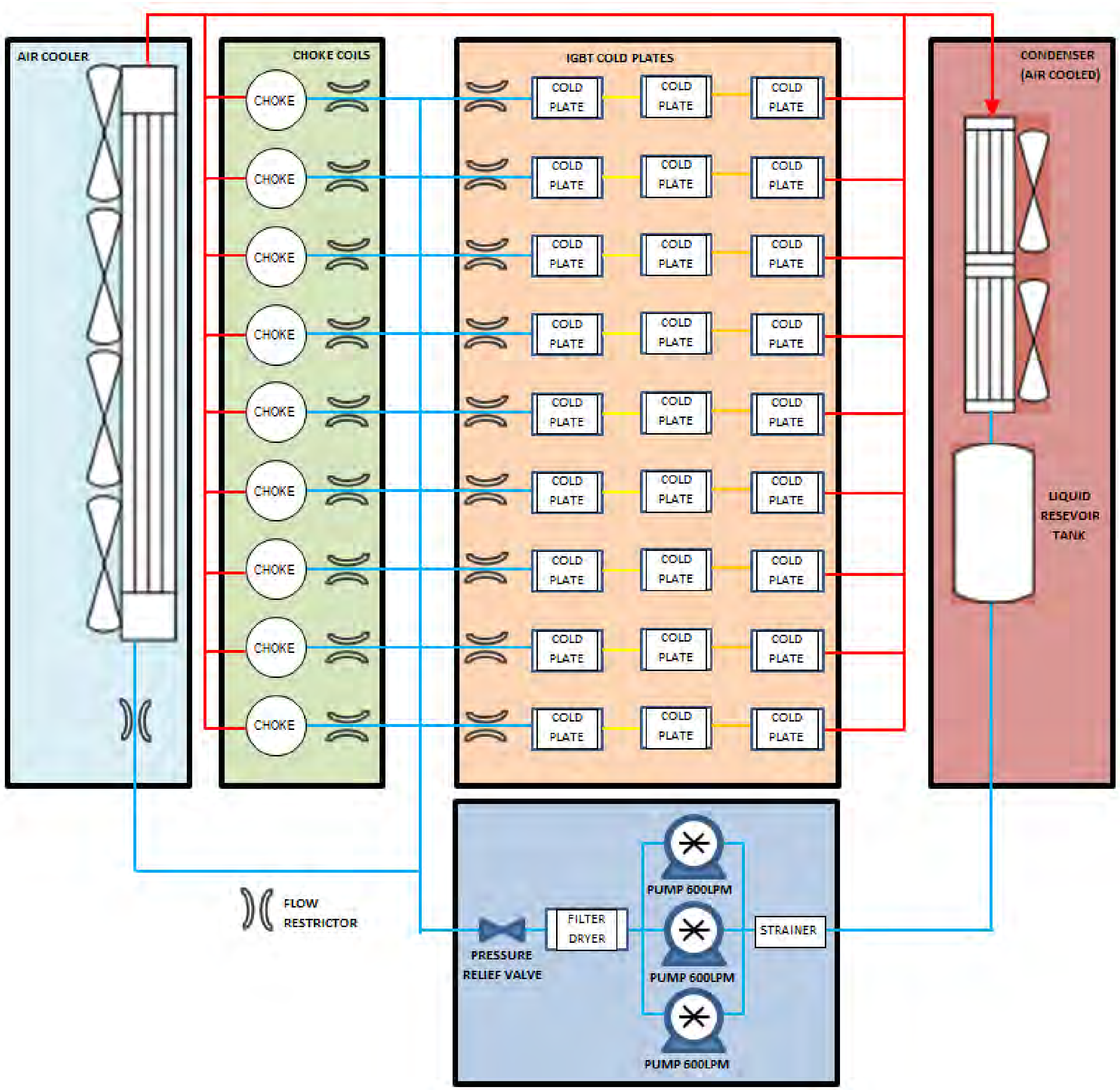


Figure 3-12: Two phase cooling system diagram

Fluid

The cooling system utilizes refrigerant R134a as the vaporizable dielectric heat transfer fluid is readily available and commonly used in commercial and industrial systems. R134a has a favorable latent heat of vaporization values for temperature ranges this system will experience. It is lower in pressure when compared to other refrigerants. It is non-conductive and non-toxic, and contains no CFC's. In the event of an accidental leak or rupture the fluid will vaporize without harming or leaving residue on any of the devices in the system. 45 lbs. of refrigerant comes pre-charged with the 890GTB.

Condenser Fans

The two condenser fan motors (See Figure 3-13) are controlled by the Inverter which features Condenser Status inputs, Pump Control outputs, a Condenser Speed analog output, and a Refrigerant Level sensor. Fan motor power varies dependant on build variants and receive 380-480VAC, 3-phase power directly from the Ziehl FN063-ZIQ. GL.A7P3 Condenser Fan Controllers protected by CB3. Fans are run at variable speed to extend their life. The 890GTB will continue to operate with the loss of a single fan.

Figure 3-13: Condenser Fans and Condenser Coil

Evaporator Fans

Four 24-volt Evaporator Fans (See Figure 3-15) are controlled by a Parker Pump Controller (See Figure 3-14) part number LA471775U001 with RTD feedback from a Return Air Temperature Sensor. Fans are run at variable speed to extend their life. The 890GTB will continue to operate with the loss of a single fan.

Figure 3-14: LA471775U001 Pump Controller

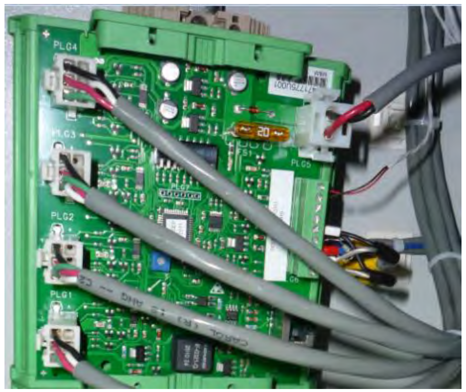


Figure 3-15: Evaporator Fans

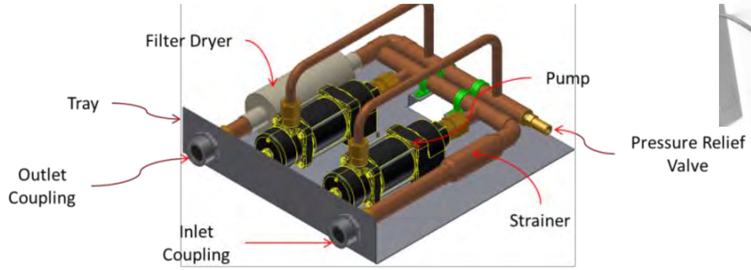
Coolant Pumps

The three-pump module (See Figure 3-16) will consist of three positive displacement pumps in parallel which are capable of providing fluid flow at 1800LPH. The 24-volt Coolant Pumps are controlled by a Parker Pump Controller part number LA471775U001 with RTD feedback from a Refrigerant Temperature Sensor. The Pump Controllers are connected to Control Power (24V DC) from power supply PS3 through a 30 amp fuse.

A two-pump module (See Figure 3-17) is shown depicting the components of a typical Pump Module. The addition of the third pump provides redundancy. The 890GTB will continue to operate with the loss of a single pump.

Figure 3-16: Three-Pump Module

Figure 3-17: Pump Module Component Identification
(Two-Pump Module shown)



Ambient Environment Conditions

With the inverter output at 110% the maximum ambient temperature is 40°C with a relative humidity of 50% and a maximum altitude of 1000m. At 100% output the maximum ambient temperature is 50°C with a relative humidity of 50% and a maximum altitude of 1000m.

The inverter will apply a linear power derating of 4% for every °C from 50°C to 55°C. Above 55°C the inverter may shut down.
Altitude Derating is 1.5% for every 100m above 1000m

Enclosure Conditions

The air temperature inside of the enclosure will typically be higher than external ambient temperature during operation. Cooling system components outside of the enclosure will be exposed to ambient conditions

DC Bus Derating

Due to an active grid harmonic mitigation algorithm used by the inverter, the 890GTB may derate operation if the battery voltage is above 1000Vdc. The derating will be 1% for every 10 volts above 1000Vdc. See figure below for typical derating for temperature and DC bus voltage.

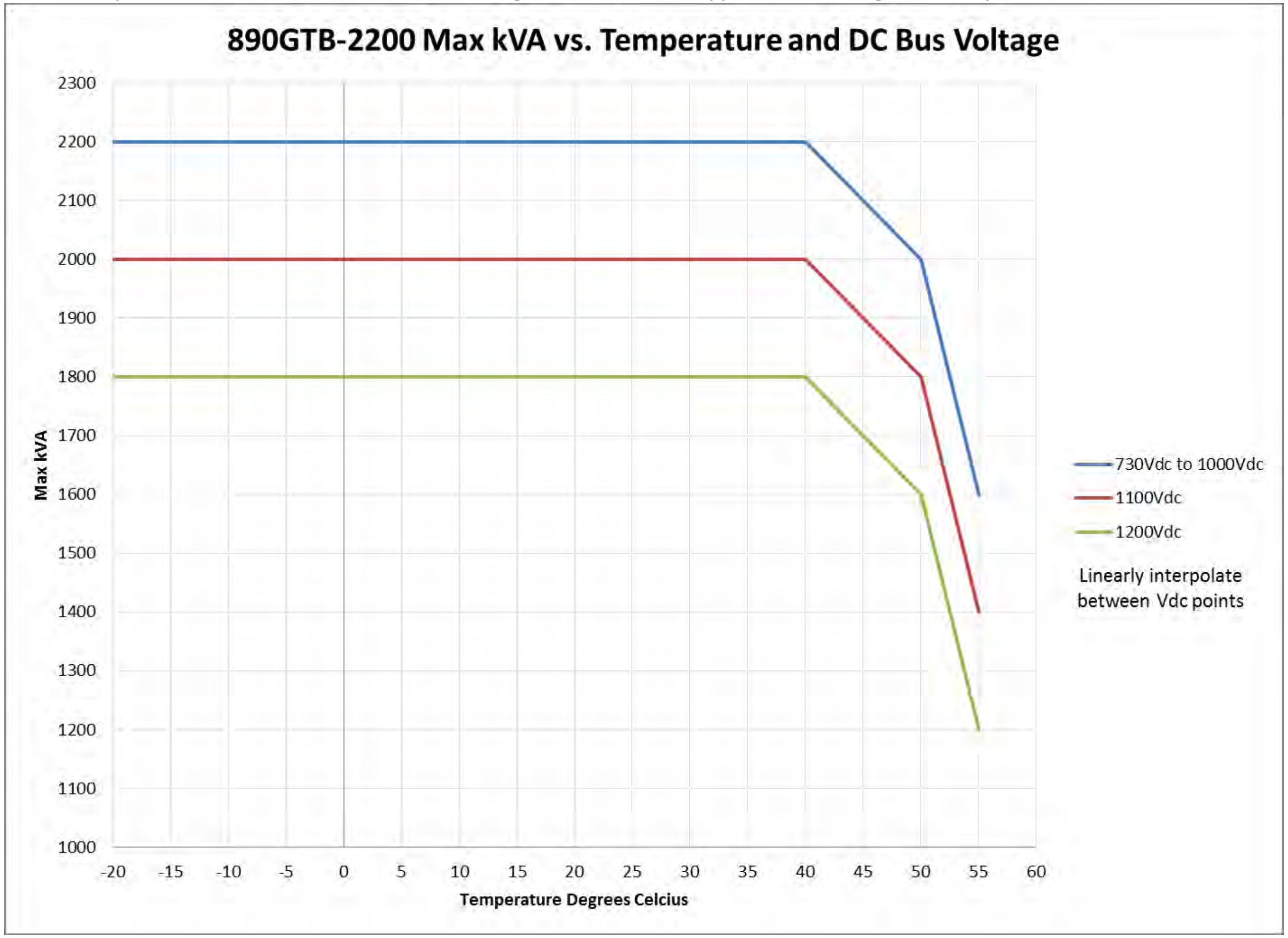


Figure 3-18: Inverter Derating

Other Environmental Factors to Consider

The 890GTB may limit output current due to extreme environmental conditions. Sustained winds of over 40MPH that are directed in direct opposition to the 890GTB condenser fans may result in output current limitation, but wind gusts should have minimal effect on system performance. The 890GTB will derate its output to allow for continued grid operation if high sustained winds are present. Consult the factory if assistance is required for wind shielding the 890GTB.

Damaging hail or large windborne foreign objects may also damage the enclosure paint system and/or condenser fins. In the event of these extreme events, the 890GTB should be inspected to ensure integrity of its paint system and health of the condenser fins. Damaged paint can result in corrosion and permanent damage to the enclosure, damaged condenser fins may cause derated output of the 890GTB.

Typical Ground Fault Detection

The BENDER IRDH275 detects ground faults in ungrounded systems by measuring the system's insulation resistance to ground. A ground fault can be detected before leakage current may even be present. The AGH150W-4 coupling device extends the voltage range to 1760 VDC. When the measured insulation resistance falls below the set response value two separately adjustable alarm contacts can be set to indicate a prewarning and main warning alarm. The measured value is indicated on the LCD display or an externally connectable measuring instrument. A fault storage setting allows the device to reset automatically or require a manual reset. An external and internal test/reset can be activated remotely or on the device. A comprehensive INFO menu displays additional information such as the current leakage capacitance. The IRDH275 continuously monitors the equipment ground connection to ensure proper operation.

Figure 3-19: Bender Ground Fault Detector and coupling device

Typical HMI

The Parker IPX10S-D HMI (See Figure 3-20) includes 2 RS-232 ports, 2 10/100BT Ethernet ports, 4 USB ports, and optional PCI expansion slots. Flexible programming allows for multiple ports to be active simultaneously. The IPX10S-D is powered from 120/220 VAC, 50/60 Hz protected by a 15 amp FNM fuse.

Figure 3-20: Parker IPX10S-D Industrial PC / Touchscreen

Isolation Transformer

An Isolation Transformer is required to connect the output of the Grid-Tie Inverter to the grid. The Battery Inverter Enclosure has provisions for accepting two dry contact inputs, a temperature warning indication (180°C), and temperature fault indication (200°C). Parker can provide specific transformer requirements upon request, but general requirements include equipping the transformer with an electrostatic shield to minimize EMI issues and to request a minimum K factor of 4. The inverter is designed for close connection to the transformer via a bus bar throat (standard option) or can be designed for cable termination in a dedicated entry box.

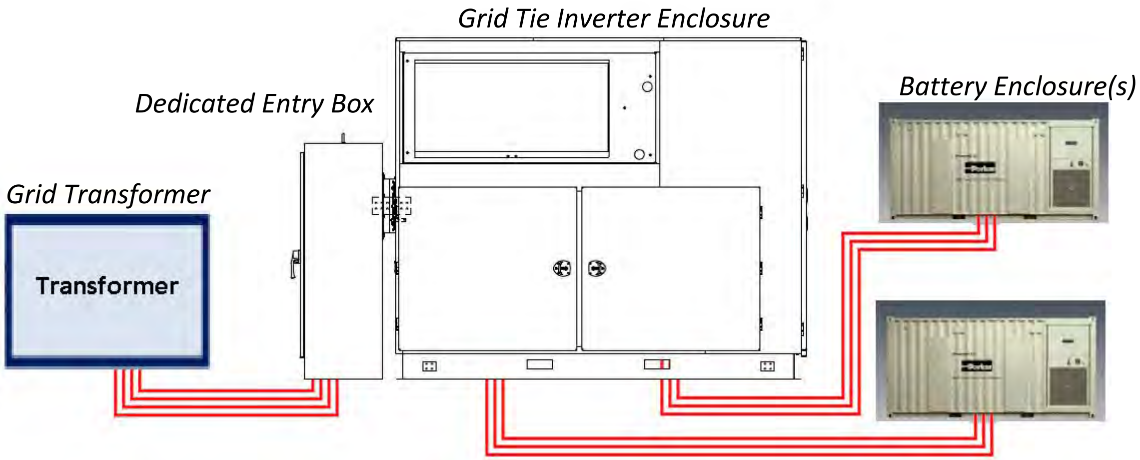


Figure 3-21: Optional Cable Termination

Line Synchronization

The AC Input from the main transformer is connected to the input of the synchronization attenuator LA471892U002 (See Figure 3-22). This unit provides a low voltage signal to the power stack control module via analog inputs. This card provides real time phase voltage feedback for synchronization, phasing, and control. The circuit also allows for the execution of power factor and VAR control. In addition it provides voltage and frequency feedback for grid protection required by IEEE 1547 and UL 1741.

Figure 3-22: Line Sync Attenuator

Typical PLC

Located in the control cabinet, a National Instrument PLC Model Number cRIO-9068 is powered by 24VDC protected by a 5 amp FNM fuse. The PLC rack includes the following modules:

Slot 01 – Thermocouple input (NI9213) monitors Inductor temperatures and ambient temperatures inside and outside of the inverter.
Slot 02 – 32 Analog inputs (NI9205)
Slot 03 – 32 Digital inputs (NI9425)
Slot 04 – 32 Digital inputs (NI9425)
Slot 05 – 32 Digital outputs (NI9476)
Slot 06 –
Slot 07 –
Slot 08 –

Figure 3-23: National Instruments cRIO-9068 PLC

Figure 3-24: Filter Inductors
(Behind Capacitor Door)

Figure 3-25: Filter Capacitors

Typical Power Monitor

A Shark Model Number 200T-60-10-V2-D-INP10 Power Quality Meter (or equivalent) receives a single-phase AC supply, protected by a 5 amp FNM fuse. The meter analyzes power quality based on Phase 1 and Phase 3 4000:5 CTs and three-phase 120V AC (Developed from the output AC power, stepped down through two 150VA single-phase potential transformers (L2 common) protected by 2A FNQR fuses). The meter provides: Active Power (W), Apparent Power (VA), Frequency (Hz), Phase Current (A), Power Factor (PF), Reactive Power (VAR), and Voltage (V) measurements with high performance accuracy.

Figure 3-26: Shark 200 Power Quality Meter

Temperature Sensing

Temperature sensing is accomplished using networks of thermistor cards daisy chained together and Thermocouple I/P Modules NI 9213 (See Figure 3-27).

The Temperature sensing cards monitor: AC Busbar temperatures (6), Capacitor busbar temperatures in the Tuned Filter (15), DC Connection Busbar Temperatures (18), Inverter Stack Busbar Temperatures (11), and Filter Busbar Temperatures (15). For each string, the hottest temperature and its location within the 890GTB will be available to the user.

Type K Thermocouple sensors monitor: each of the chokes in the Tuned Filter (9), the DC Power supplies (1), internal ambient temperature (1), external ambient temperature (1), the Main Circuit Breaker Arc Flash Box area (1), the Surge Suppression panel area (1), Refrigerant Condenser inlet (1), and Refrigerant Condenser outlet (1).

Figure 3-27: Temperature Sensor

Typical Enclosure Access Provisions

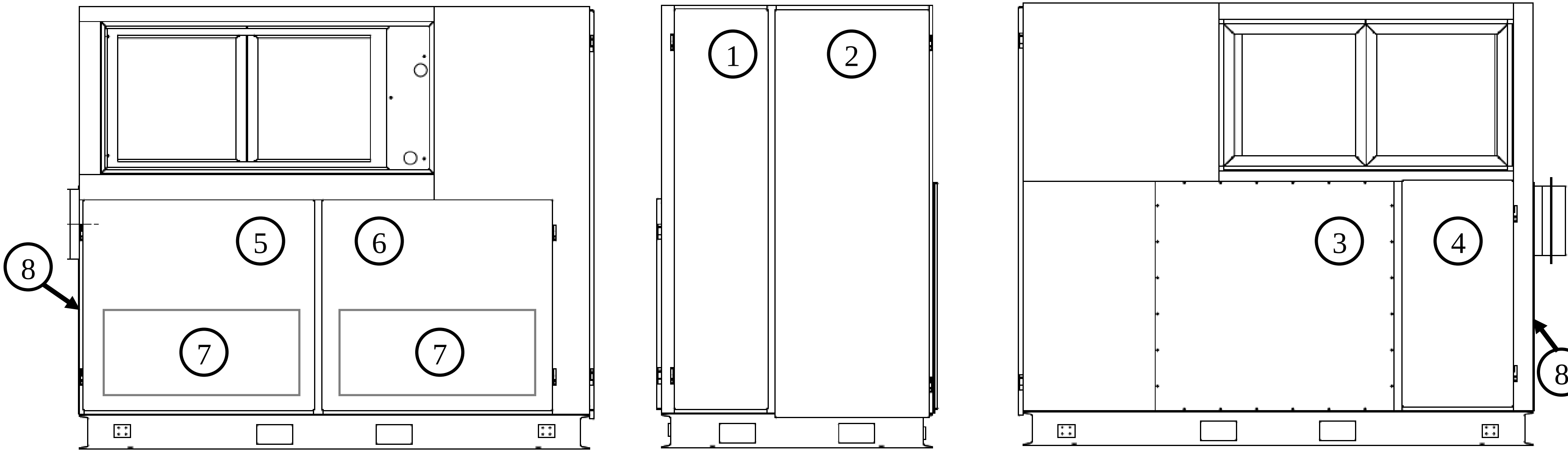


Figure 3-28: Typical 2MW Enclosure Access Provisions

Table 3-3: Typical Enclosure Access:

	Enclosure Access
1	**HMI Access Door**
2	**Inverter Access Door**
3	**Capacitor / Inductor Access**
4	**Breaker Access Door**
5	**DC Input Access**
6	**DC Input Access**
7	**Inner DC Input Access**
8	**Breaker Access**

1A

Figure 3-30: ACCESS DOOR #1

1B

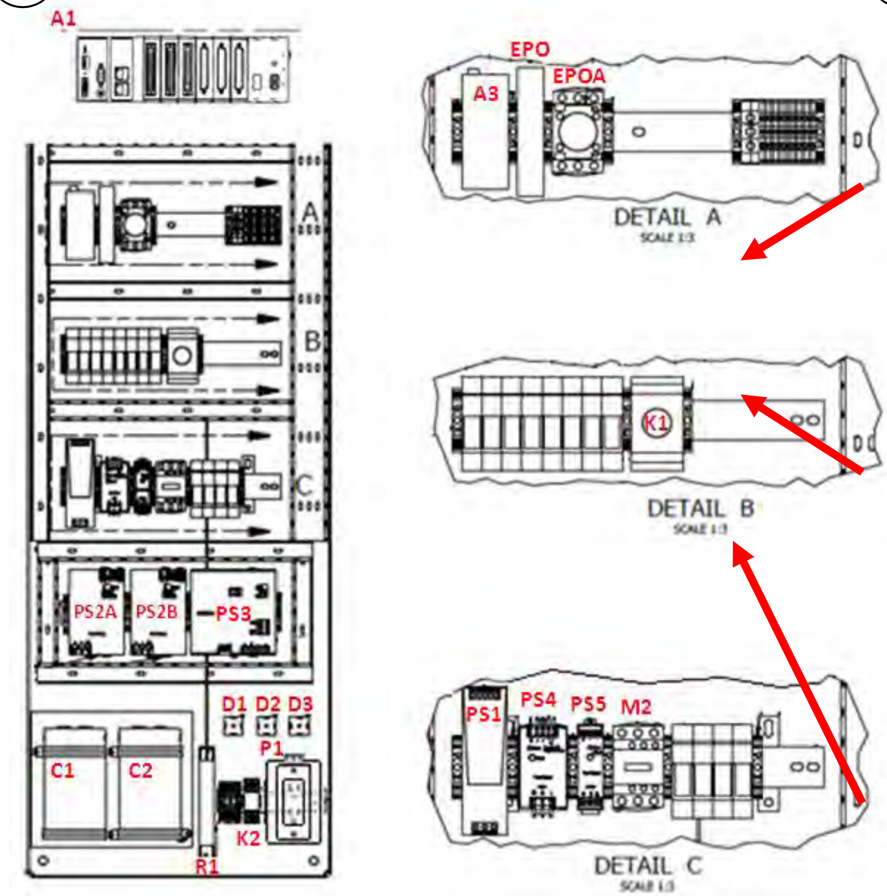


Figure 3-31: ACCESS DOOR #1 (LA473303U002)

2

Figure 3-29: ACCESS DOOR #2

ACCESS DOOR#1 (LA473304U001):

HMI, E-STOP, Selector Switches

ACCESS DOOR#1 (LA473303U002):

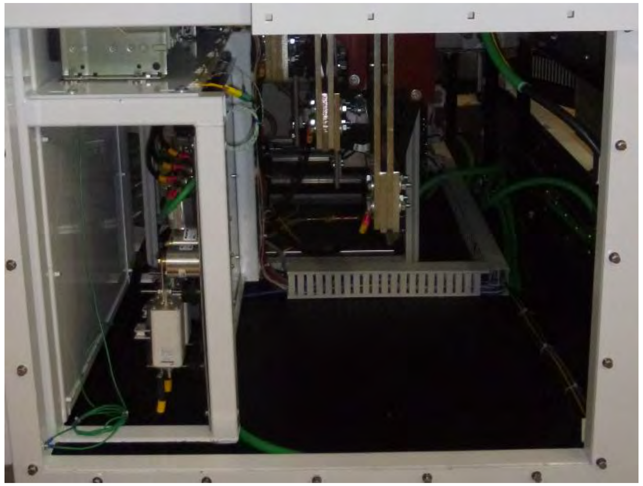
PLC (A1), - T/C Input Modules, Analog Input Modules, Digital Input Modules, Digital Output Module, Spare PLC Slot, PLC Winford Breakout Box (A2), Ethernet Port (A7), PLC Adapter Card (A9), Digital Interface Assembly (A10), Safety Monitoring Relay (EPO), Auxiliary EPO Relay (EPOA), Heater Relay (K1), LVRT (K2), Control Power Main (M2), Convenience Outlet (P1), Power Supplies (PS1-5), Fuses

ACCESS DOOR#2:

Inverter Power Stack (PCM and Phase Modules), Pump Controller, Coolant Pumps, Coolant Reservoir, Sync Attenuator (10A2), Evaporator Controller (12A2)

ACCESS COVER #3:
AC Filter Capacitors and Contactor

ACCESS COVER #4 / ACCESS DOOR #8 (TOP):
Circuit Breakers (CB2, CB3, CB4)



ACCESS COVER #3:
AC Filter Inductors, Refrigerant Accumulator, Refrigerant Pump Module

ACCESS COVER #4 / ACCESS DOOR #8 (BOTTOM):
Strikesorbs, Current Transformers (CT-P1, CT-P2), Fuses (F2, 10F8, 10F9, 10F10, F11, F12, F17, F18. F19. 10F17. 10F18. 10F19. 10F20. 10F21). Power Meter (A4). Transformer (T1. T3. T4).

Figure 3-32 ACCESS DOORS #3, #4 and #8

Figure 3-32A: #7 (Inner Doors) Closed

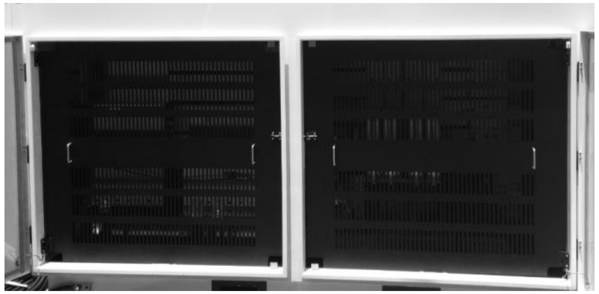


Figure 3-33: DC Input Locations (ACCESS DOORS #5(Right Side), #6(Left Side) and #7 (Inner Doors))

ACCESS DOOR #5 / #7:
DC Input connections (DC+, DC-), Input Temperature Sensors

ACCESS DOOR #6 / #7:
DC Input Contactors (DC+, DC-), DC Precharge, DC Input Contactor Temperature Sensors

HMI

HOME Screen

The HOME screen displays a lot of data pertaining to the overall state of the Inverter Enclosure:

- The state of the contactors and the Main Circuit Breaker
- The current of each AC output phase, total AC Output current, and Filter Capacitor phase currents
- The Input DC voltage, the AC Output Voltage to the Grid, and the three AC Output phase-to-phase voltages
- The Sync Frequency, Id / Iq Feedback
- Kilowatt, kVAR, and Power Factor
- The state of the Inverter Stack PCM
- R134a Refrigerant Level, Heatsink Temperature, Pump Inlet Temperature, Pump Speed, Condenser Fan Speed.
- The State Machine active state
- Temperature Sensing String Temperatures:
    - DC Panels
    - MCB Busbar
    - Filter Busbar
    - Cap Door Busbar
    - Stack Busbar
- Thermocouple readings

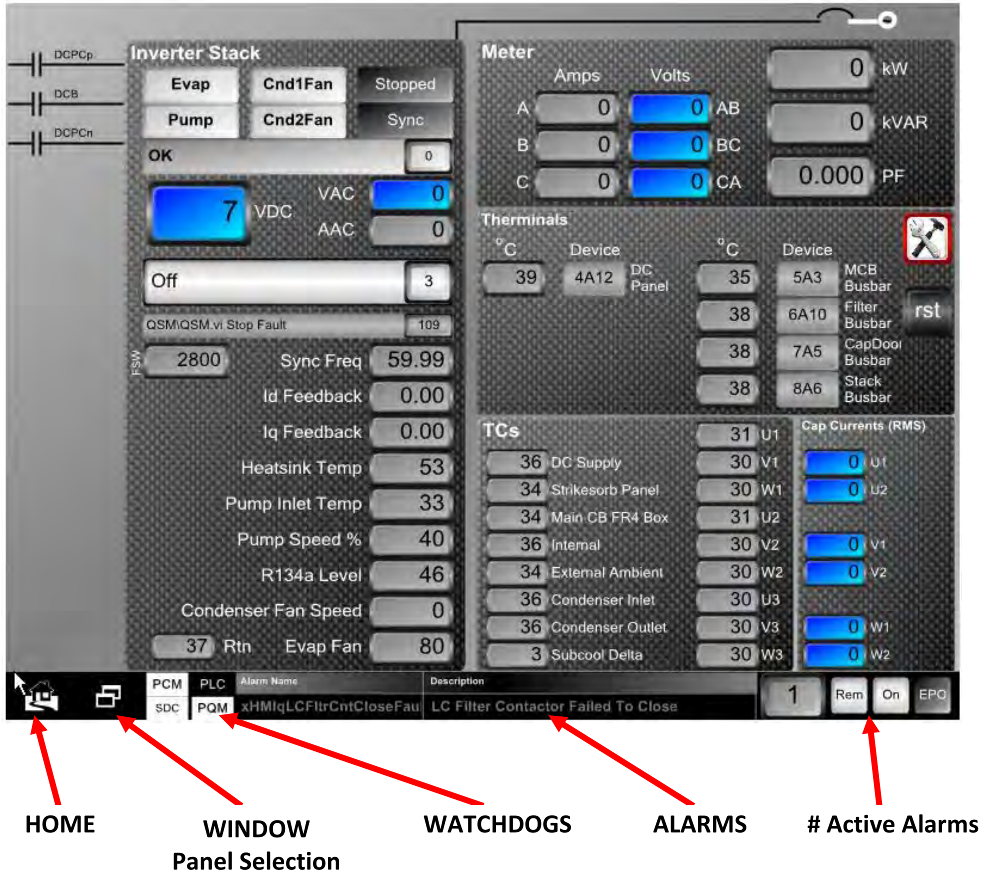


Figure 3-34: HMI HOME Screen

LOCAL / REMOTE MODE

Remote mode:

In remote mode, the external SCADA system tells the inverter when to connect / disconnect, and what real and reactive power to produce / consume.

Primary Local:

Local Remote Selector Switch is the primary means of enabling local control. When in Local, and the inverter on /off switch is moved into the On position the inverter will automatically close the pre-charge contactors, starting the DC Link charging, after enforcing an appropriate time delay the inverter will then close the DC main contactor, then the main AC Circuit Breaker, and finally the filter Main contactor. Upon FM contactor closure, the stack syncs to the line (IGBT Switching) at the LOCALLY entered power points. The real and reactive powers are entered locally at the inverter HMI – this is the principle difference between Local and Remote mode.

Engineering Development:

A more basic mode of operation can also utilized. When the invert is in the Off state, a local operator can transition the state machine to the engineering development state. In this state manual operation of the contactors (with safety interlocks enforced) is possible. Furthermore, in this engineering development state, the selector switches Local/Remote & On/Off are ignored. HMI pushbuttons are used exclusively.

Engineering development mode is designated for use only by properly trained operators and Parker EGT engineering and service personnel.

WINDOW Selection Screen

The WINDOW Selection screen allows the operator to navigate to different screens:

- HOME
- ALARM Screen
- Trend Screen
- INVERTER SETUP Screen
- PCM CONFIGURATION Screen
- Electrical Overview Screen
- Miscellaneous Screen
- Local Control Screen
- SCADA Information Screen

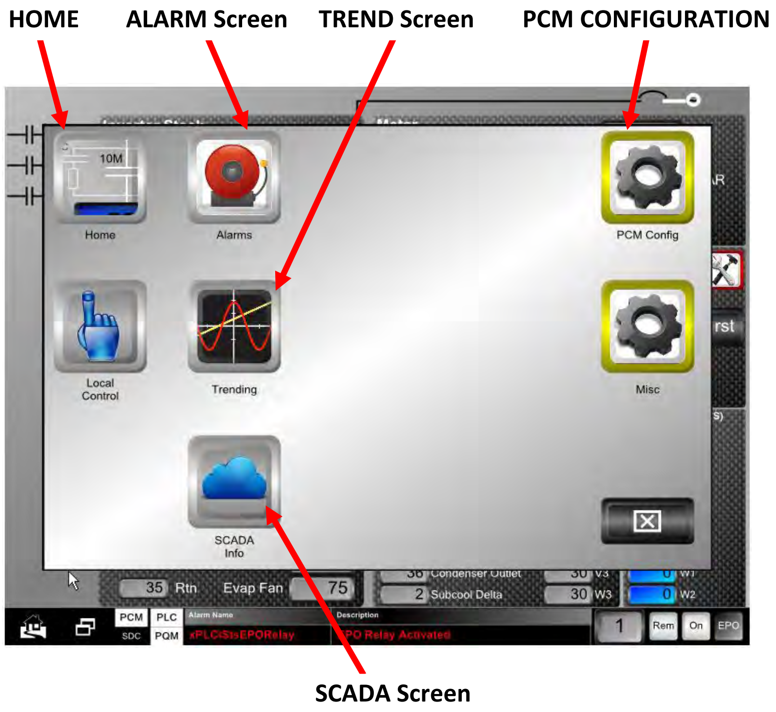


Figure 3-35: HMI WINDOW Selection Screen

SCADA Screen

The SCADA screen allows the operator to monitor SCADA communication data.

Figure 3-36: HMI SCADA Screen

PCM CONFIGURATION Screen

The PCM CONFIGURATION screen allows the operator to set the Filter Inductance, Current Loop gains, and DC Volt Demand.

Figure 3-37: HMI PCM CONFIGURATION Screen

ALARM Screen

The ALARM screen allows the operator to view, acknowledge, and clear active alarms and to view alarm history.

Figure 3-38: HMI ALARM Screen

ALARM CONTROL Screen

The ALARM CONTROL screen allows the operator to Enable and Disable Alarms and Alarm Groups.

Figure 3-39: HMI ALARM CONTROL Screen

TREND Screen

The TREND screen allows the operator to chart selected parameters

Figure 3-40: TREND and PEN SELECT Screen

Miscellaneous Screen

The MISC screen allows the operator to monitor and adjust selected data

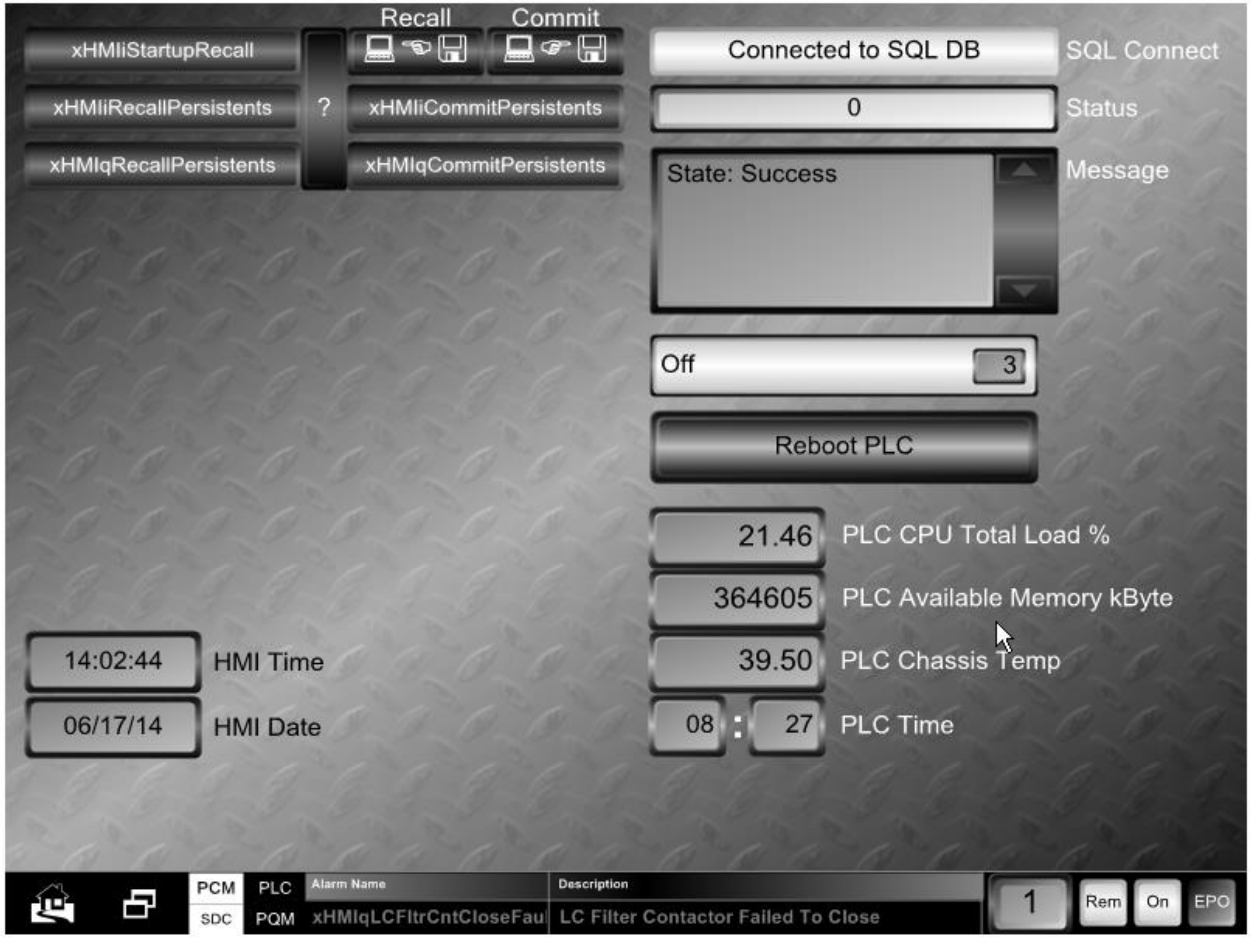


Figure 3-41: HMI MISC Screen

SCADA

Typically, a SCADA (**S**upervisory **C**ontrol **a**nd **D**ata **A**cquisition) system is used to acquire and store data from the inverter and make stored data available for users. The SCADA system also provides HMI (Human-Machine Interface) for users to interact with the inverter.

The plant control system performs the real time control of the inverters. It uses the inverter control interface to perform some the following functions: setting the inverter to various power plant controller modes, setting the limit on the real power of the inverter, regulating the reactive power output of the inverter or its power factor setting.

The plant controller implements plant level logic and closed loop control schemes to provide fast and reliable plant level control. It uses real-time commands to inverters to achieve these functions. There is one plant controller per plant that is typically located in a substation and controlling the conditions at the Point Of Interconnection (POI) or Point of Common Coupling (PCC).

The GTB uses a Sunspec (see: http://www.sunspec.org/) and MESA (see: http://mesastandards.org/) compliant interface via Modbus TCP as default standard. As part of the joint effort between the MESA Standards Alliance and the SunSpec Alliance to advance common communication standards for energy storage devices, MESA adopts the Sunspec model for all Modbus communications inside the energy storage system, and MESA will lead the SunSpec process for battery communication standards, using current MESA battery standards as the baseline. The interface can optionally be customized as needed for other users.

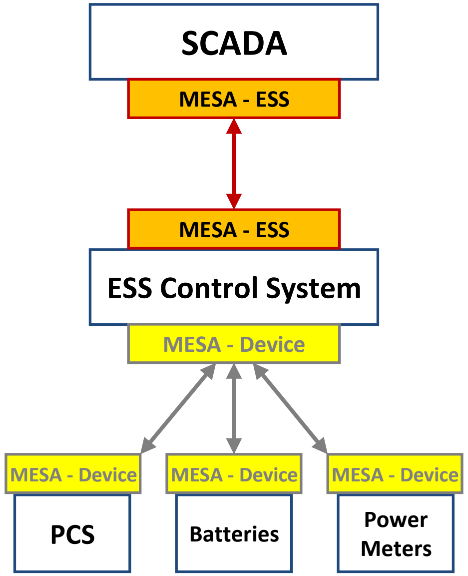


Figure 3-42: MESA Interface

MESA standardizes communication and control between the **ESS** and **SCADA** as well as standardizing connections between **ESS devices** such as power conversion systems (PCS), batteries, and power meters.

Typical Inverter Functions

Some of the typical functions of the enclosure are:

- Inverter provides monitoring data to SCADA system through a communications interface
- Inverter provides Warnings, Alarms, and Diagnostics for use by the plant SCADA system.
- Inverter provides data logging capability of inverter collected/processed data (e.g. fault history, key process parameters, including trip logs etc.)
- The PLC provides 2 discrete inputs (180°C and 200°C) to monitor transformer temperature.

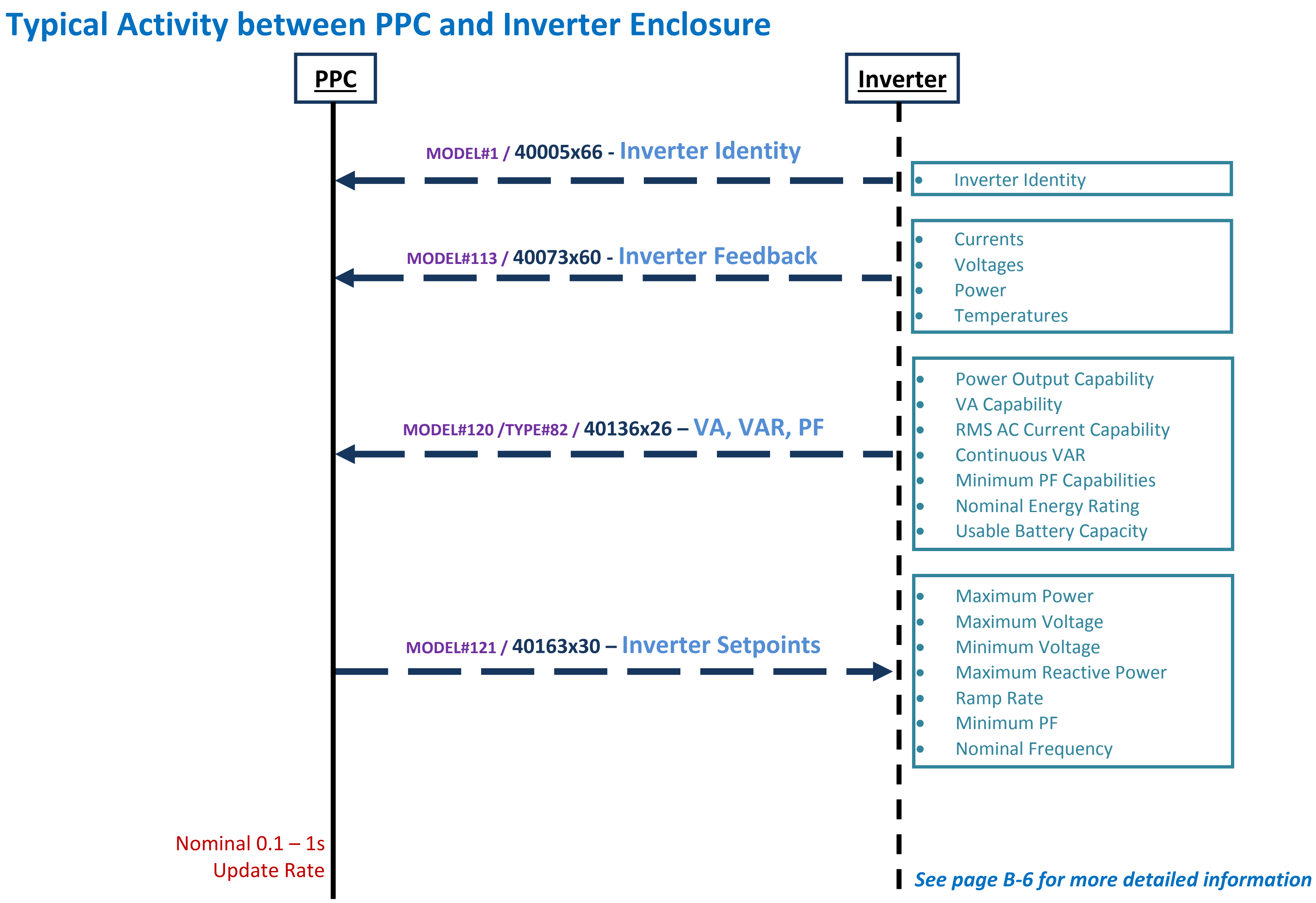


Figure 3-43a: PPC/Inverter Interface

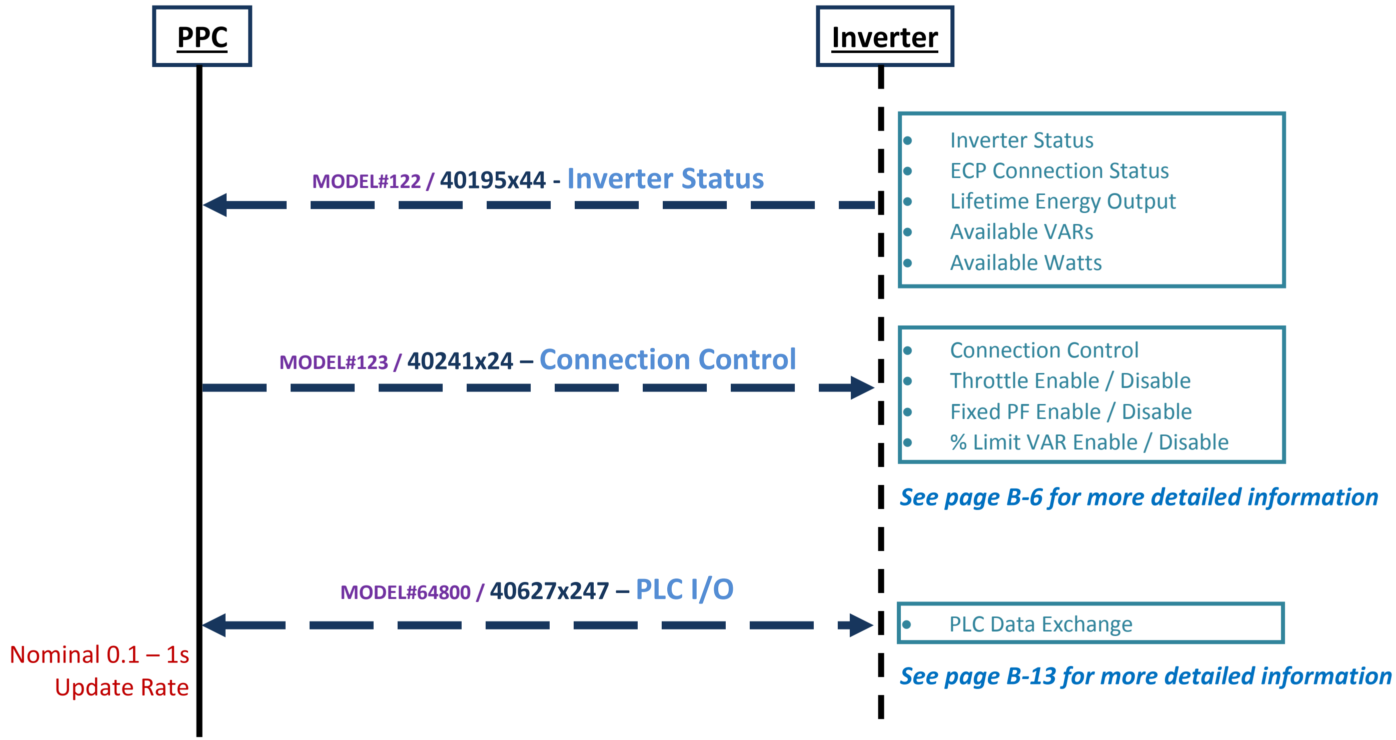


Figure 3-43b: PPC/Inverter Interface

Starting Up

On start-up, if the system responses are determined by the state machine scheme. When power is applied, a brief initialization process is started to restore volatile data changed during runtime, and to configure location, time zone, and communications parameters. Thereafter, if the On/Off switch is in the OFF position, the system will transition to the **OFFLINE** state (See the following *Simplified Machine State Diagram* for a graphical representation of machine state relationships)**.**

Start-up Pre-conditions

- Inverter Auxiliary power C/B closed.
- Inverter subsystems healthy. No faults, no EPO existing.

Start-up

- Inverter interior ambient temperature and relative humidity are examined.
- If required for temperature or humidity control, heating is enabled.
- Pre-charge contactor is closed to ramp up the inverter’s DC link voltage to operating voltage.
- Main DC contactors are closed.
- AC Main Circuit Breaker closed
- Filter Contactor Closed
- PCM runs (fires the IGBTs)

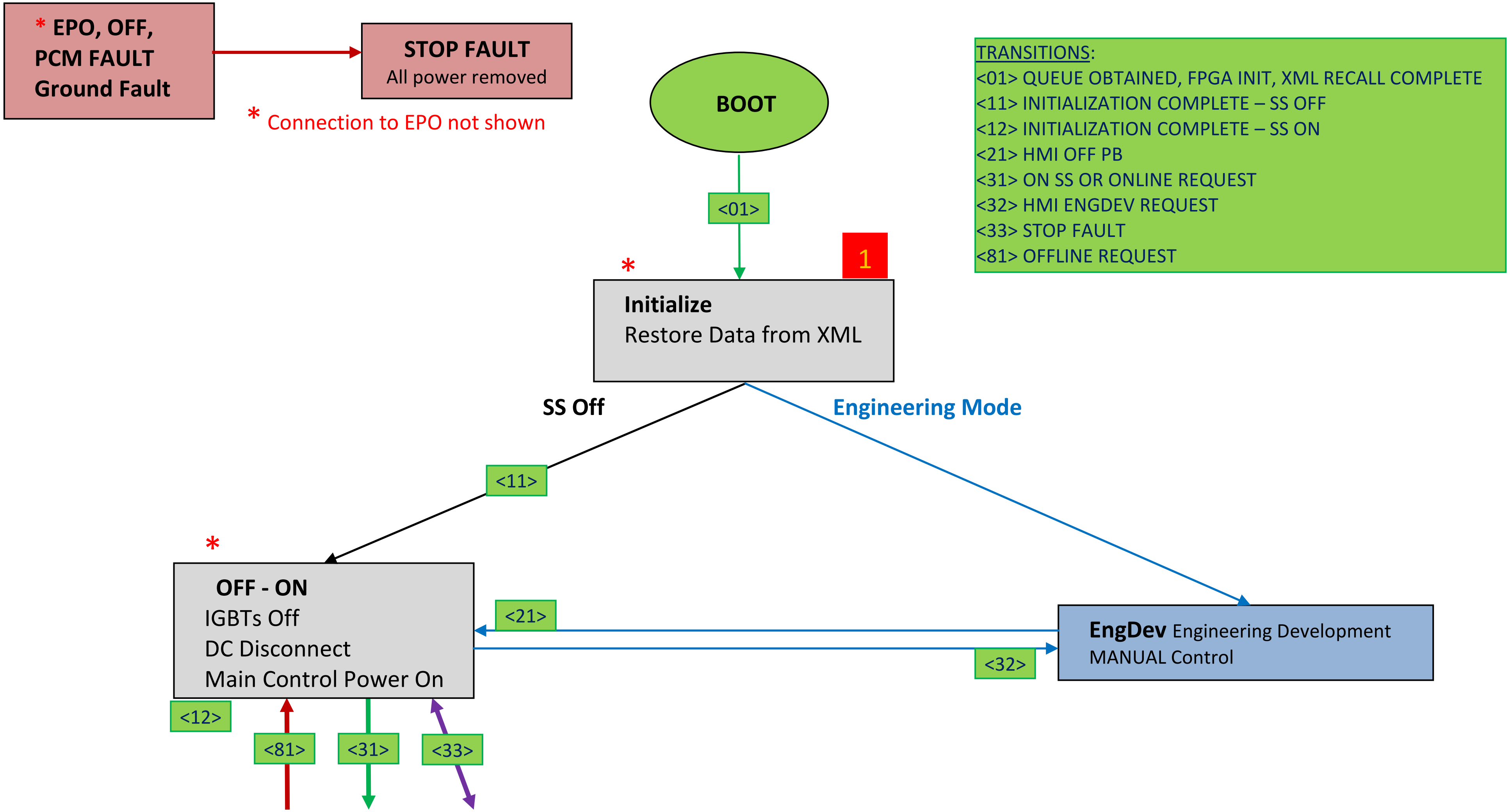
MACHINE STATES

MACHINE STATES:

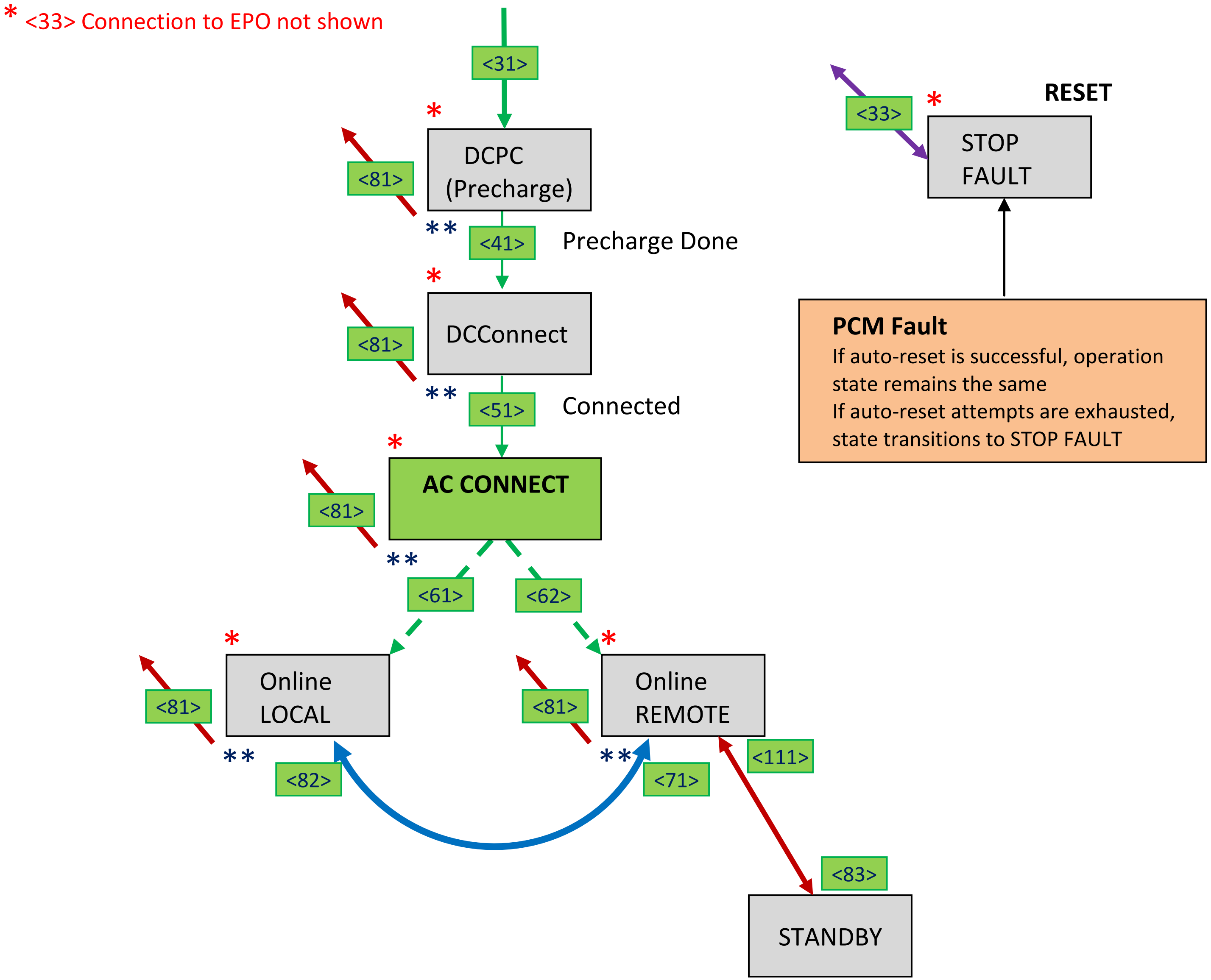
- BOOT
- INITIALIZE
- ENGINEERING DEV
- OFFLINE
- DC PRECHARGE
- DC CONNECT
- STOP FAULT
- AC CONNECT
- ONLINE LOCAL
- ONLINE REMOTE

<01> QUEUE OBTAINED, FGPA INIT, XML RECALL COMPLETE
<11> INITIALIZATION COMPLETE – SS OFF
<12> INITIALIZATION COMPLETE – SS ON
<21> HMI OFF PB
<31> ON SS OR ONLINE REQUEST
<32> HMI ENGDEV PB
<33> STOP FAULT
<41> DC PRECHARGE COMPLETE
<51> DC CONNECT COMPLETE
<61> AC CONNECT COMPLETE - LOCAL
<62> AC CONNECT COMPLETE - REMOTE
<81> OFF SS OR OFFLINE REQUEST
<83> EXIT STANDBY
<111> ENTER STANDBY

Typical Simplified Machine State Diagram:



1 Initially when the Battery Inverter Enclosure is powered up, the ***INITIALIZE*** sequence completes and the initial ***MACHINE STATE*** is chosen based on the state of **S7 (Inverter OFF/ON)** and whether **Engineering Mode** is selected.



<u>TRANSITIONS</u>:
<31> ONLINE REQUEST
<33> STOP FAULT
<41> DC PRECHARGE COMPLETE
<51> DC CONNECT COMPLETE
<61> AC CONNECT COMPLETE - LOCAL
<62> AC CONNECT COMPLETE - REMOTE
<71> LOCAL -> REMOTE
<81> OFFLINE REQUEST
<82> REMOTE -> LOCAL
<83> EXIT STANDBY
<111> ENTER STANDBY

Plant Control Mode

When the inverter is under the control of a central Power Plant Controller (PPC), it should adhere to PPC commands and settings.

Stop Inverter

When the system goes to the Stop_Inverter state, the inverter will stop and disconnect the DC connections.

Standby

The purpose of this command is to stop the inverter from producing any power. When the system goes to the Standby state, the inverter will be taken to the Idle state 0kW, 0kVAR. This will allow fast response should the bit be cleared.

Active Power Control On

The purpose of this command is to set the inverter in active power control mode. In the case when this mode is on, the inverter will limit its maximum output to the given active power limit (Active Pwr % Limit). The inverter may adhere to a ramp rate limit if so configured to reach the new set point. Note that no action is necessary if the inverter is already producing less active power limit or the inverter is already turned off for other reasons. When this mode is turned off, the inverter will continue its normal operation without this constraint.

VAR Control Mode

The purpose of this command is to set the inverter VAR control mode or Power Factor mode (assumed to be default). In the VAR control mode, the inverter is provided a target for reactive power production. The inverter should produce that reactive power as long as it capable of doing so and it is within its normal operating limits.

LVRT Event Behaviour

In general, the Inverter LVRT behaviour should take precedence over the commands from the control system. If and when possible the inverter should maintain the commanded set points (Active and Reactive) after fault removal. If there is a communication loss following an LVRT event or other causes, and the communications are not re-established within a configurable time period the inverter should revert to default, stand-alone mode of operation.

Stand-Alone Mode

In Stand-Alone mode the Inverter should limit its Active Power generation to the level at the time of transitioning to Stand-Alone mode. The Inverter should transition to Power Factor control mode. In this mode the Inverter should maintain power factor on its terminals to PF at the time of transition to Stand-Alone mode. The Inverter should maintain power factor controlling generated reactive power.

Shutting Down

To shut the system down, stop the inverter if it is running. Once the inverter is stopped disconnect the battery supplies.

Typical Inverter available data

Inverter control module data

1,368 Parameters are defined in the PCM. A complete list of these available parameters can be found in the product manual, **HA473002U001** (**Appendix D)**. Furthermore, internal, application specific, numerical quantities can also be made available to the fieldbus. Most typically, these would be the result of calculations within the VM (virtual machine) function block space.

Power meter data

Any parameter within the power meter can be made available to the fieldbus. A complete list of the available parameters can be found in the **E149701** Shark 200T Power Meter User Manual.

Battery Inverter Enclosure controller data

Any parameter within the inverter central controller can be made available to the fieldbus. This includes any point of analog or digital I/O that is wired to the controller.

Inverter – SCADA available data

See **Appendix B** **(pages B-6 to B-33)** for the Inverter – SCADA available data.

Chapter 4 Troubleshooting

The following tables can be used to troubleshoot a loss of function, possibly due to a tripped circuit breaker or blown fuse. They list the component identifier used in the circuit diagrams and the type, rating and location of each device.

WARNING:

IMPORTANT All electrical work must be done in accordance with local, national, and/or international electrical codes by a qualified electrician.

IMPORTANT WARNING: Battery Strings can produce dangerous electrical voltage levels.

IMPORTANT WARNING: Extreme Arc Flash and Shock Hazards

- Flash Hazard Boundary 60”
- Up to 24.46 Cal/cm^2 at 18”
- Class 3 PPE Level (Rated at 25 Cal/cm^2) – 2 layers of clothing: cotton underwear + fire resistant shirt and pants or coveralls + multilayer flash suit, VR gloves-tools, with appropriate flash hood.
- Limited Approach Boundary 120”
- Restricted Approach Boundary 12”
- Prohibited Approach Boundary 1”

Figure 4-1: Electrical Work Hazard

Typical Enclosure Protection

Function	ID	Type	Rating	Location
Power Grid Isolation Transformer	**CB1**	**_ _ _**	**200**	**External**
Inverter Isolation from Grid	CB2	WL	3000	**ACCESS #4 / #8**
220V Control Power	CB3	HEG	100	**ACCESS #4 / #8**
220V LVRT Power	F2	FNM	30	**ACCESS #4**
120V 3-phase to Power Monitor	F17, F18, F19	FNQR	2	**ACCESS #4 / #8**
AC Surge Suppression	10F8, 10F9, 10F10	AJT	100	**ACCESS #4**

LA473303U002 Protection

Function	ID	Type	Rating	Location
24VDC EPO Supply	F1	FNM	4	**ACCESS #1**
230V Aux Power to Heater control	F2	FNM	10	**ACCESS #1**
220V UPS Power for EPO, PLC Outputs	F3	FNM	5	**ACCESS #1**
230V Aux Power to LVRT	F4	FNM	5	**ACCESS #1**
220V UPS Power to HMI	F13	FNM	5	**ACCESS #1**
220V UPS Power to Power Meter	F14	FNM	5	**ACCESS #1**
PS2 24VDC LVRT Supply	F20	FNM	2.5	**ACCESS #1**
PS2 24VDC LVRT Supply to Inverter Stack	F21	FNM	20	**ACCESS #1**
PS2 24VDC LVRT Supply	F22	FNM	20	**ACCESS #1**
PS1 24VDC UPS Supply to EPO and PLC I/O	F23	FNM	5	**ACCESS #1**
PS3 24VDC Supply to Pump	F24	FNM	20	**ACCESS #1**
PS3 24VDC Supply to Evaporator	F25	FNM	20	**ACCESS #1**
PS1 24VDC UPS Supply	F26	FNM	2.5	**ACCESS #1**
PS3 24VDC Supply to non-LVRT	F28	FNM	5	**ACCESS #1**

Typical Inverter Protection

Function	ID	Type	Rating	Location
3-phase Sync	10F17, 10F18, 10F19	FNQR	2	**ACCESS #4 / #8**
DC Surge Suppression	10F20, 10F21	AJT	200	**ACCESS #4 / #8**
DC Precharge	10F24, 10F25	DET	10	**ACCESS #6/#7**

WARNING: Internal fuses can only be accessed with AC utility disconnect switches, DC Input disconnects open (deenergized) and Locked Out / Tagged Out.

Typical Table of Symptoms and Possible Causes

NOTE: This list is not intended to be an exhaustive list of all possible failures.
See **Appendix F** for more information and a list of annunciated system faults and warnings

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
CB2 Trips	Inverter Disconnect Breaker	10A1 Inverter	Short Circuit Overload Rodents / Pests EPO Active	**Shut Down** **Inverter Trips**
CB3 Trips	380-480VAC – 120/220VAC Control Power Breaker	Heater LA473303U001 Assy A1 PLC, PS3-PS5 A4 Shark Energy Meter Condenser Fan Controls	Transformer T1 Failure Short Circuit / Overload Rodents / Pests	**Shut Down**
F1 Blowing	+24V EPO Supply	EPO Relay	Short Circuit /Overload	**Shut Down**
F2 Blowing	220VAC Supply	Heater	Short Circuit /Overload	**Shut Down**
F3 Blowing	220VAC UPS Supply	K1, K3, EPOA	Short Circuit /Overload	**Shut Down**
F4 Blowing	220VAC Supply LVRT	PS2a/b +24VDC LVRT, Inverter Stack, PLC I/O	Short Circuit / Overload	**Shut Down**
F13 Blowing	220VAC A5 HMI	Human-Machine Interface	Short Circuit / Overload	**No Local Control** **Still able to communicate** **over SCADA or laptop**
F14 Blowing	220 VAC Shark Energy Meter	Power Quality Meter	Short Circuit / Overload	**Keep Running, Lose P and Q close trim, Failure Annunciated**
F17 - F19 Blowing	Transformer T3, T4	Power Monitor voltage sensor	Transformer Failure Short Circuit / Overload	**Keep Running, Failure Annunciated**

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
F20 Blowing	PS2 Branch Protection	LVRT Supply OK PLC Input (DI30)	Short Circuit, Overload	**Shut Down**
F21 Blowing	PS2 Branch Protection	PS2 24VDC LVRT Supply for 10A1 (Inverter Stack)	Short Circuit, Overload	**Shut Down**
F22 Blowing	PS2 Branch Protection	PS2 24VDC LVRT Supply for PLC I/O and A9	Short Circuit, Overload	**Shut Down**
F23 Blowing	PS1 Branch Protection	24VDC UPS Supply for EPO and A9	Short Circuit, Overload	**Keep Running** **Repair at end of the day**
F24 Blowing	PS3 Branch Protection	PS3 24VDC Control Power For Pump Controller	Short Circuit, Overload	**Shut Down**
F25 Blowing	PS3 Branch Protection	PS3 24VDC Control Power for 12A2 (Evaporator)	Short Circuit, Overload	**Keep Running, Failure Annunciated, Likely Trip on Over Temperature Fault Imminent**
F26 Blowing	PS1 Branch Protection	24VDC UPS Supply	Short Circuit, Overload	**Keep Running** **Repair at end of the day**
F28 Blowing	PS3 Branch Protection	Non-LVRT Supply OK PLC Input (DI31)	Short Circuit, Overload1	**Shut Down**
10F8 - 10F10 Blowing	VR1 – VR4 MOVs	AC Surge Suppression	Voltage Surge MOV VR1 – VR4 shorted harmonics (filter failure) fatigue / loose connection	**Keep Running, Failure Annunciated** (ACSTRIKE FAULT)
10F17 – 10F19 Blowing	10A2	Line sync module	Short Circuit, Overload	**Inverter would trip**
10F20, 10F21 Blowing	VR5, VR6 MOV	DC Surge Suppression	Voltage Surge MOV VR5 – VR6 shorted	**Lose grounding connection to the array, Inverter would trip**
10F24, 10F25 Blowing	Precharge Protection	Precharge Circuit	Short Circuit, Overload	**Cannot Restart**

4-6 Troubleshooting

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
System will not start up	EPO Safety Monitoring Relay	EPO Tripped	Component Failure S4 Depressed Access Panel / Door Open	**Reset EPO**
	HMI Fault Annunciated	**SEE HMI FAULT TABLE (page 4-xx)**		
	M2	Control Power Contactor	Component Failure	**Operate S3 manually to run equipment**
Bus does not Precharge	Precharge connection to DC bus PLC A5 Module 5 Digital Output 1 Low	DCPC Contactor	connector failure, component failure Component Failure Program Issue	**Cannot Start**
	10R1, 10R2	Precharge Resistor	component failure (open)	
	10F24, 10F25	Precharge Fuse	Fuse Blown	
System takes longer than normal to start up	Heater	Heater fails to come on or doesn’t heat effectively	Fuse failure, signal/contactor failure, heater element failure	**Unable to manage condensation**
	PLC A5 Module 5 Digital Output 18 K3 Failure	Heater never comes on	Component Failure Program Issue	
	Pump Controller 12A2	Fans on during heat cycle		**Loss of efficiency, shorten fan life**
	DCPC	Precharge Contactor	High resistance terminals	**Precharge time slightly longer, Slight power loss during Precharge**
No Ride Through Capability	D1, R1, C1, C2	Ride Through Drop Out Delay	Component Failure	**Shut Down**
EPO Trip	EPO Safety Monitoring Relay	EPO Switch	Component Failure Switch Depressed	**Shut Down**
		Main Access Door Filter Access Door DC Connection Access Door DC Contactor Access Door	Component Failure Switch Activated	
		EPOA Relay	Component Failure Relay Not Activated	

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
EPO will not reset	EPO Safety Monitoring Relay	S8 – S12, both channels must close within 30 mS to reset the Safety Relay		**Shut Down**
		EPO Reset Switch	Switch S5 Fails to Close	
	Inverter 10A-1, Digital Input 7 Low	EPO Status	Component Failure	
EPO does not trip	EPO Safety Monitoring Relay	EPO Safety Monitoring Relay	Component Failure	**IGBTs ON when System Faults**
	Inverter 10A-1, Digital Input 7 High	EPO Status		**Contactor contacts degrade**
Ground Fault (10F21, 10F22 not blown)	Bender	AC Connection Points, High-Voltage Connections	Short Phase-to-Ground Structural Damage Water Damage Rodents / Pests	**PLC Detects Ground Fault, Shut Down Lose grounding connection to the array, Inverter would trip**
	Fuse Indicator	False Indication	Component Failure	**Inverter would trip**
Sporadic Nuisance Ground Fault Trips	Bender Ground Fault Monitor	False Indication	Component Failure Noise	**Ground Fault Trip**
DC Bus remains connected to DC Inputs	DCB+, DCB-	DC Contactor	welded power contacts	**DC Bus remains connected to the Battery Feed. Inverter would trip**
	DCPC	Precharge Contactor	welded contacts	
Ground Fault Annunciation Failure	10F21, 10F22 Fuse Indication	Malfunction (Remains Closed)	Component Failure	**No indication Fuse is Open**
				DC Input becomes ungrounded Significant noise relative to ground on DC Inputs.
Surge Fuse Annunciation Failure	10F8, 10F9,10 F10, 10F21, or 10F22 Fuse Indication	False Open Indication	Component Failure	**Keep Running, Failure Annunciated**
		Malfunction (Remains Closed)		**No indication Fuse is Open**
Inverter Trip	Inverter 10A-1	**SEE INVERTER FAULT TABLE (page A-18)**		

4-8 Troubleshooting

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
Overheating Imbalanced Current Overcurrent Trip	L1, L2, L3	AC Connection Points	Loose connection Corrosion Harmonics (filter failure)	**Shut Down**
Current Imbalance	FM1, FM2, FM3	Filter Inductors	Component Failure (Open)	**Degradation of Functions** **Current Sharing Fault**
Current Sharing Fault	L21, L22, L23 L31, L32, L33 L41, L42, L43			
Ambient Temperature High – Overheating			Shorted Turns	
Loss of Power	PS1	+24VDC UPS Supply Power	Component Failure	**Keep Running** **Repair at end of the day**
Loss of Control Power	PS2a, PS2b Primary	+24VDC LVRT Supply	K2, PS2, PS3, T1 Component Failure	**Shut Down**
	PS3 Primary	+24VDC Cooling Power Supply	Short Circuit /Overload	
Loss of efficiency Lower power output	Shark Meter	Power Loss	Fuse, component or wiring failure	**Keep Running, Failure Annunciated**
		Ethernet Failure	Noise, component or cable failure	
	FM1, FM2, FM3	Filter Contactor Failure	Contactor not closing	
	Cannot trim output KW	CT Failure	CTP1, CTP2 Open	
	Cannot trim output KVAR	PT Failure	F17,F18,F19,T3,T4 Open	
	Battery Container	Loss of DC Input	Failure in DC Supply	
	DCB	DC Contactor fails to close	Component failure	

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
Failure to sync to grid	Inverter 10A-1 Analog Input 1, 2, 3	line input data (Voltage)	loss or distortion of signal	**Inverter would trip**
	10A2	Inverter Sync Attenuator	Component Failure	
	10F1, 10F2, 10F3	Line Sync Input Fuses	Short Circuit, Overload	
Cannot trim output KW	CT-P1, CT-P2	CT Failure	Component failure (open)	**Keep Running, Failure Annunciated (still achieve 90%)**
Cannot trim output KVAR	F17,F18,F19,T3,T4	PT Failure		
Condenser fan not running at correct speed	Inverter 10A1, Analog Output 1	Condenser speed reference	Noise, loss of signal	**Keep Running, Loss of cooling capacity, Failure Annunciated – Possible shutdown on Over Temp**
	Inverter 10A-1 Digital Output 4,5	Loss of condenser fan run signals	component failure, wiring failure	
	Inverter 10A-1 Digital Output 4,5	condenser fan run signals on all the time	component failure	**Keep Running**
Fans running all the time	PLC A5 Module 5 Digital Output 14 & 15 High	Wrong speed commanded	Component Failure Program Issue	**Lower Ambient Temperature, Shorten fan life**
Evaporator Fan reports faulted	10A-1 Inverter Digital. Input 3 Low	Healthy Status from Evaporator Fans	Failed Fan Controller (12A2)	**Keep Running, Failure Annunciated, Possible Trip on Over Temperature Fault**
Condenser Pump reports faulted	10A-1 Inverter Digital. Input 4 Low	Healthy Status from Pump Controller	Failed Pump Controller (MTD on 10A1)	
Condenser Fan reports faulted	10A-1 Inverter Digital. Input 5,6 Low	Healthy Status from Fan Controllers	Failed Pump Controller (11A1, 12A1)	

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
Heatsink Temperature High Refrigerant Temp High - Overheating	10A1 Pump Controller	Pump Control	Loss of +24V LVRT Power Component Failure	**Keep Running, Failure Annunciated, Likely Trip on Over Temperature Fault Imminent**
	11A1 Condenser Fan 1 Controller	Condenser 1 Fan Control	Loss of 220VAC Supply Power Component Failure	
	12A1 Condenser Fan 1 Controller	Condenser 2 Fan Control	Condenser Fan Failure	
	12A2 Pump Controller	Cool Door Control	Loss of +24VDC Control Power Component Failure	
Refrigerant Temperature High - Overheating	PLC A1 Module 1 TC Input 14	Condenser Inlet Temperature	Component Failure Connection Failure Physical Connection Failed Program Issue	**Keep Running, Failure Annunciated, Possible Trip on Over Temperature Fault**
	TC15 Thermocouple			
	10A-1 Inverter Analog Output 1	Condenser fan Speed low		
	PLC A1 Module 1 TC Input 15	Condenser Outlet Temperature		
	TC16 Thermocouple			
	10A1 Pump Controller	Condenser Fan Speed		
	10A-1 Inverter Digital. Input 3 Low	Condenser 1 Fan Control		
	10A-1 Inverter Digital. Input 4 Low	Evaporator Fan Control		
	10A-1 Inverter Digital. Input 5 Low	Condenser 2 Fan Control		
	12A1 Condenser Fan 1 Controller	Condenser 2 Fan Control		
	12A1 Condenser Fan 2 Controller	Condenser 2 Fan Control		

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
Ambient Temperature High - Overheating	12A2	Pump Controller	Component Failure	**Shut Down**
		(Cool Door)		
	11A1	Condenser 1		
		Fan Controller		
	12A1	Condenser 2		
		Fan Controller		
	Enclosure Heater	Remains ON all the time		
Enclosure Heater Remains ON all the time	PLC A5 Module 5 Digital Output 18	Heater Enable ON all the time	Component Failure	**Failure Annunciated**
			Program Issue	**Inverter would trip**
	Heater Contactor (K3)		Component Failure,	**Keep Running, Clipping sooner,**
			Welded Contacts	**Trip on Over Temperature Fault**
Enclosure Heater Intermittent	PLC A5 Module 6 Digital Output 18	Intermittent Signal	Component Failure	**Logic does not execute properly**
			Program Issue	**System may not Shut Down (Depending on exact nature of failure)**
	Heater Contactor (K3)		Noise	
Customer cannot operate Service Lights	DS1, DS2	Service Lights	Component Failure	**Keep Running, Would not know the HMI is disabled, Still accessible from SCADA or Local communications**
	S2	Service Light Switch		
	PLC A5 Module 5 Digital Output 30	Digital Output stays OFF	Component Failure	
			Program Issue	
Service Lights stay on all the time	DS1, DS2	Service Lights	Component Failure	**Keep Running, Would think the HMI is disabled, HMI would still respond to commands**
	S2	Service Light Switch		
	PLC A5 Module 5 Digital Output 30	Digital Output stays ON	Component Failure	
			Program Issue	
Current indication on power meter incorrect	Shark Meter CT-P1, CT-P2	Jumper failure	Component Failure	**Keep Running, Failure Annunciated**
increased harmonics	C3-A, C3-B, C3-C, C4-A, C4-B, C4-C, C5-A, C5-B, C5-C	filter capacitors	Component Failure (fail open)	**Overheating, Imbalanced Current, Overcurrent Trip**

4-12 Troubleshooting

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
increased KVARS	FM1, FM2, FM3	filter contactors	Component Failure (welded contacts)	**Increases losses**
increased losses				**Decreased efficiency**
increased ambient temp, clipping sooner than anticipated	Enclosure Heater	Remains ON all the time	Component Failure	
Loss of Filter Current Indication	CT-U1, CT-V1, CT-U2, CT-W2, CT-U3, CT-W3	Loss of output	Component Failure	**Loss of Diagnostics, Loss of Filter Current Indication**
No data being logged locally	Industrial PC Fault	PC OS Fault		
		PC Hardware Fault	Component Failure	**Keep Running**
	HMI Fault	HMI Hardware Fault		
HMI Keypad not responsive	HMI Keypad	Cannot enter data locally	Wiring or Component Failure	**Keep Running, Still accessible from SCADA, Local Laptop**
No Local Serial Communications	Serial Com Cable	Cannot enter data from Laptop	Wiring or Component Failure	**Keep Running, Still accessible from SCADA, HMI Keypad**
Cannot select Local Mode at Inverter	S6 Switch	Malfunction (Contacts remain closed)	Component Failure	**Keep Running, Still accessible from SCADA or Local communications**
Cannot select Remote Mode at Inverter		Malfunction (Contacts remain open)		
Cannot select OFF at Inverter	S7 Switch	Malfunction (Contacts remain closed)	Component Failure	**Keep Running, Still accessible from SCADA or Local communications**
Cannot select ON at Inverter		Malfunction (Contacts remain open)		
Contactor state mismatch	DCB, DCPC, FM1, FM2, FM3, K2, M2	Auxiliary state different from commanded state	Component Failure	**Keep Running, Failure Annunciated**
HMI Suspend Light off when HMI is suspended	DS2	Light doesn't work	Component Failure	**Keep Running, Still accessible from SCADA or Local communications**
HMI Suspend Light on when HMI is not suspended		Light stays on	Program Issue	**Keep Running, HMI would still respond to commands**

Typical Equipment-Specific Problems

NOTE: See **Appendix F** for more information and for a list of annunciated system faults and warnings

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
Loss of Communications with the PLC	PLC (A1)	Ethernet Connection	Connection Failure	Loss of Communication to SCADA
Loss of all PLC I/O Functions		A1 Controller	Component Failure	logic does not execute Shut Down
		A1 Backplane	Component Failure	
		A1 Controller	Program Issue	Logic does not execute properly System may not Shut Down (Depending on exact failure)
Loss of all PLC I/O from One Module		A1 I/O Module	Component Failure	
		A1 Backplane	Connection Failure	
Loss of a Single TC I/O Point	PLC (A1) NI9213 - Module 1	A1 I/O Module	Connection Failure	
		Field Device	Component Failure	
		A1 Controller	Program Issue	
Loss of All PLC TC I/O		A1 Backplane	Component Failure	
Loss of a Single PLC Analog I/O Point	PLC (A1) NI9205 - Module 2 PLC Adapter Card (A9)	A1 I/O Module	Component Failure	
		Field Device	Connection Failure	
		A1 Controller	Program Issue	
Loss of All PLC Analog I/O		A1 Backplane	Connection Failure	
		PLC Adapter Card (A9)	Component Failure	
Loss of a Single PLC Digital Input Point	PLC (A1) NI9425 - Module 3 Module Breakout Box)	A1 I/O Module	Component Failure	
		Field Device	Connection Failure	
		A1 Controller	Program Issue	
Loss of All PLC Digital Inputs		A1 Backplane	Connection Failure	
		Module Breakout Box (A2)	Component Failure	
Loss of a Single PLC Digital Input Point	PLC (A1) NI9425 - Module 4 Module Breakout Box	A1 I/O Module	Component Failure	
		Field Device	Connection Failure	
		A1 Controller	Program Issue	
Loss of All PLC Digital Inputs		A1 Backplane	Connection Failure	
		Module Breakout Box (A11)	Component Failure	

4-14 Troubleshooting

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
Loss of a Single PLC Digital Output Point	PLC (A1) NI9476 - Module 5 Digital Interface Assembly (A10)	A1 I/O Module	Component Failure	**Logic does not execute properly System may not Shut Down (Depending on exact failure)**
		Field Device	Connection Failure	
		A1 Controller	Program Issue	
Loss of All PLC Digital Outputs		A1 Backplane	Connection Failure	
		Digital Interface Assy (A10)	Component Failure	
A3 Ethernet Switch Failure	A3	Loss of Communications	Component Failure	**No Local Communications**
A4 Shark Meter Fails	Power Quality Meter	Loss of Power	Component Failure	**Keep Running, Lose Communication on Shark Meter, Lose P and Q close trim, Failure Annunciated**
	F14	Fuse	Short Circuit / Overload	
	Ethernet	Ethernet Failure	Component Failure Cable Failure Noise	
A5 LCD Touchscreen does not respond	Industrial PC Fault	PC OS Fault PC Hardware Fault	Component Failure	**No Local Control Still able to communicate over SCADA or laptop**
	HMI Fault	HMI Program Fault HMI Hardware Fault		
	HMI does not respond	A10 Digital Interface Board		
A5 LCD Touchscreen does not wake / sleep	HMI not suspending	A10 Digital Interface Board	Component Failure	**No Local Control Still able to communicate over SCADA or laptop**
	HMI not waking	A10 Digital Interface Assy S13 Force HMI On		
A5 LCD Touchscreen	Annunciated Fault	**SEE HMI FAULT TABLE (page 4-41)**		
A7 Ethernet Switch Failure	A7	Loss of Communications	Component Failure	**Lose SCADA Communication; Still have local communication to Inverter; Controlled Shutdown after customer-defined period**
10A-1	890GT Inverter	**SEE INVERTER FAULT TABLE (page A-18)**		

PROBLEM	ITEM	FUNCTION	POSSIBLE CAUSE(s)	Effect on System
11A1 Failure	Condenser Fan Controller 1	Loss of power to controller	Component Failure Short circuit / Overload Fan Failure / Loss of Airflow Loss of power	**Loss of cooling capacity** **Clipping sooner** **Trip on Over Temperature Fault**
11B1	Condenser 1 Fan	Fan does not turn		
12A1 Failure	Condenser Fan Controller 2	Loss of power to controller		
12B1	Condenser 2 Fan	Fan does not turn		
12A2 Failure	Cool Door Controller	Loss of power to controller		**No internal cooling or mixing** **Loss of cooling capacity**
12B1, 12B2, 12B3, 12B4	Cool Door Fans	Fan does not turn		
12RT1	Cool Door Thermistor	Out of Bounds Temperature Reported	Component Failure	**Keep Running, Failure Annunciated**

Typical Level of Training Required to Replace Components

ITEM	Access	Part Number	Description	Level 1[A]	Level 2[B]	Level 3[C]	Notes
10A1	2	LA472972W001	PCM	X	X	X	6
10F24-25	5		Precharge Fuses 10A 1000VDC	X	X	X	6
11A1/12A1	2		Condenser Fan Controller	X	X	X	6
11A1/12A1			Evaporator Fan	X	X	X	6
A1	1		PLC Chassis	X	X	X	6
A1	1		PLC I/O Module	X	X	X	6
A2	1	CI473490	WINFORD BREAKOUT BOX	X	X	X	6
A3	1		ETHERNET SWITCH 8-PORT	X	X	X	
A5	1		INDUSTRIAL PC AND TOUCHSCREEN	X	X	X	6
CB3	4 / 8		AC C/B 600VAC 100A 65kA	X	X	X	1, 6
DCB +/-	6		DC Contactors	X	X	X	1, 6
EPOA (T)	1	DM353132	TIMER AUX TDD 1O 1C 120VAC	X	X	X	6
FUSE			NON-BOLTED FUSES	X	X	X	6
LIGHT	1		LF1B-N Series LED Light Strip 134mm	X	X	X	6
LIGHT	4		LF1B-N Series LED Light Strip 580mm	X	X	X	6
PS1-5	1		Power Supplies	X	X	X	6
P/B	1		SWITCHES and SWITCH Components	X	X	X	6
S8-14			Magnetic safety Sensor, Actuator	X	X	X	6
T1	4 / 8		Transformer 315VAC/220VAC 4.5KVA	X	X	X	6
T2	4 / 8		Transformer 315VAC/120VAC 4KVA	X	X	X	6
VR1-3	4 / 8		AC Surge Suppression 240VAC	X	X	X	1, 6
VR4	4 / 8		AC Surge Suppression 400VAC	X	X	X	1, 6
VR5,6	4 / 8		DC Surge Suppression 600VAC	X	X	X	1, 6
10A1	2	LA472957T790	Phase Module	P	X	X	5, 6
10A1	2	LA473080U001	Aux Power Dist Assembly	P	X	X	6
10A2	2	LA471892U002	AFE SYNCHRONIZATION ATTENUATOR	P	X	X	6
10R1,2	5	CZ389853	Resistor 460VAC 100Ω 100W	P	X	X	6
12B1-4	2		Evaporator Fan	P	X	X	6
A10	1	LA473974	Digital Interface Assy (Digital Board)	P	X	X	6

ITEM	Access	Part Number	Description	Level 1[A]	Level 2[B]	Level 3[C]	Notes
A9	1	LA473505	PLC Adapter Card (Analog Board)	P	X	X	6
A9	1	LA472975	PLC Adapter Card (Analog Board)	P	X	X	6
CABLE	1 / 2	CM471619U003	CABLE CAT 5 ETHERNET 3 FEET	P	X	X	6
CABLE	1 / 2	CM471619U007	CABLE CAT 5 ETHERNET 7 FEET	P	X	X	6
CABLE	1 / 2	CM471619U018	CABLE CAT 5 ETHERNET 18 FEET	P	X	X	6
CABLE	2	CM472916U001	CBL_ASSY_6W_4W_SHORT	P	X	X	6
CABLE	2	CM472916U002	CBL_ASSY_6W_4W_MEDIUM	P	X	X	6
CABLE	2	CM472916U003	CBL_ASSY_6W_4W_LONG	P	X	X	6
CABLE	2	CM472916U004	CBL_ASSY_6W_4W_XLONG	P	X	X	6
CABLE	1		PLC 37-pin Shielded I/O Cable	P	X	X	6
CABLE	1		PLC 37-pin Shielded I/O Cable	P	X	X	6
DCPC	5		DC Contactor 500A 1000VDC 1NO	P	X	X	1, 6
10A1	2	8903/IM/00/00	ETHERNET MODBUS/TCP TECHBOX		X	X	6
10A1	2	LA471775U001	Pump Controller		X	X	6
10F20	4 / 8		Surge Suppression Fuse		X	X	1, 6
12A2	2	LA471775U001	Evaporator Fan Controller		X	X	6
A4	4 / 8	DA473172U001	Power Meter Modbus TCP 90-265VAC		X	X	6
CB2	4 / 8		AC Circuit Breaker 600VAC 3000A		X	X	1, 3, 4, 6
CT-P1,2	4 / 8		AC Current Transformers 4000:5 0.3%		X	X	1, 6
EPO	1		Relay Safety		X	X	6
F8-10	4 / 8		DC AJT Fuse 1000VDC 100A		X	X	6
	2 / 3		Refrigerant Pump		X	X	4, 6
12RT1	2 / 3		Thermistor R134a / Return Air		P	X	6
C1,2	1		LVRT Capacitor 400VDC 10000uF		P	X	6
EPOA	1		LVRT Relay 240VAC 50/60HZ 15A		P	X	6, 8
FM1	3		LC Filter Contactor		P	X	1, 6
K1	1	DB470805U035	CONTACTOR AC 3P 3O 1O 35A		P	X	6, 8
L23,33,43	3	LA473332U003	Reactor 40uH 960A, Bottom		P	X	1, 6
L22,32,42	3	LA473332U002	Reactor 40uH 960A, Middle		P	X	1, 6
L21,31,41	3	LA473332U001	Reactor 40uH 960A, Top		P	X	1, 6
	2	LA472957T790	Assembly 1 Phase Output Grid Tie		P	X	1, 6

ITEM	Access	Part Number	Description	Level 1[A]	Level 2[B]	Level 3[C]	Notes
R		CZ472682U330	RES METAL FILM 330K OHM 3W_ 5%		P	X	6
TC			Sensor, Thermocouple, Type K		P	X	6
C	3		LC Filter Capacitors 77uF			T	1, 6
AC CT	3		AC CT 400A 150mA			T	1, 6

[A] Maintenance performed by technician having completed Level 1 Training, Plant/Facility Service (Maintenance) Qualified

[B] Maintenance performed by technician having completed Level 2 Training, Factory Field Service (Technician) Qualified

[C] Maintenance performed by technician having completed Level 3 Training, Factory Service (Engineer) Qualified

T – Requires timely advisement, P – Requires Prior Permission

1. Requires Torque Wrench qualification
2. Requires Programming
3. Requires NEMA AB 4 standard test
4. Requires specialized test equipment
5. Replaceable as a unit, Disassembly by end user is not authorized
6. Power must be off, locked out, tagged out
7. CB2 needs to be locked out, tagged out
8. Must be replaced when next higher assembly removed

Typical PLC I/O Associated Fault Codes

NOTE: See **Appendix F** for more information and for a list of annunciated system faults and warnings

FAULT MESSAGE	SLOT	POINT	TYPE	I/O NAME	MEANING	DESCRIPTION
AC Surge Suppression Fuse Fault	3	34	DI	DI28	VR1-4 shorted, 10F8-10 blown, fuse indicator open	Failure Annunciated, Continue running
Aux Power CB Area Ambient Temperature Fault	1	14	TC	TC13	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Aux Power CB Area Ambient Temperature Warning					Measured Temp < -20 C >65 C	Warning Annunciated
Aux Power Transformer Area Ambient Temperature Fault	1	15	TC	TC14	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Aux Power Transformer Area Ambient Temperature Warning					Measured Temp < -20 C >65 C	Warning Annunciated
Buffered 24VDC Supply Fault	3	30	DI	DI24	LVRT 40A Supply < 17V	Warning sent to SCADA, PLC to autorestart inverter when the 24V supply is regulating properly.
Cap Door Therminal Temperature Fault 7A1 - 7A15	2	12 13	AI	Thermister Index	Measured Temp < -40 C >100 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Cap Door Therminal Temperature Warning 7A1 - 7A15					Measured Temp < -20 C >90 C	Warning Annunciated
Condenser Inlet Temperature Fault	1	16	TC	TC15	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Condenser Inlet Temperature Warning					Measured Temp < -20 C >65 C	Warning Annunciated
Condenser Outlet Temperature Fault	1	17	TC	TC16	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Condenser Outlet Temperature Warning					Measured Temp < -20 C >65 C	Warning Annunciated
DC Contactor Failed To Close DC Contactor Failed To Open	3	3	DI	DI2	Command State and AUX confirmation do not agree	Warning Annunciated indicating which DC contactor will not close
	5	1	DO	DO0		
DC Panel 1 Therminal Temperature Fault 4A1 - 4A18	2	16 17	AI	Thermister Index	Measured Temp < -40 C >100 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
DC Panel 1 Therminal Temperature Warning 4A1 - 4A18					Measured Temp < -20 C >90 C	Warning Annunciated
DC Precharge Contactor (+) Failed To Close	3	1	DI	DI0	DCPC (+) Command and AUX do not agree	Disable output, manual reset required. Maintenance required.
	5	2	DO	DO1		
DC Precharge Contactor (-) Failed To Close	3	2	DI	DI1	DCPC (-) Command and AUX do not agree	
	5	3	DO	DO2		
DC Supply Area Ambient Temperature Fault	1	11	TC	TC10	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C

FAULT MESSAGE	SLOT	POINT	TYPE	I/O NAME	MEANING	DESCRIPTION
DC Supply Area Ambient Temperature Warning					Measured Temp < -20 C >65 C	Warning Annunciated
DC Surge Suppression Fuse Fault	3	35	DI	DI29	VR5 shorted, 10F20 blown, fuse indicator open	Failure Annunciated, Continue running
EPO Pushbutton Actuated	3	22	DI	DI18	EPO Switch Open	Disable output, manual reset required. Maintenance required.
EPO Relay Activated	4	5	DI	DI4	EPO Status	Disable output, manual reset required. Maintenance required.
External Ambient Temperature Fault	1	13	TC	TC12	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
External Ambient Temperature Warning					Measured Temp < -20 C >65 C	Warning Annunciated
External Temp Requires Inverter De-Rate					Measured Temp >55 C	Inverter power output de-rated
Filter Busbar Therminal Temperature Fault 6A1 - 6A15	2	10 11	AI	Thermister Index	Measured Temp < -40 C >100 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Filter Busbar Therminal Temperature Warning 6A1 6A15					Measured Temp < -20 C >90 C	Warning Annunciated
Filter U1 Current High Fault	2	1	AI	AN0	Filter Current High	Inverter Stops
Filter U1 Current High Warning					Filter Current High	Warning Annunciated
Filter U1 Current Low Warning					Filter Current Low	Warning Annunciated
Filter U2 Current High Fault	2	2	AI	AN1	Filter Current High	Inverter Stops
Filter U2 Current High Warning					Filter Current High	Warning Annunciated
Filter U2 Current Low Warning					Filter Current Low	Warning Annunciated
Filter V1 Current High Fault	2	3	AI	AN2	Filter Current High	Inverter Stops
Filter V1 Current High Warning					Filter Current High	Warning Annunciated
Filter V1 Current Low Warning					Filter Current Low	Warning Annunciated
Filter V2 Current High Fault	2	4	AI	AN3	Filter Current High	Inverter Stops
Filter V2 Current High Warning					Filter Current High	Warning Annunciated
Filter V2 Current Low Warning					Filter Current Low	Warning Annunciated
Filter W1 Current High Fault	2	5	AI	AN4	Filter Current High	Inverter Stops
Filter W1 Current High Warning					Filter Current High	Warning Annunciated
Filter W1 Current Low Warning					Filter Current Low	Warning Annunciated
Filter W2 Current High Fault	2	6	AI	AN5	Filter Current High	Inverter Stops
Filter W2 Current High Warning					Filter Current High	Warning Annunciated
Filter W2 Current Low Warning					Filter Current Low	Warning Annunciated

FAULT MESSAGE	SLOT	POINT	TYPE	I/O NAME	MEANING	DESCRIPTION
Heater Failed To Turn Off	5	22	DO	DO18	Command State and AUX confirmation do not agree	Disable output, manual reset required. Maintenance required.
Heater Failed To Turn On						
Internal Ambient Temperature Fault	1	14	TC	TC11	Measured Temp < -40 C >70 C	Wait until internal temperatures are < 65C. Autorestart.
Internal Ambient Temperature Warning					Measured Temp < -20 C >65 C	Warning Annunciated
Inverter Busbar Therminal Temperature Fault 8A1 - 8A11	2	14 15	AI	Thermister Index	Measured Temp < -40 C >100 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Inverter Busbar Therminal Temperature Warning 8A1 - 8A11					Measured Temp < -20 C >90 C	Warning Annunciated
LC Filter Choke L21 Overtemp Switch	4	6	DI	DI5	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L22 Overtemp Switch	4	7	DI	DI6	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L23 Overtemp Switch	4	8	DI	DI7	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L31 Overtemp Switch	4	11	DI	DI8	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L32 Overtemp Switch	4	12	DI	DI9	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L33 Overtemp Switch	4	13	DI	DI10	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L41 Overtemp Switch	4	14	DI	DI11	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L42 Overtemp Switch	4	15	DI	DI12	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke L43 Overtemp Switch	4	16	DI	DI13	Measured Temp >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke U1 Temperature Fault	1	1	TC	TC1	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke U1 Temperature Warning					Measured Temp < -20 C >135 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke U2 Temperature Fault	1	4	TC	TC4	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke U2 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated
LC Filter Choke U3 Temperature Fault	1	7	TC	TC7	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke U3 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated

FAULT MESSAGE	SLOT	POINT	TYPE	I/O NAME	MEANING	DESCRIPTION
LC Filter Choke V1 Temperature Fault	1	2	TC	TC2	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke V1 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated
LC Filter Choke V2 Temperature Fault	1	5	TC	TC5	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke V2 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated
LC Filter Choke V3 Temperature Fault	1	8	TC	TC8	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke V3 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated
LC Filter Choke W1 Temperature Fault	1	3	TC	TC3	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke W1 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated
LC Filter Choke W2 Temperature Fault	1	6	TC	TC6	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke W2 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated
LC Filter Choke W3 Temperature Fault	1	9	TC	TC9	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 135C
LC Filter Choke W3 Temperature Warning					Measured Temp < -20 C >135 C	Warning Annunciated
LC Filter Contactor Failed To Close	4	4	DI	DI3	Command State and AUX confirmation do not agree	Disable output, manual reset required. Maintenance required.
LC Filter Contactor Failed To Open	5	25	DO	DO25		
MCB Busbar Therminal Temperature Fault 5A1 -5A6	2	8 9	AI	Thermister Index	Measured Temp < -40 C >100 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
MCB Busbar Therminal Temperature Warning 5A1 - 5A6					Measured Temp < -20 C >90 C	Warning Annunciated
PLC Available Memory < 10kBytes					PLC available Free Memory	Warning Annunciated
R134a Level Fault	2	23	AI	AN22	R134a Level	Inverter Stops
R134a Level Warning					R134a Level	Warning Annunciated
Relative Humidity Heating Active					@85% starts heat until brought down to 80%	Heater is activated regardless of interior ambient temperature – in an a attempt to bring the relative humidity down
SQL Connection Issue					Data logging has been unexpectedly interrupted. A SQL Express configuration error, data base deletion, table deletion etc… has occurred	The InteractX runtime cannot connect to the SQL db.
Un-Buffered 24VDC Supply Fault	4	32	DI	DI25	NON-LVRT 40A Supply < 17V	Warning sent to SCADA, PLC to autorestart inverter when the 24V supply is regulating properly.

FAULT MESSAGE	SLOT	POINT	TYPE	I/O NAME	MEANING	DESCRIPTION
	2	19	AI	AI18	Refrigerator Pump Inlet Temperature	
	2	20	AI	AI19	Condenser Fan Speed	
	2	25	AI	AI25	Evaporator Return Air Temperature	
	2	26	AI	AI26	Evaporator Fan Speed	
	3	17	DI	DI16	AC MAIN CB ON	
	3	18	DI	DI17	AC MAIN CB OFF	
	3	20	DI	DI19	LOCAL/ REMOTE SS	
	3	21	DI	DI20	INVERTER ON	
	3	22	DI	DI21	INVERTER OFF	
	3	28	DI	DI27	Anti-Islanding (K1)	
	3	31	DI	DI30	Transformer 180°C	
	3	32	DI	DI31	Transformer 200°C	
	4	20	DI	DI16	BYPASS MODE	
	4	21	DI	DI17	FORCE HMI ON	
	4	22	DI	DI18	SERVICE LIGHTS	
	4	23	DI	DI19	RESET EPO	
	4	31	DI	DI24	INVERTER RUNNING	
	4	32	DI	DI226	INGRESS DETECTION	
	5	17	DO	DO14	PUMP SPEED DEMAND BIT 0	
	5	18	DO	DO15	PUMP SPEED DEMAND BIT 1	
	5	24	DO	DO19	BREAKER OPEN	
	5	25	DO	DO20	BREAKER CLOSED	
	5	26	DO	DO22	FORCE HMI ON (lamp)	
	5	27	DO	DO23	INVERTER RUN COMMAND	
	5	30	DO	DO24	EPO FAULT RESET	
	5	32	DO	DO26	PCS-SDC ALARM	
	5	33	DO	DO27	PCS-SDC SPARE	
	5	34	DO	DO28	PCS-SDC SPARE	
	5	35	DO	DO29	PCS-SDC SPARE	
	5	36	DO	DO30	NON-LVRT +24VDC OK	
	5	37	DO	DO31	220V POWER (HMI)	

890GTB Inverter I/O List

See **Appendix F** for more information and a list of annunciated system faults and warnings

Term	Point	Range	Description	ASSOCIATED FAULT(s)
X12-01	AN 0V		0V reference for analog IO	
X12-02	AN IN 1	±10V	L(cb) Voltage for SYNC	
X12-03	AN IN 2	±10V	L(ab) Voltage for SYNC	
X12-04	AN IN 3	±10V		
X12-05	AN IN 4	±10V	Total DC Current	
X12-06	AN OUT 1	±10V	Condenser Speed Reference	
X12-07	AN OUT 2	±10V	Internal mixing fan assembly Speed Reference	
X12-08	+10V REF	+10V (output)		
X12-09	-10V REF	-10V (output)		
X13-01	24V Input	24VDC (nom) 18-28V	8A maximum	
X13-02	24V Input			
X13-03	0V Input	0V	0VDC Input	
X13-04	0V Input			
X14-01	Dig OUT 3			
X14-02	(DOUT3A+3B)			
X14-03	USER 24V			
X14-04	0V		0VDC Input	
X15-01	Dig IN 1	0, 24V	Inverter Run Command	
X15-02	Dig IN 2		Main CB Closed	
X15-03	Dig IN 3		Evaporator Control Healthy	**Evaporator Fans Controller Fault**
X15-04	Dig IN 4		Pump Health (from pump controller)	**Refrigerant Pump Controller Fault**
X15-05	Dig IN 5		Condenser Fan 1 Control Healthy	**Condenser Fan 1 Controller Fault**
X15-06	Dig IN 6		Condenser Fan 2 Control Healthy	**Condenser Fan 2 Controller Fault**
X15-07	Dig IN 7		EPO Status Healthy	
X15-08	Dig OUT 1		Inverter Running	
X15-09	Dig OUT 2			

X16-01	Dig OUT 4		+24V	
X16-02	(DOUT4A+4B)		Condenser Fan 1 Control Run	
X16-03	Dig OUT 5		+24V	
X16-04	(DOUT5A+5B)		Condenser Fan 2 Control Run	
X16-05	Dig OUT 6			
X16-06	(DOUT6A+6B)			
X16-07	UNUSED			
X16-08	Mtr Therm A		Jumpered Together	
X16-09	Mtr Therm B			
TB1-1	Therm		Coolant Temperature	Refrigerant Temp Warning
TB1-2	0V		thermistor Common	
TB1-3	DI-2	+24	Pump Speed Demand (bit 1)	
TB1-4	DI-2	+24	Pump Speed Demand (bit 2)	
TB1-5	Pump 0V	0V	Common	
TB1-6	Pump +24V	+24V	Jumpered Together	
TB1-7	Pump OP			
TB1-8	Pump OP		Pump Health (to X15-04)	Refrigerant Pump Controller Fault
TB1-9	Pump Temp		Pump Inlet Temperature	Refrigerant Temp Pump Inlet Warning
TB1-10	Pump Cond		Condenser Fan Speed	
PLG5-1	Pump Sup	+24V	Pump +24V Supply	
PLG5-2	Pump Comn	0V	Pump Supply Common	
PLG11-1	+24V (FS5)		(Jump to PLG11-3)	
PLG11-2	0V			
PLG11-3	I/O Cathode		(Jump to PLG11-1)	
PLG11-4	I/O Emitter			
PLG11-5	I/O Anode			
PLG11-6	I/O Kathode		(Jump to OV)	

TB1 and PLG-5 located on LA471775U001 (Pump Controller), PLG11 located on LA473080U001 (Power Distribution Board)

System PLC I/O Assignments

SLOT	POINT	TYPE	I/O NAME	DESCRIPTION
1	1	TC	TC1	CHOKE U1
1	2	TC	TC2	CHOKE V1
1	3	TC	TC3	CHOKE W1
1	4	TC	TC4	CHOKE U2
1	5	TC	TC5	CHOKE V2
1	6	TC	TC6	CHOKE W2
1	7	TC	TC7	CHOKE U3
1	8	TC	TC8	CHOKE V3
1	9	TC	TC9	CHOKE W3
1	10	TC	TC10	DC Power Supplies
1	11	TC	TC11	Internal Ambient
1	12	TC	TC12	External Ambient
1	13	TC	TC13	MCB FR4 Box Ambient
1	14	TC	TC14	Strikesorb Panel Ambient
1	15	TC	TC15	Condenser Outlet
1	16	TC	TC16	Condenser Inlet
2	1	AI	AN0	U1 Filter Current
2	2	AI	AN1	U2 Filter Current
2	3	AI	AN2	V1 Filter Current
2	4	AI	AN3	V2 Filter Current
2	5	AI	AN4	W1 Filter Current
2	6	AI	AN5	W2 Filter Current
2	7	AI	AN6	Spare
2	8	AI	AN7	Spare
2	9	AI	AN8	AC Busbar Thermistor
2	10	AI	AN9	AC Busbar Index
2	11	AI	AN10	AC Filter Thermistor
2	12	AI	AN11	AC Filter Index
2	13	AI	AN12	AC Capacitor Thermistor
2	14	AI	AN13	AC Capacitor Index
2	15	AI	AN14	AC Inverter Thermistor
2	16	AI	AN15	AC Inverter Index
2	17	AI	AN16	DC Panel Thermistor

SLOT	POINT	TYPE	I/O NAME	DESCRIPTION
2	18	AI	AN17	DC Panel Index
2	19	AI	AN18	Refrigerant Pump Inlet
2	20	AI	AN19	Condenser Fan Speed
2	21	AI	AN20	Spare
2	22	AI	AN21	Spare
2	23	AI	AN22	R134a Refrigerant Level
2	24	AI	AN23	Spare
2	25	AI	AN24	Spare
2	26	AI	AN25	Evaporator Air Thermistor
2	27	AI	AN26	Evaporator Fan Speed
2	28	AI	AN27	Spare
2	29	AI	AN28	Spare
2	30	AI	AN29	Spare
2	31	AI	AN30	Spare
2	32	AI	AN31	Spare
3	1	DI	DI0	DC Precharge + AUX
3	2	DI	DI1	DC Precharge - AUX
3	3	DI	DI2	DC Contactor AUX
3	4	DI	DI3	Spare
3	5	DI	DI4	Spare
3	6	DI	DI5	Spare
3	7	DI	DI6	Spare
3	8	DI	DI7	Spare
3	11	DI	DI8	Spare
3	12	DI	DI9	Spare
3	13	DI	DI10	Spare
3	14	DI	DI11	Spare
3	15	DI	DI12	Spare
3	16	DI	DI13	Spare
3	17	DI	DI14	Spare
3	18	DI	DI15	Spare
3	20	DI	DI16	AC MAIN CB ON
3	21	DI	DI17	AC MAIN CB ALARM TRIPPED
3	22	DI	DI18	EPO Input
3	23	DI	DI19	Local / Remote SS

SLOT	POINT	TYPE	I/O NAME	DESCRIPTION
3	24	DI	DI20	INVERTER ON
3	25	DI	DI21	INVERTER OFF
3	26	DI	DI22	Spare
3	27	DI	DI23	Spare
3	30	DI	DI24	LVRT 40A Supply OK
3	31	DI	DI25	NON - LVRT 40A Supply OK
3	32	DI	DI26	Spare
3	33	DI	DI27	Anti-Islanding (K1)
3	34	DI	DI28	AC Strikesorb Fuses OK
3	35	DI	DI29	DC Strikesorb Fuses OK
3	36	DI	DI30	Transformer 180^{o}C
3	37	DI	DI31	Transformer 200^{o}C
4	1	DI	DI0	Spare
4	2	DI	DI1	Spare
4	3	DI	DI2	Spare
4	4	DI	DI3	AC Filter Contactor AUX
4	5	DI	DI4	EPO STATUS
4	6	DI	DI5	LC21 Choke Temp Status
4	7	DI	DI6	LC22 Choke Temp Status
4	8	DI	DI7	LC23 Choke Temp Status
4	11	DI	DI8	LC31 Choke Temp Status
4	12	DI	DI9	LC32 Choke Temp Status
4	13	DI	DI10	LC33 Choke Temp Status
4	14	DI	DI11	LC41 Choke Temp Status
4	15	DI	DI12	LC42 Choke Temp Status
4	16	DI	DI13	LC43 Choke Temp Status
4	17	DI	DI14	Spare
4	18	DI	DI15	Spare
4	20	DI	DI16	BYPASS MODE
4	21	DI	DI17	FORCE HMI ON
4	22	DI	DI18	SERVICE LIGHTS
4	23	DI	DI19	RESET EPO
4	24	DI	DI20	Spare
4	25	DI	DI21	Spare
4	26	DI	DI22	Spare

SLOT	POINT	TYPE	I/O NAME	DESCRIPTION
4	27	DI	DI23	Spare
4	30	DI	DI24	INVERTER RUNNING
4	31	DI	DI25	Spare
4	32	DI	DI26	INGRESS DETECTION
4	33	DI	DI27	Spare
4	34	DI	DI28	Spare
4	35	DI	DI29	Spare
4	36	DI	DI30	Spare
4	37	DI	DI31	Spare
5	1	DO	DO0	DC BUS MAIN CONTACTOR
5	2	DO	DO1	DCPC+ CONTACTOR
5	3	DO	DO2	DCPC- CONTACTOR
5	4	DO	DO3	Spare
5	5	DO	DO4	Spare
5	6	DO	DO5	Spare
5	7	DO	DO6	Spare
5	8	DO	DO7	Spare
5	11	DO	DO8	Spare
5	12	DO	DO9	Spare
5	13	DO	DO10	Spare
5	14	DO	DO11	Spare
5	15	DO	DO12	Spare
5	16	DO	DO13	Spare
5	17	DO	DO14	Pump Speed Demand Bit 0
5	18	DO	DO15	Pump Speed Demand Bit 1
5	20	DO	DO16	Spare
5	21	DO	DO17	Spare
5	22	DO	DO18	Heater on (K3)
5	23	DO	DO19	BREAKER OPEN
5	24	DO	DO20	BREAKER CLOSE
5	25	DO	DO21	Spare
5	26	DO	DO22	FORCE HMI ON (lamp)
5	27	DO	DO23	INVERTER RUN COMMAND
5	30	DO	DO24	EPO FAULT RESET
5	31	DO	DO25	AC FILTER CONTACTOR

SLOT	POINT	TYPE	I/O NAME	DESCRIPTION
5	32	DO	DO26	PCS-SDC ALARM
5	33	DO	DO27	PCS-SDC SPARE
5	34	DO	DO28	PCS-SDC SPARE
5	35	DO	DO29	PCS-SDC SPARE
5	36	DO	DO30	NON-LVRT +24VDC OK
5	37	DO	DO31	220V POWER (HMI)

Thermistor Card Temperature Strings

Thermistor Cards 4A1 – 4A18

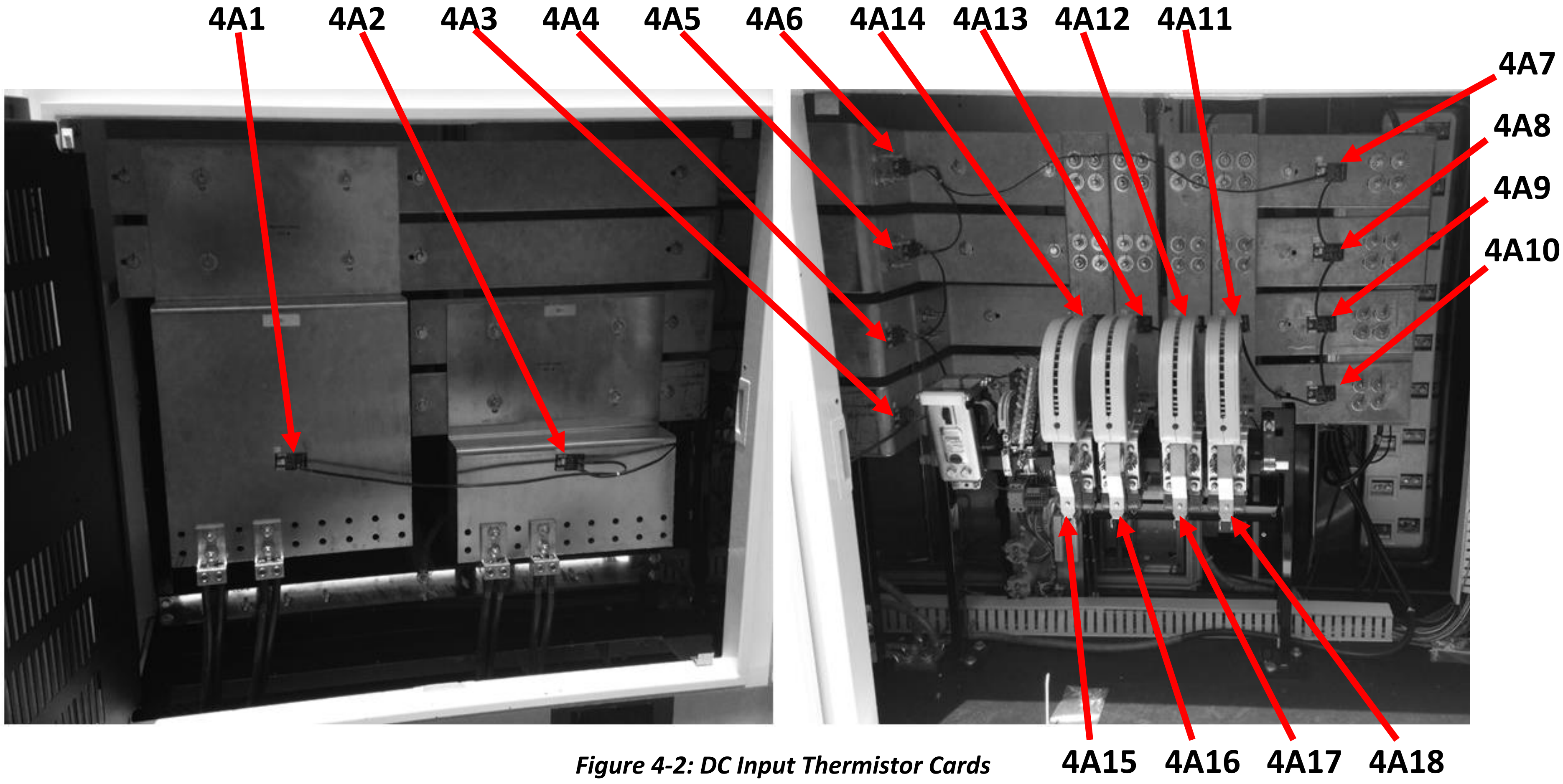


Figure 4-2: DC Input Thermistor Cards

Thermistor Cards 5A1 – 5A6 and 6A1 – 6A15

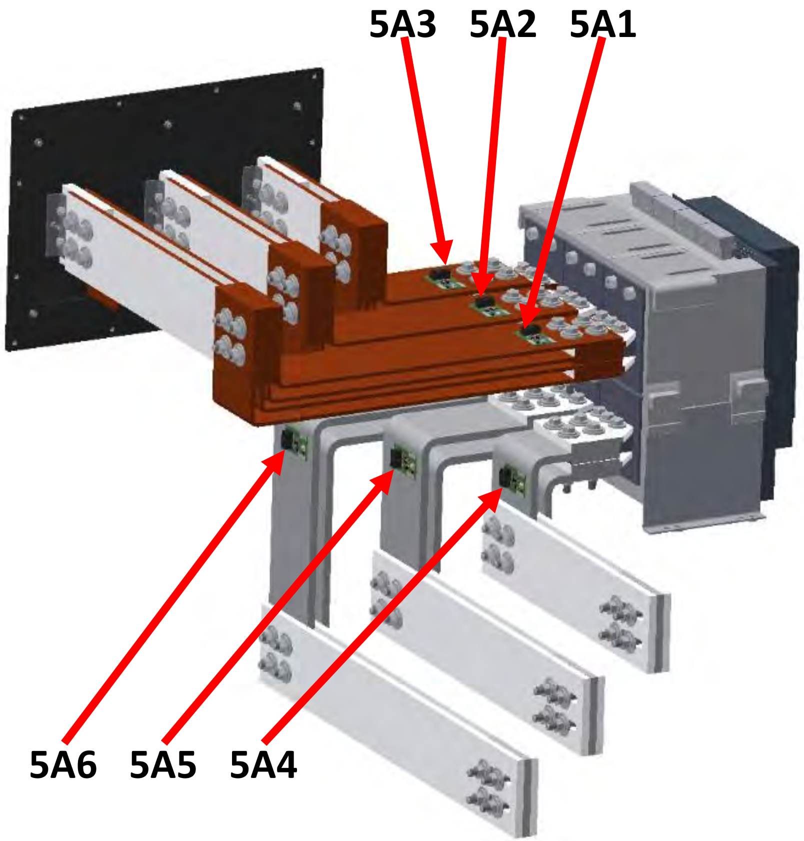


Figure 4-3: MCB Thermistor Cards

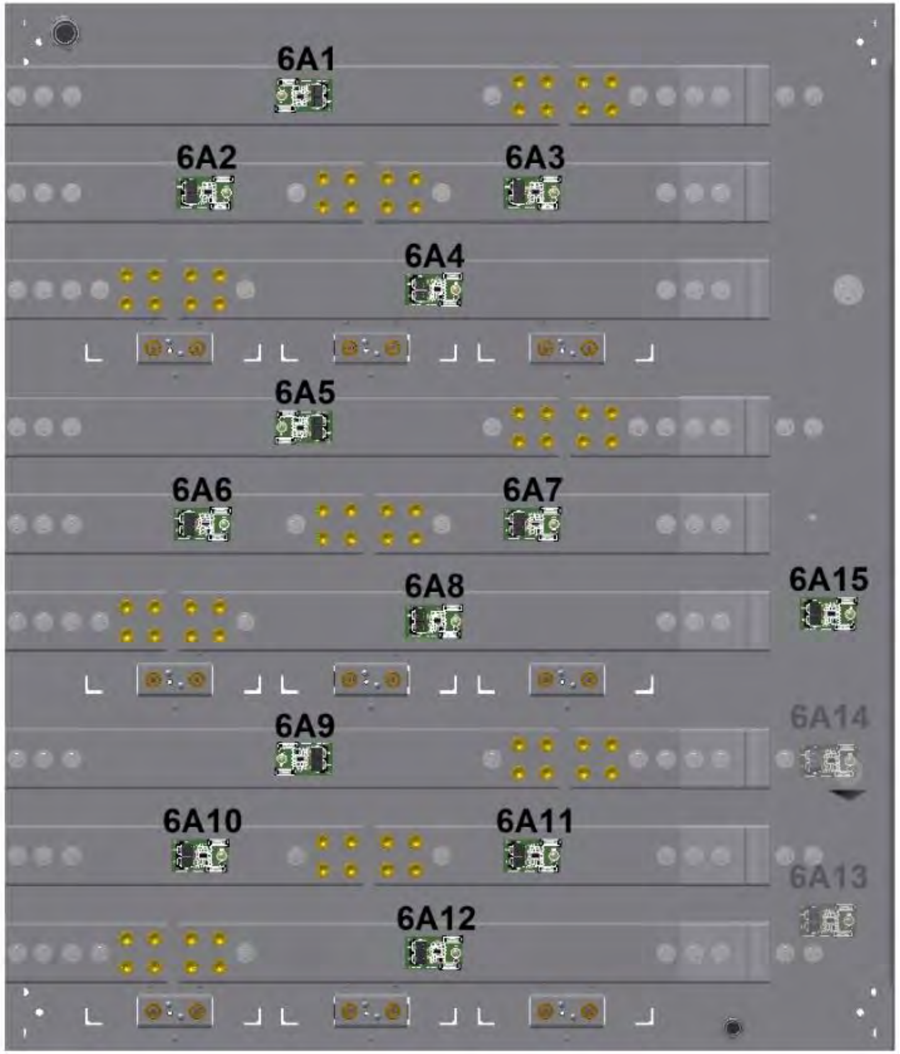


Figure 4-4: Filter Thermistor Cards

Thermistor Cards 7A1 – 7A15 and 8A1 – 8A11

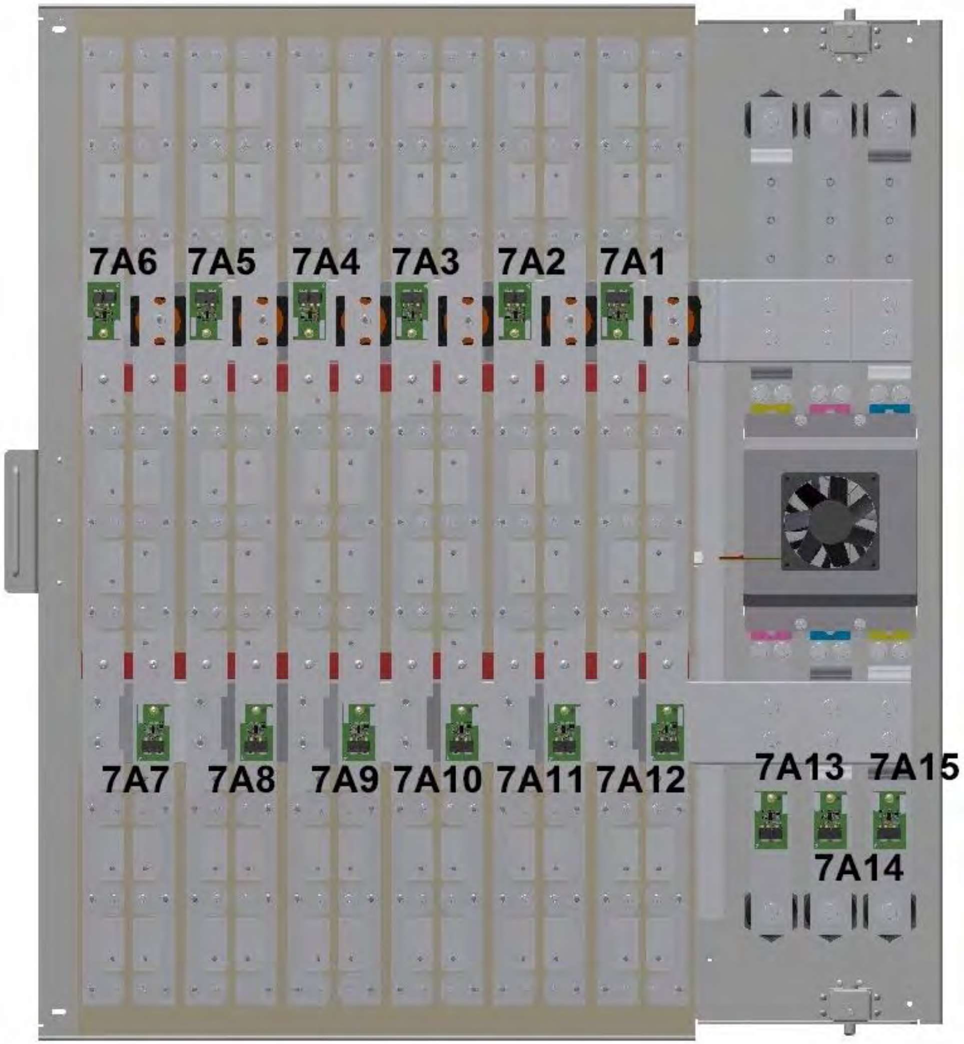


Figure 4-5: Cap Door Thermistor Cards

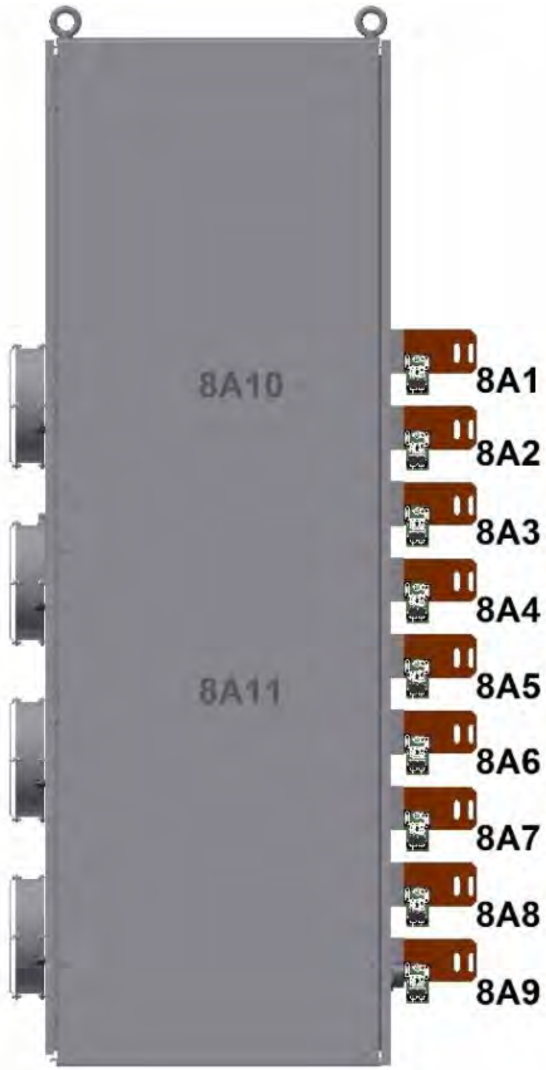


Figure 4-6: Inverter Thermistor Cards

Inverter Keypad Faults

See Appendix A **(Page A-18)** for the Keypad Fault List.

KEYPAD FIRST TRIP INDICATION							
STATE	**MEANING**		**STATE**	**MEANING**		**STATE**	**MEANING**
0	OK		31	Unknown		62	Ref Encoder Fail Error
1	Over Voltage		32	Other		63	Drive Config
2	Under Voltage		33	Max Speed Low		64	64
3	Overcurrent		34	Mains Volts Low		65	Custom Trip 1
4	Heatsink		35	Not at Speed		66	Custom Trip 2
5	External Trip		36	Mag Current Fail		67	Custom Trip 3
6	Input 1 Break		37	Negative Slip F		68	Custom Trip 4
7	Input 2 Break		38	TR Too Large		69	Custom Trip 5
8	Motor Stalled		39	TR Too Small		70	Custom Trip 6
9	Inverse Time		40	Max RPM Data Error		71	Custom Trip 7
10	Brake Resistor		41	Stack Trip		**72**	**Current Balance**
11	Brake Switch		42	Leakage L Timeout		**73**	**System Volts**
12	Opstation		43	Pwer Loss Stop		74	Left Fan
13	Lost Comms		44	Motor Turning Error		75	Right Fan
14	Contactor Feedback		45	Motor Stalled Error		76	CS Phase Loss
15	Speed Feedback		46	At Torque Limit Err		77	CS Temperature
16	Ambient Temp		47	Firewire ISR Timeout		78	CS Bridge
17	Motor Overtemp		48	Encoder Cal Error		79	Earth Fault
18	Current Limit		49	Output Gearbox Ratio Error		80	Stack Mismatch
19	Trip 19 (Reserved)		50	Appliction Not Running		81	CM Overtemp
20	24V Failure		51	Application Error		82	V Phase Missing
21	Low Speed Over I		52	Firmware Error		83	W Phase Missing
22	Trip 22 (Reserved)		53	TRIP_ENUM_TRACKING_ERROR		84	Temp Imbalance
23	Encoder 1 Fault		54	TRIP_ENUM_LOOP_OVERSPEED		85	Sharing Fault
24	Desat Over I		55	TRIP_ENUM_HOME_LIMIT_SWITCH		86	PCM Comms Loss
25	VDC Ripple		56	TRIP_ENUM_HOME_SOFT_LIMIT		87	Ref Pump Board
26	Brake Short CCT		57	Resolver Error		88	Refrigerant Temp
27	Overspeed		58	I2T Motor Trip		89	Cooling System
28	Trip 28 (Reserved)		59	TRIP_ENUM_SYNC_TIMEOUT		90	VRT Mains Loss
29	Trip 29 (Reserved)		60	Safe Torque Off		91	Mains Imbalance
30	Trip 30 (Reserved)		61	Ref Encoder Cal Error			
These faults are not applicable to this application. If any of these faults are displayed on the keypad, contact Parker EGT Product Support							

CHECKSUM FAIL

When the inverter powers-up, non-volatile memory is checked to ensure that it has not been corrupted. In the rare event of corruption being detected, the unit will not function. This may occur when replacing the control board with an un-programmed control board (This may result in an "incompatible power board' fault), if updating the firmware is interrupted, or if power is disconnected before installing a configuration has completed.

Inverter Indications

The failure is indicated by the STATUS LED showing SHORT FLASH. This indicates ( ) the inverter is in configuration mode. Configuration mode requires a keypad or communications link, etc. to perform resetting actions. If none are available, the PCM must be returned to Parker EGT for reprogramming, refer to Maintenance and Repair.

Keypad Indications

The keypad displays the message opposite.

1. Acknowledge the message by pressing key (This action automatically loads default parameters and the ENGLISH 50Hz product code.)
2. Reload the product code.
3. Perform a SAVE CONFIG (SYSTEM menu).

Note: ***The keypad will display a failure message if the*** PARAMETER SAVE ***is unsuccessful. This indicates that the inverter has developed a fault and must be returned to Parker EGT. Refer to "Routine Maintenance and Repair".***

COOLING SYSTEM TROUBLESHOOTING

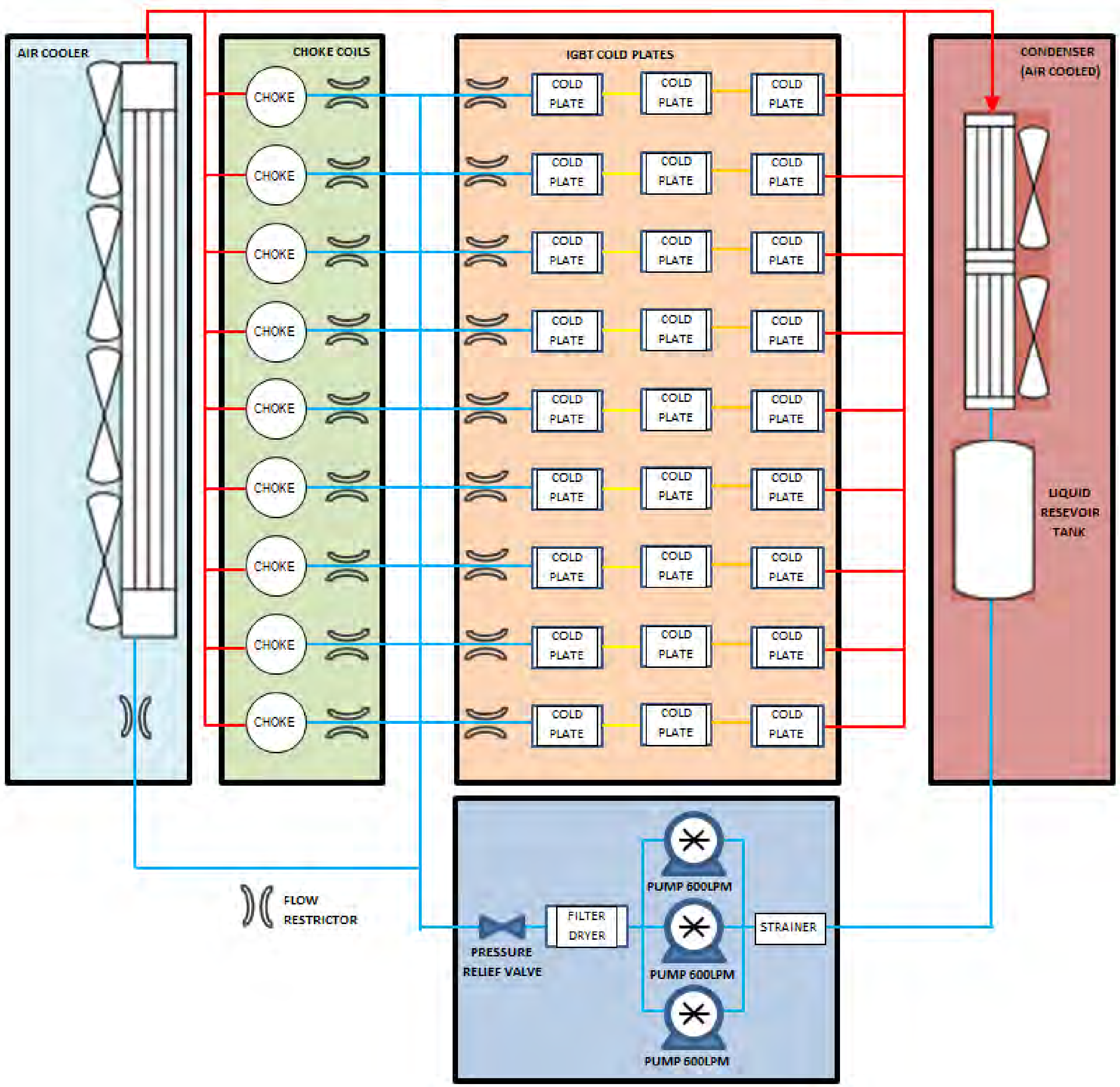


Figure 4-7: Two phase cooling system diagram

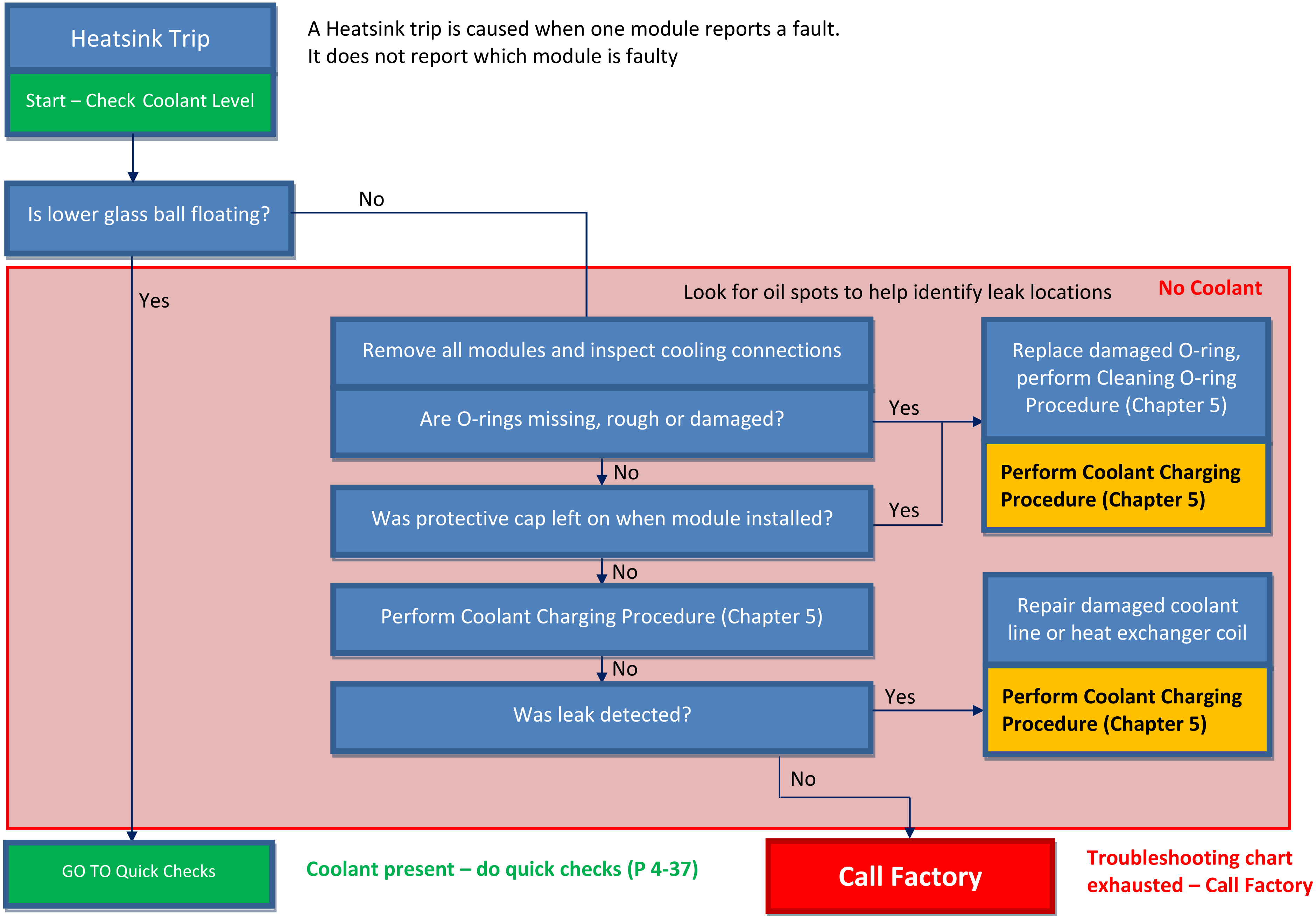
Using Flow Charts

In almost all cases, a heatsink or over temperature trip will signal a fault in the cooling system. Use the following flowcharts to diagnose the fault. Faults caused by other sources are covered separately in this chapter.

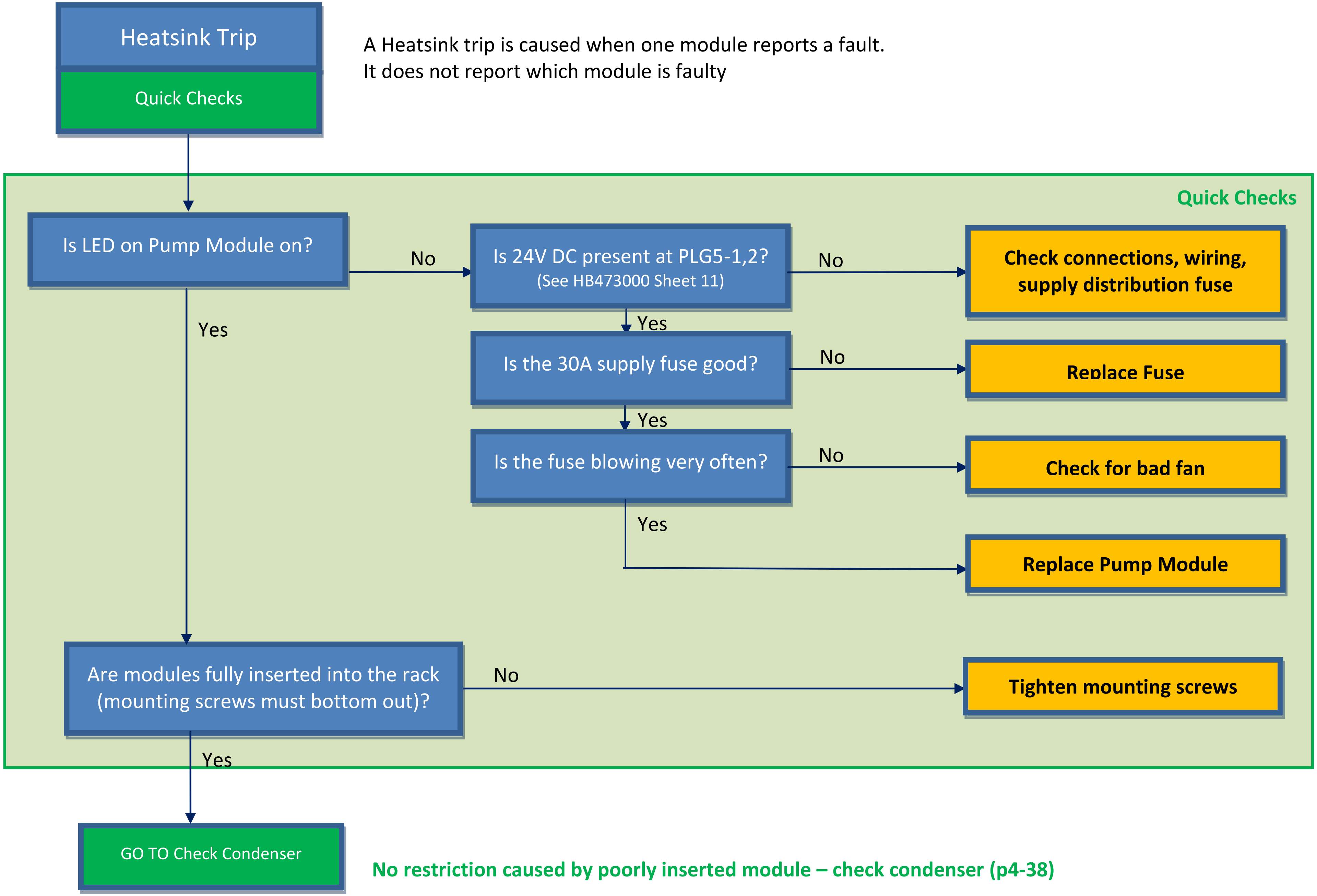
Destinations for Jumping to a new page

Questions or actions to perform

Final Corrective action

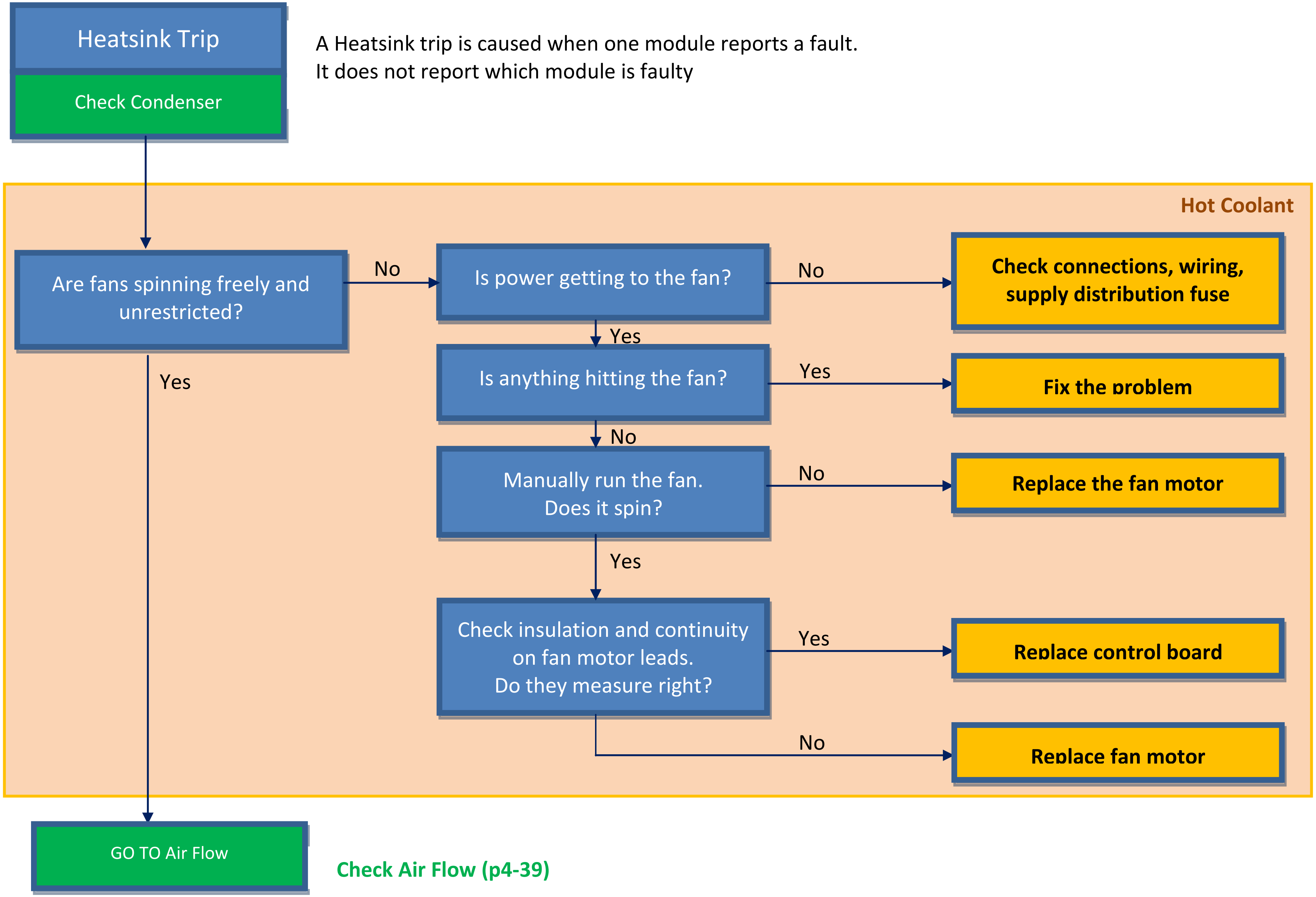

Heatsink Trip
Start – Check Coolant Level
A Heatsink trip is caused when one module reports a fault.
It does not report which module is faulty
Is lower glass ball floating?
No
Yes
Look for oil spots to help identify leak locations
No Coolant
Remove all modules and inspect cooling connections
Are O-rings missing, rough or damaged?
Yes
Replace damaged O-ring, perform Cleaning O-ring Procedure (Chapter 5)
Perform Coolant Charging Procedure (Chapter 5)
No
Was protective cap left on when module installed?
Yes
No
Perform Coolant Charging Procedure (Chapter 5)
Repair damaged coolant line or heat exchanger coil
No
Was leak detected?
Yes
Perform Coolant Charging Procedure (Chapter 5)
No
GO TO Quick Checks
Coolant present – do quick checks (P 4-37)
Call Factory
Troubleshooting chart exhausted – Call Factory

A Heatsink trip is caused when one module reports a fault.
It does not report which module is faulty



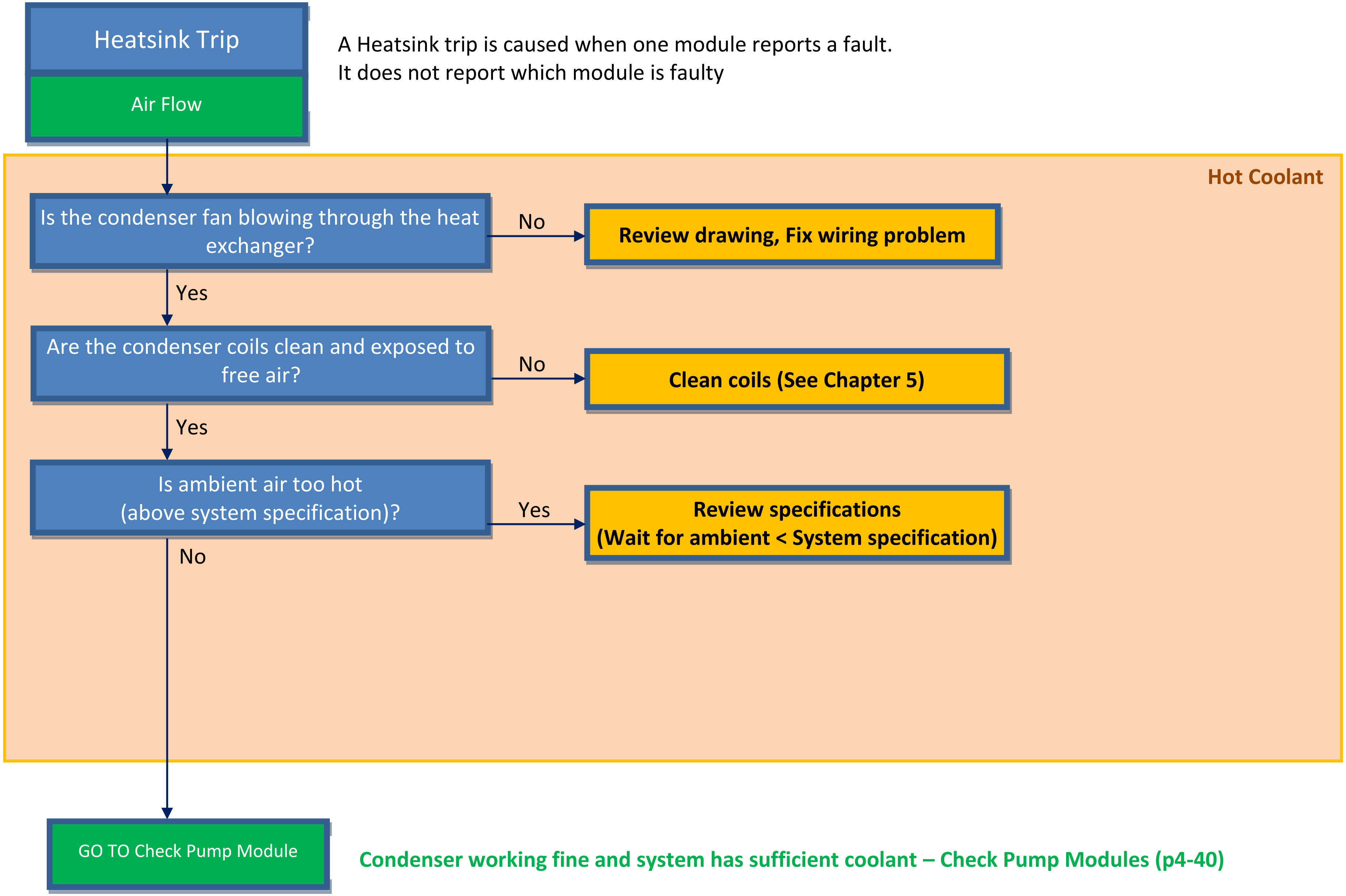
No restriction caused by poorly inserted module – check condenser (p4-38)

A Heatsink trip is caused when one module reports a fault.
It does not report which module is faulty

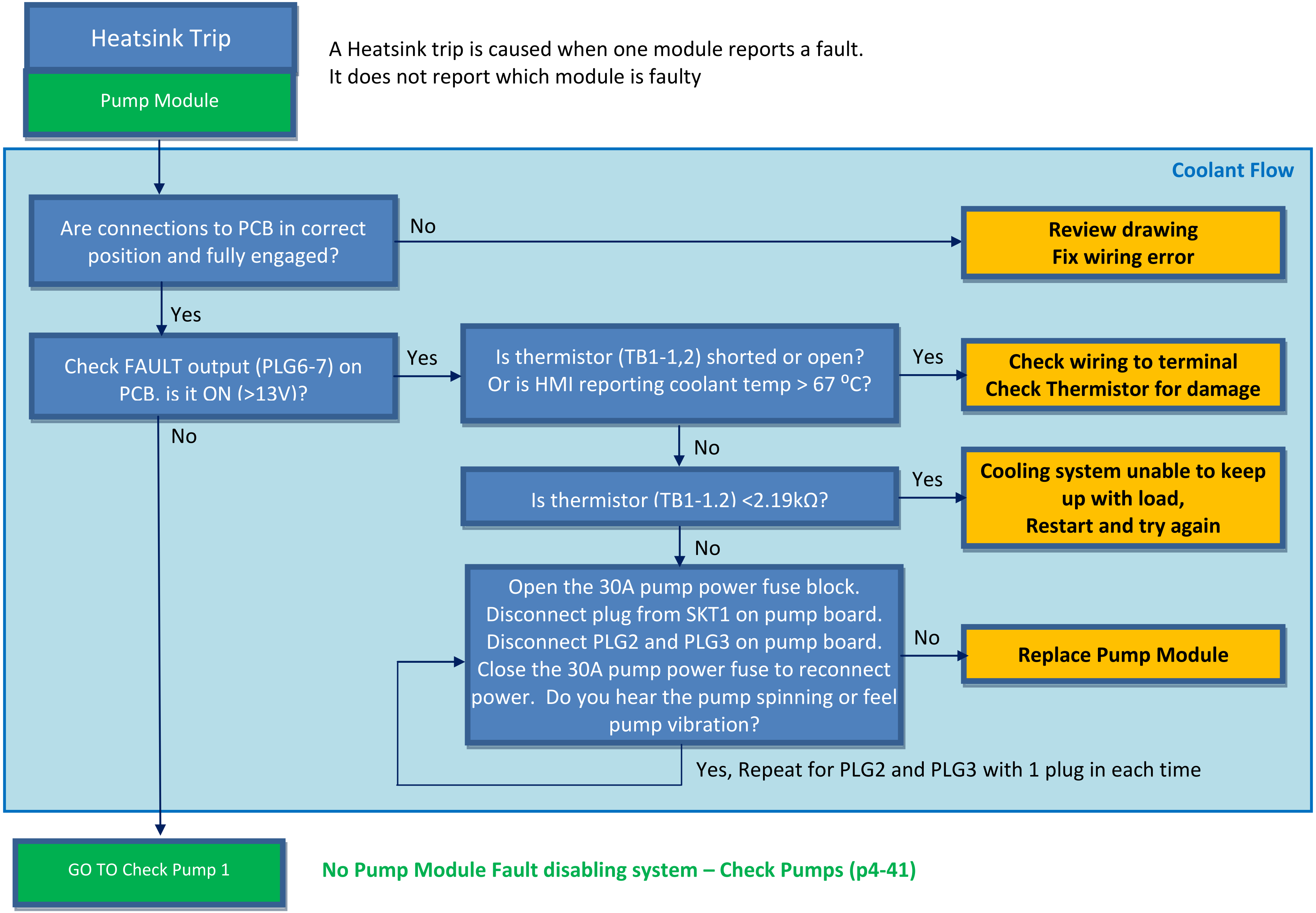


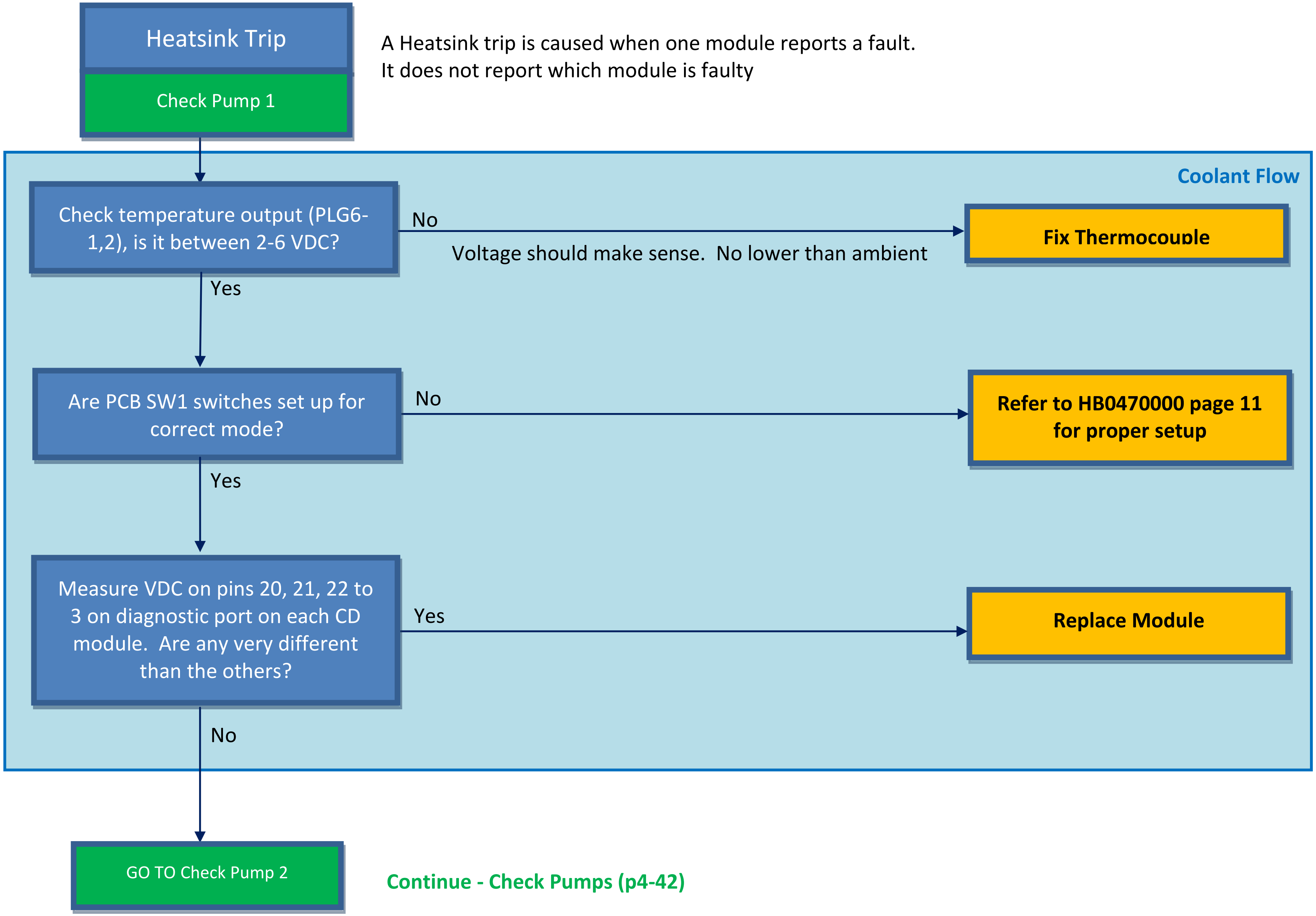
Check Air Flow (p4-39)

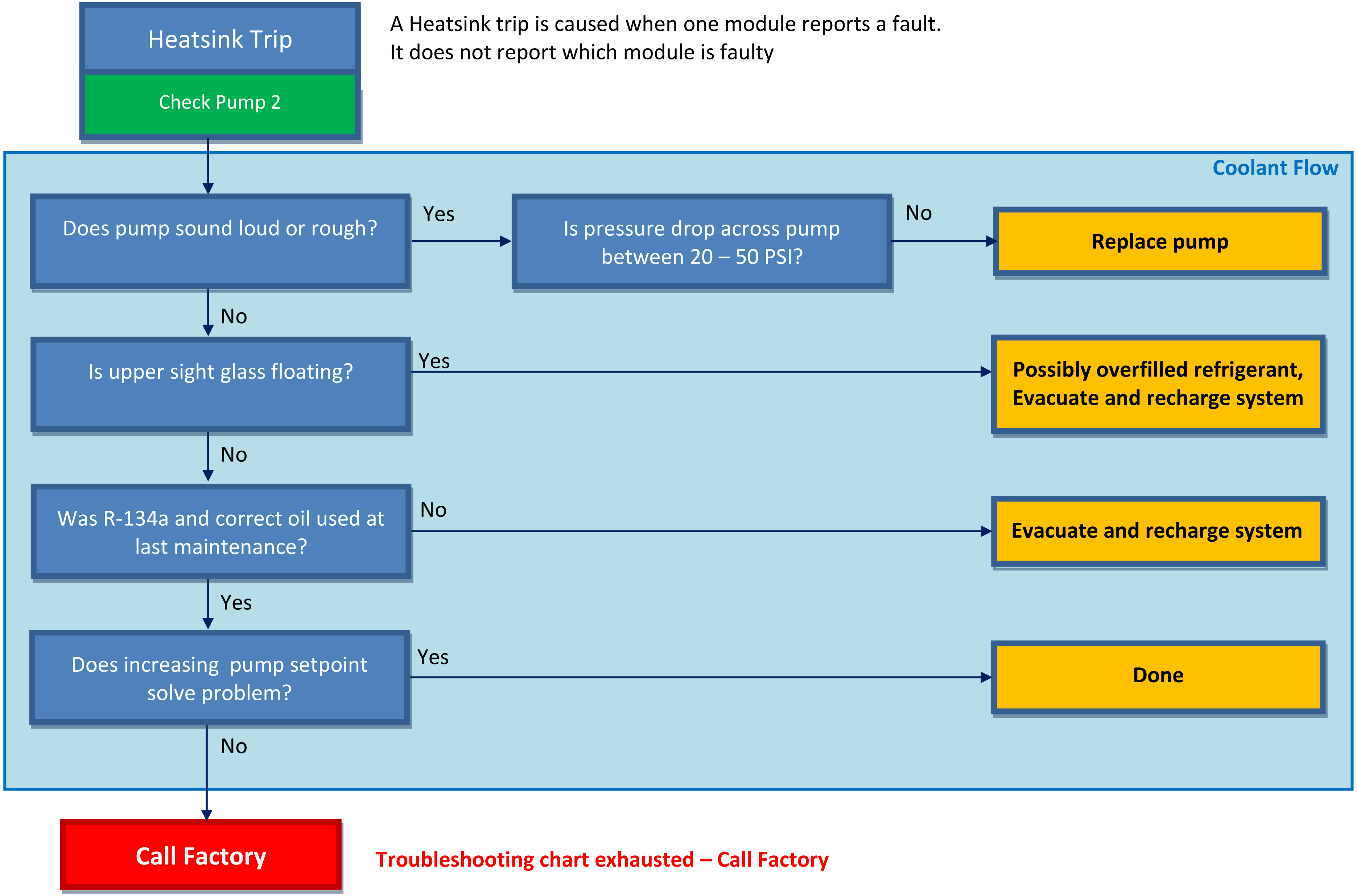
A Heatsink trip is caused when one module reports a fault.
It does not report which module is faulty



Condenser working fine and system has sufficient coolant – Check Pump Modules (p4-40)


Heatsink Trip
Pump Module
A Heatsink trip is caused when one module reports a fault.
It does not report which module is faulty
Coolant Flow
Are connections to PCB in correct position and fully engaged?
No
Review drawing
Fix wiring error
Yes
Check FAULT output (PLG6-7) on PCB. is it ON (>13V)?
Yes
Is thermistor (TB1-1,2) shorted or open?
Or is HMI reporting coolant temp > 67 °C?
Yes
Check wiring to terminal
Check Thermistor for damage
No
No
Is thermistor (TB1-1.2) <2.19kΩ?
Yes
Cooling system unable to keep up with load,
Restart and try again
No
Open the 30A pump power fuse block. Disconnect plug from SKT1 on pump board. Disconnect PLG2 and PLG3 on pump board. Close the 30A pump power fuse to reconnect power. Do you hear the pump spinning or feel pump vibration?
No
Replace Pump Module
Yes, Repeat for PLG2 and PLG3 with 1 plug in each time
GO TO Check Pump 1
No Pump Module Fault disabling system – Check Pumps (p4-41)


Heatsink Trip
Check Pump 1
A Heatsink trip is caused when one module reports a fault.
It does not report which module is faulty
Coolant Flow
Check temperature output (PLG6-1,2), is it between 2-6 VDC?
No
Fix Thermocouple
Voltage should make sense. No lower than ambient
Yes
Are PCB SW1 switches set up for correct mode?
No
Refer to HB0470000 page 11 for proper setup
Yes
Measure VDC on pins 20, 21, 22 to 3 on diagnostic port on each CD module. Are any very different than the others?
Yes
Replace Module
No
GO TO Check Pump 2
Continue - Check Pumps (p4-42)


Heatsink Trip
Check Pump 2
A Heatsink trip is caused when one module reports a fault.
It does not report which module is faulty
Coolant Flow
Does pump sound loud or rough?
Yes
Is pressure drop across pump between 20 – 50 PSI?
No
Replace pump
No
Is upper sight glass floating?
Yes
Possibly overfilled refrigerant, Evacuate and recharge system
No
Was R-134a and correct oil used at last maintenance?
No
Evacuate and recharge system
Yes
Does increasing pump setpoint solve problem?
Yes
Done
No
Call Factory
Troubleshooting chart exhausted – Call Factory

Typical HMI Annunciated Fault Codes

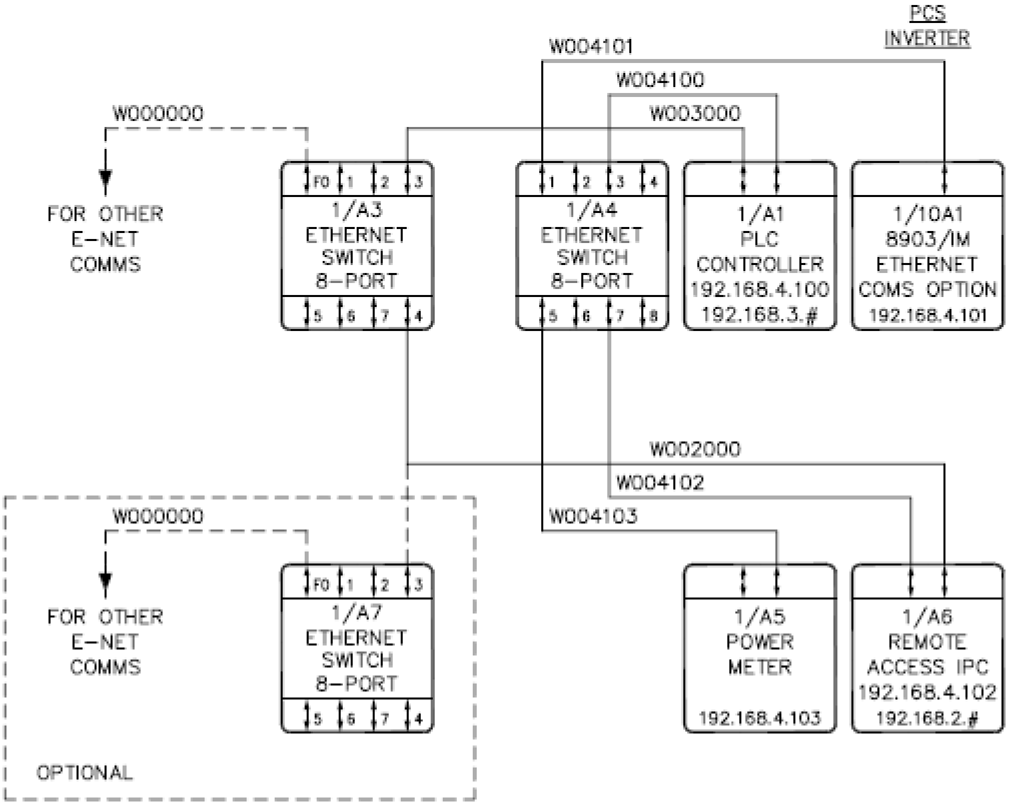
This table provides a list of the fault messages that appear on the HMI, the meaning of the message, and required action associated with the annunciated fault.

Trip Name	Description	Possible Reason(s) for Trip	Response to Trip	Action from O&M Team
AUX SUPPLY LOW	120V supply is below LVRT standards.	Grid brown-out event occurred	Disable output, autorestart when supply is above requirement	Possible maintenance required
CONDENSER FAIL	Condenser Cooling Fans **10A1 INVERTER** **X15-05 = Condenser Fan 1 Health** **X15-06= Condenser Fan 2 Health**	Both fans failed.	Disable output, manual reset required	Maintenance required
CONDENSER FAN		One of the fans has failed.	Warning only. Derate output to maintain temperature	Maintenance required
EXTERNAL AMBIENT	External Ambient Temp >55C	Temperature sensor failure, It is too hot outside	Shut down, Wait until external temp < 55C, then autorestart	Maintenance required if external ambient temp is actually <55C
HI FREQ FAULT	Line frequency out of FqRT boundaries. **(Moving from APP to firmware – Verbiage may change)**	Excessive line harmonics, Line fault has occurred.	Disable output, manual reset required.	Maintenance required.
LOW FREQ FAULT				
HIGH AC VOLTS AB	AC line above VRT standards. **(Faults rolling into VRT MAINS LOSS – Verbiage may change)**	Transformer fault, Line voltage not regulated well by the utility	Disable output, manual reset required. On Severe High AC volts CB2 opens.	Maintenance required.
HIGH AC VOLTS BC				
HIGH AC VOLTS CA				
HMI Thermal Shutdown Pending	Local HMI (A5)	Disabled due to extreme interior ambient temp due to climate or cooling system performance	Keep Running, Annunciate Warning, Can force the HMI on when at the inverter	None

Trip Name	Description	Possible Reason(s) for Trip	Response to Trip	Action from O&M Team
HMI WARN	Local HMI (A5)	Disabled due to extreme interior ambient temp due to climate or cooling system performance	Keep Running, Annunciate Warning, Can force the HMI on when at the inverter	None
HMIWATCHDOG FAULT	Local HMI (A5) Watchdog timeout detected by main controller	Ethernet Failure, HMI Failure, HMI Runtime Busy	Inverter continues to run	Maintenance required
INTERNAL AMBIENT	Internal ambient temperature > 70C.	Internal heat exchanger fans are blocked, Excessive ambient temp, Condenser fans not spinning	Wait until internal temperatures are < 65C. Autorestart.	Maintenance required if more than 1 event occurs in succession.
LOCAL MODE	The inverter is receiving SCADA commands but has been set to be in local mode.	SCADA trying to command the inverter while the inverter is in local mode.	Warning only. Inverter will only respond to local commands.	None.
LOW AC VOLTS AB **LOW AC VOLTS BC** **LOW AC VOLTS CA**	AC line below LVRT standards.	Brownout event occurred, Line is not energized, Transformer fault, AC voltage measurement problem, AC breaker not functioning properly	Disable output, manual reset required	Maintenance required
PCM WATCHDOG FAULT	Parallel Control Module watchdog timeout has been detected by main controller	Ethernet failure, PCM Failure, 8903/IM Failure, 890 Firmware Update in progress	Disable output, manual reset required.	Maintenance required.
PQMWATCHDOG FAULT	Power quality meter watchdog timeout has been detected by main controller	Ethernet media failure, Power Meter Failure / reboot, Meter reconfiguration in progress.	Inverter continues to run	Maintenance required
SCADA INACTIVE	Not receiving commands (transfer trip) and/or updates from the plant SCADA system.	Inverter is in remote mode and has lost comms with the plant SCADA system, Loss of power to the DAS or plant SCADA	Configurable timeout setting. Enter standalone mode and go back to last retained values (if stored) or to 100% and unity PF if last mode was not retained	Maintenance required
TEMP DERATE	External ambient is between 50C and 55C.	Temperature sensor failure It's too hot outside	Warning only. Derate output to maintain temperatures.	None.

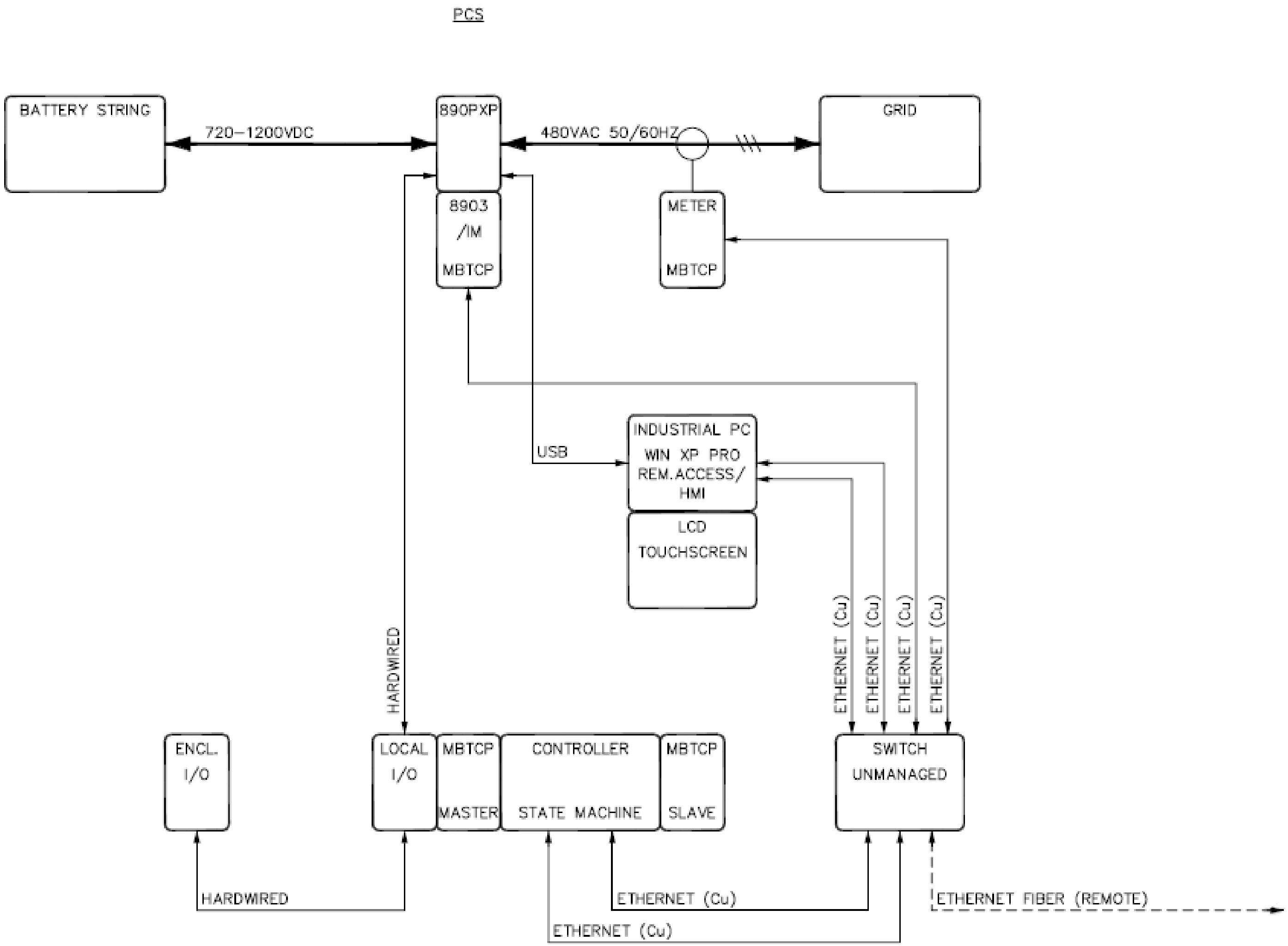
Typical Ethernet Topology Diagram

This diagram provides the IP addresses for the Ethernet Network

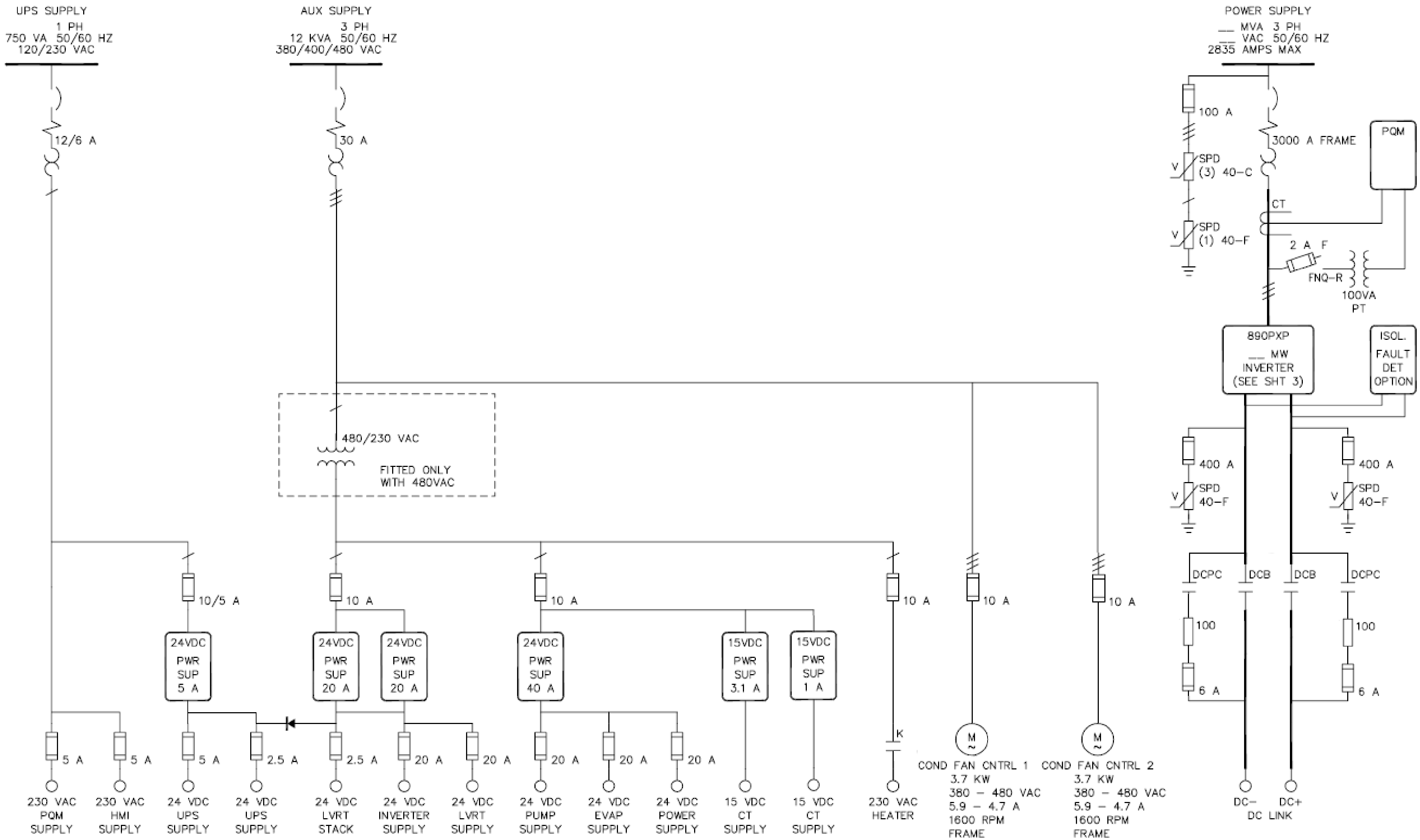


Typical System One-Line Drawing (Shown with 480VAC Grid Connection)

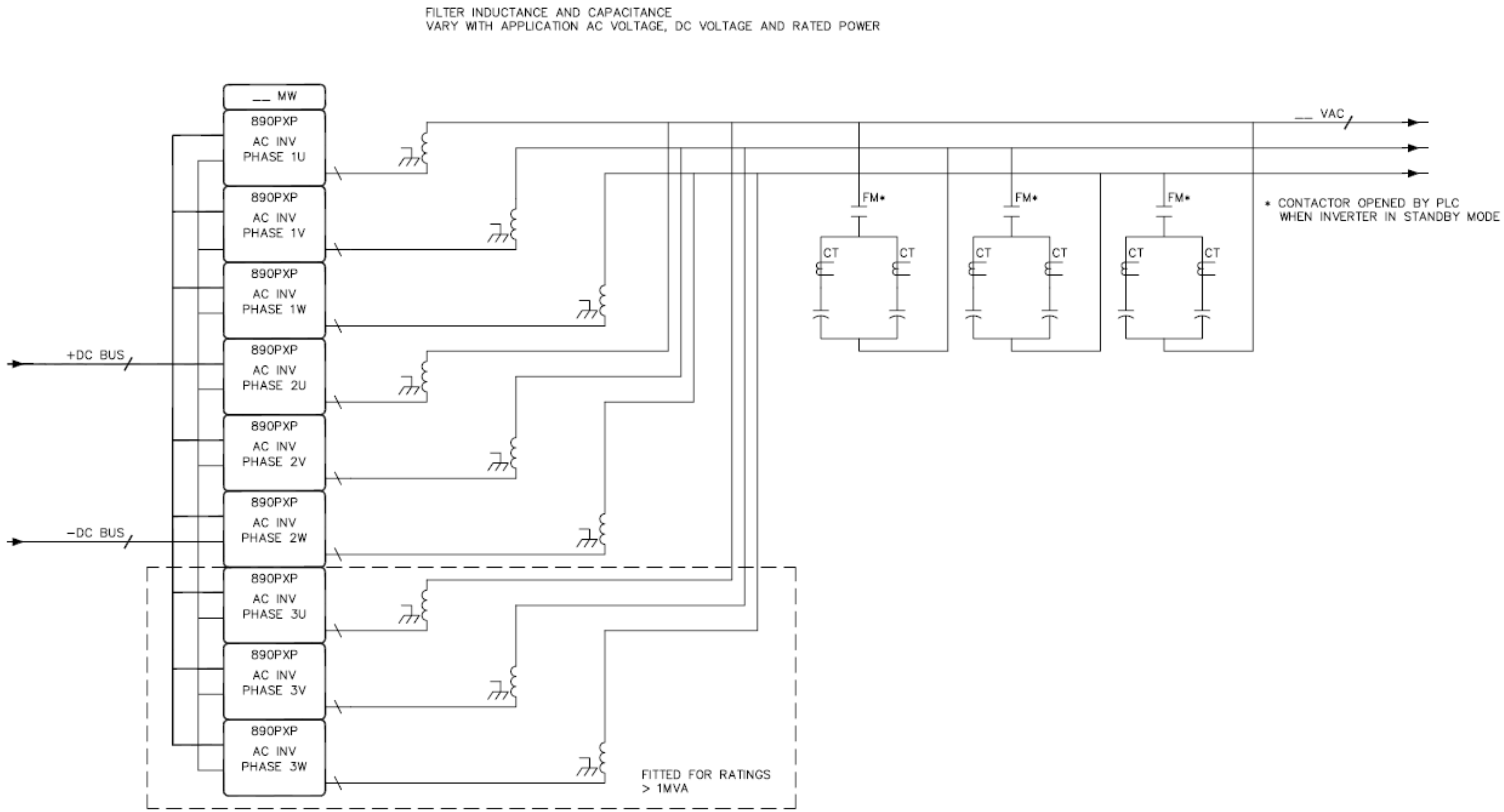
This diagram provides the IP addresses for the Ethernet Network



Network One Line



Input Power One Line



Output Power One Line

Chapter 5 Maintenance

This section provides general maintenance instructions. It does not provide detailed repair or diagnostic instructions. Contact a licensed HVAC technician when requiring service of the condensers or container air conditioner.

WARNING:

IMPORTANT All electrical work must be done in accordance with local, national, and/or international electrical codes by a qualified electrician.

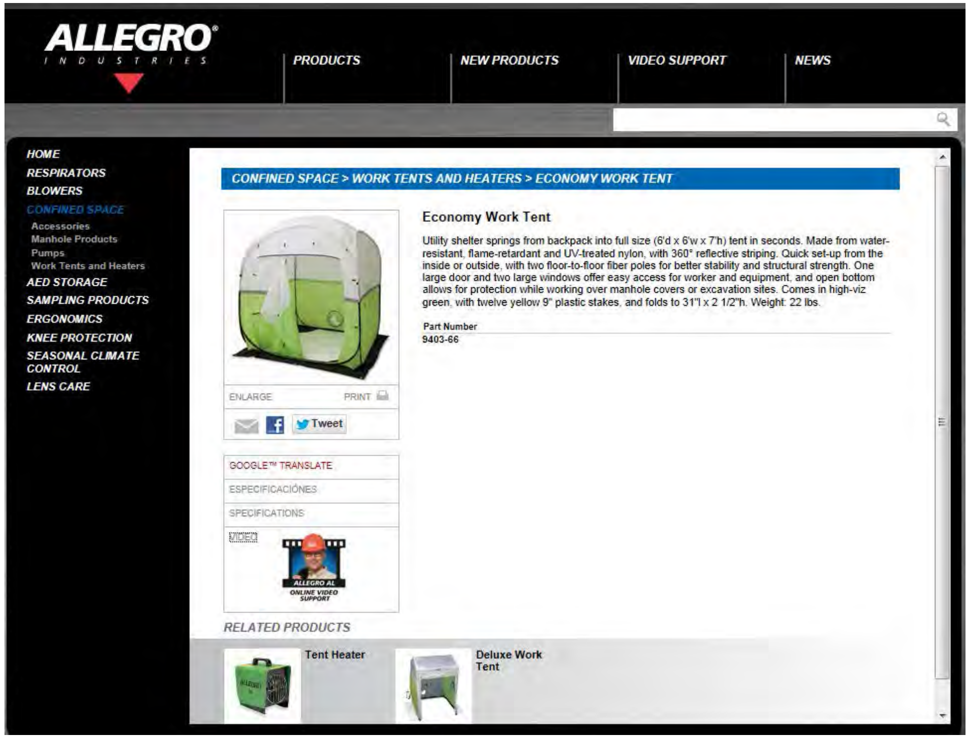
IMPORTANT WARNING: Battery Strings can produce dangerous electrical voltage levels.

IMPORTANT WARNING: Extreme Arc Flash and Shock Hazards

- Flash Hazard Boundary 60”
- Up to 24.46 Cal/cm^2 at 18”
- Class 3 PPE Level (Rated at 25 Cal/cm^2) – 2 layers of clothing: cotton underwear + fire resistant shirt and pants or coveralls + multilayer flash suit, VR gloves-tools, with appropriate flash hood.
- Limited Approach Boundary 120”
- Restricted Approach Boundary 12”
- Prohibited Approach Boundary 1”

General Maintenance Notes

Maintenance of the 890GTB should be performed in an environment suitable for the service personnel working on the equipment and should be done in such a manner as to prevent ingress of foreign materials including dust and liquids inside of the 890GTB. Failure to do so may result in premature failure of the 890GTB and possible degradation of internal high voltage insulation barriers which may pose a safety risk for users. In many instances, it is advisable that service personnel use service tents for maintaining the equipment in environmental conditions that warrant sheltering of the service personnel or the 890GTB. Service tents are recommended to be used to protect personnel and equipment from sun exposure, precipitation, windblown contaminants including dust, and other environmental hazards. There are many manufacturers of service tents each with products that provide varying benefits and features to users. An example of one such supplier is shown below for reference.



Typical Preventative Maintenance and Service Schedule

The table below represents a typical energy storage inverter maintenance profile. Actual usage profile may warrant more or less frequent maintenance.

Action	Component	Frequency
Test	EPO Operation	Annually
Inspect	CB2 Main Disconnect Circuit Breaker	Annually*
Inspect	Coolant system for damage	Annually
Inspect	Inspect AC connections (Enclosure to Isolation Transformer)	Annually
Inspect	Inspect DC connections	Annually
Review	Coolant system level (via SCADA)	Annually ***
Review	SCADA Temperature Data Trends	Annually ***
Inspect	Enclosure (External) for leaks / damage / corrosion	6 Months
Test	GFI Duplex Receptacles	6 Months
Test	Ground Fault	6 Months
Clean	Heat Exchanger Fins	6 Months
Replace	Coolant Pumps	7 years
Replace	Condenser Fans	7 years
Replace	Internal Fans	10 years
Replace	Control Power Supplies	10 years
Replace	AC Filter Capacitors	10 years
While there is no general rule how often some components should be cleaned. Frequency and method of cleaning will depend on the user environment and must be determined by the operating personnel. A prudent approach would be to inspect components on a monthly or quarterly basis during the first year of operation and determine the frequency based on those inspections.		

* Before closing the Circuit Breaker after a short-circuit breaking operation, the condition of the contact system and arc flash chutes must be checked

** Should be checked by the end of the first week and by the end of the first month, then frequency can be reduced to annually

*** In the first year of operation, measurements should be recorded each quarter, in subsequent years frequency may be reduced to Annual recording.

Preventative Maintenance

NOTE: ***The Annual Inspection is comprised of a complete Preventative Maintenance Inspection. The 6-month Inspections are a subset of the annual inspection.***

*** WARNING: Inspections to be performed inside the enclosure can only be accomplished safely with AC utility disconnect switches open, Battery disconnects open (deenergized) and Locked Out / Tagged Out.**

General state of the unit such as cleanliness and corrosion:

- The enclosure is a sealed system as long as the doors and access panels remain closed. However opening the enclosure for maintenance presents an opportunity for dirt or foreign material to enter the enclosure.
- Ensure the enclosure, access panels, and doors are well-maintained. During de-energized maintenance, enclosures are to be cleaned of all loose dirt and debris using a vacuum cleaner*.
- The enclosure should be examined for evidence of water seepage. The top of the enclosure should be examined for evidence of water.
- Check proper mechanical support and sealing of AC output chute. Check conductor insulation for abrasion or cracks. Examine chute joints for clean and tight connections.
- Where seals and/or gaskets are installed, these should be examined and repaired or replaced as necessary.
- All doors and access panels should be properly secured during operation.
- Heater elements should be cleaned, examined for damage and/or deterioration, and tested. Repair or replace heater elements as necessary.

NOTE:** ***The use of compressed air is not recommended since this may cause foreign particles to become embedded in the insulation or damage insulators. Any buildup of dirt or other contaminates that will not come off with vacuuming should be cleaned with lint free rags using cleaning solvents recommended by the manufacturer.

Obstruction of the ventilation

- Fan grills are to be cleaned of all dust and/or dirt accumulations.
- Fan blades should be cleaned of dirt and dust.
- Ensure that ventilation openings are not obstructed.

NOTE: ***In environments where there is an extreme exposure to adverse conditions, the frequency of maintenance for enclosures should be increased as conditions warrant.***

Figure 5-1: Typical Grid-Tie Inverter Enclosure Condenser Air Flow

Cooling System

See Condenser Maintenance and Service (Page 5-15)

Cables and Bus

WARNING: Cables and Busbars **must** be de-energized if they are to be touched or moved during maintenance.

- Examine for signs of deterioration, cracking, flaking, or overheating.
- Examine for signs of tracking or arcing.
- Examine cable insulation for signs of deterioration, cracking, flaking, or overheating.
- Ensure that all busbars, cables and connections are clean and dry.

Capacitors

- The area around the capacitors should be examined for evidence of dielectric leakage.
- The capacitors should be inspected to ensure they are free of damage or deformation.

NOTE: ***Spare capacitive components (Including filter doors) have a shelf life of 5 to 12 years. Capacitors that remain on the shelf for extended periods of time have a tendency to degrade.***

Capacitor electrolytes use a very thin film of oxide on the positive electrode that acts as an insulator between the plates. They need a small leakage current to keep this oxide layer in place. If capacitors remain unpowered for long periods the oxide layer can break down which can result in the capacitor exploding when power is applied.

This can be resolved by a process called reforming. Reforming the capacitors can take some time, hours typically for those that have not seen any power for many years. Naturally, this does require some patience and diligence. **Reforming applies voltage to the capacitor - but in a controlled manner so if the plates are shorted internally, the current is limited to a safe value. This allows the oxide layer to slowly reform, without producing excessive heat and gases.**

Reforming can be avoided by applying power to the components periodically.

Circuit Protection Devices

- Circuit breakers and ground-fault circuit interrupters require operation or testing as recommended by the equipment manufacturer. According to IEC standard 60947-1, Low Voltage Switchgear and Control gear, "The manufacturer shall specify in his documents or catalogues the conditions, if any, for installation, operation and maintenance of the equipment during operation and after a fault, and measures to be taken with regard to the equipment."

Main Circuit Breaker (CB2) – Disassemble, Inspect, Reassemble

- Refer to Siemens WL Circuit Breaker Operating Manual 3ZX1812-0WL20-1AN0- Section 24 (Catalog No: WLULOPMAN1 - Order # CBIM-01001-0504)

Molded-Case Circuit Breakers

- Molded-case circuit breakers should be kept clean for proper ventilation of the breakers. These types of breakers are usually tripped by a thermal element that senses an increase in temperature due to excessive current draw. However, if dirt accumulates on the surrounding of the breaker, the heat build-up may not be permitted to dissipate properly and result in nuisance tripping.
- Clean the breaker housing and inspect it for cracks or signs of overheating. Tighten all connections. Exercise the breaker several times to ensure the mechanism has freedom of movement and to allow contact wiping.

Connectors

- Examine for signs of deterioration, cracking, flaking, overheating, tracking or arcing.
- Ensure that all connectors are clean and dry.

Insulators and Conductor Supports

- ♦ Inspect for signs of discoloration, melting, cracking, broken pieces, and other physical damage or deterioration.
- ♦ Clean all loose dirt with lint free rags. For contaminates that will not remove easily, solvents approved by the manufacturer may be used.
- ♦ Examine for evidence of moisture that may lead to tracking or flashover while in operation.
- ♦ Examine surrounding areas for signs of tracking, arcing, or overheating.
- ♦ Repair or replace damaged insulators and supports as necessary.
- ♦ Examine all bolts and connecting devices for signs of deterioration, corrosion, or overheating.
- ♦ Examine marked bolts to ensure the connection has not loosened or moved.
- ♦ Examine any places where dissimilar metals come into contact for signs of galvanic action.
- ♦ Apply an antioxidant compound to all aluminum-to-copper connections.

Connection Torque

- ♦ Ensure that bolts and connecting devices are tight, according to manufacturer's specifications (If there is no manufacturer specification for torque, refer to the **Torque (NM)** chart (See **Appendix E**, page **E-20**).
- ♦ Use the **Inspection** torque values, and be careful not to over torque bolts and connecting devices since damaged connectors and insulators can be very time-consuming to replace.
- ♦ Use the inspection torques for 6/6 screws for all busbar connections and general use unless the screw material requires lower torque. Use the torques for 8/8 screws only where specified (These torques are generally used for very high loads).
- ♦ If a connection has more than one bolt and any bolt in the connection has to be re-torqued, then all bolts of that connection should be re-torqued.

Example of marking bolted connection

Figure 5-2: Bolted Connection Marking

- Any connections requiring re-torqueing should be re-marked and documented as requiring re-torqueing. Marking should be applied over bolts, screws/nuts, washers and lock-washers to the mounting surface, to indicate if the connection has moved at any time.

NOTE: ***The frequency of this inspection depends on the operating environment, and changes in load experienced by the circuit. The greater the load changes, the greater the temperature swing to which the connections are exposed. The resulting expansion and contraction of the connections creates loose connections over time. Unless connections are made incorporating Bellville washers, during the first year of operation connection torque should be checked quarterly, then annually in subsequent years. Connections should be re-torqued every 3 – 5 years.***

Control Transformers

- After de-energizing and grounding the transformer, clean all coils, connections, and insulators of loose dust or dirt deposits with a vacuum cleaner.
- Examine the transformer for signs of overheating, deterioration, arcing, loose or broken parts, or other abnormal conditions.
- Ensure all connections are tightened according to manufacturer's specifications.
- Ensure that transformer vent openings of any enclosed-type control transformer are free from dust, dirt accumulations and obstruction.

NOTE: ***Additional suggested testing includes an insulation resistance test, and a winding resistance test. These are non-destructive tests which can be performed to track the condition of the insulation over time. Detailed records should be maintained and analyzed to identify undesirable trends that may indicate the onset of an insulation failure.***

Fuse-blown indication mounting

- Switches still mounted securely
- Examine arrestor leads for damage and/or deterioration. Repair or replace as necessary

GFI Test Requirements

- Verify ground connection
- Measure the resistance between ground and neutral (should be greater than 1 megohm)
- Test GFI operation
- Record test date and results

SCADA

- Transformer data (such as, voltage, current, and temperature readings) should be recorded on a regular basis in order to determine operating conditions of the transformer. Peak, or redline, indicators should be recorded and reset. Readings taken on a weekly basis can provide important information about the loading of the transformer that is needed before additional loads can be added to the transformer.
- Inductor, contactor, transformer, busbar, refrigerant, and ambient Temperature trends should be reviewed and analyzed for rising heat levels not attributable to external ambient temperatures.

Surge Arrestors

- Clean and inspect porcelain for signs of damage or deterioration. Repair or replace as necessary.
- Examine arrestor leads for damage and/or deterioration.
- Perform resistance tests and grounding electrode circuit resistance tests. These should be conducted according to manufacturer's recommendations.

Transformer and Inductor Leads

- Meg-ohm meters should be used to test the insulation quality of all transformer and inductor leads. The power leads should be meggered at least once per year. Recording the results of each annual test will show trends in breakdown of electrical insulation. Early detection of insulation degradation will allow repair or replacement of the affected lead before a failure occurs.

WARNING: When meggering inductors, ensure the inverter is not connected to the inductors. The voltage used in megging can damage solid-state semiconductors in the inverter. **DO NOT TOUCH** the component under test or the test leads when megging.

Thermocouple connections

- Inspect connection for signs of discoloration, melting, cracking, broken pieces, and other physical damage or deterioration.
- Clean all loose dirt with lint free rags. For contaminates that will not remove easily, solvents approved by the manufacturer may be used. Examine for evidence of moisture that may lead to tracking or flashover while in operation.
- Examine surrounding areas for signs of tracking, arcing, or overheating. Repair or replace damaged insulators and supports as necessary.
- Examine for any signs of galvanic action.
- Ensure that bolts and connecting devices are tight.

Record Keeping

- ♦ The electrical preventive maintenance program should be well-documented as to scope and frequency of maintenance.
- ♦ Record all routine maintenance activities and the results of routine testing for trending purposes.
- ♦ Document all repair and/or replacement of electrical components.
- ♦ When changes are made to the electrical distribution system, update all applicable drawings and maintenance schedules to reflect the changes. Ensure that spare parts inventories are updated for any new equipment added based on the manufacturer's recommendations.

Standards

- ♦ Any electrical preventive maintenance program should be performed in accordance with accepted industry standards and work / safety practices. This includes, but is not limited to, the latest releases of the following:
  - **National Fire Protection Association (NFPA) 70**, *National Electrical Code.*
  - **National Fire Protection Association (NFPA) 70B**, *Recommended Practice for Electrical Equipment Maintenance.*
  - **National Fire Protection Association (NFPA) 70E**, Standards for Electrical Safety in the Workplace
  - **International Electrical Testing Association (NETA)**, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.*
  - **National Electrical Manufacturers Association (NEMA) Standard AB4**, *Procedures for Verifying Field Inspections and Performance Verification of Molded-Case Circuit Breakers*. Applicable Federal or State OSHA Regulations, including among others **29 CFR 1910.269, Subpart S (29 CFR 1910.301-399)**, and the General Duty Clause (**29 USC 651, et al, Section 5**), or the equivalent state standards.

Recommended Coordinated Inspections

♦ Disconnect Switches

- ♦ Inspect and clean* insulators and conductors.
- ♦ Tighten connections in accordance with manufacturer's specifications. Do not over tighten as this may result in damage to connectors.
- ♦ Check the operation of the arc blades, if applicable, and ensure proper wipe of the main contacts. Interphase linkages and operating rods should be inspected to make sure that the linkage has not been bent or distorted and that all fastenings are secure. The position of the toggle latch to the switch operating linkage should be observed on all closed switches to verify the switch is mechanically locked in a closed position. Operate switch manually several times to ensure proper operation, and then by motor if power-operated. Ensure that all moving parts are properly secured and lubricated as specified by the manufacturer.
- ♦ Contact resistance testing of each phase contact should be performed. The results should be recorded and analyzed to ensure proper contact is being made. If the contact resistance of the switch exceeds recommended minimums, repair or replace the switch immediately

♦ Liquid-Filled (Isolation) Transformer

- ♦ Insulating liquid samples should be taken annually and screen tested for dielectric breakdown, acidity, color, power factor, and interfacial tension. A Dissolved-Gas-in-Oil (DGA) test conducted by a qualified testing laboratory should be performed annually. The results should be trended to track conditions and schedule maintenance as necessary.
- ♦ Examine the transformer tank and bushings for evidence of leakage. Inspect the bushings, insulators, and surge arrestors for broken or damaged parts, signs of overheating or arcing, or tracking.
- ♦ Clean* all bushings, insulators, and surge arrestors of any dirt or dust accumulation.
- ♦ Tighten all conductor connections in accordance with manufacturer's recommendations.
- ♦ If applicable, perform a ground resistance test to ensure a value of 25 ohms or less.

NOTE: * ***If cleaning solvents are used, ensure that they are as recommended by the manufacturer. Where abnormal environmental conditions exist, more frequent inspection and cleaning may be required.***

General Inspection

NOTE: ***A General Inspection should be performed on each visit to the Enclosure. General Inspections are cursory in nature and not intended to be inordinately time-consuming***

- **Silent operation of the fans**
- **General state of the enclosure (external) such as cleanliness and corrosion**
- **Obstruction of the ventilation**

Condenser Maintenance and Service

WARNING - Disconnect all power before service!
Ensure Battery Disconnects are Open and Locked Out / Tagged Out
Ensure Isolation Transformer Disconnect is Open and Locked Out / Tagged Out

General Guidelines for the Servicing and Maintenance of Refrigerant Cooled Inverters

The purpose of this section is to provide a reference for anyone involved in the operation, installation or maintenance of the Parker EGT line of refrigerant cooled inverters

Overview

- Refrigerant cooled inverters use the refrigerant R134a as a heat exchange medium and are available in two main variants:
    1. Water cooled heat exchanger
    2. Fan cooled, externally mounted condenser.
- Unlike a vapor compression unit, the refrigerant cooled inverter does not employ a compressor in the system and any gas-liquid phase change occurs in the heat exchangers. System parameters are monitored and maintained by a high volume microprocessor controlled variable speed pump.
- All fittings in the system are designed to seal shut when the connection is broken which enables replacement of key components, should the need arise, without evacuating the system.
- If by some chance a leak should occur in the refrigerant system, there will be no damage to electronic components as there would be in a comparable water cooled system. Onboard temperature sensors would also force a shutdown of the inverter in such a case, further reducing any chance of damage to the inverter.
- A refrigerant recovery unit and associated equipment are required to service the refrigerant cooling system of the inverter.

Refrigerant Safety

WARNING - Care should be taken when handling and using R-134a. Leaking R-134a can cause frostbite and severe eye damage if contact occurs. Safety glasses and heavy gloves should be worn when handling refrigerants.

A refrigerant scale should always be used when evacuating R-134a from the inverter cooling system. The weight of the refrigerant being removed must be determined to prevent the possibility of overfilling the recovery tank and know how much refrigerant has been lost.

WARNING - A recovery tank filled beyond 80% of its capacity can explode under certain circumstances due to the expansion characteristics of the refrigerant as temperature increases. A 30 pound recovery tank should NEVER be filled with more than 24 pounds of refrigerant.

Refrigerant fill weights are system specific and are dependent upon the type of heat exchanger, and the distance between the inverter and the heat exchanger.

It is suggested that all documentation for each recovery unit be read and understood before initial use of the unit. There may be subtle differences in their operation that are model specific.

Standard Practices for Using Refrigerant Recovery Units

This section will briefly familiarize untrained personnel with the procedures necessary to safely remove and replace refrigerant in the refrigerant cooled inverter. By adhering to a few general guidelines the care and maintenance of the cooling system will be a simple straightforward process.

Avoid contamination of refrigerant and system! The system can be contaminated by not purging air from the refrigerant hoses, charging manifold or the recovery unit itself. The recovery tanks should be purchased new and never used for any other refrigerant. Special care must be taken to completely remove all refrigerant from a recovery tank. Introducing a non R-134a refrigerant into the cooling system from a contaminated tank will lower the cooling capacity of the system. Air or moisture in the system will have the same effect.

Avoid loss of lubricant. Lubricant can be lost by evacuating refrigerant as a liquid and carrying the oil out of the system while doing so. Always make sure to return as much refrigerant as possible in its liquid state to avoid excessive loss of the lubricant. Excessive loss of lubricant will shorten system pump life and result in expensive repairs.

Carefully weigh refrigerant during extraction and recharge of system to ensure the system is correctly filled. There is no other way to determine the exact amount of refrigerant in a system. Sight glasses on the expansion tanks give an approximation, but system performance is the key indicator of refrigerant volume. Too much or too little refrigerant will cause poor cooling system performance. As mentioned earlier, overfilling a recovery tank could lead to a potentially deadly tank explosion.

Due to the fact that there is no compressor in the system, refrigerant must be pumped back into the system by reversing the evacuation process.

Recovering the refrigerant from system (A single-pump tray is shown for simplicity)

Materials needed:

- Refrigerant recovery unit equipped with inline filter on inlet side
- Refrigerant charging manifold with sight glass
- Three refrigerant hoses equipped with ball valves
- Refrigerant scales
- Clean, empty recovery tank(s)

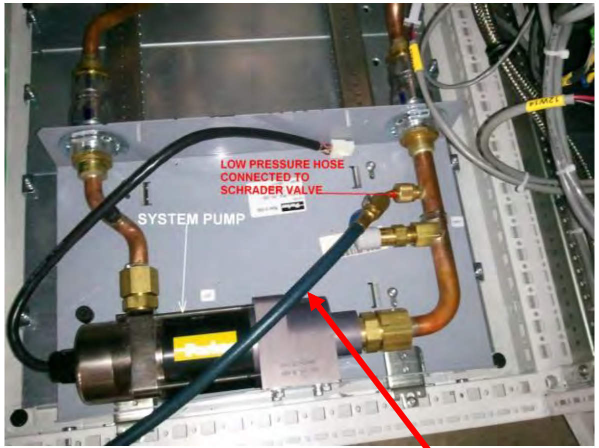
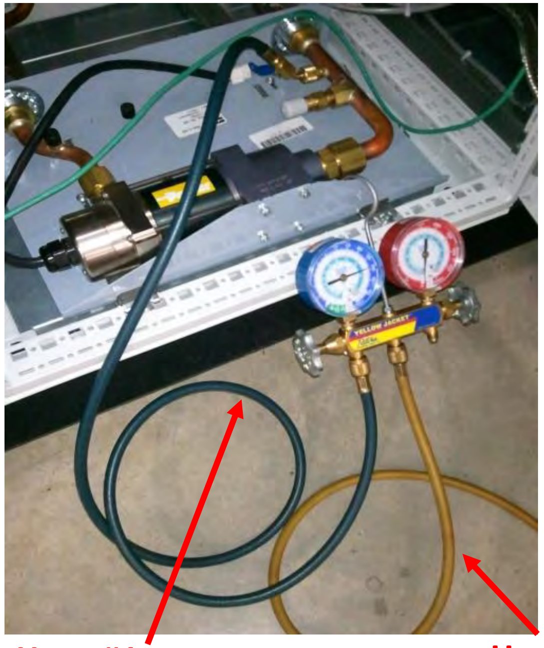


Figure 5-3 Hose #1



Hose #1 *Figure 5-3a* Hose #2

Figure 5-4 Hose #2

Figure 5-5 Hose #3

Recovery procedure:

1. Turn off three phase power to system
2. Shut all valves on hoses and recovery unit
3. Locate Schrader valve 'in' pump piping (**Figure 5-3**) and connect low pressure hose (located under low pressure manifold gauge) to valve. (**Figure 5-3a**)
4. Connect additional hose (end w/o ball valve) to center port of charging manifold.   Make sure the valve remains closed.
5. Open valves at system connection and on low pressure side of charging manifold.
6. Briefly open the valve on the free hose end until hissing of escaping refrigerant is heard.
7. Immediately close valve and connect to recovery unit filter. (**See Figures 5-4 & 5-5**)

   Recovery hoses have now been purged.

8. Place recovery tank on scale,
9. Connect third refrigerant hose to outlet of recovery unit and purge hose and recovery unit by opening valves on recovery unit.
10. Immediately connect hose to valve marked "liquid" on recovery tank (**See Figure 5-6**).
11. Set scale to zero,

   System is now ready to be evacuated.

Figure 5-6

12. Open all valves except inlet valve on recovery unit.

13. Start unit and slowly open inlet valve.

14. Observe refrigerant scale and monitor the amount of refrigerant being recovered. Do not exceed the 80% recovery tank limit. Change tanks, if required, making sure to record weights and continue until gauge on recovery unit descends into the vacuum range.

Once into this range, recovery can be considered complete.

Refilling the system:

Refilling the system is essentially the exact reverse of the extraction procedure with the same attention being paid to avoiding contamination of the system and the weight of the refrigerant being put into the unit.

On the Recovery Unit, move hose #2 to the red 'Out' connection and hose #3 to the filter on the blue 'In' connection (**Figure 5-7**).

Proceed to charge the system to the appropriate pounds listed below.

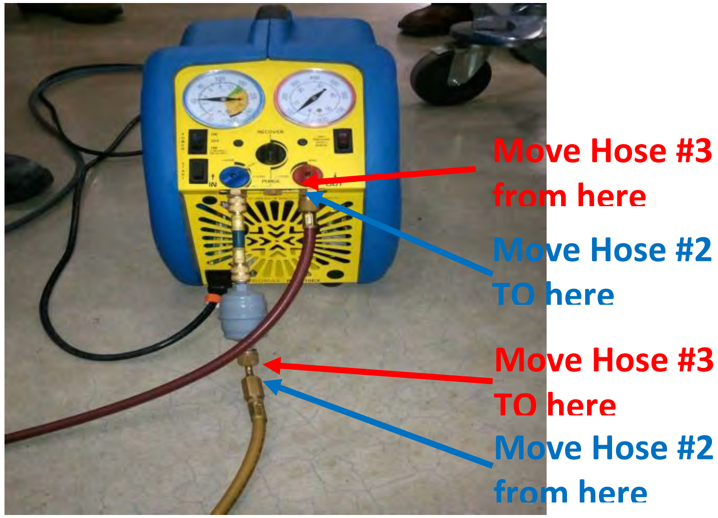


Figure 5-7

Drive Type	R-134a charge (#)
890GTB	45 pounds
Water cooled standard 890PX-C	13 pounds

Cooling System Components

The cooling system utilizes a refrigerant vaporizable dielectric fluid (VDF) as the working coolant. The fluid is pumped around a closed loop consisting of pumps, plumbing, cold plate(s) where the heat is removed from the devices being cooled, an evaporator, and a condenser.

Photographs of typical components are shown in **Figures 5-8 to 5-11**.

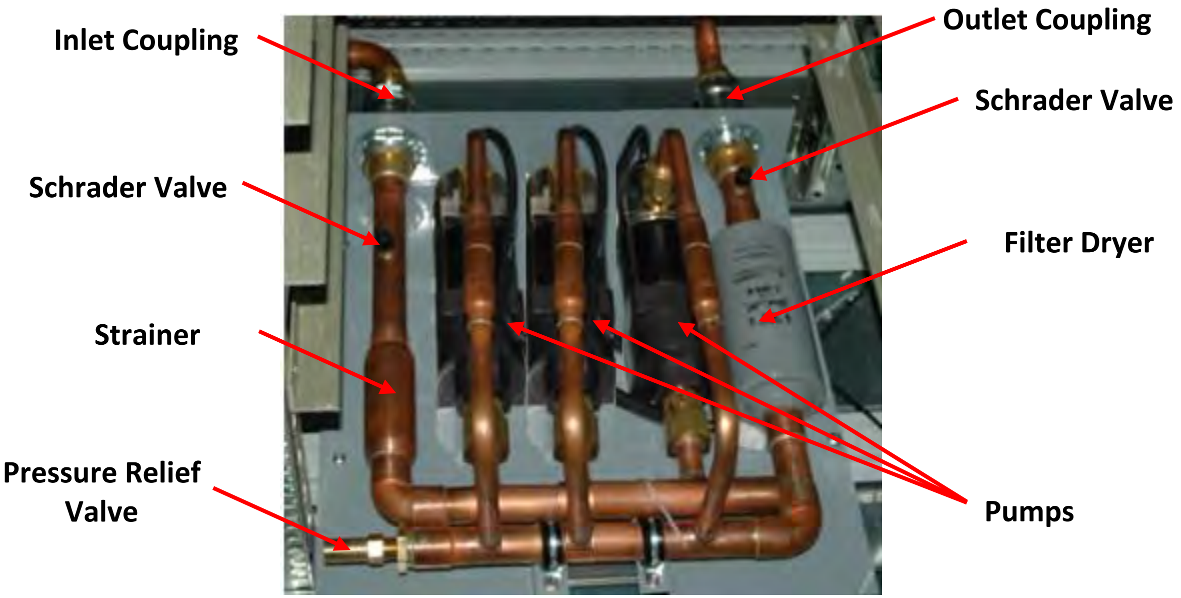


Figure 5-8: 3-pump assembly

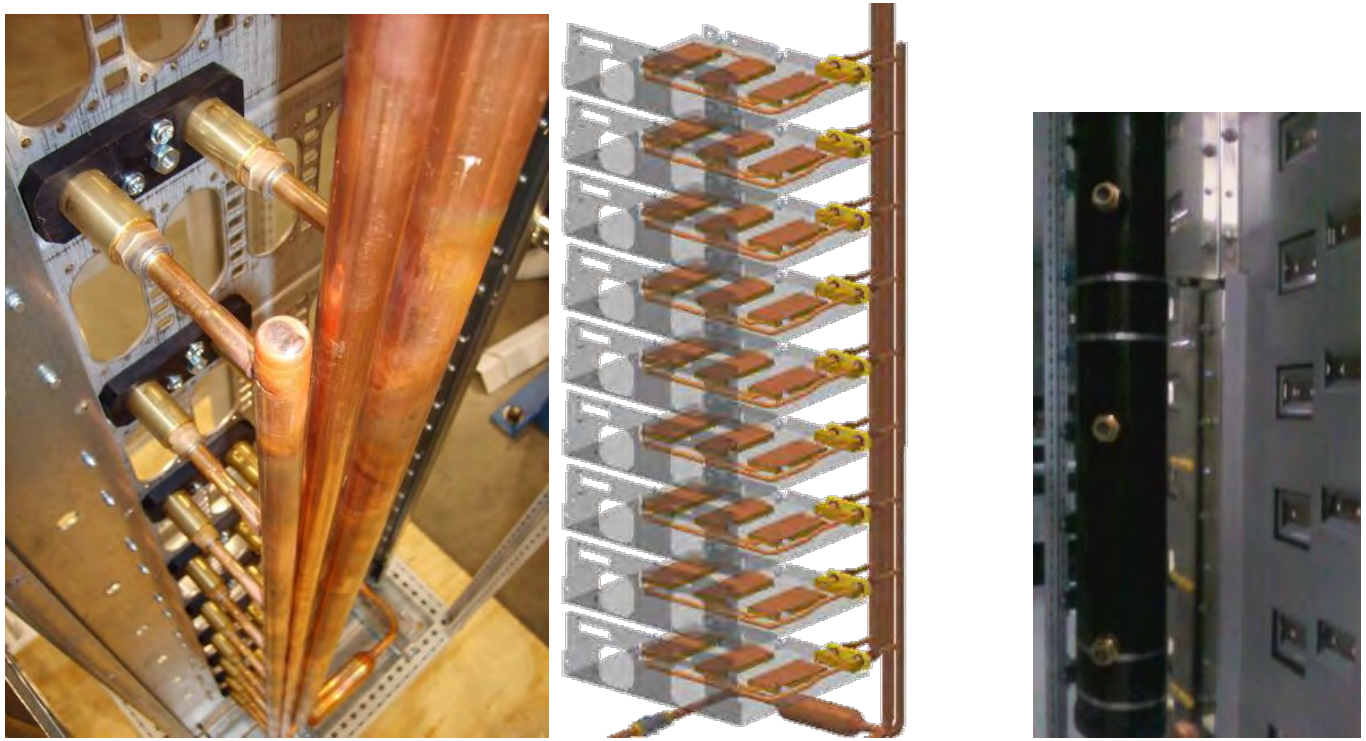


Figure 5-9: Typical plumbing system used in system showing IGBT Coldplates, piping, and accumulator

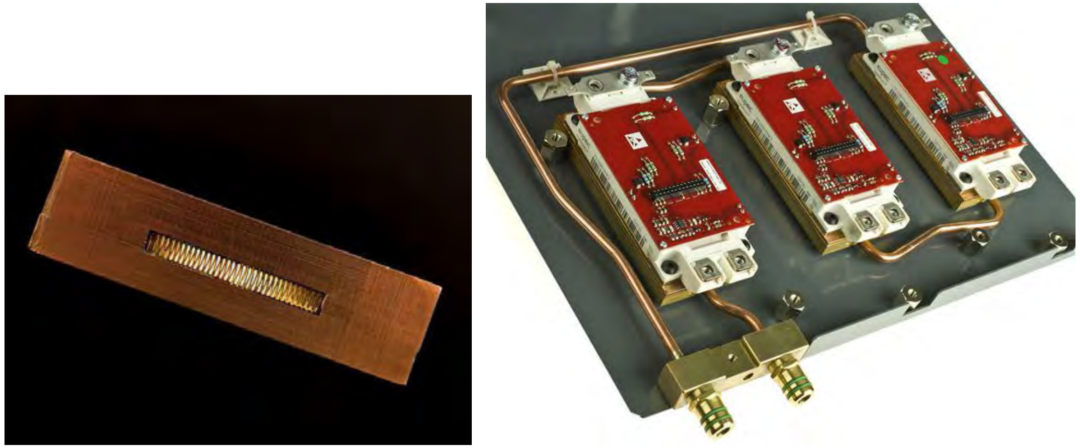


Figure 5-10: Details of ColdPlate for IGBTs

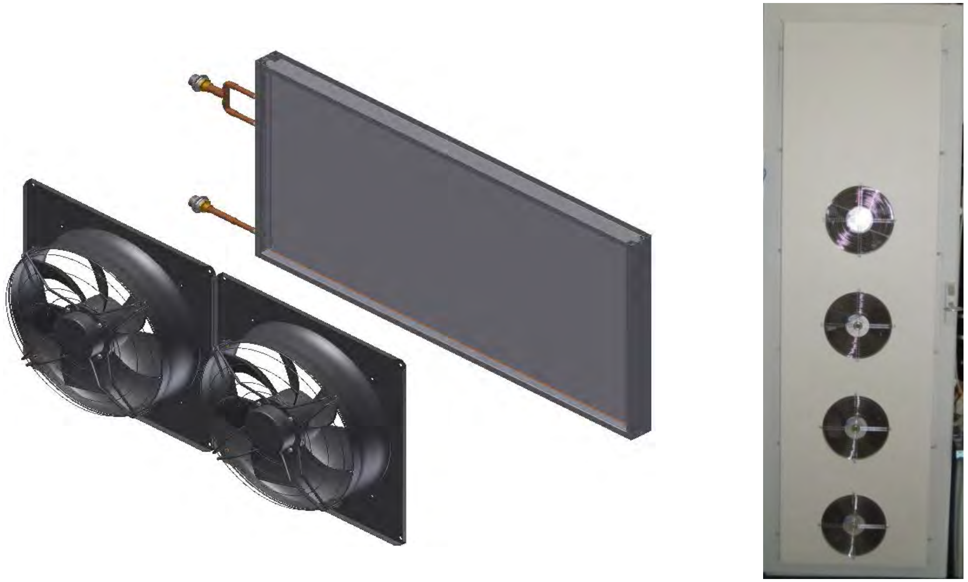


Figure 5-11: Air cooled condenser / Inverter Stack Door

Inspection

- Check the cleanliness of the finned condenser.

NOTE: ***The cleanliness of the finned condenser is essential to ensure smooth operation and long life of the equipment. There is no general rule how often it should be cleaned. Frequency and method of cleaning depend on the user environment and must be determined by the operating personnel. The equipment is always supplied in a clean state. Should, during installation and/or test runs, contamination reach a state where capacity drops may be expected, it is necessary to clean them before operation.***

- Properly assessing and addressing damage to condenser coils will help insure economical operation of the cooling system and avoid unnecessary and possibly more expensive repair costs later.
  - The condenser coil construction is copper tubing with aluminum fins which are attached mechanically to the copper tubing. The aluminum fin stock is relatively thin and easily bent. The severity with which they are bent, the depth of the deformity and the total surface area of the coil affected are some of the primary factors that should be taken into account when deciding to repair or replace a condenser coil:
    - ***Negligible damage*** which involves minor deformation of the fin surface over less than 10 percent of the surface area. The depth of the deformation to the fins does not extend to the condenser tubing and no deformation of the condenser tubing has occurred. With negligible damage, the air flow through the condenser coil is not significantly impeded. While this type of damage is not aesthetically pleasing, it generally does not require corrective action.
    - ***Minor damage*** to a condenser coil is described as shallow indentations in the coil surface that exceeds 10 percent, but does not involve more than 15

Figure 5-12: Finned Condenser - No Deformation

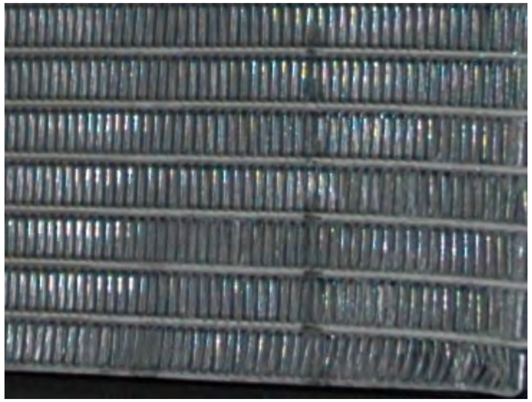


Figure 5-12a: Finned Condenser - Deformed Area

percent of the coil surface area. This level of damage requires straightening out the condenser fins to restore optimum air flow through the coil.

- ***Moderate damage*** is defined as coil indentations or paths of bent fins that are at least 1/8 inch deep and cover more than 15 percent of the coil surface area, but does not involve more than 30 percent of the coil surface. This level of damage is more difficult to address and will require a minimum response of straightening the fins. Coils with a moderate level of damage may not readily be restored to optimum air flow conditions. Moderately damaged coils may require 30 minutes or more per square foot of damaged coil surface area to straighten the fins.
- ***Severe damage*** is defined as indentations in the coil surface that are from ¼ inch to 3/8 inch deep. The damage will cover 30 percent or more of the coil surface area. This degree of damage cannot be ignored and will eventually lead to equipment failure if not properly addressed. Because of the nature of severe damage, it is far more difficult to straighten the fins, but it may still be possible to do so. However, it is a very labor-intensive project. Allow 40 minutes to an hour per square foot of damaged coil surface area to straighten the fins. This level of damage may also involve damage to the refrigerant tubing in the coil. In some cases, it may be a better choice to replace the condenser coil rather than attempting to repair it.

Figure 5-13: Condenser / Evaporator Fin Repair Tools
(L-R) FST (for 8,10,12,14 Fins per Inch), FST2 (for 16,18,20,22 Fins per Inch), Straight-nose Pliers

Fan Motors and Repair Switches

- The only electrical components vulnerable to potential malfunction are the fan motors and switches.
- In the event of motor or switch failure, affected motor should be removed from unit and tested separately from the unit.
- If the motor and or switches continue to malfunction then they will need to be replaced.

Mechanical Cleaning of the Heat Exchanger

- Blow down the fins with air (only suitable for light, dry and dusty deposits)
- Cleaning with compressed air (maximum pressure 6 bar, minimum distance from fins – 8 inches)
- With light contamination and fibrous material, mainly at the inlet of the fins, clean with a soft brush or use an industrial vacuum cleaner.

WARNING: When cleaning the unit, it must be out of operation and all electrical power disconnected.

Hydraulic Cleaning of the Heat Exchanger

- For oil containing deposits it is acceptable to add detergent to the water. Make sure not to deform the fins.
- When using chemical substances make sure they do not attack the heat exchanger material and casing. Rinse the heat exchanger and casing after treatment.
- When cleaning with liquid or compressed air the fans must be switched off and do not spray them directly
- Cleaning must be continued until all contamination has been removed.
- Always clean / spray in the direction of the fins. Never clean at 90° to the fins.

WARNING: When cleaning the unit, it must be out of operation and all electrical power disconnected.

R134a Refrigerant Level Sight Glass

- Sight glass is located on the Refrigerant Accumulator.
- Check the sight glass for the R134a Refrigerant Level is only required when the Refrigerant Level Sensor is suspected to be faulty.
- If the sensor indicates the level is good, but the temperature is not able to be correctly regulated, physically check the R134a level.
- The LOWER sight glass ball should be floating at the top of the sight glass.

Check for evidence of coolant leakage

WARNING: When physically checking the R134a level, the unit must be out of operation and all electrical power disconnected.

Figure 5-14: R134a Refrigerant Accumulator and Sight Glasses

Typical Recommended Refrigerant Component Replacement Schedule

Action	Component	Frequency
Replace	Coolant Pumps	7 years
Replace	Condenser Fans	7 years
Replace	Internal Fans	10 years

Detailed Test Procedures

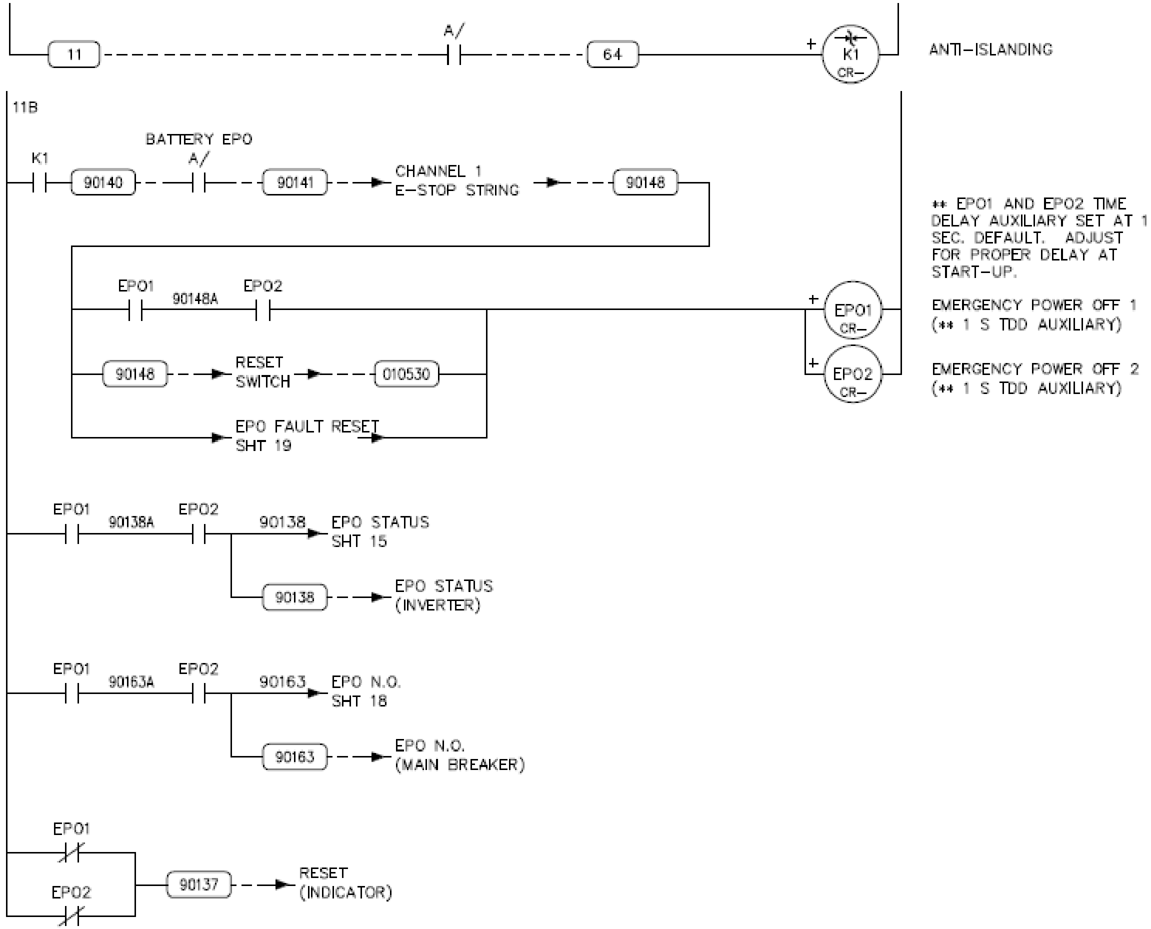
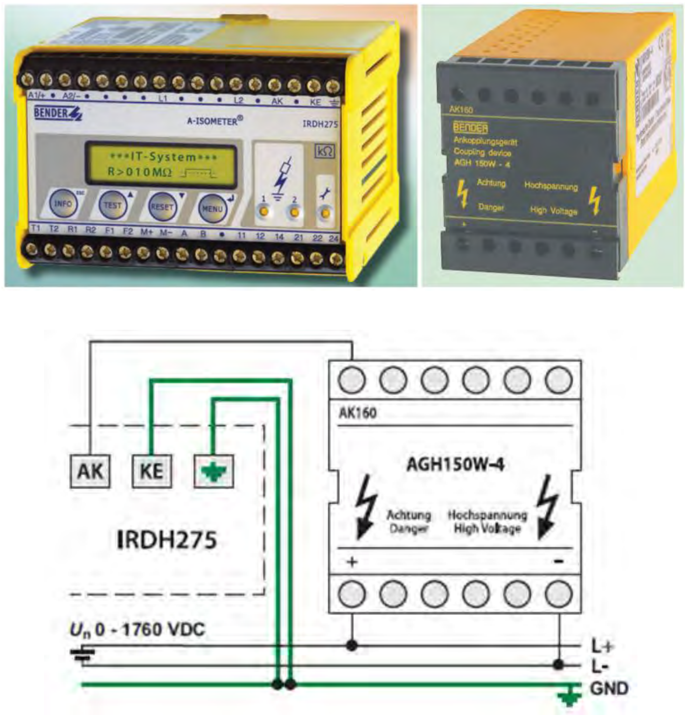


Figure 5-15: Typical 890GTB EPO

Initial state: control power on and EPO energized

1.) Ensure EPO state is faulted on loss of Anti-Islanding, Battery EPO, or Channel 1 E-Stop String. Confirm operation of EPO Relays, EPO Status to Inverter, and EPO Status to Main Breaker.

2.) Ensure EPO resets via RESET SWITCH and PLC Logic. Confirm operation of EPO Relays and Reset Indication.



(11, 12, 14) Alarm relay 1, normally energized or de energized contact
(21, 22, 24) Alarm relay 2 / System Fault Relay,
Normally energized or deenergized Contact

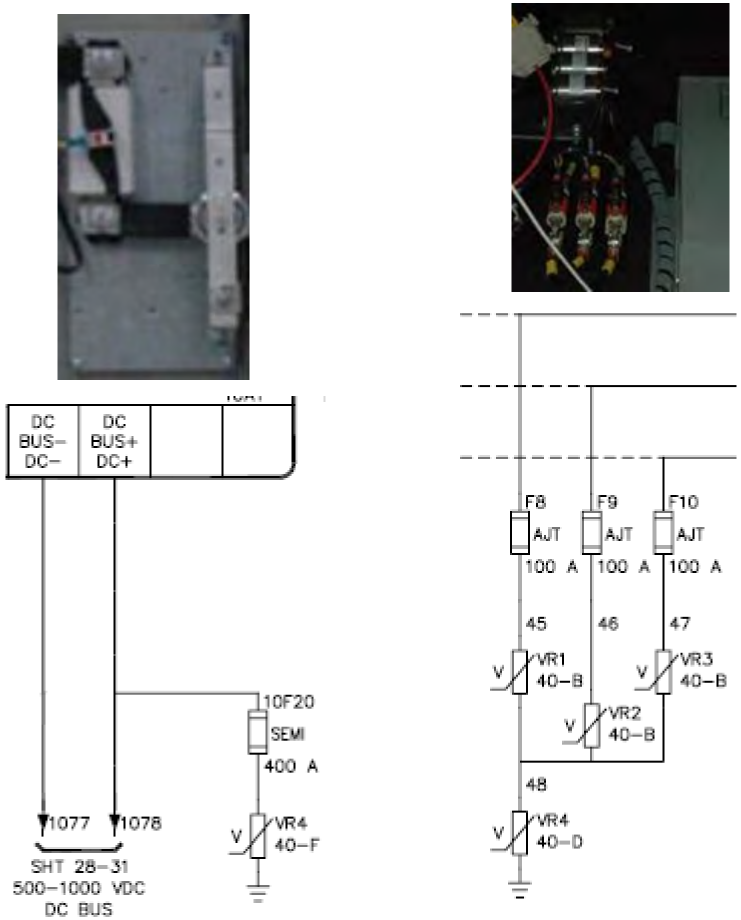


Figure 5-16: Typical 890GTB Ground Fault Circuits

Initial state: all power off

1.) Check fuses F5, F8, F9, F10, and 10F20 for continuity.

2.) Check surge suppression Strikesorbs resistance.

Procedures

Module Replacement

WARNING: RISK OF ELECTRICAL SHOCK

Failure to follow procedure may result in damage to the inverter and possible electrical shock hazard!
Isolate inverter from grid connection and DC Voltage feed source before attempting this procedure! Make sure the power is OFF, and that it cannot be switched on accidentally while you are working. Allow at least 10 minutes for the system's capacitors to discharge to safe voltage levels (<50V).

Removing Phase Module

1. Unplug the cables from the front of the module.
2. Disconnect DC BUS connections from left side of the phase module
3. Loosen the captive bolts securing the module until it is free.
4. Use a 5 mm hex driver to disengage the module from the rack.
5. Pull the module towards you and slide it out of the rack. (Approximate weight 40 lbs. (18 kg))
6. Install caps on the refrigerant line connections on the back of the module.

Figure 5-17: 890GT Phase Module

Installing Phase Module

NOTE: The module types will only function properly when fit into their correct locations due to the positions of their connectors; but, the phase modules are identical and can be interchanged.

1. Remove the caps from the refrigerant line connections on the back of the module.
2. Insert the module and push it to the back of the rack to make the electrical and refrigerant connections.
3. Secure the module. Tighten to 8 Nm (6.2 lb-ft).
   The bolts should bottom out when the module is properly inserted.
4. Connect DC BUS connections from left side of the phase module.
   Tighten to 16.5 Nm (12.8 lb-ft).
5. Refit the cables to the front of the module.

Figure 5-17: 890GT Phase Module

IMPORTANT: After removing or installing phase modules, check the refrigerant level to ensure that refrigerant has not been lost. See details in your system maintenance manual regarding cooling system inspection.

Parallel Control Module (PCM)

Replacing the PCM follows the same procedures for the phase modules except that there are many more cables to connect. This section lists the special details when making the connections after the module is screwed into place.

1. **SAVE YOUR APPLICATION DATA.** The factory makes every attempt to save the application data when repairing a PCM. To be safe, use DSELite to save the application data before removing the PCM. The control power must be on to save the data.
2. Load your application data using DSELite into the replacement PCM after it is secured in the power stack.
3. It is critically important that the phase module control cables are installed into the proper U, V or W terminal. The phase modules are organized into stacks of three modules, one for each phase (U, V, and W). These groups are labeled 1, 2, and 3. The output phases from each stack are wired in parallel.
4. Make sure to reconnect every cable to the PCM. There are 32 possible connections or terminal blocks although not every connection is required for every application.

This photo shows the connection points (the illustration does not show a 8903/IM cards installed).

When replacing the PCM, be sure to install your configuration from the back-up disc using DSELite.

There are many connections to the module. Take special care to ensure that each wire is securely connected to its proper terminal.

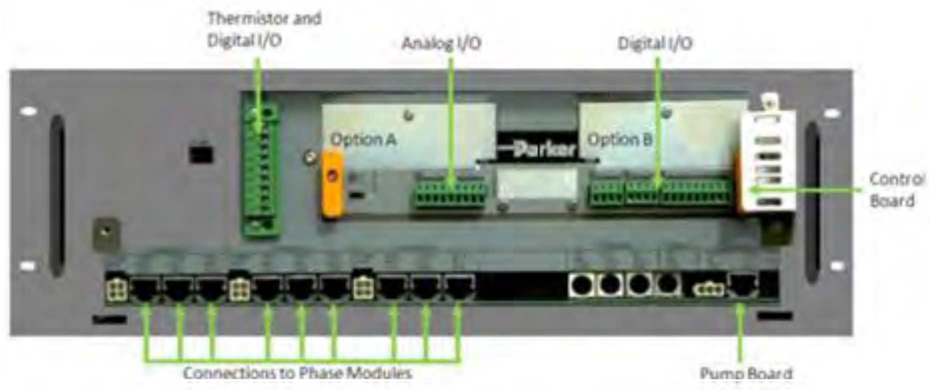


Figure 5-18: 890GT PCM

IMPORTANT: Crossing phase wires will cause an overcurrent or desat trip upon starting the inverter.

Removing the Control Board

The control board assembly is removable from the PCM. This is required to replace or add option boards.

Note: Refer to the Option Card Technical Manual for fitting/wiring details.

1. Remove the wire support bracket (A) if it is installed.
2. Loosen the screws (B) securing Option A and Option B, if fitted.
3. Undo the captive screws (C) located in the handles of the control board. Gently pull on the handles to withdraw the board from the inverter, supporting any attached option boards.

Installing the Control Board

Note: The boards are sliding in slots. Make sure to align the board with the slots when reinstalling the assembly.

1. Fit the control board (with attached options) into the Inverter. Push the board gently to engage the connectors on the rear edge of the control board with the Inverter's connectors.
2. Tighten the captive screws (C) located in the handles of the control board.
3. Tighten the captive screws (B), if fitted.
4. Replace the wire support bracket (A).

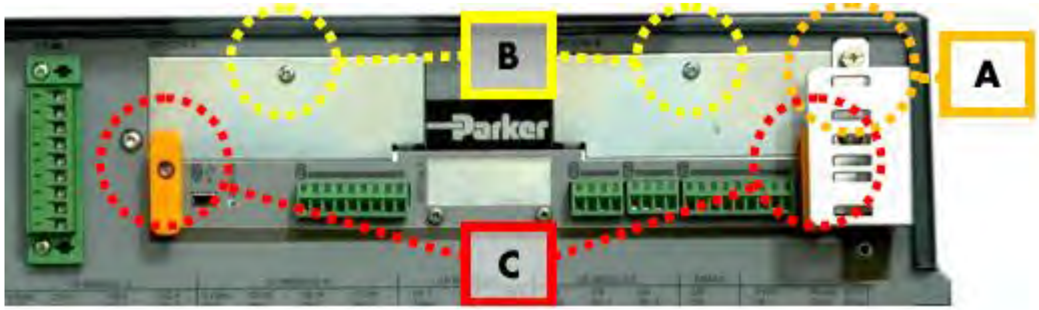


Figure 5-19: 890GT Control Board

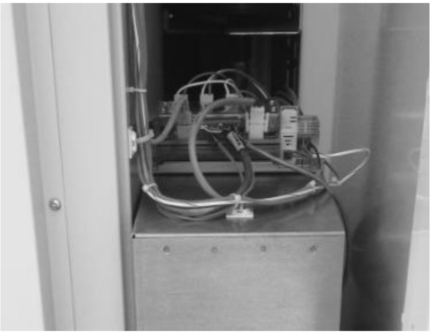


Figure 5-20a: 890GTB Pump Control Module Location

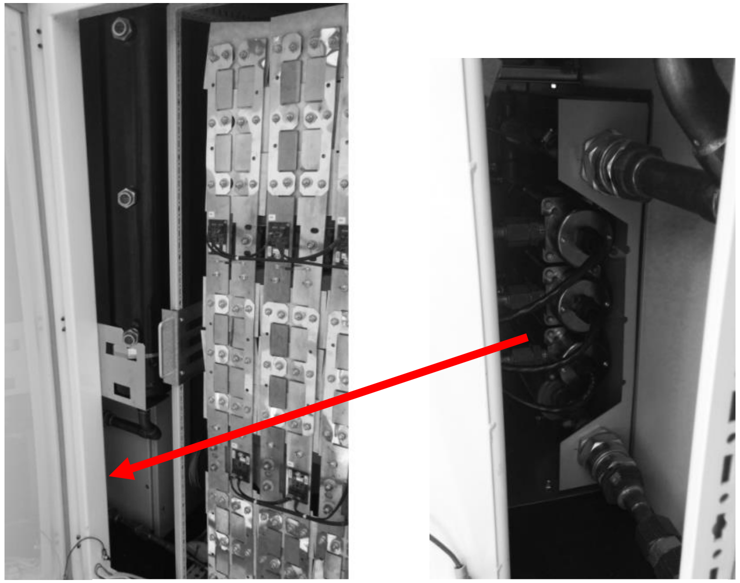


Figure 5-20b: 890GTB Pump Tray Location

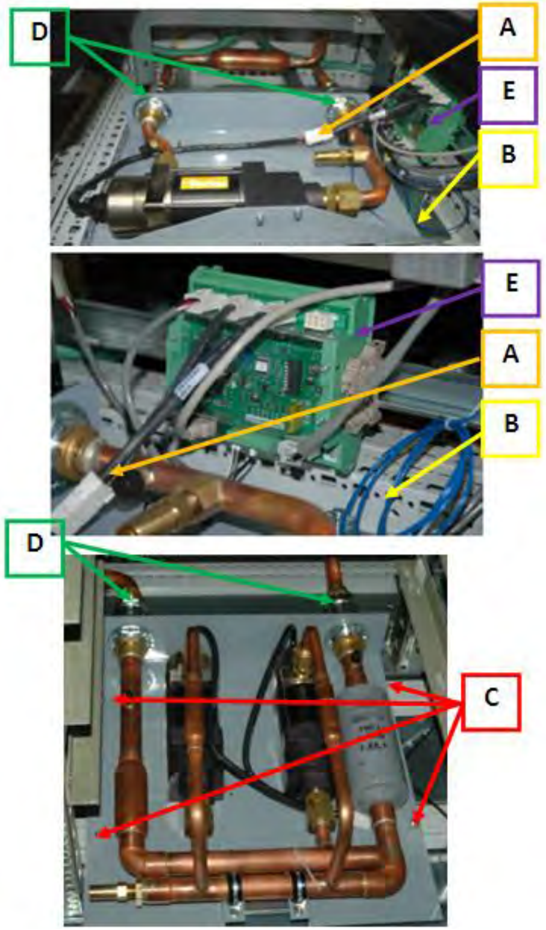


Figure 5-20: 890GTB Pump Tray and Pump Module Connections

Removing the Pump Tray

1. Unplug the pump wires (A) and thermistor wires (B).
2. Remove the four screws (C) on the bottom of the tray that secure the tray to the enclosure.
3. Disconnect the two coolant lines (D) on the back of the tray.
4. Pull the tray out of the enclosure.

Installing the Pump Tray

1. Slide the tray into the enclosure.
2. Connect the two coolant lines (D) on the back of the tray. Support the static side of the coupling with wrench while applying torque of 61Nm (45 lb-ft) to the coupling).
3. Install the four screws (C) on the bottom of the tray that secure the tray to the enclosure. Torque screws to 4Nm (3.1 lb-ft).
4. Connect the pump wires (A) and thermistor wires (B).

Pump Control Module

The pump control module (E) is mounted to right of the power stack. When replacing the assembly, the dip switches must be set to match the equipment. Refer to Appendix E for detailed information on the pump control module.

Cleaning O-ring couplings

IMPORTANT: Overfilling and underfilling can degrade system performance and cause nuisance trips.

Use this procedure to clean or repair the o-ring seals on refrigerant cooled modules, condenser, and bypass valve fittings.

TOOLS

- Dow Corning 111 lubricant/sealant
- Isopropyl alcohol
- Soap, water, small foam brush and small soft bristle brush

Figure 5-21: Phase Module 'O'-Ring Location

PROCEDURE

1. Place the module so that the coupling angles downward to prevent cleaning fluids from entering the fitting.
2. If a protective cap was left on the coupling during installation, carefully remove any plastic out of the couplings.

IMPORTANT: Do not use compressed air or water under high pressure.

3. Use soap, water and a foam brush to clean the inside of the coupling. Rinse thoroughly.

Note: Moisture in the system will result in poor performance and premature component failure. Extended vacuuming is recommended after any potential introduction of water.

4. Clean the outside of the coupling using soap, water and a soft bristle brush. Rinse thoroughly and dry with a lint free cloth.
5. Inspect the O-rings. If any o-ring appears damaged or cut, replace it with a new o-ring (part number BO472917U014). Use isopropyl alcohol and a lint free cloth to clean the O-rings. Apply Dow Corning lubricant to the O-rings.

Removing an Inductor

1. Open Capacitor Panel to access Inductors.
2. Unplug the cable from the front of the Inductors to be removed (A).
3. Use 5 mm hex driver, turning Jackscrew (B) counterclockwise to disengage inductor Electrical Connection (C) and Coolant Connection (D) from rack.
4. Using Handle (E), Pull Inductor towards you and remove from Rack (Approximate weight 154 lbs. (70 kg))
5. Install caps on the refrigerant line connections on the back of the module.

CAUTION: Inductors are heavy. Exercise caution handling inductors during removal and installation

Figure 5-22a: GTB Filter Capacitor Panel

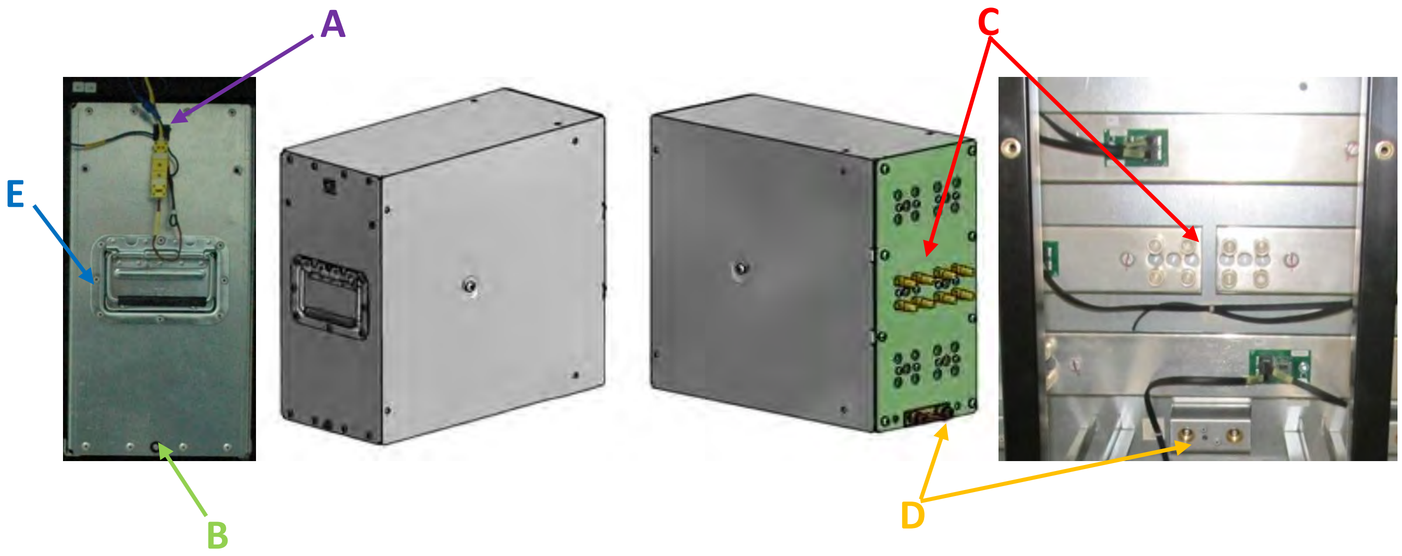


Figure 5-22c: GTB Filter Inductor and Connections

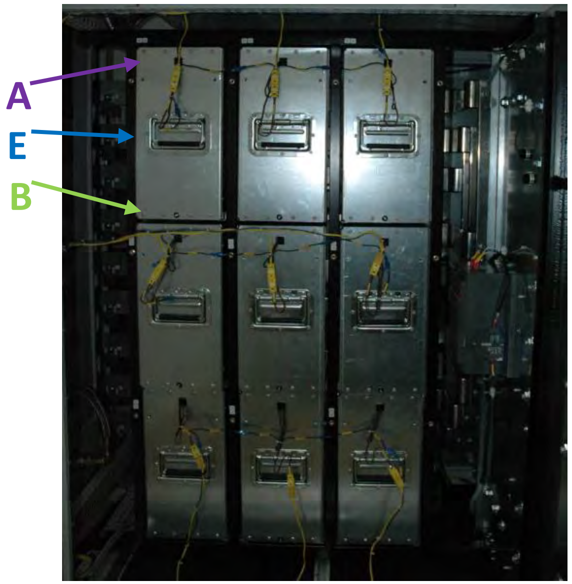


Figure 5-22b: GTB Filter Inductors

Installing an Inductor

1. Open Capacitor Panel to access Inductors.
2. Remove the caps from the refrigerant line connections on the back of the module.
3. Slide the inductor into the appropriate slot in the rack (There are specific Inductors for Top, Middle, and Bottom Positions)
4. Use 5 mm hex driver, turning Jackscrew (B) clockwise to engage inductor Electrical Connection (C) and Coolant Connection (D) into rack. Tighten to 8 Nm (6.2 lb-ft). The bolt should bottom out when the module is properly inserted.
5. Plug the cable into the front of the Inductor (A).
6. Close and secure Capacitor Panel.

Figure 5-22c: GTB Filter Capacitor Panel

CAUTION: Inductors are heavy. Exercise caution handling inductors during removal and installation

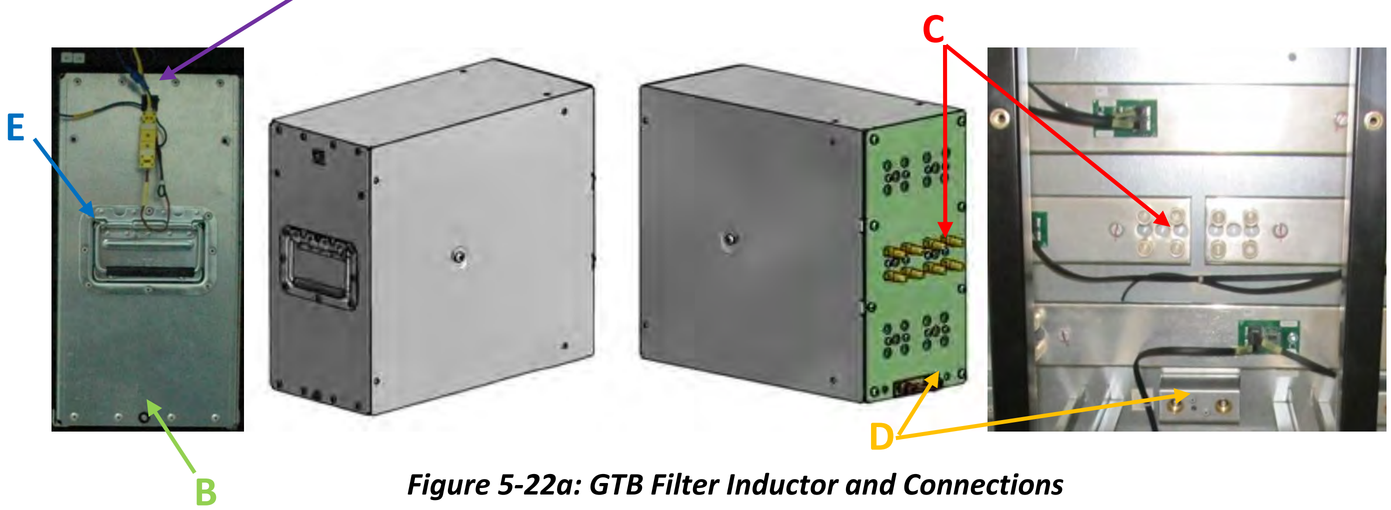


Figure 5-22a: GTB Filter Inductor and Connections

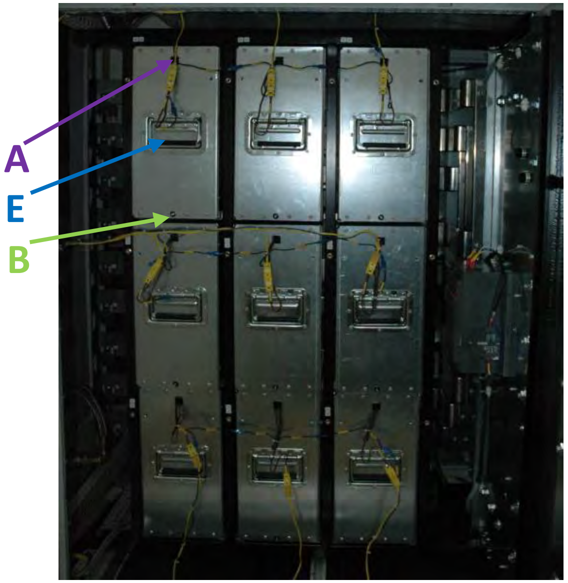


Figure 5-22b: GTB Filter Inductors

Inclement Weather Servicing

See page 5-3.

OSHA REGULATIONS:

Lockout/Tag out Policy & Procedure:

- **1910.147 – The control of hazardous energy**

Electrical Power Generation:

- **1910.269 – Utility Construction & Maintenance**

Personal Protective Equipment:

- **1910.132 – General**
- **1910.133 – Eye and face**
- **1910.134 – Respirator**
- **1910.135 – Head**
- **1910.136 – Foot**
- **1910.137 – Electrical**
- **1910.138 – Hand**

Chapter 6 PPE

This section provides general information on Personal Protective Equipment. Supervisors must assess the job tasks performed by their workers and document what personal protective equipment (PPE) is necessary for the work being performed. Each worker who is required to use PPE must be provided with training.

WARNING:

IMPORTANT **All electrical work must be done in accordance with local, national, and/or international electrical codes by a qualified electrician.**

IMPORTANT **WARNING: Battery Strings can produce dangerous electrical voltage levels.**

IMPORTANT **WARNING: Extreme Arc Flash and Shock Hazards**

- **Flash Hazard Boundary 60”**
- **Up to 24.46 Cal/cm^2 at 18”**
- **Class 3 PPE Level (Rated at 25 Cal/cm^2) – 2 layers of clothing: cotton underwear + fire resistant shirt and pants or coveralls + multilayer flash suit, VR gloves-tools, with appropriate flash hood.**
- **Limited Approach Boundary 120”**
- **Restricted Approach Boundary 12”**
- **Prohibited Approach Boundary 1”**

This section does not take the place of the specific training supervisors must provide their workers who use personal protective equipment (PPE)
Refer to the most current revision of the OSHA informational booklet OSHA 3151-12R for information on personal protective equipment (PPE).

OSHA PPE REGULATIONS:

- **1910.95 – Hearing**
- **1910.132 – General**
- **1910.133 – Eye and face**
- **1910.134 – Respirator**
- **1910.135 – Head**
- **1910.136 – Foot**
- **1910.137 – Electrical**
- **1910.138 – Hand**

Guidelines

It is important to note that engineering controls should be the primary method of establishing a safe workplace. Personal protective equipment should only be used where engineering controls are not feasible.

General Requirements

1. Supervisors must assess the job tasks performed by their workers and document what personal protective equipment (PPE) is necessary for the work being performed, document certification of hazard assessment which identifies: the workplace evaluated, the person certifying that the evaluation has been performed, and the date(s) of the hazard assessment.
2. Based on the hazards identified, the supervisor must document the appropriate level of PPE that has been selected for all appropriate workers and inform them of the PPE selection decisions.
3. The selected PPE must be fitted to appropriate workers, maintained in a sanitary and reliable condition, and used appropriately by workers as required.
4. Defective or damaged PPE must be removed from service immediately
   Note: The OSHA standard has a non-mandatory Appendix B which contains example procedures for conducting a hazard assessment.

6-4 Personal Protective Equipment

Training Requirements

1. Each worker who is required to use PPE must be provided with training.
2. Training on PPE must include all of the following elements: when PPE is necessary; what PPE is necessary; how to properly don, doff, adjust, and wear PPE; the limitations of the PPE; Any testing requirements (electrical PPE) ; and the proper care, maintenance, useful life and disposal of the PPE.
3. Workers must demonstrate an understanding of the training and the ability to use PPE properly before being allowed to perform work requiring the use of PPE. (Workers must be retrained when there is reason to believe that they do not have the understanding or skill to use PPE properly)
4. Retraining must be conducted whenever changes in the workplace or changes in types of PPE make previous training obsolete. **NFPA 70E states that retraining is required in intervals not to exceed three years.**
5. There must be written certification for each person who has received PPE training that includes the following: a statement indicating the person understood the training; the name of the person trained; the date(s) of the training; and the subject of the certification.

Protection Requirements

Head, Foot, and Hand Protection

1. Protective helmets must be used wherever there is the possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns.
2. Protective helmets must meet the American National Standard for Personnel Protection Requirements, ANSI Z89.1-1986 (Protective Headwear for Industrial Workers).
3. Protective footwear must be used wherever there is the danger of foot injuries due to falling or rolling objects, objects piercing the sole, or where feet are exposed to electrical hazards.
4. Protective footwear must meet the requirements of the American National Standard for Personal Protection--Protective Footwear, ANSI Z41-1991.
5. Appropriate protective gloves must be used wherever there is the danger to hands of exposure to hazards such as those from skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns, and harmful temperature extremes.

Eye and Face Protection

1. Workers are required to wear appropriate eye protective devices while participating or observing activities which present a potential eye safety hazard.
2. All protective eye and face devices must comply with ANSI Z87.1-1989.

   Note: Regular prescription eye glasses do not meet this requirement. Goggles or other protective glasses meeting the American National Standard must be worn over-top prescription eye glasses.

Hearing Protection

1. Whenever feasible, employers are required to reduce the noise at the source through engineering solutions. When this is not possible or economically feasible it is acceptable to use hearing protection as a temporary solution. The term hearing conservation as defined by OSHA includes the following aspects, which the employer is responsible to carry out:
   A. Monitoring of the noise environment. If the TWA (Time Weighted Average) noise level is exceeding 85 dB(A), a hearing conservation program is required.
   B. Several different types of hearing protectors are required to be offered to the employees. The employees are required to use the hearing protection, and the employer is responsible for the enforcement.
   C. Establishing a baseline audiogram for each noise exposed employee, and annual hearing tests thereafter in order to monitor the hearing health of the employees.
   D. Take corrective action when it is concluded that a noise induced hearing damage is occurring. Corrective action can entail further education and training in the use and importance of full time use of hearing protection. Seeking the use of hearing protectors better suited to the environment and the individual.

6-6 Personal Protective Equipment

OSHA's Permissible Noise Exposure

dB	Hours Exposure
90 dB	8.0 hours
92 dB	6.0 hours
95 dB	4.0 hours
97 dB	3.0 hours
100 dB	2.0 hours
102 dB	1.5 hours
105 dB	1.0 hours
110 dB	30 minutes
115 dB	15 minutes

Posting Requirements

1. All areas and equipment requiring the use of PPE devices shall be posted with a sign indicating this requirement.

   Note: The warning signs on the enclosure should be inspected at each visit to ensure that the warning signs have not become illegible.

OSHA Personal Protective Equipment Policy & Procedure (1910.0132- .0136)

- Personal Protective Equipment, or PPE, must be provided, used, and maintained in a sanitary and reliable condition when there is a reasonable probability of injury or illness that can be prevented by such protection.
- PPE includes protection for eyes, face, head and extremities, protective clothing, respiratory devices, protective shields and barriers.
- When employees provide their own PPE, the employer is responsible to assure its adequacy.
- All personal protective equipment shall be of safe design and construction for the work to be performed. See ANSI Z133 as well as the other ANSI standards it references for details.
- The employer has to assess the workplace (including the shop) to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:
    1. Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified;
    2. Communicate selection decisions to each affected employee; and,
    3. Select PPE that properly fits each affected employee.
- The employer has to verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and, which identifies the document as a certification of hazard assessment.

Personal Protective Equipment Inspection

All PPE is to be inspected prior to and after each use. If the PPE is damaged, do not use it. Damaged PPE must be replaced.

Hard Hats

- Class G (or A) helmets help protect against impact and low-voltage electrical conductors. Shells are proof-tested at 2200 volts of electrical charge.
- Class E (or B) helmets help protect against impact and high-voltage electrical conductors. Shells are proof-tested at 20,000 volts.
- Type 1 Hardhats protect against impacts to the top of the head.
- Type 2 Hardhats protect the head from top and side impacts.

INSPECTION:

- The suspension system is not excessively worn
- The straps are not torn
- The plastic components are not broken
- The helmet has not sustained damage from an impact, poor treatment, or excessive use
- The shell is not dented, cracked or broken
- The shell has not been damaged by high temperature
- The shell has not been degraded by UV light (white chalky substance on the surface of the shell)

Hearing (must be ANSI Z87 compliant).

- Ear Plugs and Ear Muffs individually protect against noise level of 28-30 dB (A).
- For greater levels of protection Ear Plugs and Ear Muffs can be worn in conjunction to protect against higher noise levels.

INSPECTION:

- The Ear plugs do not have cracks, hardening, discoloration, rips, cuts, tears, holes, or microbial growth (bad odor emanating from the Ear Plugs).

Eyewear (must be ANSI Z87 compliant).

- Safety Glasses and Goggles protect against moving particles and objects.
- Polycarbonate Face Shields protect against moving particles and objects
- Polycarbonate Face Shields with a reflective coating protect against moving particles and objects and against radiant energy (UV light and heat).
- Arc Flash Category 2 Face Shield with a reflective coating is designed to attach to a standard hardhat and protects against moving particles and objects and against radiant energy at a rating of 8 Cal/cm^2

INSPECTION:

- The eyewear does not have broken or damaged components.
- The eyewear does not have elastic straps that are excessively worn or splitting.
- The eyewear does not have lenses that are scratched or abraded in a manner that would obstruct vision.

6-10 Personal Protective Equipment


Class 2 Hood


Class 4 Hood

Arc Flash Hood

- Arc Flash Hood with a Face Shield with a reflective coating and a 15” front bib fits over a standard hard hat and protect against moving particles and objects and against radiant energy at a rating of 8, 12, 20, 40 Cal/cm^2. The hood / bib material depends on the Category the Arc Flash Hood is designed to protect against and can be a combination of Indura, Nomex, Protera, RevoLite, TuffWeld and Kevlar.

INSPECTION:

- The face shield is not broken or damaged.
- The eyewear does not have elastic straps that are excessively worn or splitting.
- The face shield is not scratched or abraded in a manner that would obstruct vision.
- The material of the hood does not have burns, cracks, hardening, discoloration, rips, cuts, tears, holes or microbial growth (bad odor emanating from the Arc Flash Hood).

Class 00 Gloves

Class 0 Gloves

Class 1 Gloves

Indura Gloves

Leather Gloves

Gloves (It will be necessary to wear one type of glove over another)

- Class 00 Gloves provide protection up to 500 volts and are constructed of rubber blends.
- Class 0 Gloves provide protection up to 1000 volts and are constructed of rubber blends.
- Class 1 Gloves provide protection up to 7500 volts and are constructed of rubber blends.
- Class 2 Gloves provide protection up to 17,000 volts and are constructed of rubber blends.
- Arc Flash Fire Resistant Gloves are not electrically insulated. They are rated in Cal/cm^2 ratings of 12, 20, 36, 40, 51 Cal/cm^2. They are constructed of Indura.
- Leather gloves are not electrically insulated. They protect Electrical insulating gloves from damage due to abrasions or puncture.

INSPECTION:

- The eyewear does not have cracks, hardening, discoloration, rips, cuts, tears, pin-holes or microbial growth (bad odor emanating from the glove).

6-12 Personal Protective Equipment



Footwear (must be ANSI Z41 compliant).

- Hard Toe Boots protect against injury from falling, rolling, or lacerating objects. The hard toes are constructed of metal or acrylics. The boot material is available in leather, synthetic leather, chemical resistant material, or cut resistant materials such as Kevlar.

INSPECTION:

  - The footwear does not have cracks, hardening, discoloration, rips, cuts, tears, holes, or microbial growth (bad odor emanating from the footwear).

Class 1 Nomex Underwear

Class 2 Indura Underwear

Arc Flash Undergarments

- ***Arc Flash Undergarments are available, but not specifically required. Undergarments made of natural, non-melting fabrics are acceptable.***
- Undergarments fit under clothing and protect against radiant energy at a rating of 4 - 18 Cal/cm^2. The garment material (typically Indura or Nomex) depends on the Calorie-rating. Material weight ranges from 4-8 oz.

INSPECTION:

  - The material does not have burns, discoloration, rips, cuts, tears, holes or microbial growth (bad odor emanating from the garment).

Class 1 Nomex Clothing

Class 2 Indura Clothing

Arc Flash Garments

- Arc Flash garments are shirts, pants or socks that protect against radiant energy at a rating of 4-12 Cal/cm^2. The garment material (typically Indura or Nomex) depends on the Calorie-rating. Material weight ranges from 4-9 oz.

INSPECTION:

- The material does not have burns, discoloration, rips, cuts, tears, holes or microbial growth (bad odor emanating from the garment).

Category 1 Nomex Coveralls

Category 2 Protera Coveralls

Arc Flash Coveralls

- Coveralls fit over clothing and protect against radiant energy at a rating of 5.7 - 12.3 Cal/cm^2. The coverall material (typically Indura or Nomex) depends on the Calorie-rating. Material weight ranges from 4-8 oz.

INSPECTION:

- The material does not have burns, discoloration, rips, cuts, tears, holes or microbial growth (bad odor emanating from the garment).

6-14 Personal Protective Equipment

Category 3 Indura Coveralls

Category 4 Indura Arc Flash Suit

Category 4 Arc Flash Suit

Arc Flash Suit

- An Arc Flash Suit fits over clothing and is comprised of a coat and a pair of bibs. The Arc Flash Suit protects against radiant energy at a rating of 8-40 Cal/cm^2. The material depends on the Calorie-rating the Arc Flash Suit is designed to protect against and is typically constructed of multiple layers of a combination of Indura, Nomex, Protera, RevoLite, TuffWeld or Kevlar. Material weight ranges from 7 oz. For an 8 Cal/cm^2 Category 2 Arc Flash Suit to 13 oz. Lined with 5.5 oz. for a 40 Cal/cm^2 Category 4 Arc Flash Suit.

INSPECTION:

- The material does not have burns, discoloration, rips, cuts, tears, holes or microbial growth (bad odor emanating from the garment).

Class 2 Balaclava

Class 4 Balaclava

Arc Flash Balaclava

- Arc Flash Balaclava a style of head protection worn under a standard hard hat with a goggles or a Face Shield with a reflective coating that protects against moving particles and objects and against radiant energy at a rating of 8, 12, 20, 40 Cal/cm^2. The balaclava material and number of layers depend on the Category the Arc Flash Hood is designed to protect against and can be a combination of Indura, Nomex, Protera and Kevlar.

INSPECTION:

- The material of the balaclava does not have burns, cracks, hardening, discoloration, rips, cuts, tears, holes or microbial growth (bad odor emanating from the Arc Flash Balaclava).

NOTE: NFPA 70E 2012 [Section 130.7(C)(13)(b)]: When inside the AFB and anticipated exposure is 12 cal/cm^2 or less, employees will now be required to wear either an arc-rated balaclava with an arc rated, wrap-around style face shield (protecting face, chin, ears, forehead and neck), or an arc-rated hood like that used in an arc flash suit. But when anticipated incident energy exposure is greater than 12 cal/cm^2, then an arc-rated hood will now be required.

6-16 Personal Protective Equipment

Appendix A Inverter Keypad

The Enclosure is fitted with an externally mounted keypad for the AC890GT inverter. It provides for local control of the inverter, monitoring, and complete access for application programming. This appendix shows how to use the keypad to navigate through the AC890GT inverter menu, the function of the control keys, and keypad indications. The main menu maps are shown here.

6901 Keypad

The 6901 Keypad is a plug-in MMI (Man-Machine Interface) option that provides local control of the Inverter, monitoring, and complete access for application programming.

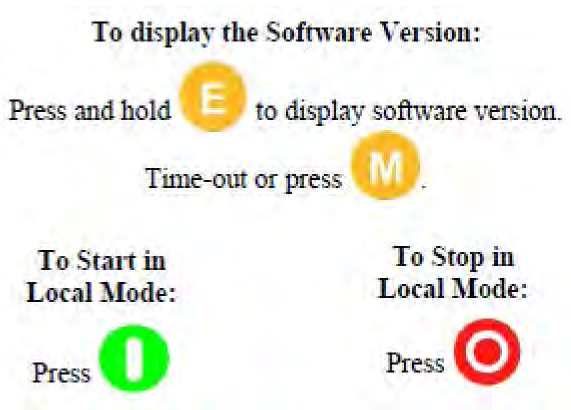
The 6901 Keypad can be mounted up to 3 meters away from the 890GTB.

Caution: Usage of the keypad is restricted to qualified Level 3 service personnel only.
(Typically Parker Service and Engineering personnel)

The keypad displays the OPERATOR, DIAGNOSTICS, QUICK SETUP, SETUP & SYSTEM menus *(SETUP menu lists all parameters available in the DSE 890 Configuration Tool)*

Initial Power-Up Conditions

The Keypad will display the Operator menu.



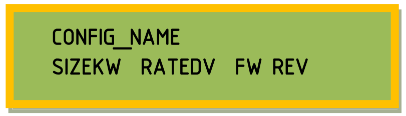


Figure 3-1: Initial Start-up Display

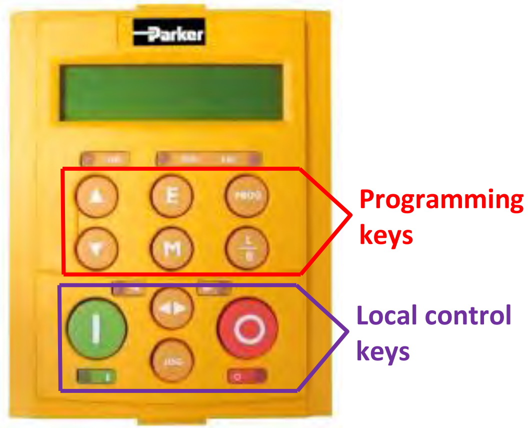


Figure 3-2: 6901 Keypad

Keypad Description

The keypad has ten buttons, seven LEDs and a backlit, LCD display.

Control Key Definitions

The button functions change as the Inverter status changes. The following table lists the functions each button controls. The next section, Display, shows meanings of the messages in each mode.

Navigation Mode shows the functions when moving around the Inverter menus. The structure is shown later in this chapter.

Parameter Mode shows the actions when changing or viewing a parameter in the menus. This mode generally occurs after Navigation functions.

Local Mode lists the functions when you control the Inverter with the keypad.

Trip Mode functions are the keypad actions after the Inverter has tripped.

	Navigation Mode Stepping through the Menu	**Parameter Mode** View/Change Parameters	**Local Mode** Hand Icon Visible	**Trip Mode** Alarm Indicator Visible
			Start the inverter	Resets a TRIP and starts the Inverter
	Press and hold to toggle between LOCAL and REMOTE		Stop the inverter	Resets a TRIP and allows inverter to operate
	Enter selected Menu or Parameter	Move curser to the left for faster changes	Press for 2 sec to access the menu	
	Exit the displayed menu	Save the new value, Return to Parameter Menu (Navigation)	Leave the Menu	Clear a TRIP message from the display
	Step to previous menu item	Increase the value	Increase Setpoint	
	Step to next menu item	Decrease the value	Decrease Setpoint	
	Toggles between the current location in the Operator Menu and any other menu, Hold for 3 seconds to access SAVE CONFIG Menu			
	Switch to LOCAL Mode, Displays Local Setpoint Screen		Switch to REMOTE Mode	
			Change output direction	
			Runs at the JOG setpoint and stops when released	

Display Definitions

The display shows three types of Inverter information: *menu* items in Navigation mode, *parameter* values in Parameter mode, and *alarms* along with status information in Trip mode.

Parameter Mode

Parameter mode displays a parameter value like in Figure 3-3. The parameter value is shown with units. The types of units are **A** for Amps, **Hz** for frequency, **S** for seconds, **V** for volts, and **%** for percentage.

Figure 3-3: Parameter Display

Navigation Mode

Figure 3-4 shows a typical menu item in *Navigation* mode. In this mode, the top line shows the current menu and the bottom line shows the menu level, like “menu at level 1”.

Figure 3-4: Menu Display

Trip Mode

The inverter is in *Trip* mode when the OK LED is flashing. Figure 3-5 shows a sample alarm message. Look up the Display Message in the tables in the **Inverter Keypad Fault List (Page A-18)** for information on every alarm.

Figure 3-5: Alarm Display

Status LEDs

There are seven status LEDs on the keypad. Each LED operates one of three different ways:

OFF FLASH ON

Figure 3-6 shows the seven status LEDs. The sequence and reference LEDs indicate the control mode, either Local or Remote. The reverse, forward, start and stop LEDs show direction and operating status. The following tables describe their functions in more detail.

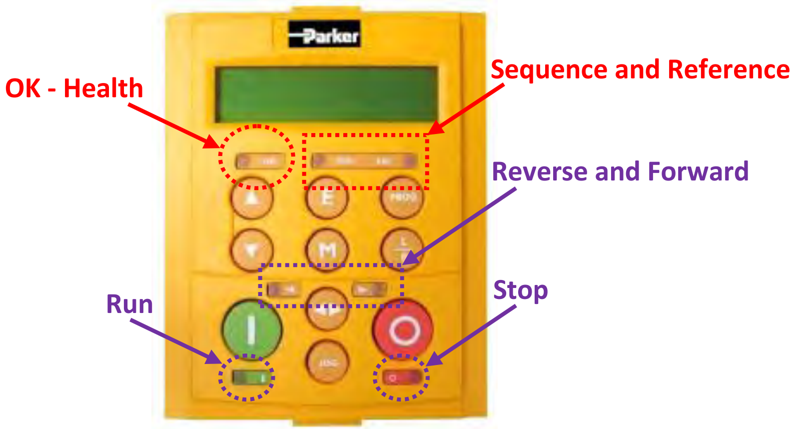
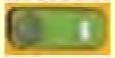


Figure 3-6: 6901 Keypad

OK, RUN, STOP Status LEDs

The OK (health), run and stop LEDs combine to show the inverter status as illustrated in the following table:

OK 	RUN 	STOP 	AC890GT Inverter State
			Re-configuration
			Tripped
			Stopped
			Stopping
			Operating with zero demand. **Enable** FALSE, or **Contactor Feedback** FALSE
			Operating
			Auto Restarting, Waiting for a trip to clear
			Auto Restarting, Timing

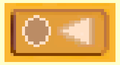
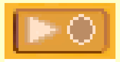
SEQ (Sequence) and REF (Reference) Status LEDs

The SEQ and REF LEDs show the control settings for the inverter. SEQ indicates that the operating control of the Inverter, either local (using the keypad) or remote. REF shows the source of the speed setpoint, either local (using the keypad) or remote. For grid-tie inverters, users have no need to switch between local and remote control as a result both LEDs should always be OFF.

		Local / Remote Mode
		In Remote Mode: Start, Stop, and Speed (Ref) are controlled from the terminals
		In mixed Local Mode: Start and Stop are controlled using the RUN, STOP, JOG, and FWD/REV keys. Speed (Ref) is controlled from the terminals
		In mixed Local Mode: Start and Stop are controlled from the terminals. Speed (Ref) is controlled using the up (▲) and down (▼) keys.
		In Local Mode: Start, Stop, and Speed (Ref) are controlled using the keypad keys.

FWD (Forward) and REV (Reverse) Status LEDs

The forward and reverse direction LEDs show the inverter control direction. For grid-tie inverters, these LEDs have little meaning. The FWD LED should always be ON.

		Forward / Reverse State
		The requested control direction and actual direction are both Forward
		The requested control direction and actual direction are both Reverse
		The requested control direction is Forward and actual direction is Reverse
		The requested control direction is Reverse and actual direction is Forward

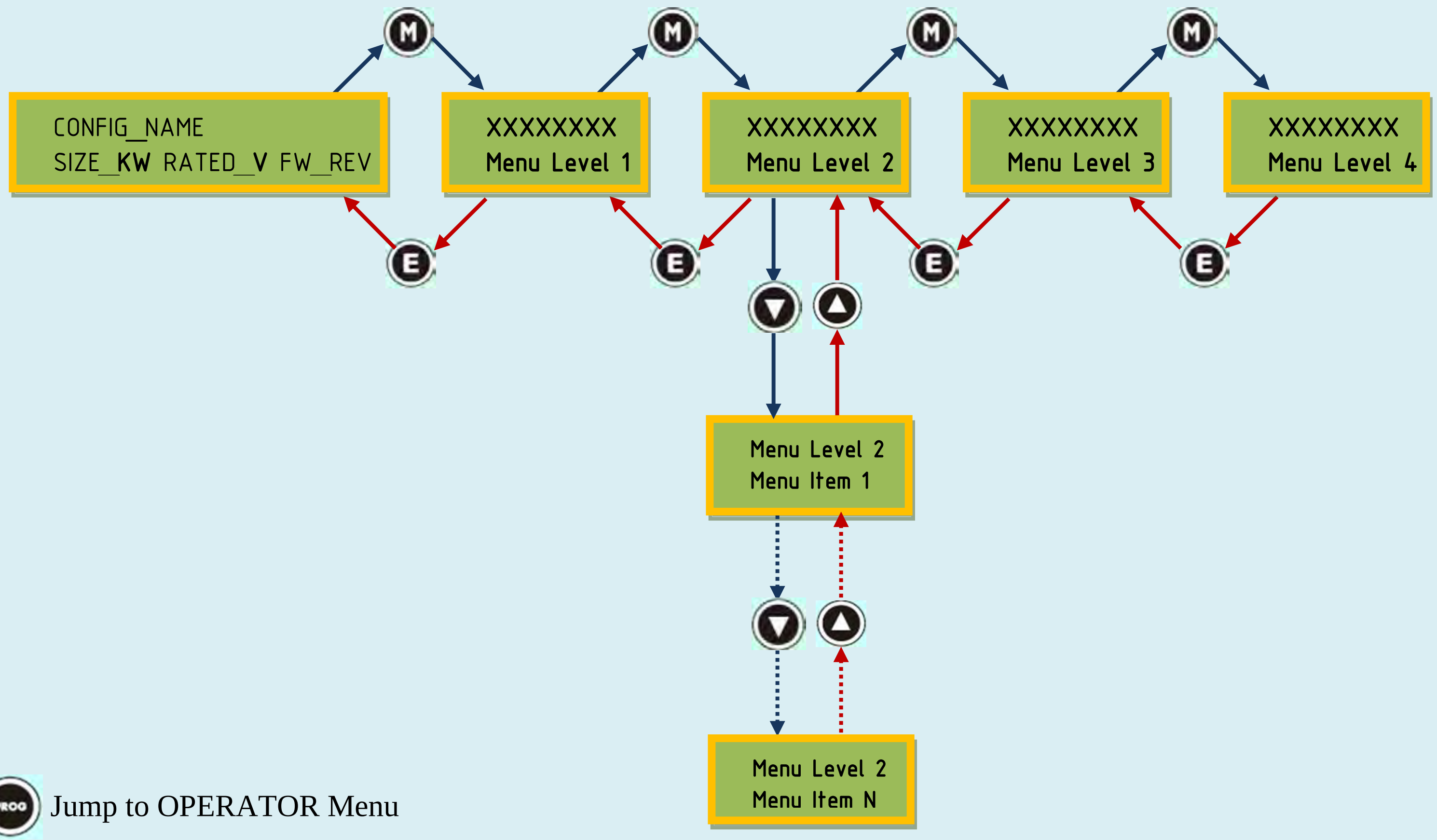
The Menu System

The menu system follows a "tree" structure shown on the following page when *VIEW LEVEL = ADVANCED*.

Action	Description	Comments	Display
	Welcome Screen	Shows the Configuration, Rating and Firmware Revision	CONFIG_NAME SIZEKW RATEDV FW REV
Press M	Operator Menu	Customized list of Setup Parameters	OPERATOR menu at level 1
Press ▼	Diagnostics Menu	View Diagnostic parameters contained in the SETUP Menu	DIAGNOSTICS menu at level 1
Press ▼	Quick Setup Menu	Short list of commonly used setup parameters	QUICK SETUP menu at level 1
Press ▼	Setup Menu*	All parameters for programming an application	SETUP menu at level 1
Press ▼	System Menu	Save application and select Macro	SYSTEM menu at level 1

* This Menu is not viewable unless the VIEW LEVEL is set to ADVANCED

Menu Navigation

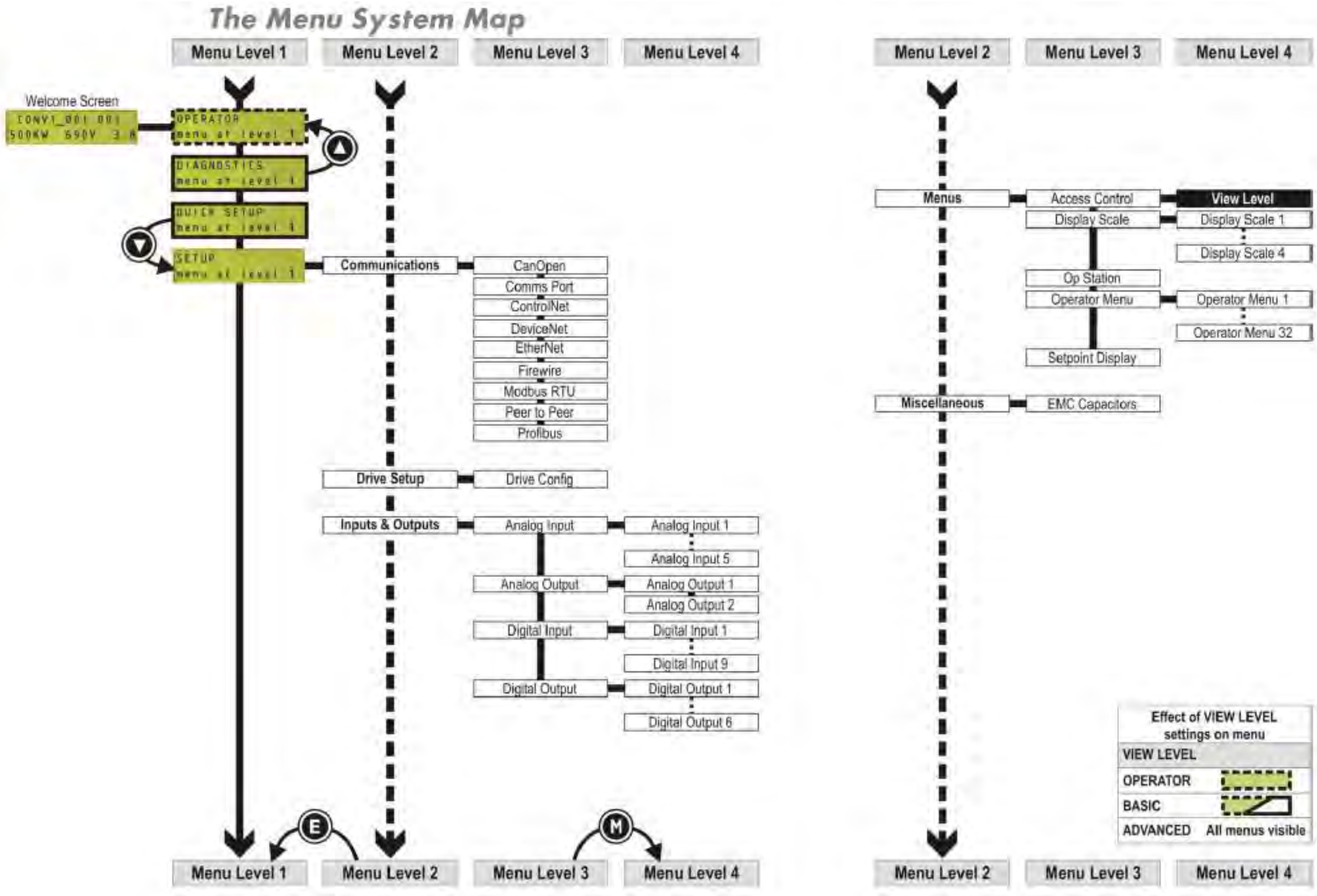


Press PROG Jump to OPERATOR Menu

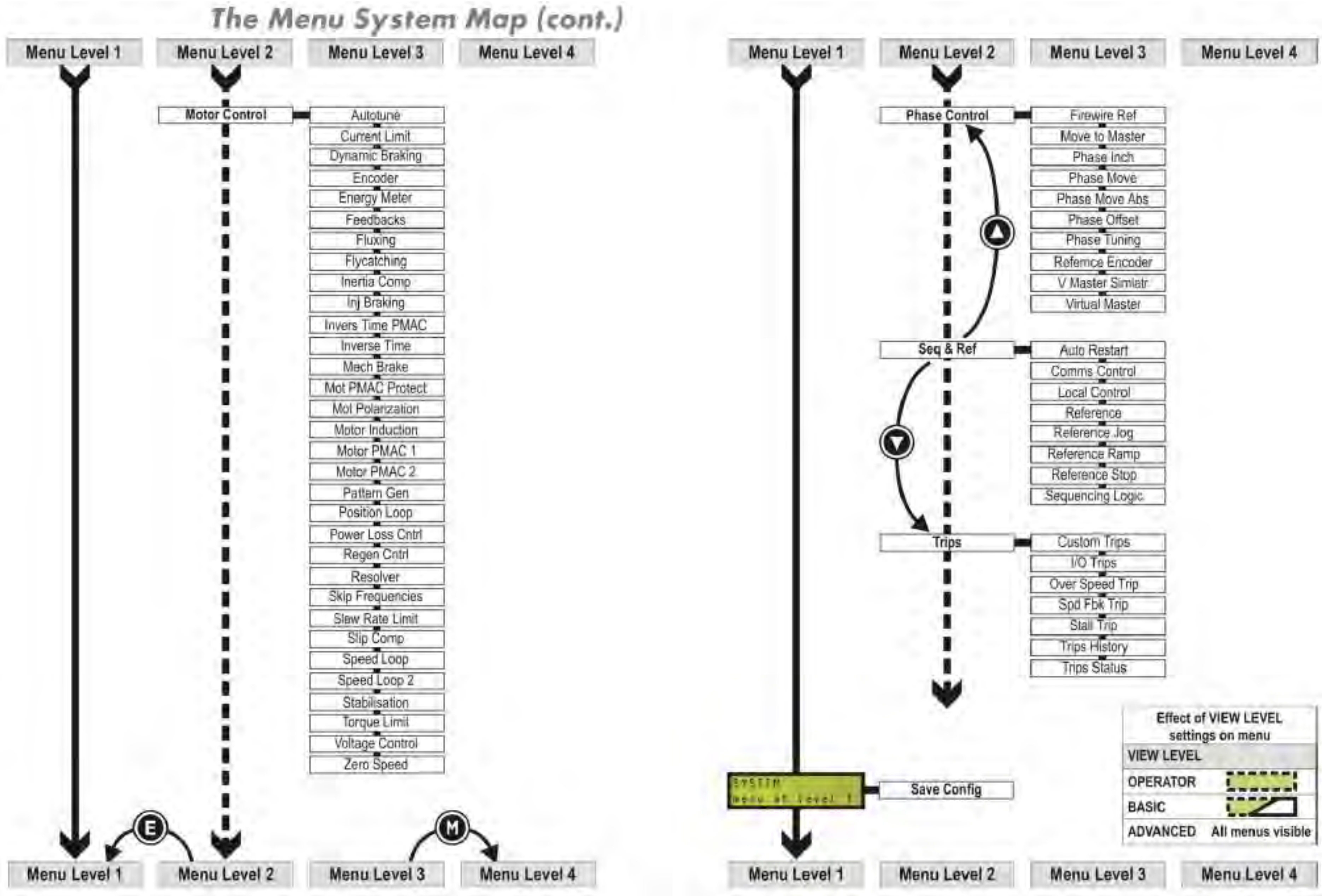
Press PROG Jump back to original Menu position

Press PROG Jump to SAVE CONFIG Menu

(Hold for 3 seconds)



The Menu System Map
Menu Level 1
Menu Level 2
Menu Level 3
Menu Level 4
Welcome Screen
500KW 690V
OPERATOR
menu at level 1
DIAGNOSTICS
menu at level 1
QUICK SETUP
menu at level 1
SETUP
menu at level 1
Communications
CanOpen
Comms Port
ControlNet
DeviceNet
EtherNet
Firewire
Modbus RTU
Peer to Peer
Profibus
Drive Setup
Drive Config
Inputs & Outputs
Analog Input
Analog Input 1
Analog Input 5
Analog Output
Analog Output 1
Analog Output 2
Digital Input
Digital Input 1
Digital Input 9
Digital Output
Digital Output 1
Digital Output 6
E
M
Menu Level 1
Menu Level 2
Menu Level 3
Menu Level 4
Menu Level 2
Menu Level 3
Menu Level 4
Menus
Access Control
View Level
Display Scale
Display Scale 1
Display Scale 4
Op Station
Operator Menu
Operator Menu 1
Operator Menu 32
Setpoint Display
Miscellaneous
EMC Capacitors
Effect of VIEW LEVEL settings on menu
VIEW LEVEL
OPERATOR
BASIC
ADVANCED
All menus visible
Menu Level 2
Menu Level 3
Menu Level 4



The Menu System Map (cont.)
Menu Level 1
Menu Level 2
Menu Level 3
Menu Level 4
Motor Control
Autotune
Current Limit
Dynamic Braking
Encoder
Energy Meter
Feedbacks
Fluxing
Flycatching
Inertia Comp
Inj Braking
Invers Time PMAC
Inverse Time
Mech Brake
Mot PMAC Protect
Mot Polarization
Motor Induction
Motor PMAC 1
Motor PMAC 2
Pattern Gen
Position Loop
Power Loss Cntrl
Regen Cntrl
Resolver
Skip Frequencies
Slew Rate Limit
Slip Comp
Speed Loop
Speed Loop 2
Stabilisation
Torque Limit
Voltage Control
Zero Speed
E
M
Phase Control
Firewire Ref
Move to Master
Phase Inch
Phase Move
Phase Move Abs
Phase Offset
Phase Tuning
Refernce Encoder
V Master Simlatr
Virtual Master
Seq & Ref
Auto Restart
Comms Control
Local Control
Reference
Reference Jog
Reference Ramp
Reference Stop
Sequencing Logic
Trips
Custom Trips
I/O Trips
Over Speed Trip
Spd Fbk Trip
Stall Trip
Trips History
Trips Status
SYSTEM
menu at level 1
Save Config
Effect of VIEW LEVEL settings on menu
VIEW LEVEL
OPERATOR
BASIC
ADVANCED All menus visible

Instructions and Procedures

This section contains common short-cuts and procedures. There are keypad procedures for entering and changing passwords. The short-cuts for resetting the factory default values and changing the application macro are at the end.

How to save the application

Note: ***This procedure saves only information for keypad parameters.***

Action	Description	Comments	Display
Press PROG		Start at any menu location	DIAGNOSTICS menu at level 1
Press PROG	Jump to **SAVE CONFIG** Menu	Hold button for at least 3 seconds	SAVE CONFIG menu at level 2
Press M	Enter Menu	Can select any APP using ▲ ▼	SAVE CONFIG * APP
Press M	Press ▲ to save	Can press M to cancel save	SAVE CONFIG "UP" TO CONFIRM
	Menu displayed after save completed		SAVE CONFIG menu at level 2
Press PROG	Jump to **OPERATOR** Menu	This is the normal function of this button	SETPOINT (REMOTE) * 0.00%

Setting Advanced Menu Level

Often the menus are set to Basic level to speed keypad navigation by hiding the **SETUP** menu. To expose all menus and parameters, set **VIEW LEVEL** to **ADVANCED**.

At menu level 1, navigate to the **QUICK SETUP** menu using .

Press and then to show VIEW **LEVEL**.

Press and change the value from **BASIC** to **ADVANCED** and then when done.

Press again and now navigate to the **SETUP** menu

Resetting to Factory Defaults (2-Button Reset)

This sequence will load factory default settings into the inverter. **This is not necessarily the configuration installed in the inverter when it shipped.** A copy of the default configurations is part of the documentation shipped with the inverter. **This procedure will change sensitive and important parameters**. It is strongly recommended that the configuration be extracted and saved using **DSE Lite** prior to resetting the inverter to factory default settings.

Action	Description	Comments	Display
During power-up press and hold		Hold buttons for at least 2 seconds until the LEDs flash	RESTORE DEFAULTS "UP" TO RESTORE
Press	Accept changes	Can press to cancel the change	CONFIG_NAME SIZEKW RATEDV FW REV

The changes are not saved when making this change. You must perform a PARAMETER SAVE to save the default values.

Getting Quick Tag Information

Press and hold (M) for about three seconds to display the parameter tag number. The tag number is used for serial communications through the P3 port on the Inverter.

Action	Description	Comments	Display
		Example – can check any parameter	RAMP TIME 100.00%
Press and hold (M)		Hold button for at least 3 seconds	RAMP TIME PREF 326
Press (▲)		Return to parameter value	RAMP TIME 100.00%

Resetting the Product Code (3-Button Reset)

This procedure may be required when replacing a control board or module. The LEDs will flash when a new control board is installed and immediately go to this selection.

A 3-button reset allows the user to set the product code, 890PX, language (future), and default supply frequency. Changing the frequency causes the frequency dependent parameters to use new factory default values.

If the product code choices do not match your target power board, change parameter *890PX* to *TRUE*. It is accessible from in the *SYSTEM* menu. Then go back to the *PRODUCT CODE* parameter to select the correct value.

MPORTANT: Other functions are available in this menu (*REFORMAT FLASH, RESTART, EXIT TO BOOT*). These are for internal Parker EGT use and should not be performed.

Action	Description	Comments	Display
During power-up press and hold ▲ E PROG		Hold buttons for at least 2 seconds until the LEDs flash	POWER BOARD 1.5KW 400V
Press M to change	Use ▲ ▼ to scroll to product board selection	If an invalid selection is made, it will be ignored	POWER BOARD >> 1.5KW 400V
Press E	Exits the change mode		POWER BOARD 500KW 690V
Press E	Use ▲ ▼ to scroll to other product setting menus		POWER BOARD menu at level 2
Press ▼ Press M to enter	Press M to change, Press E when done	890PX TRUE to select 890PX product codes and operate properly	890PX menu at level 2
Press ▼ Press M to enter	Press M to change, Press E when done	DEFAULT 60 HZ TRUE for 60 Hz supplies	DEFAULT 60 HZ menu at level 2
Press E twice	Updates the inverter with new selections	Start up Display	CONFIG_NAME 500KW 690V FW REV

Password Protection

When activated, password protection makes all parameters “read-only”, which prevents unauthorized users from accidentally changing settings. You enable password protection by changing *PASSWORD* to a value other than **0000**. Repeat this procedure and set the *PASSWORD* to **0000** to disable password protection.

IMPORTANT: Remember your password. Otherwise, to regain control for changes, you must reset the factory defaults and you will lose all of your settings.

Action	Description	Comments	Display
Press E and/or M	Navigate to **menu level 1**	Use ▲ ▼ to navigate to **SETUP**	SETUP menu at level 1
Press M	Navigate to **menu level 2**	Use ▲ ▼ to navigate to **MENUS**	MENUS menu at level 2
Press M	Navigate to **menu level 3**	Use ▲ ▼ to navigate to **ACCESS CONTROL**	ACCESS CONTROL menu at level 3
Press M			PASSWORD XXXX
Press M (Press E when done)	Use ▲ ▼ to set **PASSWORD**	When set to **0000** password protection is **OFF**, for all other values it is **ON**	PASSWORD >> 0002
Press E several times	Activates password protection		PASSWORD LOCKED

Remember to perform a *CONFIG SAVE* if you need the password saved on power down.

Using Password Protection

Whenever password protection is active, the *PASSWORD* screen is displayed when you attempt to change any *SETUP* or *PARAMETER* value. You must enter the correct password to temporarily deactivate password protection. The following table illustrates entering a password.

To re-activate existing password protection, press the E key several times until *PASSWORD LOCKED* appears on the display.

Action	Description	Comments	Display
	Use ▲ ▼ to try and change setpoint		BASE SPEED HZ >> 60.00HZ
	Display changes briefly	Message displays for about 1 second	PASSWORD LOCKED
Press and hold M	Display changes	Display shows default password	PASSWORD >> 0000
Press M			PASSWORD XXXX
Use ▲ ▼ to set **PASSWORD**	Enter password	Example – the password is 0002	PASSWORD >> 0002
Press E	Displays last parameter	With correct password entered, can change any parameters as needed	BASE SPEED HZ >> 60.00HZ
Press E several times	Exit to **menu level 1,** and re-activate password	When finished with changes, reactivate password	PASSWORD LOCKED

Inverter Keypad Fault List

This table provides a list of the fault messages that appear on the inverter keypad, the meaning of the message, and required action associated with the annunciated fault. See **Appendix F** for more information and for a list of annunciated system faults and warnings

STATE	**KEYPAD DISPLAY**	**MEANING**	**ACTIONS**
72	**CURRENT BALANCE**	Poor current sharing between IGBTs within a CD module, Manufacturing defect in a CD module	PLC to autorestart. Maintenance required if more than 1 event occurs in succession.
4	**HEATSINK**	Module assembly defect	Disable output; wait for IGBT temperature to < 70C. Autorestart. Disable if more than 3 successive events. Maintenance required.
3	**OVERCURRENT**	The output current being drawn from the Inverter is too high, Short circuit of the output, Excessive line disturbance	Automatic Restart (5) - Possible maintenance required
1	**OVERVOLTAGE**	The Inverter internal DC link voltage is too high. The supply voltage is too high. Failure to synchronize properly to the line	Automatic Restart (5) - Possible maintenance required
73	**SYSTEM VOLTS**	Control and fan supply volts low on a CD module. The supply is overloaded. A fan is shorted. Low voltage supply wiring fault	PLC to autorestart inverter when the 24V supply is regulating properly. Autorestart and warning notification sent to SCADA
2	**UNDERVOLTAGE**	The Inverter internal DC link voltage is too low. The supply voltage is too low. The supply voltage is missing. Array voltage is missing	PLC Logic to determine if sleep mode is required or if there's a mains problem. - Possible maintenance required
If any fault is displayed on the keypad (when connected) other than those listed, Contact Parker EGT Product Support			

Appendix B Programming

The AC890GT Grid-Tie Inverter uses a small subset of the functionality of the AC890 control platform. This appendix highlights the functions used for grid-tie applications.

- Configure the Inverter
- Programming with Block Diagrams

Configure the Inverter

IMPORTANT: Inverters are shipped pre-configured from the factory. This section is for reference only!

An AC890GT grid-tie inverter uses a combination of native 890 function blocks and library function blocks for control. If you receive a replacement control board or PCM (LA471780U001), you must configure it to your application. To do this, use DSELite supplied on the CD.

Note: ***The keypad controls only native 890 function blocks. It does not have access to any library function blocks inserted using DSELite.***

Configure the Inverter

The simplest method for configuring an inverter is to reinstall the original configuration using DSELite. The DSELite configuration tool has a full Help system. Insert the DSELite disk into your PC and follow the on-screen instructions.

You can use the tool to manually set-up the inverter so that it meets the requirements for your application. This involves connecting input and output terminals to desired function block parameters, creating sequencing logic, configuring communication channels, and entering desired parameter values.

This manual describes inverter functionality programmed into a standard Parker EGT grid-tie inverter.

Connecting to a PC

Connect the Grid-Tie inverter via the USB port on the front of the inverter to your PC using an approved USB lead.

Configuring the Inverter using the Keypad

Refer to **Appendix A** for instructions using the 6901 keypad.

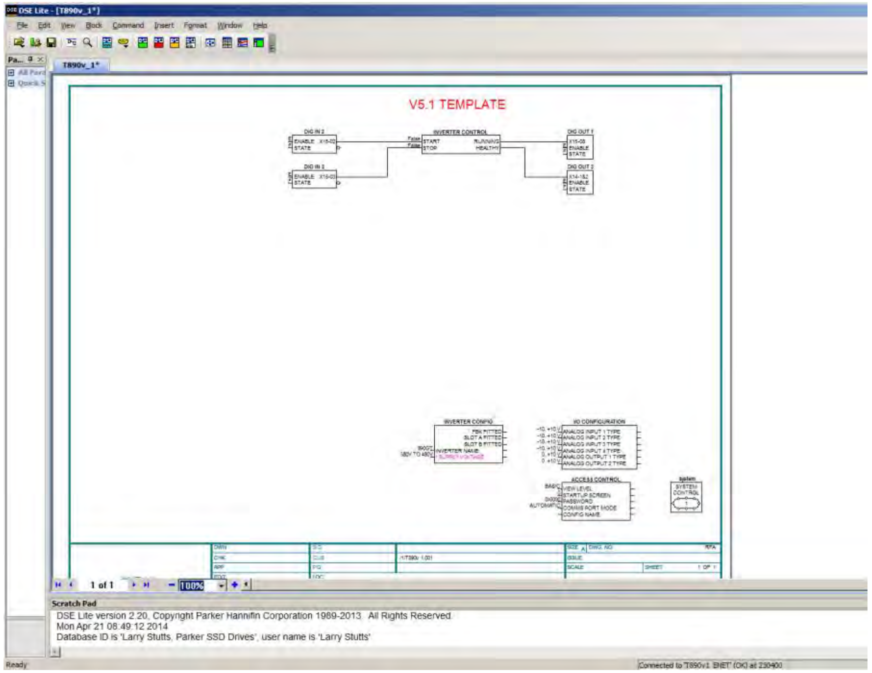
The keypad is limited to changing parameter values discussed in this chapter. Often this is sufficient after the configuration has been loaded using DSELite.

Saving your Changes

If parameter values have been modified, the new settings must be saved. The inverter will then retain the new settings during power-down. Refer to **Appendix A (Page A-12)** for instructions on how to save the application.

Programming with Block Diagrams

Block diagram programming provides a visual method of planning the software to suit your application. The blocks described here are those blocks used by the Shipping Configuration(s) in DSELite (the configuration shipped with your product may vary). The figure below shows a typical block diagram as seen in DSELite.



The processes performed by the shipping configuration are represented as a block diagram, consisting of *function blocks* and *links:*

- Each function block contains the parameters required for setting-up a particular processing feature. Sometimes more than one instance of a function block is provided for a feature, for example multiple digital inputs.
- Software links are used to connect the function blocks. Each link transfers the value of an output parameter to an input parameter of another (or the same) function block.

Each individual block is a processing feature; that is, it takes the input parameter, processes the information, and makes the result available as one or more output parameters.

Programming Rules

The following rules apply when programming:

- Function block output parameter values cannot be changed (because they are a result of the processing in the function block).
- Function block input parameter values that receive their values from an internal link in the Block Diagram cannot be changed (as they will change back to the value they receive from the link when the inverter is running).

Function Block Descriptions

For function block descriptions, refer to Firmware Version 5.1 Manual (HA473746U001) Section 3.

Function Blocks

Page	Block	Page	Block	Page	Block	Page	Block
			I/O Hardware Configuration				
3-15	ANALOG INPUT	3-18	ANALOG OUTPUT	3-24	DIGITAL INPUT	3-25	DIGITAL OUTPUT
3-15,18	I/O CONFIGURATION						
			Sequencing/Referencing				
3-19	AUTO RESTART	3-46	LOCAL CONTROL	3-55	SEQUENCING LOGIC		
			Inverter Control				
3-22	CURRENT LIMIT	3-31	ENERGY METER	3-32	FEEDBACKS	3-36	GRID CONTROL
3-41	INVERSE TIME	3-42	INVERTER	3-47	MPPT	3-52	PATTERN GEN
3-54	POWER LIMIT						
			Communications				
3-21	COMMS CONTROL	3-34	FIELDBUS				
			Trips				
3-23	CUSTOM TRIPS	3-40	I/O TRIPS	3-59	TRIPS HISTORY	3-60	TRIP STATUS
			Menus				
3-14	ACCESS CONTROL	3-27	DISPLAY SCALE	3-49	OP STATION	3-50	OPERATOR MENU
3-58	SETPOINT DISPLAY						
			Miscellaneous				
3-44	INVERTER CONFIG	3-30	EMC CAPACITORS				

DSE Lite Configuration Tool

See Grid-Tie Inverter Engineering Reference (HA473002U001**) Appendix B or:**

DSE Lite User Manual: HA471486U001_04.pdf

Connection: Page 1-6

Configuration: Page 2-18

Firmware: Page 6-8 ***(Should only be used by Parker EGT or suitably qualified personnel)***

Chart Recording: Page 4-5

IP Address: 192.168.1.100

Grid-Tie Inverter – Typical SunSpec Model Information

890GT_ SunSpec Model Information		Holding Reg.			
Description		**Address**	**Tag/*Constant***	**Type**	**Scale / Units**
Sunspec Identifier		40001	*0x53756E53*	uint32	0x53756E53
Model Identifier		40003	*1*	uint16	1
Model Length		40004	*66*	uint16	66 Dec x48 Hex
Manufacturer		40005	P	uint16	ASCII
		40006	A	uint16	ASCII
		40007	R	uint16	ASCII
		40008	K	uint16	ASCII
		40009	E	uint16	ASCII
		40010	R	uint16	ASCII
		40011		uint16	ASCII
		40012	H	uint16	ASCII
		40013	A	uint16	ASCII
		40014	N	uint16	ASCII
		40015	I	uint16	ASCII
		40016	F	uint16	ASCII
		40017	F	uint16	ASCII
		40018	I	uint16	ASCII
		40019	N	uint16	ASCII
		40020		uint16	ASCII
Model		40021	8	uint16	ASCII
		40022	9	uint16	ASCII
		40023	0	uint16	ASCII
		40024	G	uint16	ASCII
		40025	T	uint16	ASCII
		40026	_	uint16	ASCII
		40027		uint16	ASCII
		40028		uint16	ASCII
		40029		uint16	ASCII
		40030		uint16	ASCII
		40031		uint16	ASCII
		40032		uint16	ASCII
		40033		uint16	ASCII
		40034		uint16	ASCII
		40035		uint16	ASCII
		40036		uint16	ASCII

890GT_ SunSpec Model Information		Holding Reg.			
Description		**Address**	**Tag/*Constant***	**Type**	**Scale / Units**
Options		40037	sPLCqUserField1	uint16	ASCII
		40038		uint16	ASCII
		40039		uint16	ASCII
		40040		uint16	ASCII
		40041		uint16	ASCII
		40042		uint16	ASCII
		40043		uint16	ASCII
		40044		uint16	ASCII
Version		40045	sPLCqUserField2	uint16	ASCII
		40046		uint16	ASCII
		40047		uint16	ASCII
		40048		uint16	ASCII
		40049		uint16	ASCII
		40050		uint16	ASCII
		40051		uint16	ASCII
		40052		uint16	ASCII
Serial Number		40053	sPLCqSerialNumber	uint16	ASCII
		40054		uint16	ASCII
		40055		uint16	ASCII
		40056		uint16	ASCII
		40057		uint16	ASCII
		40058		uint16	ASCII
		40059		uint16	ASCII
		40060		uint16	ASCII
		40061		uint16	ASCII
		40062		uint16	ASCII
		40063		uint16	ASCII
		40064		uint16	ASCII
		40065		uint16	ASCII
		40066		uint16	ASCII
		40067		uint16	ASCII
		40068		uint16	ASCII
Device Address		40069	1	uint16	N/A (ModbusTCP)
pad		40070	0x8000	uint16	pad (Force Even Length)
Model Identifier		40071	113	uint16	113 (Inverter FLOAT Model)
Model Length		40072	60	uint16	Model Length

890GT_ SunSpec Model Information		Holding Reg.			
Description		Address	Tag/*Constant*	Type	Scale / Units
AC Current	0	40073	Sum of next three tags (active phases)	float32	Amps
Phase A Current	1	40075	rPQMiAmpsA	float32	Amps
Phase B Current	2	40077	rPQMiAmpsB	float32	Amps
Phase C Current	3	40079	rPQMiAmpsC	float32	Amps
Phase Voltage AB	4	40081	rPQMiVoltsAB	float32	Volts AC
Phase Voltage BC	5	40083	rPQMiVoltsBC	float32	Volts AC
Phase Voltage CA	6	40085	rPQMiVoltsCA	float32	Volts AC
Phase Voltage AN	7	40087	rPLCqNotImplemented	float32	Volts AC
Phase Voltage BN	8	40089	rPLCqNotImplemented	float32	Volts AC
Phase Voltage CN	9	40091	rPLCqNotImplemented	float32	Volts AC
AC Power	10	40093	rPQMiWatts60Cycle	float32	Watts AC
Line Frequency	11	40095	rPQMiFrequency	float32	HZ
AC Apparent Power	12	40097	rPQMiVAs60Cycle	float32	VA
AC Reactive Power	13	40099	rPQMiVARs60Cycle	float32	VAr
AC Power Factor	14	40101	rPQMiPF	float32	unitless
AC Energy	15	40103	dwPQMiWattHourTotal	uint32	WattHours
DC Current	16	40105	rPLCqNotImplemented	float32	Amps DC
DC Voltage	17	40107	rPCMiDCLinkVolts	float32	Volts DC
DC Power	18	40109	rPLCqNotImplemented	float32	W
Cabinet Temperature	19	40111	rPLCiTempInternalAmbient	float32	deg C
Heat Sink Temperature	20	40113	rPCMiHeatsinkTemp	float32	deg C
Transformer Temperature	21	40115	rPLCqNotImplemented	float32	deg C
Other Temperature	22	40117	rPLCiTempR134aPumpInlet	float32	deg C
Enumerated value. Operating state	23	40119		enum16	Enumerated value. Operating state **
Vendor specific operating state code	23	40120	890gt_QSMState	enum16	Vendor specific operating state code **
Bitmask value. Event fields	24	40121	dwPLCqNotImplemented	bitfield32	Bitmask value. Event fields
Reserved for future use	25	40123	dwPLCqNotImplemented	bitfield32	Reserved for future use
Vendor defined events	26	40125	dwPLCqNotImplemented	bitfield32	Vendor defined events
Vendor defined events	27	40127	dwPLCqNotImplemented	bitfield32	Vendor defined events
Vendor defined events	28	40129	dwPLCqNotImplemented	bitfield32	Vendor defined events
Vendor defined events	29	40131	dwPLCqNotImplemented	bitfield32	Vendor defined events
Model Identifier		40133	120	uint16	Inverter Controls Nameplate Ratings
Model Length		40134	26	uint16	Model Length
Device Type		40135	82	enum16	4 = PV, 82=PV_STOR
Continuous power output capability		40136	2000	uint16	W
Scale factor		40137	3	sunssf	
Continuous Volt-Ampere capability.		40138	2000	unit16	VA

** See Page B-12

890GT_ SunSpec Model Information		Holding Reg.			
Description		**Address**	**Tag/*Constant***	**Type**	**Scale / Units**
Scale factor		40139	3	sunssf	
Continuous VAR capability in quadrant 1.		40140	2000	int16	VAr
Continuous VAR capability in quadrant 2.		40141	2000	int16	VAr
Continuous VAR capability in quadrant 3.		40142	-2000	int16	VAr
Continuous VAR capability in quadrant 4.		40143	-2000	int16	VAr
Scale factor		40144	3	sunssf	
Maximum RMS AC current level capability.		40145	2835	unit16	A
Scale factor		40146	0	sunssf	
Minimum power factor capability in quadrant 1.		40147	0	int16	cos()
Minimum power factor capability in quadrant 2.		40148	-1	int16	cos()
Minimum power factor capability in quadrant 3.		40149	-1	int16	cos()
Minimum power factor capability in quadrant 4.		40150	0	int16	cos()
Scale factor		40151	0	sunssf	
Nominal energy rating of storage device.		40152	500	uint16	Wh
Scale factor		40153	3	sunssf	
The useable capacity of the battery.		40154	wPLCqNotImplemented	uint16	AH
Scale factor for amp-hour rating.		40155	0	sunssf	
Maximum rate of energy transfer into the storage device.		40156	2000	uint16	W
Scale factor		40157	3	sunssf	
Maximum rate of energy transfer out of the storage device.		40158	2000	uint16	W
Scale factor		40159	3	sunssf	
Pad register.		40160	x8000	pad	
Model Identifier		40161	121	uint16	
Model Length		40162	30	unit16	
Setting for maximum power output. Default to WRtg.		40163	wSSiWMax	uint16	W
Voltage at the PCC.		40164	wSSiVRef	uint16	V
Offset from PCC to inverter.		40165	wSSiVRefOfs	int16	V
Setpoint for maximum voltage.		40166	wSSiVMax	uint16	V
Setpoint for minimum voltage.		40167	wSSiVMin	uint16	V
Setpoint for maximum apparent power. Default to VARtg.		40168	wSSiVAMax	uint16	VA
Setting for maximum reactive power in quadrant 1. Default to VArRtgQ1.		40169	iSSiVArMaxQ1	int16	VAr
Setting for maximum reactive power in quadrant 2. Default to VArRtgQ2.		40170	iSSiVArMaxQ2	int16	VAr

890GT_ SunSpec Model Information		Holding Reg.			
Description		**Address**	**Tag/*Constant***	**Type**	**Scale / Units**
Setting for maximum reactive power in quadrant 3. Default to VArRtgQ3.		40171	iSSiVArMaxQ3	int16	VAr
Setting for maximum reactive power in quadrant 4. Default to VArRtgQ4.		40172	iSSiVArMaxQ4	int16	VAr
Default ramp rate of change of active power due to command or internal action.		40173	wSSiWGra	uint16	% WMax/min
Setpoint for minimum power factor value in quadrant 1. Default to PFRtgQ1.		40174	iSSiPFMinQ1	int16	cos()
Setpoint for minimum power factor value in quadrant 2. Default to PFRtgQ2.		40175	iSSiPFMinQ2	int16	cos()
Setpoint for minimum power factor value in quadrant 3. Default to PFRtgQ3.		40176	iSSiPFMinQ3	int16	cos()
Setpoint for minimum power factor value in quadrant 4. Default to PFRtgQ4.		40177	iSSiPFMinQ4	int16	cos()
VAR action on change between charging and discharging: 1=switch 2=maintain VAR characterization.		40178	wSSiVArAct	enum16	1 = Switch, 2 = Maintain
Calculation method for total apparent power. 1=vector 2=arithmetic.		40179	wSSiClcTotVA	enum16	1 = Vector, 2 = Arithmetic
Setpoint for maximum ramp rate as percentage of nominal maximum ramp rate. This setting will limit the rate that watts delivery to the grid can increase or decrease in response to intermittent PV generation.		40180	wSSiMaxRmpRte	uint16	% Wgra
Setpoint for nominal frequency at the ECP.		40181	wSSiECPNomHz	uint16	Hz
Identity of connected phase for single phase inverters. A=1 B=2 C=3.		40182	wSSiConnPh	enum16	1 = A, 2 = B, 3 = C
Scale factor for real power.		40183	iSSiWMax_SF	sunssf	
Scale factor for voltage at the PCC.		40184	iSSiVRef_SF	sunssf	
Scale factor for offset voltage.		40185	iSSiVRefOfs_SF	sunssf	
Scale factor for min/max voltages.		40186	iSSiVMinMax_SF	sunssf	
Scale factor for apparent power.		40187	iSSiVAMax_SF	sunssf	
Scale factor for reactive power.		40188	iSSiVArMax_SF	sunssf	
Scale factor for default ramp rate.		40189	iSSiWGra_SF	sunssf	
Scale factor for minimum power factor.		40190	iSSiPFMin_SF	sunssf	
Scale factor for maximum ramp percentage.		40191	iSSiMaxRmpRte_SF	sunssf	
Scale factor for nominal frequency.		40192	iSSiECPNomHz_SF	sunssf	
Model Identifier		40193	122	uint16	
Model Length		40194	44	uint16	
PV inverter present/available status. Enumerated value.		40195	wPLCqNotImplemented	bitfield16	
Storage inverter present/available status. Enumerated value.		40196	*various*	bitfield16	

890GT_ SunSpec Model Information		Holding Reg.			
Description		**Address**	**Tag/*Constant***	**Type**	**Scale / Units**
ECP connection status: disconnected=0 connected=1.		40197	xPLCiMCBOn	bitfield16	
AC lifetime active (real) energy output.		40198	dwPQMiWattHourTotal	acc64	Wh
AC lifetime apparent energy output.		40202	dwPQMiVAHourTotal	acc64	VAh
AC lifetime reactive energy output in quadrant 1.		40206	0	acc64	VArh
AC lifetime reactive energy output in quadrant 2.		40210	0	acc64	VArh
AC lifetime negative energy output in quadrant 3.		40214	0	acc64	VArh
AC lifetime reactive energy output in quadrant 4.		40218	0	acc64	VArh
Amount of VARs available without impacting watts output.		40222	*various*	int16	Var
Scale factor for available VARs.		40223	3	sunssf	
Amount of Watts available.		40224	*various*	uint16	W
Scale factor for available Watts.		40225	3	sunssf	
Bit Mask indicating setpoint limit(s) reached.		40226	dwPLCqNotImplemented	bitfield32	
Bit Mask indicating which inverter controls are currently active.		40228	dwPLCqNotImplemented	bitfield32	
Source of time synchronization.		40230	ntp_	string	
Seconds since 01-01-2000 00:00 UTC		40234	*(current TS) - (12:00:00 01/01/200 TS)*	uint32	S
Bit Mask indicating active ride-through status.		40236	xPCMiLVRTActive	bitfield16	
Isolation resistance.		40237	wPLCqNotImplemented	uint16	
Scale factor for isolation resistance.		40238	0	sunssf	
Model Identifier		40239	123	uint16	
Model Length		40240	24	uint16	
Time window for connect/disconnect.		40241	15	uint16	S
Timeout period for connect/disconnect.		40242	30	uint16	S
Enumerated valued. Connection control.		40243	wSSiConn	enum16	1 = connect, 0 = disconnect
Set power output to specified level.		40244	wSSIWMaxLimPct	uint16	%
Time window for power limit change.		40245	wSSiWMaxLimPct_WinTms	uint16	S
Timeout period for power limit.		40246	wSSiWMaxLimPct_RvrtTms	uint16	S
Ramp time for moving from current setpoint to new setpoint.		40247	wSSiWMaxLimPct_RmpTms	uint16	S
Enumerated valued. Throttle enable/disable control.		40248	wSSiWMaxLim_Ena	enum16	1 = enabled, 0 = disabled
Set power factor to specific value - cosine of angle.		40249	iSSiOutPFSet	int16	cos()
Time window for power factor change.		40250	wSSiOutPFSet_WinTms	uint16	S
Timeout period for power factor.		40251	wSSiOutPFSet_RvrtTms	uint16	S
Ramp time for moving from current setpoint to new setpoint.		40252	wSSiOutPFSet_RmpTms	uint16	S

890GT_ SunSpec Model Information		Holding Reg.			
Description		**Address**	**Tag/*Constant***	**Type**	**Scale / Units**
Enumerated valued. Fixed power factor enable/disable control.		40253	wSSiOutPFSet_Ena	enum16	1 = enabled, 0 = disabled
Reactive power in percent of WMax.		40254	iSSiVArWMaxPct	int16	%
Reactive power in percent of VArMax.		40255	iSSiVArMaxPct	int16	%
Reactive power in percent of VArAval.		40256	iSSiVArAvalPct	int16	%
Time window for VAR limit change.		40257	wSSiVArPct_WinTms	uint16	S
Timeout period for VAR limit.		40258	wSSiVArPct_RvrtTms	uint16	S
Ramp time for moving from current setpoint to new setpoint.		40259	wSSiVArPct_RmpTms	uint16	S
Enumerated value. VAR percent limit mode.		40260	wSSiVArPct_Mod	enum16	
Enumerated valued. Percent limit VAr enable/disable control.		40261	wSSiVArPct_Ena	enum16	1 = enabled, 0 = disabled
Scale factor for power output percent.		40262	0	sunssf	
Scale factor for power factor.		40263	-3	sunssf	
Scale factor for reactive power percent.		40264	0	sunssf	

40119 Enumerated value - Operating States ** See Page B-8		
Value	Label	Description
1	Off	Device is not operating
2	Sleeping	Device is sleeping / auto-shutdown
3	Starting	Device is staring up
4	MPPT	Device is auto tracking maximum power point
5	Throttled	Device is operating at reduced power output
6	Shutting down	Device is shutting down
7	Fault	One or more faults exist
8	Standby	Device is in standby mode
9	Started	Device is Started

40120 890GT QSM State - (Vendor specific code) ** See Page B-8		
Value	Label	Description
1	Boot	Device is Booting
2	Initialize	Device is Initializing
3	EngDev	Device in Engineering Development Mode
4	Off	Device is Off
5	DCPC	Device is DC Precharging
6	DCConnect	Device is DC Connecting
7	ACConnect	Device is AC Connecting
8	Online Local	Device is online in local mode
9	Online Remote	Device is online in remote mode
10	Stop Fault	Device is faulted
11	Exit	Device is in exit

Grid-Tie Inverter – Typical SunSpec SCADA available data

890GT_ SunSpec Model Information								
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**			
Model Identifier	40265	64800	uint16				0	
Model Length	40266	247	uint16				1	
Watchdog Timer (Scada to Inverter)	40267	wSSiControllerHb	uint16		0-3 (rollover)	14 bytes (20mS read / write)	2	0
Set Operation	40268	wSSiSetOperation	enum16				3	1
	1		bool		Start			
	2		bool		Stop			
	3		bool		Enter Standby			
	4		bool		Exit Standby			
			bool					
			bool					
			bool					
			bool					
Alarm Reset	40269	wSSiAlarmReset	uint16		1 = Reset		4	2
Charge Current Limit	40270	wSSiChargeLimit	uint16		DC Amps		5	3
Discharge Current Limit	40271	wSSiDischargeLimit	uint16		DC Amps		6	4
Charge / Discharge Current Limit Scale Factor	40272	iSSiChargeDischargeLimit_SF	sunssf				7	5
Watchdog Timer (Inverter to Scada)	40273	wSSqPCSHb	unit16		0-3 (rollover)		8	
Local / Remote Enum	40274	wSSqLocalRemote	enum16		1 = Remote, 2 = Local			
Boolean Word 1	40275		bitfield32		Bitwise	120 words Modbus Frame Limit		
DC Main Contactor Status	.00	xPLCiStsDCBCnt	Bool	Maintained	1 = Closed			
	.01		Bool					
	.02		Bool					
	.03		Bool					
	.04		Bool					
	.05		Bool					
	.06		Bool					
	.07		Bool					
DC Precharge Contactor Status +	.08	xPLCiStsDCPCPCnt	Bool	Maintained	1 = Closed			
DC Precharge Contactor Status -	.09	xPLCiStsDCPCNCnt	Bool	Maintained	1 = Closed			
DC Precharge Contactor Status Delayed	.10	xHMIqStsDCPCCntDelay	Bool	Maintained	1 = Closed			
	.11		Bool					

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
LC Filter Contactor Status	.12	xPLCiStsLCFltrCnt	Bool	Maintained	1 = Closed
	.13		Bool		
	.14		Bool		
Heater Status	.15	rPLCiStsHeater	Bool	Maintained	1 = On
AC Main Circuit Breaker Status	.00	xPLCiMCBOn	Bool	Maintained	1 = Closed
AC Main Circuit Breaker Tripped	.01	xPLCiMCBTripped	Bool	Maintained	1 = Tripped
	.02		Bool		
	.03		Bool		
Local / Remote SS Status	.04	xPLCiRemoteSS	Bool	Maintained	1 = Switch in Remote Poistion
On / Off SS Status	.05	xPLCiOnSS	Bool	Maintained	1 = Switch in On Position
	.06		Bool		
	.07		Bool		
EPO Pushbutton Status	.08	xPLCiStsEPOPBMasked	Bool	Maintained	1 = Not Actuated
EPO Relay Status	.09	xHMIqStsEPORelayMasked	Bool	Maintained	1 = OK
	.10		Bool		
AC Surge Suppression Fuse Fault	.11	xPLCiStsACSurgeSuppression	Bool	Maintained	1 = OK
DC Surge Suppression Fuse Fault	.12	xPLCiStsDCSurgeSuppression	Bool	Maintained	1 = OK
Un-Buffered 24VDC Supply Fault	.13	xHMIqFaultDCNormalSupply	Bool	Maintained	1 = Fault
Buffered 24VDC Supply Fault	.14	xHMIqFaultDCBufferedSupply	Bool	Maintained	1 = Fault
-15VDC Supply Fault	.15	xHMIqFault_15VDCSupply	Bool	Maintained	1 = Fault
Boolean Word 2	40277		bitfield32		Bitwise
DC Contactor Failed To Open	0	xHMIqFaultDCBCntOpen	Bool	Maintained	1 = Contactor Failed To Open
DC Contactor Failed To Close	.01	xHMIqFaultDCBCntClose	Bool	Maintained	1 = Contactor Failed To Close
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
DC Precharge Contactor Failed To Open +	.08	xHMIqFaultDCPCPOpen	Bool	Maintained	1 = Contactor Failed To Open
DC Precharge Contactor Failed To Open -	.09	xHMIqFaultDCPCNOpen	Bool	Maintained	1 = Contactor Failed To Open
DC Precharge Contactor Failed To Close +	.10	xHMIqFaultDCPCPCntClose	Bool	Maintained	1 = Contactor Failed To Close

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
DC Precharge Contactor Failed To Close -	.11	xHMIqFaultDCPCNCntClose	Bool	Maintained	1 = Contactor Failed To Close
LC Filter Contactor Failed To Open	.12	xHMIqFaultLCFltrCntOpen	Bool	Maintained	1 = Contactor Failed To Open
LC Filter Contactor Failed To Close	.13	xHMIqFaultLCFltrCntClose	Bool	Maintained	1 = Contactor Failed To Close
Heater Fault Off	.14	xHMIqFaultHeaterOff	Bool	Maintianed	1 = ContactorFailed To Open
Heater Fault On	.15	xHMIqFaultHeaterOn	Bool	Maintained	1 = ContactorFailed To Close
	.00		Bool		
	.01		Bool		
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 3	40279		bitfield32		Bitwise
External Temp/Fan Fail/Pump Fail Requires Inverter De-Rate	.00	xHMIqWarnTempDerate	Bool	Maintained	1 = Warning
Relative Humidity Heating On	.01	xPLCqRHHeatingReq	Bool	Maintained	1 = Heating Active
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
R134a Level Warning	.00	xHMIqWarnLevelR134a	Bool	Maintained	1 = Warning
R134a Level Fault	.01	xHMIqFaultLevelR134a	Bool	Maintained	1 = Fault
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
Pump Inlet Temperature Warning	.08	xHMIqWarnTempR134PmpInlet	Bool	Maintained	1 = Warning
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 4	40281		bitfield32		Bitwise
LC Filter Choke Overtemp Switch L21	.00	xHMIqStsLCChokeTempL21	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L22	.01	xHMIqStsLCChokeTempL22	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L23	.02	xHMIqStsLCChokeTempL23	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L31	.03	xHMIqStsLCChokeTempL31	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L32	.04	xHMIqStsLCChokeTempL32	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L33	.05	xHMIqStsLCChokeTempL33	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L41	.06	xHMIqStsLCChokeTempL41	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L42	.07	xHMIqStsLCChokeTempL42	Bool	Maintained	0 = Overtemp
LC Filter Choke Overtemp Switch L43	.08	xHMIqStsLCChokeTempL43	Bool	Maintained	0 = Overtemp
	.09		Bool		

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
	.00		Bool		
	.01		Bool		
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 5	40283		bitfield32		Bitwise
PLC-HMI Watchdog	.00	xHMIqWatchdog	Bool	Pulse Train	1 HZ Pulse Train
PLC-SDC Watchdog	.01	xPLCiSDCWatchdog	Bool	Pulse Train	1 HZ Pulse Train
PLC-PQM Watchdog	.02	xPQMiWatchdog	Bool	Pulse Train	1 HZ Pulse Train
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
PLC - PCM Comms Fault	.00	xHMIqPCMCommsFault	Bool	Maintained	1 = PCM Watchdog Timeout
PLC - SDC Comms Fault	.01	xHMIqSDCCommsFault	Bool	Maintained	1 = SDC Watchdog Timeout
PLC - PQM Comms Fault	.02	xHMIqPQMCommsFault	Bool	Maintained	1 = PQM Watchdog Timeout
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 6	40285		bitfield32		Bitwise
Commit Persistents Acknowledgement	.00	xHMIqCommitPersistents	Bool	Maintained	1 = Commit Request Complete
Recall Persistents Acknowledgement	.01	xHMIqRecallPersistents	Bool	Maintained	1 = Recall Request Complete
HMI Shutdown Warning	.02	xHMIqWarnHMIShutdown	Bool	Maintained	1 = Warning
HMI Shutdown (via VBA script)	.03	xHMIqHMIShutdown	Bool	Maintained	1 = Runtime and OS Shurdown
HMI Shutdown Override	.04	xHMIqHMIShutdownOverride	Bool	Maintained	1 = Override
	.05				
	.06				
	.07				

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
	.08				
	.09				
	.10				
	.11				
	.12				
	.13				
	.14				
	.15				
Active Power Priority Enabled (Local)	.00	xHMIqAPPEnabled	Bool	Maintained	1 = Active Power Priority Enabled (Local)
Local VAR Mode Enabled	.01	xHMIqLocalVARModeEnabled	Bool	Maintained	1 = Local VAR Mode Enabled
	.02				
	.03				
	.04				
	.05				
	.06				
	.07				
kW kVAR Control Mode Enabled	.08	xPCMqkWkVARControl	Bool	Maintained	1 = kW kVAR Control Enabled (EngDev State)
kW PID Enabled	.09	xHMIikWPIDEnable	Bool	Maintained	1 = kW PID Enabled
kVAR PID Enabled	.10	xHMIikVARPIDEnable	Bool	Maintained	1 = kVAR PID Enabled
	.11				
	.12				
	.13				
	.14				
	.15				
Boolean Word 7	40287		bitfield32		Bitwise
Reactor U1 Temperature Warning	.00	xHMIqWarnTempLCChokeU1	Bool	Maintained	1 = Warning
Reactor V1 Temperature Warning	.01	xHMIqWarnTempLCChokeV1	Bool	Maintained	1 = Warning
Reactor W1 Temperature Warning	.02	xHMIqWarnTempLCChokeW1	Bool	Maintained	1 = Warning
Reactor U2 Temperature Warning	.03	xHMIqWarnTempLCChokeU2	Bool	Maintained	1 = Warning
Reactor V2 Temperature Warning	.04	xHMIqWarnTempLCChokeV2	Bool	Maintained	1 = Warning
Reactor W2 Temperature Warning	.05	xHMIqWarnTempLCChokeW2	Bool	Maintained	1 = Warning

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
Reactor U3 Temperature Warning	.06	xHMIqWarnTempLCChokeU3	Bool	Maintained	1 = Warning
Reactor V3 Temperature Warning	.07	xHMIqWarnTempLCChokeV3	Bool	Maintained	1 = Warning
Reactor W3 Temperature Warning	.08	xHMIqWarnTempLCChokeW3	Bool	Maintained	1 = Warning
DC Power Supply Area Temperature Warning	.09	xHMIqWarnTempDCSupply	Bool	Maintained	1 = Warning
Internal Ambient Temperature Warning	.10	xHMIqWarnTempInternalAmbient	Bool	Maintained	1 = Warning
External Ambient Temperature Warning	.11	xHMIqWarnTempExternalAmbient	Bool	Maintained	1 = Warning
Aux Power CB Area Temperature Warning	.12	xHMIqWarnTempAuxPwrAmbient	Bool	Maintained	1 = Warning
Aux Power Transformer Area Temperature Warning	.13	xHMIqWarnTempAuxPwrXfrmrAmbient	Bool	Maintained	1 = Warning
Condenser Inlet Temperature Warning	.14	xHMIqWarnTempR134CndInlet	Bool	Maintained	1 = Warning
Condenser Outlet Temperature Warning	.15	xHMIqWarnTempR134CndOutlet	Bool	Maintained	1 = Warning
Reactor U1 Temperature Fault	.00	xHMIqFaultTempLCChokeU1	Bool	Maintained	1 = Fault
Reactor V1 Temperature Fault	.01	xHMIqFaultTempLCChokeV1	Bool	Maintained	1 = Fault
Reactor W1 Temperature Fault	.02	xHMIqFaultTempLCChokeW1	Bool	Maintained	1 = Fault
Reactor U2 Temperature Fault	.03	xHMIqFaultTempLCChokeU2	Bool	Maintained	1 = Fault
Reactor V2 Temperature Fault	.04	xHMIqFaultTempLCChokeV2	Bool	Maintained	1 = Fault
Reactor W2 Temperature Fault	.05	xHMIqFaultTempLCChokeW2	Bool	Maintained	1 = Fault
Reactor U3 Temperature Fault	.06	xHMIqFaultTempLCChokeU3	Bool	Maintained	1 = Fault
Reactor V3 Temperature Fault	.07	xHMIqFaultTempLCChokeV3	Bool	Maintained	1 = Fault
Reactor W3 Temperature Fault	.08	xHMIqFaultTempLCChokeW3	Bool	Maintained	1 = Fault
DC Power Supply Area Temperature Fault	.09	xHMIqFaultTempDCSupply	Bool	Maintained	1 = Fault
Internal Ambient Temperature Fault	.10	xHMIqFaultTempInternalAmbient	Bool	Maintained	1 = Fault
External Ambient Temperature Fault	.11	xHMIqFaultTempExternalAmbient	Bool	Maintained	1 = Fault
Aux Power CB Area Temperature Fault	.12	xHMIqFaultTempAuxPwrAmbient	Bool	Maintained	1 = Fault
Aux Power Transformer Area Temperature Fault	.13	xHMIqFaultTempAuxPwrXfrmrAmbient	Bool	Maintained	1 = Fault
Condenser Inlet Temperature Fault	.14	xHMIqFaultTempR134CndInlet	Bool	Maintained	1 = Fault
Condenser Outlet Temperature Fault	.15	xHMIqFaultTempR134CndOutlet	Bool	Maintained	1 = Fault
Boolean Word 8	40289		bitfield32		Bitwise
Filter U1 Leg Current Fault	.00	xPLCqFaultCurrentACFltrU1	Bool	Maintained	1 = Fault
Filter U2 Leg Current Fault	.01	xPLCqFaultCurrentACFltrU2	Bool	Maintained	1 = Fault
Filter V1 Leg Current Fault	.02	xPLCqFaultCurrentACFltrV1	Bool	Maintained	1 = Fault
Filter V2 Leg Current Fault	.03	xPLCqFaultCurrentACFltrV2	Bool	Maintained	1 = Fault
Filter W1 Leg Current Fault	.04	xPLCqFaultCurrentACFltrW1	Bool	Maintained	1 = Fault
Filter W2 Leg Current Fault	.05	xPLCqFaultCurrentACFltrW2	Bool	Maintained	1 = Fault

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
	.06				
	.07				
	.08				
	.09				
	.10				
	.11				
	.12				
	.13				
	.14				
	.15				
Filter U1 Leg Current High Warning	.00	xHMIqWarnCurrentFltrU1High	Bool	Maintained	1 = Current High
Filter U2 Leg Current High Warning	.01	xHMIqWarnCurrentFltrU2High	Bool	Maintained	1 = Current High
Filter V1 Leg Current High Warning	.02	xHMIqWarnCurrentFltrV1High	Bool	Maintained	1 = Current High
Filter V2 Leg Current High Warning	.03	xHMIqWarnCurrentFltrV2High	Bool	Maintained	1 = Current High
Filter W1 Leg Current High Warning	.04	xHMIqWarnCurrentFltrW1High	Bool	Maintained	1 = Current High
Filter W2 Leg Current High Warning	.05	xHMIqWarnCurrentFltrW2High	Bool	Maintained	1 = Current High
Filter U1 Leg Current Low Warning	.06	xHMIqWarnCurrentFltrU1Low	Bool	Maintained	1 = Current Low
Filter U2 Leg Current Low Warning	.07	xHMIqWarnCurrentFltrU2Low	Bool	Maintained	1 = Current Low
Filter V1 Leg Current Low Warning	.08	xHMIqWarnCurrentFltrV1Low	Bool	Maintained	1 = Current Low
Filter V2 Leg Current Low Warning	.09	xHMIqWarnCurrentFltrV2Low	Bool	Maintained	1 = Current Low
Filter W1 Leg Current Low Warning	.10	xHMIqWarnCurrentFltrW1Low	Bool	Maintained	1 = Current Low
Filter W2 Leg Current Low Warning	.11	xHMIqWarnCurrentFltrW2Low	Bool	Maintained	1 = Current Low
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 9	40291		bitfield32		Bitwise
	.00		Bool		
	.01		Bool		
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
	.00		Bool		
	.01		Bool		
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 10	40293		bitfield32		Bitwise
DC Panel Busbar Temperature Warning 4A17	.00	xHMIqWarnTempDCPanel4A17	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A18	.01	xHMIqWarnTempDCPanel4A18	Bool	Maintained	1 = Warning
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
DC Panel Busbar Temperature Fault 4A17	.00	xHMIqFaultTempDCPanel4A17	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A18	.01	xHMIqFaultTempDCPanel4A18	Bool	Maintained	1 = Fault
	.02		Bool		
	.03		Bool		
	.04		Bool		
	.05		Bool		
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 11	40295		bitfield32		Bitwise
DC Panel Busbar Temperature Warning 4A1	.00	xHMIqWarnTempDCPanel4A1	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A2	.01	xHMIqWarnTempDCPanel4A2	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A3	.02	xHMIqWarnTempDCPanel4A3	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A4	.03	xHMIqWarnTempDCPanel4A4	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A5	.04	xHMIqWarnTempDCPanel4A5	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A6	.05	xHMIqWarnTempDCPanel4A6	Bool	Maintained	1 = Warning

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
DC Panel Busbar Temperature Warning 4A7	.06	xHMIqWarnTempDCPanel4A7	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A8	.07	xHMIqWarnTempDCPanel4A8	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A9	.08	xHMIqWarnTempDCPanel4A9	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A10	.09	xHMIqWarnTempDCPanel4A10	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A11	.10	xHMIqWarnTempDCPanel4A11	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A12	.11	xHMIqWarnTempDCPanel4A12	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A13	.12	xHMIqWarnTempDCPanel4A13	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A14	.13	xHMIqWarnTempDCPanel4A14	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A15	.14	xHMIqWarnTempDCPanel4A15	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Warning 4A16	.15	xHMIqWarnTempDCPanel4A16	Bool	Maintained	1 = Warning
DC Panel Busbar Temperature Fault 4A1	.00	xHMIqFaultTempDCPanel4A1	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A2	.01	xHMIqFaultTempDCPanel4A2	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A3	.02	xHMIqFaultTempDCPanel4A3	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A4	.03	xHMIqFaultTempDCPanel4A4	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A5	.04	xHMIqFaultTempDCPanel4A5	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A6	.05	xHMIqFaultTempDCPanel4A6	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A7	.06	xHMIqFaultTempDCPanel4A7	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A8	.07	xHMIqFaultTempDCPanel4A8	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A9	.08	xHMIqFaultTempDCPanel4A9	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A10	.09	xHMIqFaultTempDCPanel4A10	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A11	.10	xHMIqFaultTempDCPanel4A11	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A12	.11	xHMIqFaultTempDCPanel4A12	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A13	.12	xHMIqFaultTempDCPanel4A13	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A14	.13	xHMIqFaultTempDCPanel4A14	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A15	.14	xHMIqFaultTempDCPanel4A15	Bool	Maintained	1 = Fault
DC Panel Busbar Temperature Fault 4A16	.15	xHMIqFaultTempDCPanel4A16	Bool	Maintained	1 = Fault
Boolean Word 12	40297		bitfield32		Bitwise
Main Breaker Busbar Temperature Warning 5A1	.00	xHMIqWarnTempMCBBusBar5A1	Bool	Maintained	1 = Warning
Main Breaker Busbar Temperature Warning 5A2	.01	xHMIqWarnTempMCBBusBar5A2	Bool	Maintained	1 = Warning
Main Breaker Busbar Temperature Warning 5A3	.02	xHMIqWarnTempMCBBusBar5A3	Bool	Maintained	1 = Warning
Main Breaker Busbar Temperature Warning 5A4	.03	xHMIqWarnTempMCBBusBar5A4	Bool	Maintained	1 = Warning
Main Breaker Busbar Temperature Warning 5A5	.04	xHMIqWarnTempMCBBusBar5A5	Bool	Maintained	1 = Warning
Main Breaker Busbar Temperature Warning 5A6	.05	xHMIqWarnTempMCBBusBar5A6	Bool	Maintained	1 = Warning

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Main Breaker Busbar Temperature Fault 5A1	.00	xHMIqFaultTempMCBBusBar5A1	Bool	Maintained	1 = Fault
Main Breaker Busbar Temperature Fault 5A2	.01	xHMIqFaultTempMCBBusBar5A2	Bool	Maintained	1 = Fault
Main Breaker Busbar Temperature Fault 5A3	.02	xHMIqFaultTempMCBBusBar5A3	Bool	Maintained	1 = Fault
Main Breaker Busbar Temperature Fault 5A4	.03	xHMIqFaultTempMCBBusBar5A4	Bool	Maintained	1 = Fault
Main Breaker Busbar Temperature Fault 5A5	.04	xHMIqFaultTempMCBBusBar5A5	Bool	Maintained	1 = Fault
Main Breaker Busbar Temperature Fault 5A6	.05	xHMIqFaultTempMCBBusBar5A6	Bool	Maintained	1 = Fault
	.06		Bool		
	.07		Bool		
	.08		Bool		
	.09		Bool		
	.10		Bool		
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Boolean Word 13	40299		bitfield32		Bitwise
Filter Busbar Temperature Warning 6A1	.00	xHMIqWarnTempFltrBusBar6A1	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A2	.01	xHMIqWarnTempFltrBusBar6A2	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A3	.02	xHMIqWarnTempFltrBusBar6A3	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A4	.03	xHMIqWarnTempFltrBusBar6A4	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A5	.04	xHMIqWarnTempFltrBusBar6A5	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A6	.05	xHMIqWarnTempFltrBusBar6A6	Bool	Maintained	1 = Warning

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
Filter Busbar Temperature Warning 6A7	.06	xHMIqWarnTempFltrBusBar6A7	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A8	.07	xHMIqWarnTempFltrBusBar6A8	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A9	.08	xHMIqWarnTempFltrBusBar6A9	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A10	.09	xHMIqWarnTempFltrBusBar6A10	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A11	.10	xHMIqWarnTempFltrBusBar6A11	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A12	.11	xHMIqWarnTempFltrBusBar6A12	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A13	.12	xHMIqWarnTempFltrBusBar6A13	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A14	.13	xHMIqWarnTempFltrBusBar6A14	Bool	Maintained	1 = Warning
Filter Busbar Temperature Warning 6A15	.14	xHMIqWarnTempFltrBusBar6A15	Bool	Maintained	1 = Warning
	.15		Bool		
Filter Busbar Temperature Fault 6A1	.00	xHMIqFaultTempFltrBusBar6A1	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A2	.01	xHMIqFaultTempFltrBusBar6A2	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A3	.02	xHMIqFaultTempFltrBusBar6A3	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A4	.03	xHMIqFaultTempFltrBusBar6A4	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A5	.04	xHMIqFaultTempFltrBusBar6A5	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A6	.05	xHMIqFaultTempFltrBusBar6A6	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A7	.06	xHMIqFaultTempFltrBusBar6A7	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A8	.07	xHMIqFaultTempFltrBusBar6A8	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A9	.08	xHMIqFaultTempFltrBusBar6A9	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A10	.09	xHMIqFaultTempFltrBusBar6A10	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A11	.10	xHMIqFaultTempFltrBusBar6A11	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A12	.11	xHMIqFaultTempFltrBusBar6A12	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A13	.12	xHMIqFaultTempFltrBusBar6A13	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A14	.13	xHMIqFaultTempFltrBusBar6A14	Bool	Maintained	1 = Fault
Filter Busbar Temperature Fault 6A15	.14	xHMIqFaultTempFltrBusBar6A15	Bool	Maintained	1 = Fault
	.15		Bool		
Boolean Word 14	40301		bitfield32		Bitwise
Cap Door Busbar Temperature Warning 7A1	.00	xHMIqWarnTempCapDoor7A1	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A2	.01	xHMIqWarnTempCapDoor7A2	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A3	.02	xHMIqWarnTempCapDoor7A3	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A4	.03	xHMIqWarnTempCapDoor7A4	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A5	.04	xHMIqWarnTempCapDoor7A5	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A6	.05	xHMIqWarnTempCapDoor7A6	Bool	Maintained	1 = Warning

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
Cap Door Busbar Temperature Warning 7A7	.06	xHMIqWarnTempCapDoor7A7	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A8	.07	xHMIqWarnTempCapDoor7A8	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A9	.08	xHMIqWarnTempCapDoor7A9	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A10	.09	xHMIqWarnTempCapDoor7A10	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A11	.10	xHMIqWarnTempCapDoor7A11	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A12	.11	xHMIqWarnTempCapDoor7A12	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A13	.12	xHMIqWarnTempCapDoor7A13	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A14	.13	xHMIqWarnTempCapDoor7A14	Bool	Maintained	1 = Warning
Cap Door Busbar Temperature Warning 7A15	.14	xHMIqWarnTempCapDoor7A15	Bool	Maintained	1 = Warning
	.15		Bool		
Cap Door Busbar Temperature Fault 7A1	.00	xHMIqFaultTempCapDoor7A1	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A2	.01	xHMIqFaultTempCapDoor7A2	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A3	.02	xHMIqFaultTempCapDoor7A3	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A4	.03	xHMIqFaultTempCapDoor7A4	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A5	.04	xHMIqFaultTempCapDoor7A5	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A6	.05	xHMIqFaultTempCapDoor7A6	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A7	.06	xHMIqFaultTempCapDoor7A7	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A8	.07	xHMIqFaultTempCapDoor7A8	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A9	.08	xHMIqFaultTempCapDoor7A9	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A10	.09	xHMIqFaultTempCapDoor7A10	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A11	.10	xHMIqFaultTempCapDoor7A11	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A12	.11	xHMIqFaultTempCapDoor7A12	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A13	.12	xHMIqFaultTempCapDoor7A13	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A14	.13	xHMIqFaultTempCapDoor7A14	Bool	Maintained	1 = Fault
Cap Door Busbar Temperature Fault 7A15	.14	xHMIqFaultTempCapDoor7A15	Bool	Maintained	1 = Fault
	.15		Bool		
Boolean Word 15	40303		bitfield32		Bitwise
Inverter Stack Busbar Temperature Warning 8A1	.00	xHMIqWarnTempInvBusBar8A1	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A2	.01	xHMIqWarnTempInvBusBar8A2	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A3	.02	xHMIqWarnTempInvBusBar8A3	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A4	.03	xHMIqWarnTempInvBusBar8A4	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A5	.04	xHMIqWarnTempInvBusBar8A5	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A6	.05	xHMIqWarnTempInvBusBar8A6	Bool	Maintained	1 = Warning

890GT_ SunSpec Model Information					
Description	Holding Reg. Address	Tag/*Constant*	Type	Condition	Scale / Units
Inverter Stack Busbar Temperature Warning 8A7	.06	xHMIqWarnTempInvBusBar8A7	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A8	.07	xHMIqWarnTempInvBusBar8A8	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A9	.08	xHMIqWarnTempInvBusBar8A9	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A10	.09	xHMIqWarnTempInvBusBar8A10	Bool	Maintained	1 = Warning
Inverter Stack Busbar Temperature Warning 8A11	.10	xHMIqWarnTempInvBusBar8A11	Bool	Maintained	1 = Warning
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
Inverter Stack Busbar Temperature Fault 8A1	.00	xHMIqFaultTempInvBusBar8A1	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A2	.01	xHMIqFaultTempInvBusBar8A2	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A3	.02	xHMIqFaultTempInvBusBar8A3	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A4	.03	xHMIqFaultTempInvBusBar8A4	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A5	.04	xHMIqFaultTempInvBusBar8A5	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A6	.05	xHMIqFaultTempInvBusBar8A6	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A7	.06	xHMIqFaultTempInvBusBar8A7	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A8	.07	xHMIqFaultTempInvBusBar8A8	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A9	.08	xHMIqFaultTempInvBusBar8A9	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A10	.09	xHMIqFaultTempInvBusBar8A10	Bool	Maintained	1 = Fault
Inverter Stack Busbar Temperature Fault 8A11	.10	xHMIqFaultTempInvBusBar8A11	Bool	Maintained	1 = Fault
	.11		Bool		
	.12		Bool		
	.13		Bool		
	.14		Bool		
	.15		Bool		
DC Link Volts	40305	rPCMiDCLinkVolts	float32		Volts DC
Mains Current	40307	rPCMiMainsCurrentA	float32		Amps AC (From Inverter)
Terminal Volts	40309	rPCMiTerminalVolts	float33		Volts AC (From Inverter)
Hardware Sync Frequency	40311	rPCMiHardwareSyncFreq	float34		Hertz
spare	40313		float35		
Heatsink Temperature (Hottest IGBT)	40315	rPCMiHeatSinkTemp	float36		Degrees Celsius

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
Real Current Demand	40317	rPCMiIdDemand	float37		+- 1.0 = +- Inverter Rated Current
Reactive Current Demand	40319	rPCMiIqDemand	float38		+- 1.0 = +- Inverter Rated Current
Actual PWM Frequency	40321	rPCMiActualPWMFreq	float39		Hertz
Inverter Configured Maximum Current	40323	rPCMiMaxCurrent	float40		Amps
id feedback	40325	rPCMiIdFeedback	float41		+- 1.0 = +- Inverter Rated Current
iq feedback	40327	rPCMIiqFeedback	float42		+- 1.0 = +- Inverter Rated Current
spare	40329				
spare	40331				
DC Volts Demand	40333	rPCMiDCVoltsDemand	float32		Volts DC (Voltage Mode Only)
First Trip	40335	dwPCMiFirstTrip	enum32		Enumerated Value
IGBT Control Module Status Word	40337	dwPCMiStatus	bitfield32		Bitwise
Running	.00	xPCMiRunning	Bool	Maintained	1 = Running
Tripped	.01	xPCMiTripped	Bool	Maintained	1 = Tripped
Synchronized	.02	xPCMiSynchronized	Bool	Maintained	1 = Synchronized
Close Precharge	.03	xPCMiClosePrecharge	Bool	Maintained	1 = Close Precharge
Current Control	.04	xPCMiCurrentControl	Bool	Maintained	1 = Current Control
Inverter Enabled	.05	xPCMiInverterEnabled	Bool	Maintained	1 = Inverter Enabled
Hardware Sync	.06	xPCMiHardwareSync	Bool	Maintained	1 = Hardware Sync
EPO Status	.07	xPCMiEStopStatus	Bool	Maintained	1 = EPO Picked Up
	.08		Bool		
Refrigerant Pump Healthy	.09	xInviPumpHealthy	Bool	Maintained	1 = Pump Controller Healthy
Condenser Fan 2 Healthy	.10	xInviCondenserFan2Healthy	Bool	Maintained	1 = Fan Healthy
Condenser Fan 1 Healthy	.11	xInviCondenserFan1Healthy	Bool	Maintained	1 = Fan Healthy
Evaporator Fans Healthy	.12	xInviEvaporatorFansHealthy	Bool	Maintained	1 = Fan Controller Healthy
Remote/Local Sequence	.13	xPCMiLocalSequence	Bool	Maintained	1 = Inverter In Local Control via Keypad
Heating Active	.14	xInviHeatingActive	Bool	Maintained	1 = Heating Active
Watchdog	.15	xPCMiWatchdog	Bool	Pulse Train	Pulse Train

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
Condenser Fan 1 Run Command Out	.00	xInviCondenserFan1RunOut	Bool	Maintained	1 = Fan Commended To Run
Condenser Fan 2 Run Command Out	.01	xInviCondenserFan2RunOut	Bool	Maintained	1 = Fan Commended To Run
(-)15VDC Supply Status	.02	xInvi_15VDCSupplyOK	Bool	Maintained	1 = Supply OK
Grid Mode Active	.03	xPCMi4QRegenActive	Bool	Maintained	1 = Grid Mode
Island Mode Active	.04	xPCMiVHZActive	Bool	Maintained	1 = Island Mode
LVRT Enabled	.05	xPCMiLVRTActive	Bool	Maintained	1 = LVRT Mode Enabled
DC Link High	.06	xPCMiFaultDCLinkHigh	Bool	Maintained	1 = Fault
DC Link Low	.07	xPCMiFaultDCLinkLow	Bool	Maintained	1 = Fault
Fault Over Frequency	.08	xPCMiFaultFreqHigh	Bool	Maintained	1 = Fault
Fault Under Frequency	.09	xPCMiFaultFreqLow	Bool	Maintained	1 = Fault
	.10				
	.11				
	.12				
	.13				
	.14				
	.15				
spare	40339				
spare	40341				
spare	40343				
Rated Inverter Power	40345	rPCMqRatedPowerkW	Real	~	kW
spare	40347				
Filter Capacitor RMS Current U1	40349	rPLCiCurrentACFltrU1	Real	~	Amps RMS
Filter Capacitor RMS Current U2	40351	rPLCiCurrentACFltrU2	Real	~	Amps RMS
Filter Capacitor RMS Current V1	40353	rPLCiCurrentACFltrV1	Real	~	Amps RMS
Filter Capacitor RMS Current V2	40355	rPLCiCurrentACFltrV2	Real	~	Amps RMS
Filter Capacitor RMS Current W1	40357	rPLCiCurrentACFltrW1	Real	~	Amps RMS
Filter Capacitor RMS Current W2	40359	rPLCiCurrentACFltrW2	Real	~	Amps RMS
spare	40361			~	
spare	40363			~	
spare	40365			~	
spare	40367			~	
spare	40369			~	
Watchdog Timer from SDC	40371	dwSSiControllerHb	Dword	~	counts

890GT_ SunSpec Model Information						
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**	
spare	40373			~		
spare	40375			~		
spare	40377			~		
spare	40379			~		
Charge Limit Amps	40381	rBMSiChargeLimitA	Real	~	Amps DC	
Discharge Limit Amps	40383	rBMSiDischargeLimitA	Real	~	Amps DC	
Charge Limit Power	40385	rPCMqChargeLmitkW	Real	~	kW	
Discharge Limit Power	40387	rPCMqDischargeLimitkVAr	Real	~	kVAr	
W Target from SDC	40389	rSSiPCommandW	Real	~	W	
VAr Target from SDC	40391	rSSiQCommandVAr	Real	~	Var	
spare	40393			~		
Metered AC Amps Phase A	40395	rPQMiAmpsA	Real	~	Amps	120 Words Modbus Frame Limit
Metered AC Amps Phase B	40397	rPQMiAmpsB	Real	~	Amps	
Metered AC Amps Phase C	40399	rPQMiAmpsC	Real	~	Amps	
Metered AC Volts AB	40401	rPQMiVoltsAB	Real	~	Volts	
Metered AC Volts BC	40403	rPQMiVoltsBC	Real	~	Volts	
Metered AC Volts CA	40405	rPQMiVoltsCA	Real	~	Volts	
Metered Watts	40407	rPQMiWatts60Cycle_	Real	~	Watts	
Metered VARs	40409	rPQMiVARs60Cycle_	Real	~	VARs	
Metered Power Factor	40411	rPQMiPF	Real	~	Unitless	
spare	40413			~		
spare	40415			~		
spare	40417			~		
spare	40419			~		
spare	40421			~		
spare	40423			~		
spare	40425			~		
spare	40427			~		
spare	40429			~		
Reactor U1 Temperature	40431	rPLCiTempChokeU1	Real	~	Degrees Celsius	
Reactor V1 Temperature	40433	rPLCiTempChokeV1	Real	~	Degrees Celsius	
Reactor W1 Temperature	40435	rPLCiTempChokeW1	Real	~	Degrees Celsius	
Reactor U2 Temperature	40437	rPLCiTempChokeU2	Real	~	Degrees Celsius	

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
Reactor V2 Temperature	40439	rPLCiTempChokeV2	Real	~	Degrees Celsius
Reactor W2 Temperature	40441	rPLCiTempChokeW2	Real	~	Degrees Celsius
Reactor U3 Temperature	40443	rPLCiTempChokeU3	Real	~	Degrees Celsius
Reactor V3 Temperature	40445	rPLCiTempChokeV3	Real	~	Degrees Celsius
Reactor W3 Temperature	40447	rPLCiTempChokeW3	Real	~	Degrees Celsius
DC Power Supply Area Temperature	40449	rPLCiTempDCPwrAmbient	Real	~	Degrees Celsius
Internal Ambient	40451	rPLCiTempInternalAmbient	Real	~	Degrees Celsius
External Ambient	40453	rPLCiTempExternalAmbient	Real	~	Degrees Celsius
Aux Power CB Area Ambient	40455	rPLCiTempAuxPwrAmbient	Real	~	Degrees Celsius
Aux Power Transformer Area Ambient	40457	rPLCiTempAuxPwrXfrmr	Real	~	Degrees Celsius
R134a Temperature at Condenser Inlet	40459	rPLCiTempCondenserInlet	Real	~	Degrees Celsius
R134a Temperature at Condenser Outlet	40461	rPLCiTempCondenserOutlet	Real	~	Degrees Celsius
R134a Temperature at Pump Inlet	40463	rPLCiTempR134aPumpInlet	Real	~	Degrees Celsius
Evaporator Return Air Temp	40465	rPLCiTempEvapReturnAir	Real	~	Degrees Celsius
spare	40467				
spare	40469			~	
spare	40471			~	
DC Panel Busbar Thermistor Temperature	40473	rPLCiTempDCPanel	Real	~	Degrees Celsius
DC Panel Busbar Thermistor Hottest Locations	40475	dwHMIqPosDCPanel	Dword	~	Byte-Wise *
Main Breaker Busbar Thermistor Temperature	40477	rPLCiTempMCBBusBar	Real	~	Degrees Celsius
Filter Busbar Thermistor Temperature	40479	rPLCiTempFltrBusBar	Real	~	Degrees Celsius
Cap Door Busbar Thermistor Temperature	40481	rPLCiTempCapDoor	Real	~	Degrees Celsius
Inverter Busbar Thermistor Termperature	40483	rPLCiTempInvBusBar	Real	~	Degrees Celsius
BusBar Thermistor Locations	40485	dwHMIqPosBusBar	Dword	~	Byte-Wise **
spare	40487				
spare	40489				
Condenser Fan Speed Demand	40491	rPCMiCndFansSpeedDemand	Real	~	%
Evaporator Fan Speed Demand	40493	rPLCiSpeedEvapFans	Real	~	%
Pump Speed Command	40495	rHMIqPumpSpeedCommand	Real	~	%
R134a Level	40497	rPLCiLevelR134a	Real	~	%
Interior Relative Humidity	40499	rPLCiRHInterior	Real	~	%
PLC State Machine Current State	40501	890GTAlphaQSMState	Dword	~	Enumerated Value

890GT_ SunSpec Model Information					
Description	**Holding Reg. Address**	**Tag/*Constant***	**Type**	**Condition**	**Scale / Units**
PLC State Machine Current State Origin	40503	dwHMIqStateOrigin	Dword	~	Enum - Location that queued current state
Current Target Time	40505	dwHMIqTargetTime	Dword	~	Current PLC Time (Byte-Wise) ***
PLC CPU Utilization Total	40507	rHMIqPLCCPULoad	Real	~	%
PLC Chassis Temperature	40509	rFPGAqChassisTemperature	Real	~	Degrees Celsius
PLC Available Memory	40511	rHMIqPLCAvailableMem	Real	~	kByte
	40513				

*40475 (page B-32)	
Lo Byte	
Hi Byte	1-18 = Hottest Position DC Panel
**40485 (page B-32)	
Lo Byte	1-11 = Hottest Position Inverter BusBar
	1-15 = Hottest Position Cap Door
	1-15 = Hottest Position Filter BusBar
Hi Byte	1-6 = Hottest Position MCB
***40505 (page B-33)	
Low Word	Minutes
High Word	Hour

Appendix C Certification

This Chapter outlines the additional steps that may be required to achieve EMC conformance.

C-2 Certification

Certificates: In progress

Appendix D Associated Equipment Manuals

This Appendix includes:

Bender Ground Fault Technical Bulletin	NAE1012020.pdf
National Instrument CompactRIO cRIO-9072/3/4	374639e.pdf
Stride Industrial Ethernet Switch Address	
Shark 200 & 200T Power and Energy Meter Manual	E149701_Shark100100T.pdf
Siemens WL Circuit Breaker Manual	**Document Order # CBIM-01001-0504**

Bender Ground Fault Monitor (See Technical Bulletin NAE1012020.pdf)

IRDH275 Series Digital Ground Fault Monitor / Ground Detector for Ungrounded (Floating) AC/DC Systems

DESCRIPTION

This device meets or exceeds the requirements of NEC 250.21(B) and CEC 10-106(2) for ground detectors in ungrounded AC systems, as well as the upcoming 2014 requirement of NEC 250.167(A) for ungrounded DC systems. The IRDH275 monitors for ground faults in ungrounded single-phase AC, three-phase AC, and DC systems by monitoring the system's insulation resistance. It may be connected to systems of up to 793 VAC / 650 VDC. Voltage coupler accessories, such as the AGH 150W-4, extend this range. The AMP Plus measuring principle utilized by the IRDH275 meets the requirements of modern power systems, including pure DC systems, systems with rectifiers, and systems with variable frequency drives (VFDs). In systems with high leakage capacitances, the IRDH275 automatically adapts itself to ensure an accurate reading. The IRDH275 features a digital display showing the system's insulation resistance 'in real-time. All settings are changed via the device's built-in menu. The IRDH275 utilizes an external supply voltage for power, which allows deenergized systems to also be monitored.

FUNCTION

When the insulation resistance from system to ground falls below the set response value, the alarm relays switch and the alarm LEDs activate. Two separately adjustable alarm contacts can be set to a prewarning and main warning alarm. The measured value is indicated on the LCD display or an externally connectable measuring instrument. A latching setting ("fault memory") allows the device to reset automatically or require a manual reset. An external and internal test/reset can be activated remotely or on the device. A comprehensive INFO menu displays additional information such as the system's leakage capacitance. The IRDH275 continuously monitors the equipment ground connection to ensure proper operation. The device's easy-to-use onboard menu manages all settings via the detailed LCD screen.

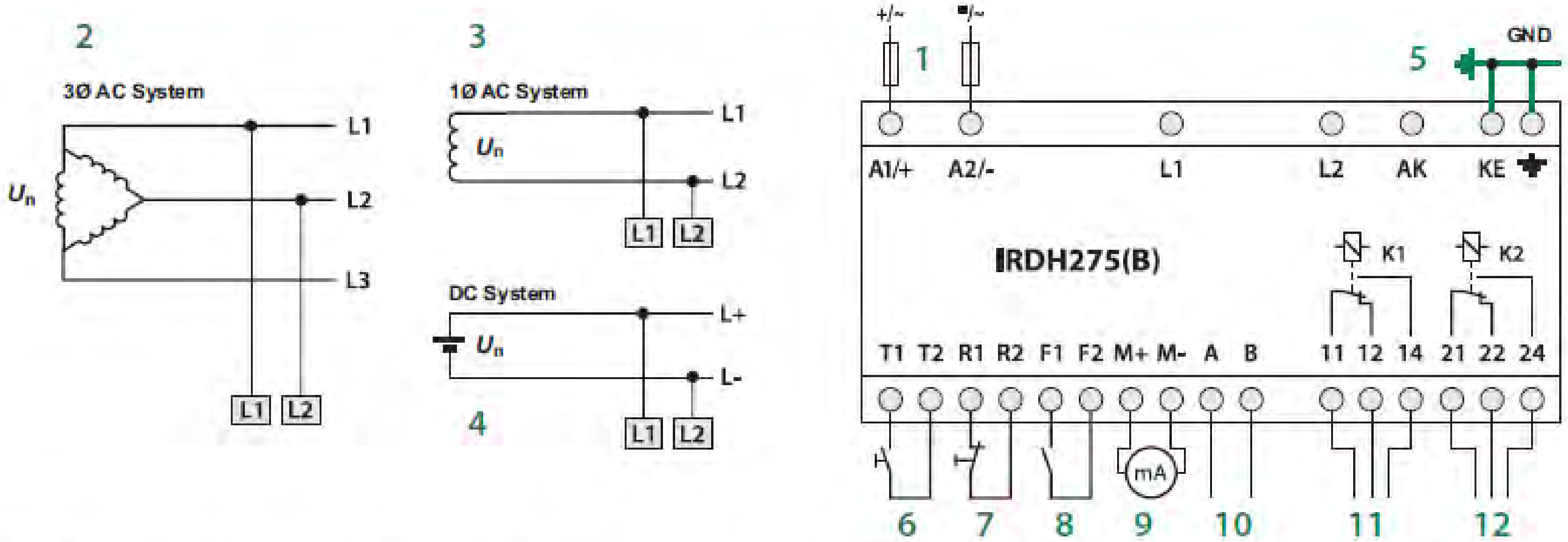
FEATURES

- Meets or exceeds requirements for NEC 250.21(B) and CEC 10-106(2), as well as the upcoming 2014 requirement of NEC 250.167(A)
- Ground fault detection via insulation monitoring for ungrounded AC/DC systems, single-phase or three-phase
- Works on systems up to 793 VAC / 650 VDC
- Voltage ranges extendable up to 7200 VAC / 1760 VDC with voltage coupler modules
- Two separate adjustable response values, 1 kΩ - 10 MΩ
- Advanced measuring principle which detects both AC and DC faults, symmetrical faults, automatically adapts to high system leakage capacitances • Info button to display device settings and system leakage capacitance
- Self-monitoring
- Automatic self-test setting
- Connection for external metering
- Built-in and external test/reset
- Two separate alarms with two voltage-free SPDT contacts
- Normally energized (failsafe) or deenergized (non-failsafe) operation
- Backlit LCD display
- RS-485 interface
- History memory with real-time clock to store up to 300 time-stamped event records
- Galvanically isolated RS-485 interface (BMS protocol) for data exchange with other
- Bender devices and communication systems
- Standby contacts and RS-485 communication for operating multiple ground fault detectors
- in systems tied together with tiebreakers or interlocks
- Galvanically isolated analog output, 0(4) - 20 mA

Only one BENDER insulation monitor may be active when several ungrounded systems are coupled together via a tiebreaker or other means. The disconnect relays and control inputs F1/F2 integrated into the IRDH275 guarantee no interference with other BENDER devices when the system tiebreaker is closed. IRDH275B models feature automatic control via RS-485 with no control inputs necessary.

The IRDH275 series uses the ***AMPPlus*** measuring principle. This measuring principle allows for the precise monitoring of modern power supply systems, pure DC systems, systems where AC/DC rectification and power conversion may occur, systems with variable frequency drives (VFDs), and systems with high leakage capacitances

Wiring



1 - External supply voltage used to power device

2 - Wiring diagram for a three-phase system. Only two connections to the system are necessary to monitor all three phases.

3 Wiring diagram for a single-phase system

4 - Wiring diagram for a DC system

5 - Equipment ground connections

6 - External test button (normally open contact)

7 - External reset button (normally closed contact). When the terminals are open, the fault message will not be stored.

8 - Standby contact. When the contact is closed, no insulation measurements take place.

9 - IRDH275: Analog output, electrically isolated: 0 - 400 µA
IRDH275B: Analog output, electrically isolated:
0 - 20 mA or 4 - 20 mA

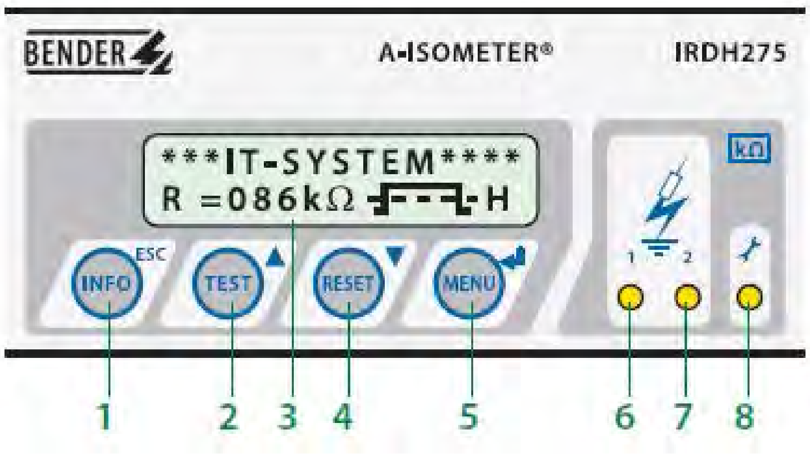
10 - RS-485 interface:

IRDH275: One-way ASCII stream with measurement status
IRDH275B: Two-way communication with other BENDER devices, including communication gateways

11 - Alarm relay 1, normally energized or de energized contact

12 - Alarm relay 2/System Fault Relay, normally energized or de-energized contact

Displays and Controls



1 - INFO key: displays pertinent system information
ESC key: Goes back a step inside device's menu

2 - TEST button: Activates self-test
Arrow up key: Scrolls up inside device's menu

3 - LCD display

4 - RESET button: Resets device
Arrow down key: Scrolls down inside device's menu

5 - MENU key: Activates device's internal menu
Enter key: Confirm change inside device's menu

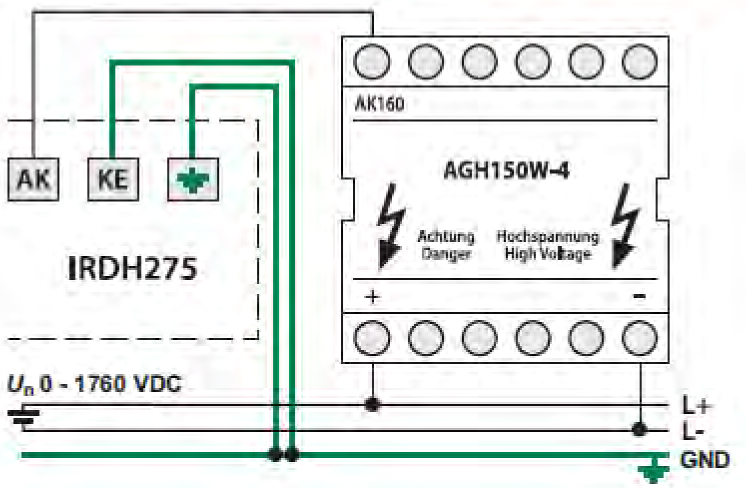
6 - Alarm LED 1 lights: Alarm, Prealarm

7 - Alarm LED 2 lights: Alarm, Main alarm

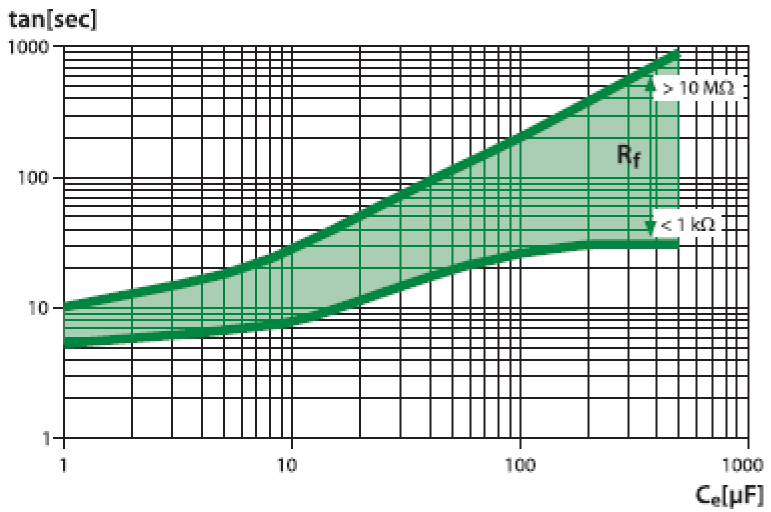
8 - System fault LED: Lights on connection or device error

Wiring diagrams – Connecting to voltage couplers

IRDH275 with voltage coupler AGH150W-4



Sample Response Times



Response times in relation to the system leakage capacitances: C_e = 1 - 500 μF, U_n = 0 - 793 V/50 Hz

National Instruments CompactRIO PLC

NI 9068 CPU Manual **(See 376007a.pdf)**

NI 9205 Analog Input Manual **(See 374188d.pdf)**

NI 9213 Thermocouple Input Manual **(See 374916a.pdf)**

NI 9225 Analog Input (3-CHANNEL VOLTAGE) Manual **(See 374707c.pdf)**

NI 9227 Analog Input (4-CHANNEL CURRENT) Manual **(See 375101c.pdf)**

NI 9425 Digital Input Manual **(See 373782e.pdf)**

NI 9476 Digital Output Manual **(See 373964d.pdf)**

CompactRIO cRIO-9068 (CPU Manual 376007a.pdf)

Reconfigurable Embedded Chassis with Integrated Intelligent Real-Time Controller for CompactRIO

① LEDs

② Reset Button

③ RS232 Serial Ports

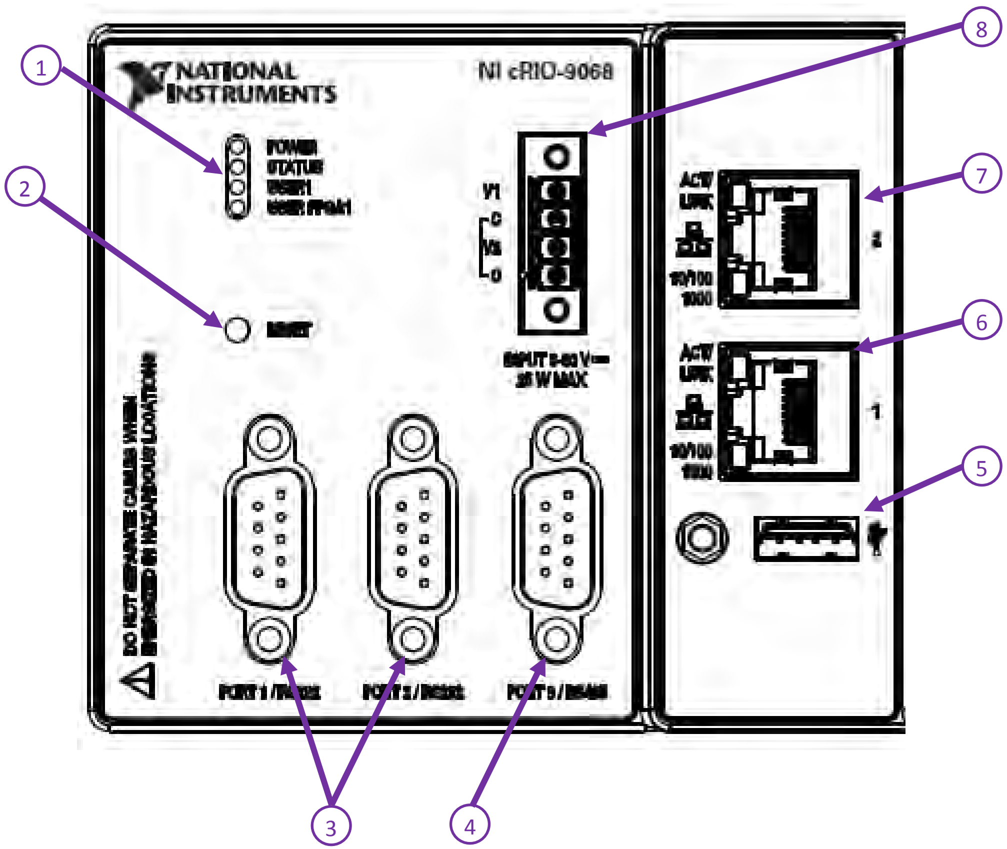
④ RS485 Port

⑤ USB Port

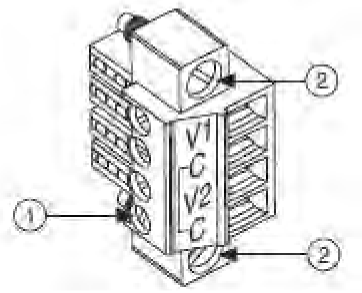
⑥ RJ-45 Ethernet Port 1

⑦ RJ-45 Ethernet Port 2

⑧ Power Connector



Wiring Power to the Chassis



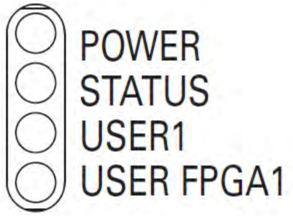
COMBICON power connector

The cRIO-9068 requires an external power supply that meets the specifications in the Power Requirements section. The cRIO-9068 filters and regulates the supplied power and provides power for all of the I/O modules. The cRIO-9068 has one layer of reverse-voltage protection. Complete the following steps to connect a power supply to the chassis.

1. Connect the positive lead of the power supply to the V terminal of the COMBICON power connector shipped with the cRIO-9068, and tighten the terminal screw. Figure 11 shows the terminal screws, which secure the wires in the screw terminals, and the connector screws, which secure the power connector on the front panel.
2. Connect the negative lead of the power supply to one of the C terminals of the power connector and tighten the terminal screw.
3. Optionally, you can connect the positive lead of another power supply to the other V terminal and the negative lead to one of the C terminals.
4. Install the power connector on the front panel of the cRIO-9068 and tighten the connector screws.

Caution The C terminals are internally connected to each other

Powering On the cRIO-9068



cRIO-9068 LEDs

When you apply power to the cRIO-9068, the controller runs a power-on self-test (POST). During the POST, the Power and Status LEDs turn on. The Status LED turns off, indicating that the POST is complete. If the LEDs do not behave in this way when the system powers on:

POWER LED

The POWER LED is lit while the cRIO-9068 is powered on. This LED indicates that the power supply connected to the chassis is adequate.

STATUS LED

The STATUS LED is off during normal operation. The cRIO-9068 indicates specific error conditions by flashing the STATUS LED a certain number of times every few seconds, as shown in Table 3.

Number of Flashes Every Few Seconds	Indication
2	The chassis has detected an error in its software. This usually occurs when an attempt to upgrade the software is interrupted. Reinstall software on the chassis. Refer to the *Measurement & Automation Explorer Help* for information about installing software on the chassis.
3	The chassis is in safe mode because the SAFE MODE DIP switch is in the ON position or there is no software installed on the chassis. Refer to the Configuring DIP Switches section for information about the Safe Mode DIP switch.
4	The software has crashed twice without rebooting or cycling power between crashes. This usually occurs when the chassis runs out of memory. Review your RT VI and check the memory usage. Modify the VI as necessary to solve the memory usage issue.
Continuously flashing or solid	The chassis has detected an unrecoverable error. Contact National Instruments.

USER1 LED

You can define the USER1 LED to meet the needs of your application. To define the LED, use the RT LEDs VI in LabVIEW. For more information about the RT LEDs VI, refer to the *LabVIEW Help*.

FPGA1 LED

You can use the FPGA1 LED to help debug your application or easily retrieve application status. Use the LabVIEW FPGA Module and NI-RIO software to define the FPGA LED to meet the needs of your application. Refer to *LabVIEW Help* for information about programming this LED.

Connecting the Chassis to a Network

Connect the chassis to an Ethernet network using RJ-45 Ethernet port 1 on the controller front panel. Use a standard Category 5 (CAT-5) or better shielded, twisted-pair Ethernet cable to connect the chassis to an Ethernet hub, or use an Ethernet crossover cable to connect the chassis directly to a computer.

Troubleshooting Network Communication

If the cRIO-9068 cannot communicate with the network, you can perform the following troubleshooting steps.

1. Hold the RESET button down for 5 seconds, and then release it. The STATUS LED turns on, and then starts blinking 3 times every few seconds. The chassis is now in safe mode with output from the serial port enabled. You can use the serial port to read the IP Address of the controller. If you want the controller to attempt a new DHCP connection, proceed to Step 2.
2. Hold the RESET button down for 5 seconds, and then release it. The STATUS LED turns on, and then starts blinking 3 times every few seconds. The cRIO-9068 attempts to establish a new DCHP connection, if it fails, it assigns itself a link-local IP Address. If the DHCP connection is successful and appropriate for your application, skip to Step 4.
3. Configure the IP and other network settings in MAX.
4. Press and release the RESET button to reboot the chassis.

Configuration / Program: LabVIEW

Configuring a Project with Connected Hardware (The controller must be attached to a chassis with C Series modules installed, connected to the same subnet as the host computer, and powered on. Refer to the CompactRIO cRIO-9072/3/4 operating instructions for information about installing the controller on a chassis, connecting the controller to a network, and wiring power to the controller.)

1. Open the existing project.
2. Right-click the project root in the **Project Explorer** window and select **New »Targets and Devices** from the shortcut menu to display the **Add Targets and Devices** dialog box.
3. Select the appropriate controller under **Real-Time CompactRIO** and click the **OK** button. If you are using a controller and chassis that are supported in Scan Interface mode, the **Select Programming Mode** dialog box appears.
   a. If the **Select Programming Mode** dialog box appears, select **LabVIEW FPGA Interface** and click the **Continue** button to put the system into LabVIEW FPGA Interface mode.
   b. If the **Discover C Series Modules?** dialog box appears, click the **Discover** button. LabVIEW adds items for the controller, the chassis, the FPGA target, and all installed C Series modules to the project. LabVIEW also adds FPGA I/O items to the project for all installed C Series module I/O.
4. Right-click a module item in the **Project Explorer** window and select **Properties** from the shortcut menu to configure module-specific settings in the **C Series Module Properties** dialog box. Some modules do not have any settings to configure other than the module name and chassis slot location. Click the **Help** button on the **C Series Module Properties** dialog box for information about the module settings.

Configuring a Project with Offline Hardware (Complete the following steps to configure the project if you do not have hardware installed.)

1. Open the existing project.
2. Right-click the project root in the **Project Explorer** window and select **New »Targets**
3. Click the **New target or device** radio button, select the appropriate controller under **Real-Time CompactRIO**, and click the **OK** button. LabVIEW adds an RT target item for the controller to the project.
4. Right-click the **RT CompactRIO Target** in the **Project Explorer** window and select **New »Targets and Devices** from the shortcut menu to display the **Add Targets and Devices** dialog box.
5. Click the **New target or device** radio button, select the appropriate chassis under **CompactRIO Chassis**, and click the **OK** button. LabVIEW adds a chassis item to the project. (***You must select the corresponding integrated chassis in this step.)***
6. Right-click the chassis item in the **Project Explorer** window and select **New»FPGA Target** from the shortcut menu. If the chassis type is supported in Scan Interface mode, the **Deploy CompactRIO Chassis Settings?** Dialog box appears. Click the **Deploy Later** button to

return to the project. LabVIEW adds an FPGA target item for the chassis to the project and puts the system into **LabVIEW FPGA Interface mode**.

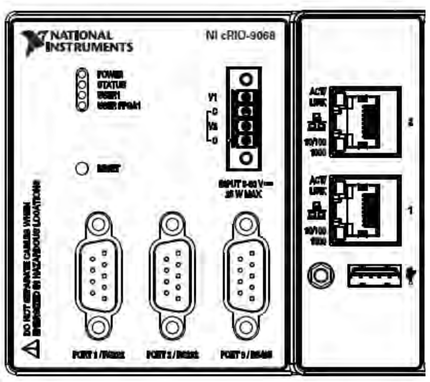
7. Right-click the **FPGA Target** in the **Project Explorer** window and select **New»C Series Modules** from the shortcut menu to display the **Add Targets and Devices** dialog box.

8. Click the **New target or device** radio button, select **C Series Module**, and click the **OK** button to display the **New C Series Module** dialog box.

9. Select the appropriate C Series module from the **Module Type** pull-down menu and click the **OK** button. LabVIEW adds a module item and FPGA I/O items for the module I/O to the project.

10. Repeat steps 7 through 9 to add additional C Series modules to the project.

11. Right-click a module item in the **Project Explorer** window and select **Properties** from the shortcut menu to configure module-specific settings in the **C Series Module Properties** dialog box. Some modules do not have any settings to configure other than the module name and chassis slot location. Click the **Help** button on the **C Series Module Properties** dialog box for information about the module settings.



NI cRIO-9068 – PLC (CPU)

IP Address: 192.168.1.1 / 192.168.1.2

EtherNet Switch – SE-SW8U-WT:

Configuration: None Required

IP Address: 192.168.1.0

Parker HPC / HPX Series PowerStation (User Guide HPXUG.pdf)

Model Number: IPX00N-D Standard Performance Package

CPU 2.0 GHz Celeron M 550 / Operating System: Windows XP Professional
DRAM 2 GB / Hard Drive: 80 GB Intel SSD
Display Size / Resolution: 10” Display / SVGA (800 x 600)
Viewing Angle: U/D = 50/60°, L/R = 70/70°
Touchscreen Interface: Analog resistive touchscreen
Ports: Serial: (2) RS232 9-Pin D-sub and (1) RS232/422/485 selectable 9-pin D-sub
Ethernet: (2) 1000Base-T w/ RJ45

Configuring the RS232/422/485 Serial Port

The COM2 serial port supports RS232, RS422, or RS485 communications.

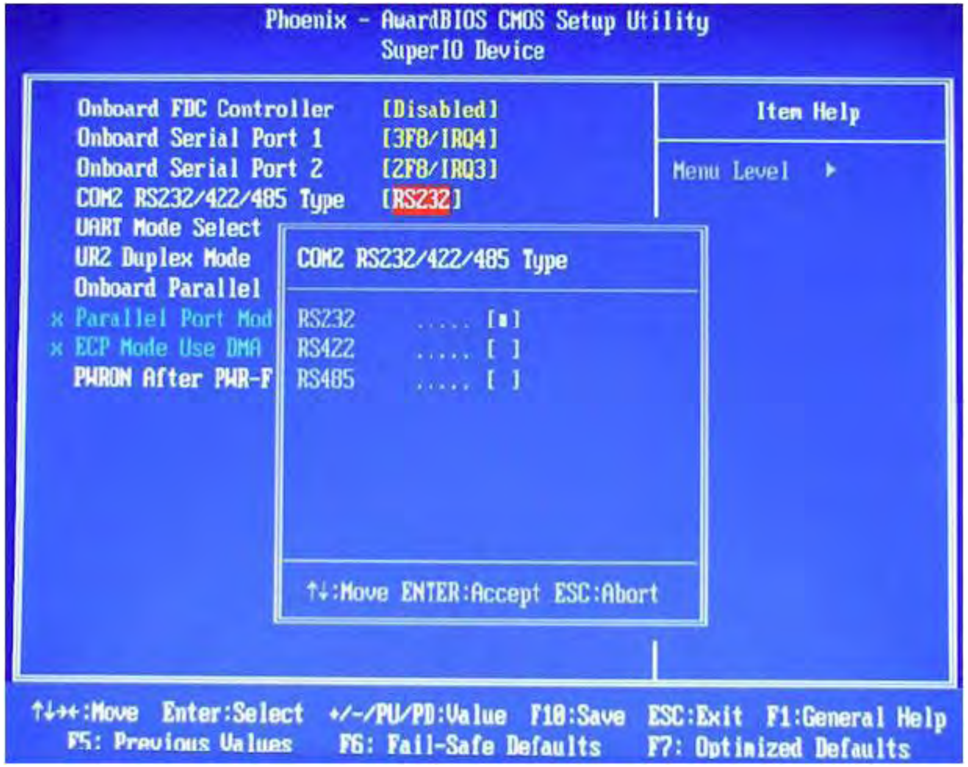
The pinout for RS232 is the same as a standard 9 pin DSUB connector as shown below:

PIN	Signal	PIN	Signal
1	DCD	**2**	RXD
3	TXD	**4**	DTR
5	GND	**6**	DSR
7	RTS	**8**	CTS
9	RI		

For RS422 or RS485, the pinouts are as follows:

PIN	Signal	PIN	Signal
1	422TXD- or 485DATA-	**2**	422RXD+
3	422TXD+ or 485DATA+	**4**	422RXD-
5	GND	**6**	DSR
7	RTS	**8**	CTS
9	RI		

This port is configured by a BIOS setting in the CMOS setup as shown below:



Soft On/Off Power Button

This button can be used to boot the PowerStation from standby or after a Windows shutdown in situations where AC power is still present and the AC power switch has been left in the On position. It functions identically to the power button found on the front of most desktop PCs.

Cleaning the Touchscreen

Occasionally, you may need to clean the PowerStation screen. Clean the screen using warm, soapy water and a cloth. You can also use any non-abrasive cleaner. See ***Touchscreen Chemical Resistance*** on page D-20, for a list of substances the screen can resist with no visible effect.

Do not use any harsh material or powder, such as steel wool or abrasive cleansers, to clean the screen surface. The surface is sensitive to scraping, sharp blows, or punctures. Therefore, keep screwdrivers or other sharp objects away from the screen surface.

Calibrating the Touchscreen

Calibrating the touchscreen ensures that it is aligned with your display. The PowerStation's touchscreen is calibrated before leaving Parker manufacturing. However, you may need to recalibrate the touchscreen after a period of time, if you are using a remote, stand-alone configuration, or whenever the cursor does not follow the touches on the screen. This section explains how to calibrate the Hampshire touchscreen driver under Windows XP Professional. To calibrate the touchscreen driver, complete the following steps:

1. Select **Start, Programs, Hampshire** TSHARC Control Panel or the Touchscreen Control Panel icon in the System Tray. The control panel appears.
2. Follow the on screen instructions for selecting which monitor to calibrate.
3. Select the **Calibration** tab.
4. With your finger, touch the center of where the arrows are pointing. The Calibration screen appears.
5. Touch the target where it appears on the screen, hold your finger there until prompted to release. The screen guides you through the *Touch - Hold - Release* process.
6. Repeat the process three more times in the other three corners of the screen. A test screen appears.
7. Move your finger across the monitor. The target should move with your finger. If so, the calibration was successful.
8. Select **Accept**.
9. On the control panel, select **Apply** and then select **OK**.

For additional information, refer to IPC-IPX Series PowerStation Series Hardware User Manual (IPX-IPC USER MANUAL.pdf).

Touchscreen/Faceplate Chemical Resistance

The PowerStation's touchscreen is designed to meet the NEMA 4 rating. Mount the PowerStation in an enclosure that supports this rating in order to provide further protection. The PowerStation's touchscreen is resistant to a variety of chemicals listed below with no visible effect.

Faceplate Chemical Resistance		
Acetone	Sulfuric Acid 10%	Motor Oil
MEK	Hydrochloric Acid 10%	Gasoline
Toluene	Acetic Acid 10%	Machine Oil
Methylene Chloride	Phosphoric Acid	Salad Oil
Isopropyl Alcohol	Sodium Hydroxide 10%	Silicone
Xylene	Carbon Tetrachloride	Silicone Grease G31
Hexane	Potassium Hydroxide	Kerosene
Butyl Cellosolve	Ammonia Water 10%	Gas Oil
Cyclohexanone	Sodium Chloride 26%	Silicone Oil
Trichloroethylene	Zinc Chloride 81%	Engine Oil
Ethanol	Cottonseed Oil	Cleaner
Methanol	Glycerine	Nitric Acid 10%
Grease		

All exposed PowerStation surfaces are resistive to the following chemicals:

- Commercial glass gleaners
- Motor Oil
- Diesel Fuel
- Silicone-based Lubricant
- Automatic Transmission Fluid
- Ammonia (10% dilute solution)
- Hydraulic Fluid
- Gasoline (leaded and unleaded)
- Alcohol (ethyl, methyl)

IMPORTANT - Sustained exposure to brake fluid or Gunk® brand degreaser can cause damage to the monitor materials.

HMI – IPX10S-D:

Configuration:

Restoring Projects with MachineShop

Restoring your projects is a simple process. Your backup may be located on a variety of devices including removable disk, Compact Flash, hard drive, or a network drive.

To restore your project, follow the steps below:

1. From the MachineShop Suite menu bar, select **File \ Restore Project**. The Restore Wizard launches.
2. Select portions of the project to include in the restore. There are several pieces of your project you can choose to include within the restore. The **Project File** is always selected and represents the structure of your MachineShop Suite project. Selecting **Global Objects** will restore any links to other files included in the project. Your individual application(s) are also included by default. All of the applications that you have developed for your MachineShop Suite Project will be selected. Deselect those you wish not to include in your restore. This allows you to restore only specific applications if desired.
3. Click **Next**. The project is created and stored at the location you specified in the wizard.

Firmware:

IP Address: 192.168.1.200

Shark Power and Energy Meter (User Guide E149701.pdf)

Statement of Calibration

Shark instruments are inspected and tested in accordance with specifications published by Electro Industries/GaugeTech. The accuracy and a calibration of the instruments are traceable to the National Institute of Standards and Technology through equipment that is calibrated at planned intervals by comparison to certified standards.

Power and Power Measurement (User Guide Chapter 1)
Meter Overview (User Guide Chapter 2)
Mechanical installation (User Guide Chapter 3)
Electrical installation (User Guide Chapter 4)
Comms installation and setup (User Guide Chapter 5)
Using the Shark® 200 Meter (User Guide Chapter 6)
Shark® 200 Meter Navigation Maps (User Guide Appendix A)

Power Meter – Shark 200T:
Electro Industries/GaugeTech Communicator EXT

Software User Manual: (Doc # E107707)
Connection: Communicator EXT User Manual Chapter 2
Configuration: Communicator EXT User Manual Chapter 5
Firmware: Communicator EXT User Manual Chapter 13
Monitoring: Communicator EXT User Manual Chapter 7

IP Address: 192.168.1.50

Overview

The Shark® 200 monitor is a multifunction power meter designed to be used in electrical substations, panel boards and as a power meter for OEM equipment. The unit provides multifunction measurement of all electrical parameters. The unit is designed with advanced measurement capabilities, allowing it to achieve high performance accuracy.

The Shark 200® meter is specified as a 0.2% class energy meter for billing applications as well as a highly accurate panel indication meter.

The Shark® 200 meter provides a host of additional capabilities, including either standard RS485 Modbus or RJ45 Ethernet, DNP Protocols and an IrDA Port panel mount interrogation.

Shark® 200 meter features that are detailed in this manual are as follows:

- 0.2% class revenue certifiable energy and demand metering
- Meets ANSI C12.20 (0.2%) and IEC 687 (0.2%) accuracy classes
- Multifunction measurement including voltage, current, power, frequency, energy, etc.
- Power quality measurements (%THD and Alarm Limits)
- V-Switch TM technology - field upgrade without removing installed meter
- Percentage of Load bar for analog meter perception
- RS485 or RJ45 Modbus communication

The Shark® 200 comes in either of two models - the Meter/Transducer or the Transducer only.

Shark® 200T Digital Transducer

A Digital Transducer only unit proves either RS485 or RJ45 communication via Modbus RTU, Modbus ASCII and DNP 3.0 (V-3 and V-4) protocols. The unit is designed to install using DIN Rail Mounting

Universal Voltage Inputs

Voltage inputs allow measurement up to Nominal 480VAC (Phase to Reference) and 600VAC (Phase to Phase). This insures proper meter safety when wiring directly to high Voltage systems. The unit will perform to specification on 69 Volt, 120 Volt, 230 Volt, 277 Volt, and 347 Volt power systems.

Current Inputs

This unit provides ultra-rugged termination pass through bars that allow CT leads to be terminated on the meter. This eliminates any possible point of failure at the meter. This is a preferred technique for insuring that relay class CT integrity is not compromised (the CT will not open in a fault condition).

Measured Values

The following table lists the measured values available in Real Time, Average, Maximum, and Minimum. Harmonics up to the 40th order for Current and up to the 3rd order for Voltage are measured.

Utility Peak Demand

The Shark® 100/50 meter provides user-configured Block (Fixed) Window or Rolling Window Demand. This feature lets you set up a customized Demand profile. Block Window Demand is demand over a user-configured demand period (usually 5, 15 or 30 minutes). Rolling Window Demand is a fixed window demand that moves for a user-specified subinterval period. For example, a 15-minute demand using 3 subintervals and providing a new Demand reading every 5 minutes, based on the last 15 minutes.

Utility Demand features can be used to calculate kW, kVAR, kVA and PF readings. All other parameters offer Max and Min capability over the user-selectable averaging period. Voltage provides an instantaneous Max and Min reading which displays the highest surge and lowest sag seen by the meter.

Measured Values	Instantaneous	Average	Max	Min
Voltage L-N	X		X	X
Voltage L-L	X		X	X
Current per Phase	X	X	X	X
Current Neutral	X			
Watts (A,B,C, Tot)	X	X	X	X
VAR (A,B,C, Tot)	X	X	X	X
VA (A,B,C, Tot)	X	X	X	X
PF (A,B,C, Tot)	X	X	X	X
+Watt-hr (A,B,C, Tot)	X			
-Watt-hr (A,B,C, Tot)	X			
Watt-hr Net	X			
+VAR-hr (A,B,C, Tot)	X			
-VAR-hr (A,B,C, Tot)	X			
VAR-hr Net (A,B,C, Tot)	X			
VA-hr (A,B,C, Tot)	X			
Harmonics To the 40^{th} Order				
Frequency	X		X	X
% THD	X		X	X
Voltage Angles	X			
Current Angles	X			
% of Load Bar	X			
Waveform Scope	X			

Shark 200 Measured Values

Specifications

Mechanical

Dimensions: (Height 4.85 x Width 4.85 x Depth 4.25) inches, (H 12.32 x W 12.32 x D 10.54) cm
Mounting: Mounts in 92mm square
Weight: 2 pounds, 0.907kg (ships in a 6"/ 152.4mm cube container)

See page D-26 for Dimensions and Mounting

Power Supply

Range: D2 Option: Universal, (90 to 265) VAC @50/60Hz or (100 to 370) VDC
Power Consumption: (5-10) VA, (3.5-7.0) W (Depending on Hardware)

Voltage Inputs (Measurement Category III)

Range: Universal, Auto-ranging up to 480 VAC L-N, 600 VAC L-L
Supported hookups: 3 Element Wye, 2.5 Element Wye, 2 Element Delta, 4 Wire Delta
Input Impedance: 1M Ohm/Phase
Burden: 0.0144VA/Phase at 120 Volts
Pickup Voltage: 20Vac
Connection: 7 Pin 0.400” Pluggable Terminal Block
Input Wire Gauge: AWG#12-26/ (0.129 -3.31) mm^2
Fault Withstand: Meets IEEE C37.90.1
Reading: Programmable Full Scale to any PT Ratio

Current Inputs

Class 10: 5A Nominal, 10A Maximum
Class 2: 1A Nominal, 2A Maximum
Burden: 0.005VA per Phase Max at 11 Amps
Pickup Current: 0.1% of Nominal Connections: O or U Lug Electrical Connection
Quick Connect, 0.25" Male Tab
Fault Withstand (at 23°C): 100A/10sec., 300A/3sec., 500A/1sec.
Reading: Programmable Full Scale to any CT Ratio

See page D-26 for Electrical Connections

Isolation

All Inputs and Outputs are galvanically isolated to 2500 VAC

Environmental Rating

Storage: (-20 to +70)^{o} C
Operating: (-20 to +70) ^{o} C
Humidity: to 95% RH Non-condensing

Measurement Methods

Voltage, Current: True RMS
Power: Sampling at 400+ Samples per
Cycle on All Channels Measured Readings Simultaneously
A/D Conversion: 6 Simultaneous 24 bit Analog to Digital Converters

Update Rate

Watts, VAR and VA: Every 6 cycles
All other parameters: Every 60 cycles

Communication Format

Shark® 200 meter: RS485 (485P) and RJ45 (INP10) port through backplate

NOTE: KYZ pulse comes with both the RS485P and INP10 communication ports.

Protocols: Modbus RTU, Modbus ASCII, DNP 3.0 (V-3 and V-4)
Com Port Baud Rate: 9,600 to 57,600 bps
Com Port Address: 001-247
Data Format: 8 Bit, No Parity
Shark ®200T Transducer Default Initial Communication Baud 9600 (see Chapter 5)

The Shark® 200 meter is designed in three forms that each has communication capability. The first form uses RS485 serial communication. This allows the meter to be wired in a daisy chain connection along with other meters, and to communicate data back via serial protocol. The available protocols are Modbus RTU/ASCII or DNP 3.0. The second form of the meter is the **Shark® 200 - INP10**. This meter provides similar communication capability, but communicates over a 10/100BaseT Modbus TCP Ethernet connection. The third form of the meter is the Shark® 200B. This unit adds the capability of communicating over BACnet/IP. This allows the meter to act as a BACnet server and to transfer data to a BACnet client over an IP architecture. This meter also provides a basic web interface and a Modbus TCP connection.

The basic Shark® 200 meter provides two independent Communication ports. The first port, Com 1, is an optical IrDA port. The second port, Com 2, provides RS485 communication speaking Modbus ASCII, Modbus RTU and DNP 3.0 (V-3 and V-4) protocols. The Shark® 100B meter and Shark® 100 with the INP10 option have an RJ45 port instead of an RS485 port (see Section 5.3). The Shark® 50 meter has the RS485 port as an option, but no IrDA port.

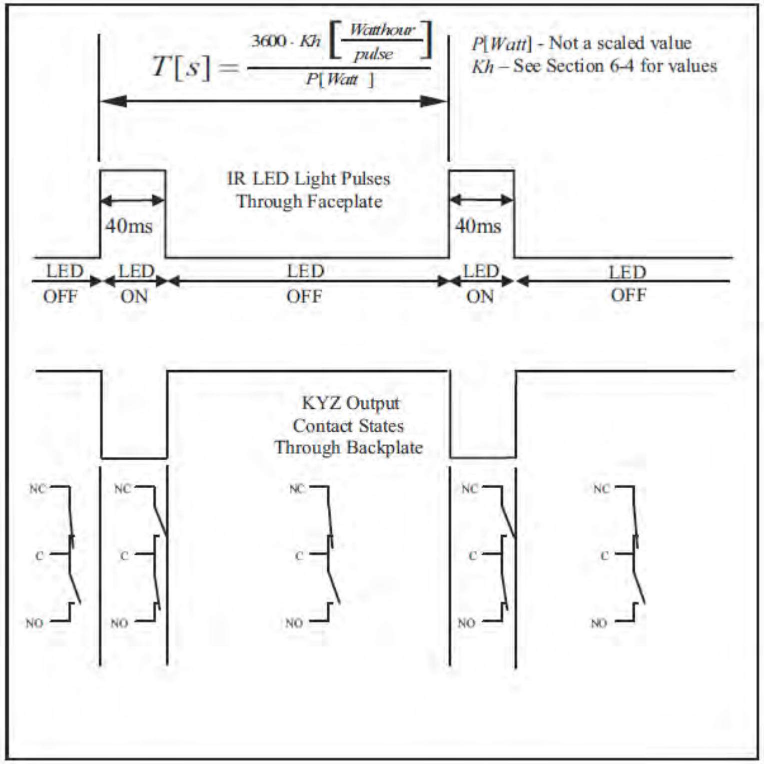
RS485/KYZ Port Specifications

RS485

RS485 Transceiver Meets or exceeds EIA/TIA-485 Standard
Type: Two-wire, half duplex
Min. Input Impedance: 96k⍰
Max. Output Current: ±60mA

Wh Pulse KYZ output contacts

Pulse Width: 40ms
Full Scale Frequency: ~6Hz
Contact type: Solid State – SPDT (NO – C – NC)
Relay type: Solid state
Peak switching voltage: DC ±350V
Continuous load current: 120mA
Peak load current: 350mA for 10ms
On resistance, max.: 35Ω
Leakage current: 1µA@350V
Isolation: AC 3750V
Reset State: (NC - C) Closed; (NO - C) Open



Output Timing

Compliance

UL Listing: USL/CNL E250818
CE (EN61326-1, FCC Part 15, Subpart B, Class A)
IEC 62053-22 (0.2% Class)
ANSI C12.20 (0.2% Accuracy)
ANSI (IEEE) C37.90.1 Surge Withstand
ANSI C62.41 (Burst)
IEC 1000-4-2 (ESD)
IEC 1000-4-3 (Radiated Immunity)
IEC 1000-4-4 (Fast Transient)
IEC1000-4-5 (Surge Immunity)
UL Listed, CE Compliant

Accuracy

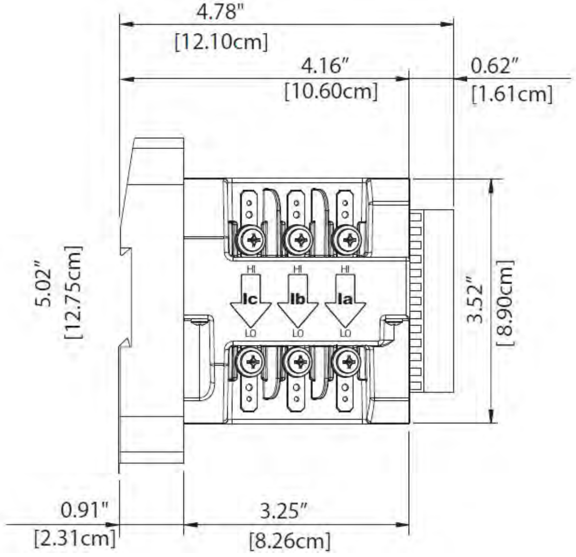
For 23^{o} C, 3 Phase balanced Wye or Delta load, at 50 or 60 Hz (as per order), 5A (Class 10) nominal unit

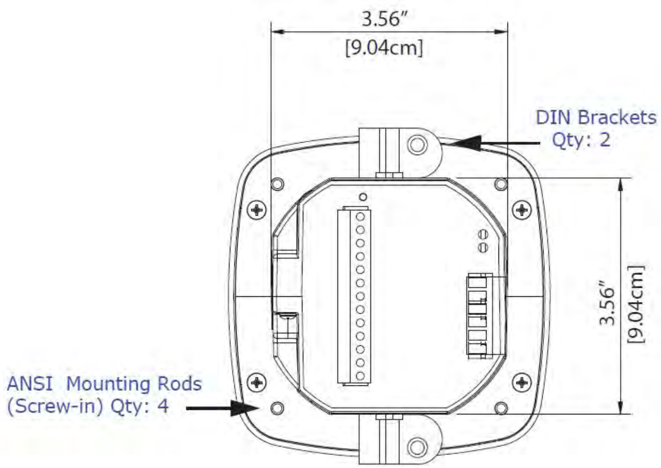
Parameter	Accuracy	Accuracy Input Range
Voltage L-N [V]	0.1% of reading[2]	(69 to 480)V
Voltage L-L [V]	0.1% of reading	(120 to 600)V
Current Phase [A]	0.1% of reading[1]	(0.15 to 5)A
Current Neutral (calculated) [A]	2.0% of Full Scale[1]	(0.15 to 5)A @ (45 to 65)Hz
Active Power Total [W]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Active Energy Total [Wh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Reactive Power Total [VAR]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Reactive Energy Total [VARh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Apparent Power Total [VA]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Apparent Energy Total [VAh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Power Factor	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Frequency	+/- 0.01Hz	(45 to 65)Hz
Total Harmonic Distortion (%)	5.0%[1]	(0.5 to 10)A or (69 to 480)V, measurement range (1 to 99.99)%
Load Bar	+/- 1 segment[1]	(0.005 to 6)A

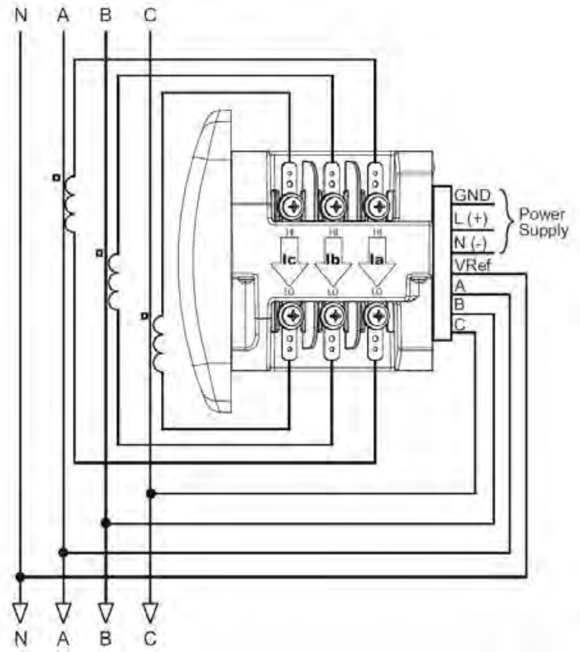
[1] For 2.5 element programmed units, degrade accuracy by an additional 0.5% of reading.

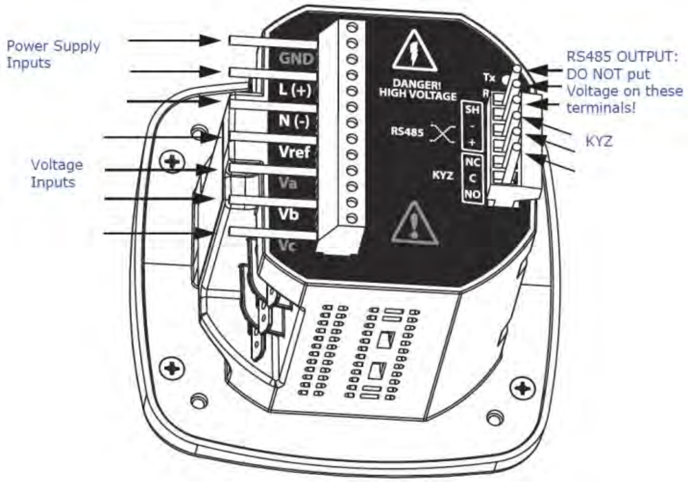
- For 1A (Class 2) Nominal, degrade accuracy by an additional 0.5% of reading.
- For 1A (Class 2) Nominal, the input current range for Accuracy specification is 20% of the values listed in the table.

[2] For unbalanced voltage inputs where at least one crosses the 150V auto-scale threshold (for example, 120V/120V/208V system), degrade accuracy by additional 0.4%.


4.78"
[12.10cm]
4.16″
[10.60cm]
0.62″
[1.61cm]
5.02″
[12.75cm]
3.52″
[8.90cm]
Ic
Ib
Ia
0.91"
[2.31cm]
3.25″
[8.26cm]


3.56″
[9.04cm]
DIN Brackets
Qty: 2
3.56″
[9.04cm]
ANSI Mounting Rods
(Screw-in) Qty: 4


N A B C
GND
L (+)
N (-)
Power
Supply
VRef
A
B
C
Ic
Ib
Ia
N A B C


Power Supply
Inputs
Voltage
Inputs
GND
L (+)
N (-)
Vref
Va
Vb
Vc
DANGER!
HIGH VOLTAGE
RS485
KYZ
SH
NC
C
NO
RS485 OUTPUT:
DO NOT put
Voltage on these
terminals!
KYZ

Ground Connections

The meter's Ground terminals should be connected directly to the installation's protective earth ground.

Use AWG# 12/2.5 mm2 wire for this connection.

Voltage Fuses

EIG recommends the use of fuses on each of the sense Voltages and on the control power, even though the wiring diagrams in this chapter do not show them.

Use a 0.1 Amp fuse on each Voltage input.

Use a 3 Amp Slow Blow fuse on the power supply.

SIEMENS Catalog No. / Bestell-Nr.: WLULOPMAN1 (Document Order # CBIM-01001-0504)

All maintenance and inspections shall be accomplished using manufacturer documentation and procedures.

These instructions are intended to point the Purchaser (end user) to the manufacturer documentation which does not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

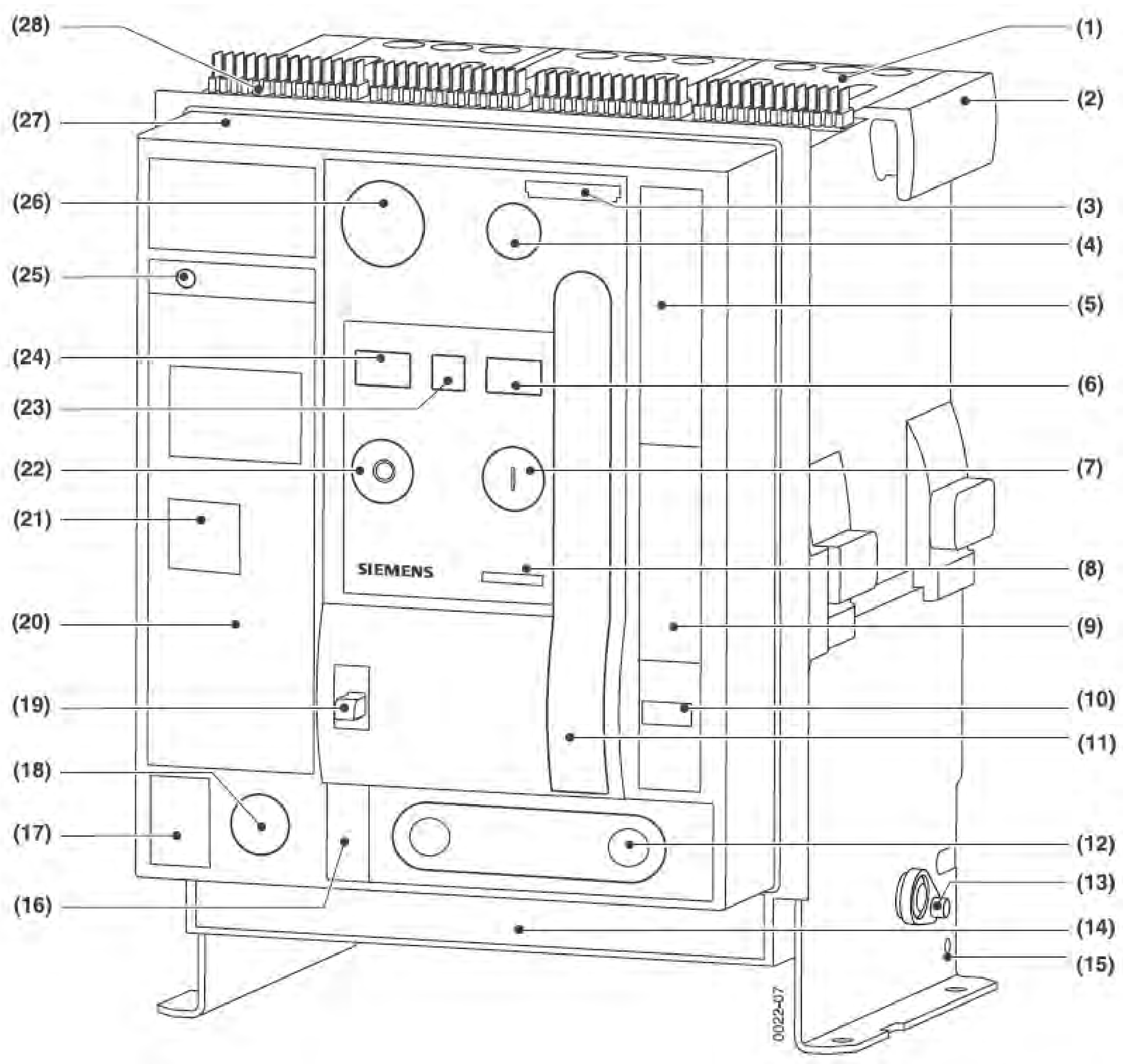
Should further information be desired or should particular problems arise which are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the local Siemens Sales Office.

The contents of that instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties or modify the existing warranty. Designations in this documentation can be trade-marks. Use by third parties for their own purposes violates the owner's rights.

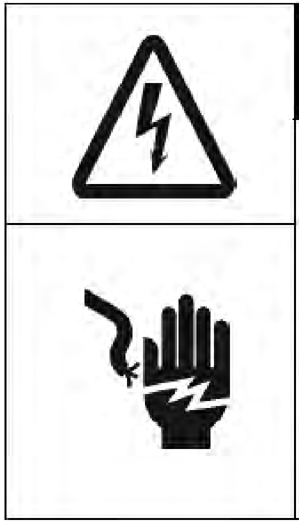
Circuit Breaker Testing and Inspections shall be accomplished in accordance with the most current publication of ANSI/NEMA AB 4 "GUIDELINES FOR INSPECTION AND PREVENTIVE MAINTENANCE OF MOLDED CASE CIRCUIT BREAKERS USED IN COMMERCIAL AND INDUSTRIAL APPLICATIONS" by qualified persons only.

SIEMENS WL Circuit Breaker Nomenclature

1. Arc chute **(Inspection 24-5)**
2. Carrying handle
3. Identification tags
4. Motor disconnect switch (option) **(13-3)** or "Electrical Closed" (option) **(13-5)**
5. Circuit breaker type label **(2-1)**
6. Stored-energy indicator**(6-6)**
7. "CLOSE" button
8. Ampere rating
9. Racking pictogram
10. Make-break operations counter (option)
11. Spring charging lever **(6-4)**
12. Racking handle
13. Draw-out unit transport shaft
14. Options label **(2-1)**
15. Grounding terminal **(15-29)**
16. Position indicator **(6-2)**
17. Table for ground-fault protection **(9-24)**
18. Key lock for racking handle (option)
19. Mechanical release of racking handle (option)
20. Trip unit **(9-1)**
21. Rating plug
22. "OPEN" button **or** "EMERGENCY OPEN" mushroom pushbutton (option)
23. Ready-to-close indicator **(6-6)**
24. Circuit breaker OPEN / CLOSED indicator **(6-6)**
25. Tripped indicator (Reset button) **(6-8)**
26. Locking device "lock OPEN" (option)
27. Front panel
28. Secondary Disconnects



(See Siemens Manual page number)



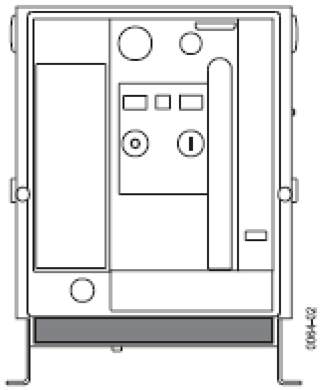
DANGER

Hazardous voltage!

Will cause death, serious personal injury, or equipment / property damage.

Disconnect power before working on this equipment.

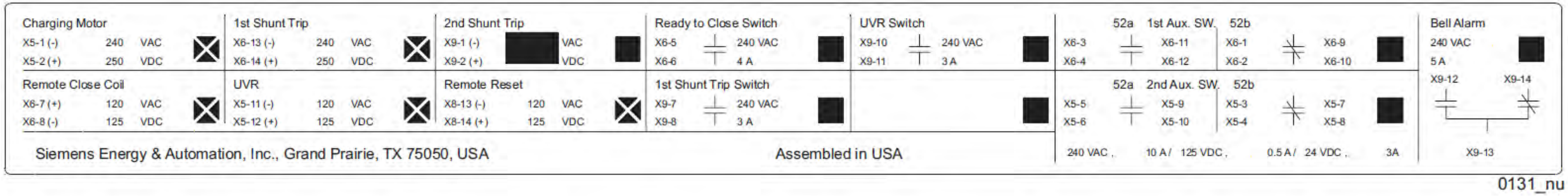
Danger if spring is charged!
Discharge spring.



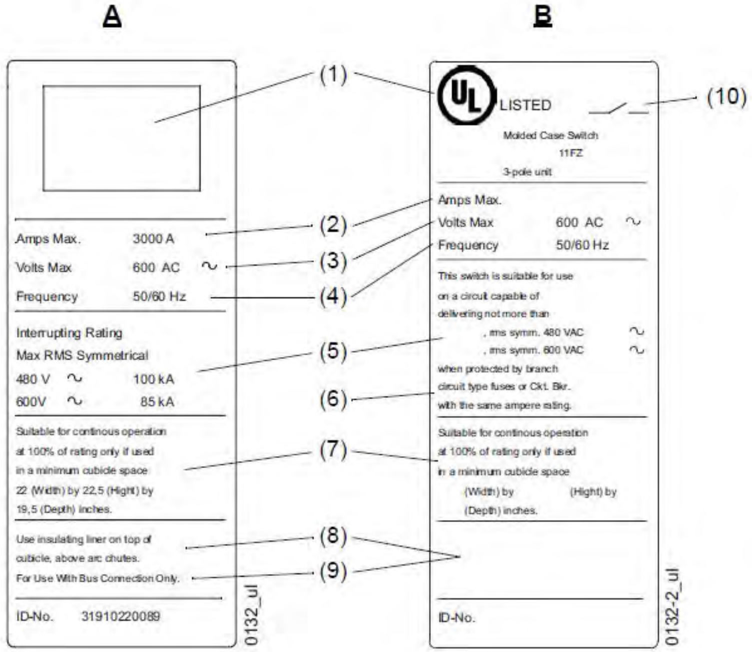
WARNING

The use of circuit breaker and circuit breaker accessories above their ratings may cause death, severe injury or heavy damage of electrical equipment.

ITEM 14 – Options Label



ITEM 5 – Type Label

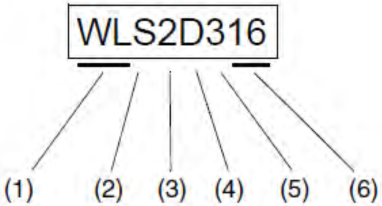


A Circuit breaker

B Non-automatic circuit breaker

(1) UL-Mark (for circuit breakers applied by a white sticker, within the shown frame)
(2) Max. Ampere rating
(3) Rated operating voltages
(4) Rated frequency
(5) Rated short-circuit breaking capacity
(6) Necessary overcurrent protection
(7) Enclosure size
(8) Arcing area
(9) Main connections
(10) Switch mark

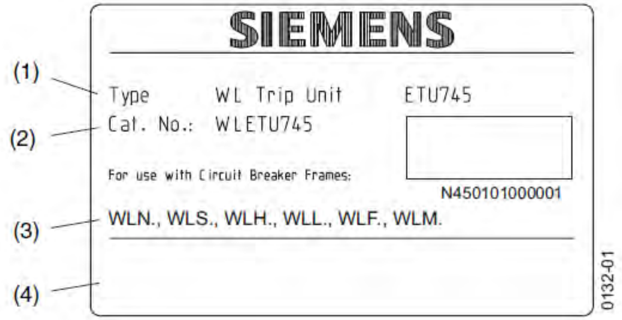
FRAME Designation



(1) Type of circuit breaker
(2) Siemens interrupting class
(3) Frame size
(4) Draw-out or fixed mounted circuit breaker
(5) No. of poles
(6) Maximum rated continuous current

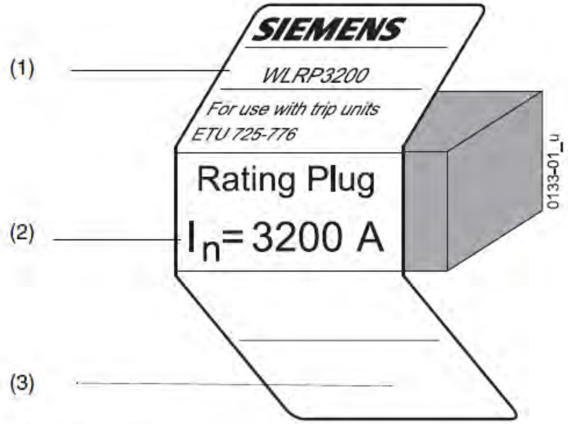
D-32 Associated Equipment

Trip Unit Designation



(1) Type
(2) Catalog number
(3) Can be used in the following types of circuit breakers
(4) Regulatory approvals on a separate label

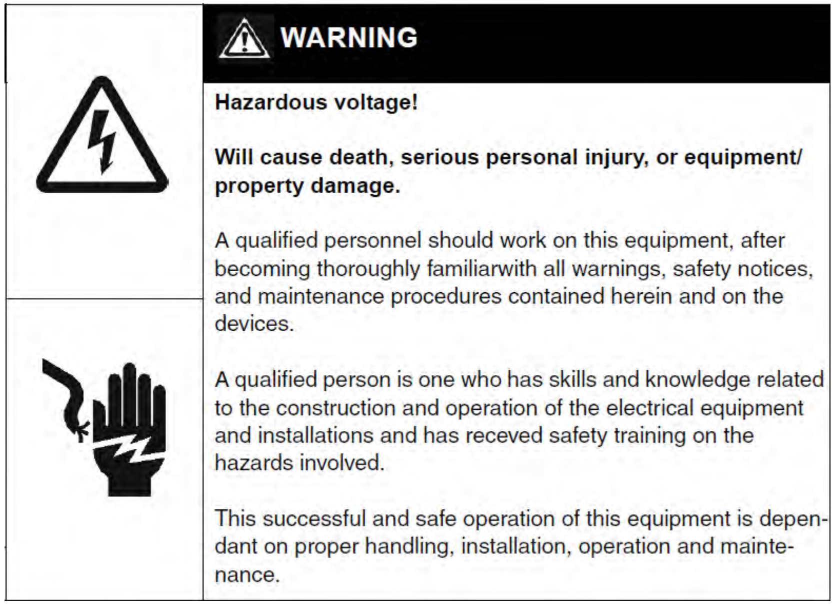
Rating Plug Label



(1) Catalog number
(2) Ampere rating of the circuit breaker
(3) Regulatory approvals on a separate label

Qualified Personnel

In regards to maintenance procedures and inspections of SIEMENS Molded Case Circuit Breakers, a "qualified person" is one who is familiar with the installation, construction and operation of said equipment and the hazards involved.



In addition, a “qualified person” has the following qualifications:
a) Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
b) Is trained in the proper care and use of protective equipment in accordance with established safety practices.
c) Is trained in rendering first aid.

The circuit breakers are suited for operation in enclosed spaces not subject to operating conditions aggravated by dust, caustic vapors or gases. Circuit breakers to be installed in dusty or damp locations must be appropriately enclosed.

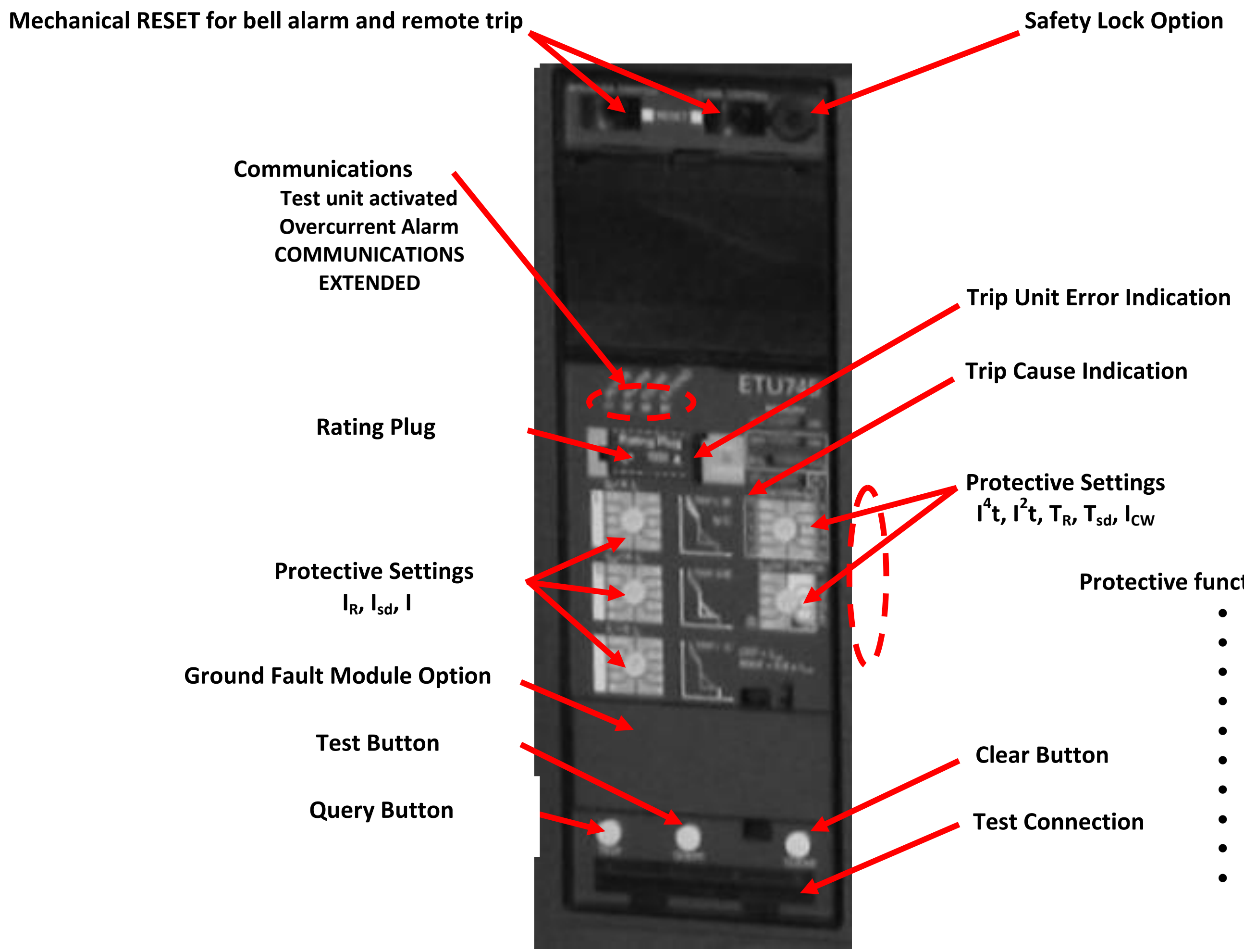
Conformity to Standards

The circuit-breaker frame and the trip units are in conformity with the standards:
- UL 489
- CSA C22.2
- NMX-J-266-ANCE-2002

The accessories are in conformity with the standards:
- UL 489
- NMX-J-266-ANCE-2002

The molded case switches are in conformity with the standards:
- UL 489
- NMX-J-266-ANCE-2002

Trip Unit ETU745



Protective functions

- Overload protection – L-tripping (page 9-22)
- Short-time-delay short-circuit tripping –
- S-tripping (page 9-22)
- Instantaneous short-circuit tripping –I-tripping (page 9-23)
- Ground-fault tripping – G-tripping (page 9-24)
- Neutral conductor protection - N-tripping (page 9-24)
- Load monitoring (load shed/load restore) (page 9-25)
- Leading signal for "L-tripping" (page 9-25)
- Switching on/off thermal memory (page 9-25)
- Ground-fault protection modules (page 9-68)

The trip cause is stored internally for at least two days if the trip unit had been activated for at least 10 min before tripping. (For unlimited time with auxiliary power).

Overload protection – L-tripping

The **current setting** I_R (Page 9-22) defines the maximum continuous current the circuit breaker can carry without tripping.
The **long time delay** t_R (Page 9-22) determines the maximum duration of an overload without tripping.

Short-time-delay short-circuit tripping – S-tripping

Short Time Delay or **short-circuit current tripping** I_{sd} (Page 9-22) defines the maximum Short-term current the circuit breaker can carry without tripping.
Short time delay or **short-circuit current tripping** time delay t_{sd} (Page 9-23) determines the maximum duration of a Short-term current overload without tripping.

Instantaneous short-circuit tripping – I-tripping

If the **current setting** I_i (Page 9-23) is exceeded, the circuit breaker is tripped instantaneously

SIEMENS WL Circuit Breaker Fault Indications

LED	State	Meaning	Description	Page
ACTIVE	Flashing LED	Trip unit is activated	($I>I_{MIN}$)	9-20
ALARM	Steady LED	Overcurrent Alarm	($I \geq I_R$)	9-20
COMM.		Communication Active	COM initiated with another module	9-20
EXTEND		Extended Function	Metering, Event saved in Memory	9-20
TRIP L		Overcurrent (Long Term)*	When Query Button Pushed	9-21
TRIP S		Overcurrent (Short Term)*	When Query Button Pushed	9-21
TRIP I		Overcurrent (Instantaneous)*	When Query Button Pushed	9-21
TRIP G		Overcurrent (Ground Fault)*	When Query Button Pushed	9-21
TU ERROR	Flashing LED	Limited protective function	Rotary coding switch in undefined intermediate Position, TU Defective	9-21
TU ERROR	Steady LED	Protective function not guaranteed	Trip unit defective	9-21

***Last Trip Displayed when Query Button is pushed**

Ground-fault tripping – G-tripping

If the trip unit is equipped with a ground-fault protection module, loads can be protected against unpermissibly high **ground-fault current**s I_G.
Ground Fault time delay t_G determines the maximum duration of a Ground Fault without tripping.

Neutral conductor protection - N-tripping

If the trip unit is equipped with a Neutral Conductor protection module, loads can be protected against unpermissibly high **neutral current**s I_N.
For tripping, the same long time delay t_R applies as for overload tripping.

For more in-depth information refer to the SIEMENS circuit breaker Operator Manual.

Inspections and Maintenance

The inspection procedure according to the most current version of NEMA AB4, section 3 must be performed once a year.

The arc chutes and contact system must be inspected according to these operation instructions. If a fault condition opens the circuit breaker, the circuit breaker should be inspected before it is re-placed into service.

Optional arc chute covers must be replaced at least after three short circuit interruptions.

DANGER

Hazardous voltages are present during operation.

Will cause death, serious personal injury, or equipment/ property damage.

De-energize and secure all primary and secondary circuits before performing service on Low Voltage Switchboard or Low Voltage Circuit Breakers, strictly adhereing to OSHA lock-out / tag-out policies.

Only qualified personnel should work on this equipment, after becoming thoroughly familiar with all warnings, safety notices, and maintenance procedures contained herein and on the devices.

The successful and safe operation of this equipment is depen-dant on proper handling, installation, operation, and mainte-nance.

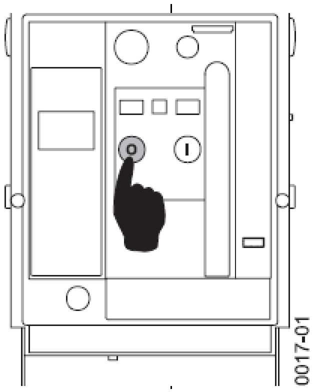
Only SIEMENS authorized repair or replacement parts shall be used on this equipment.

All maintenance / inspection policies dictated here-within must be strictly adhered to.

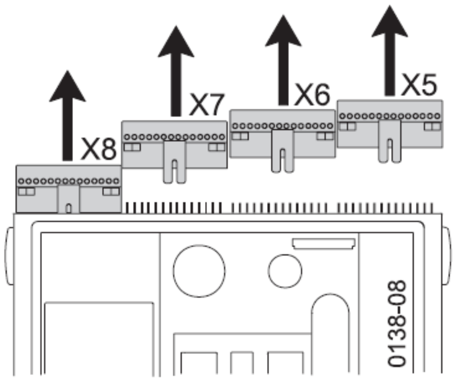
Preparation for maintenance

Opening the circuit breaker, and discharging the stored energy springs

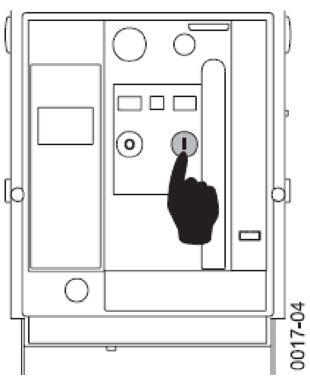
OPEN the Circuit Breaker



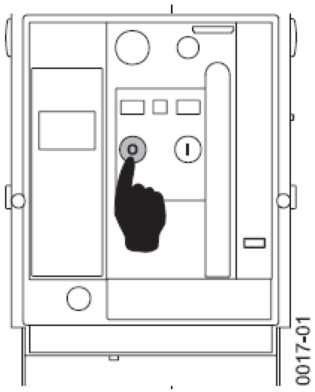
Disconnect Secondary Circuits



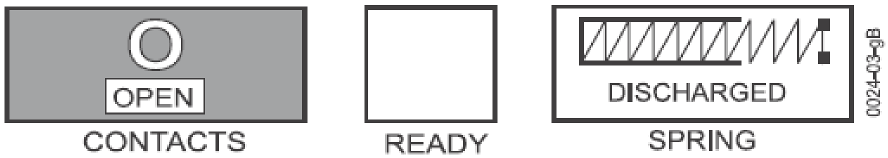
CLOSE the Circuit Breaker



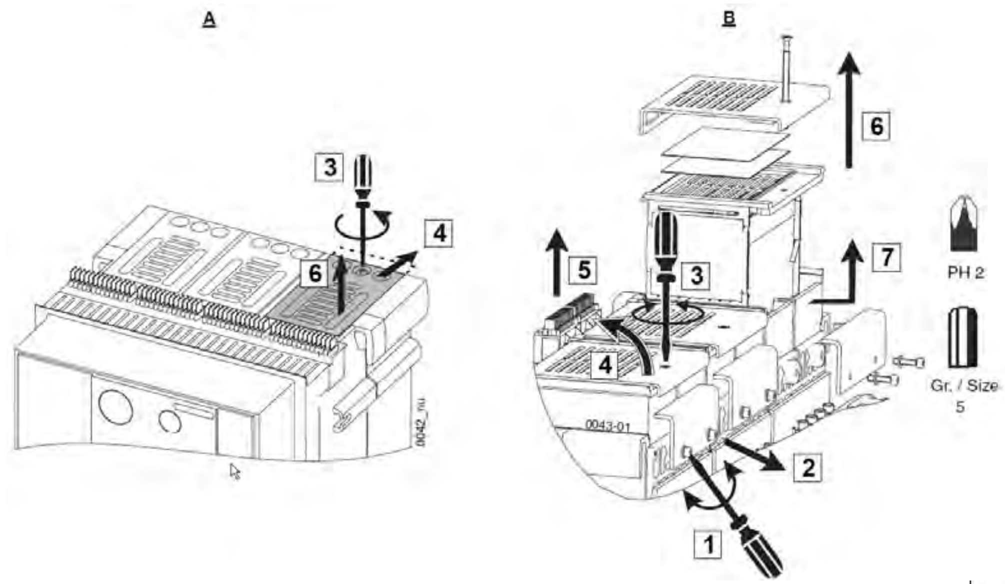
OPEN the Circuit Breaker



INDICATIONS:



Checking arc chutes



A Frame size I and II with flush arc chute
B Frame size II, C-class and frame size III

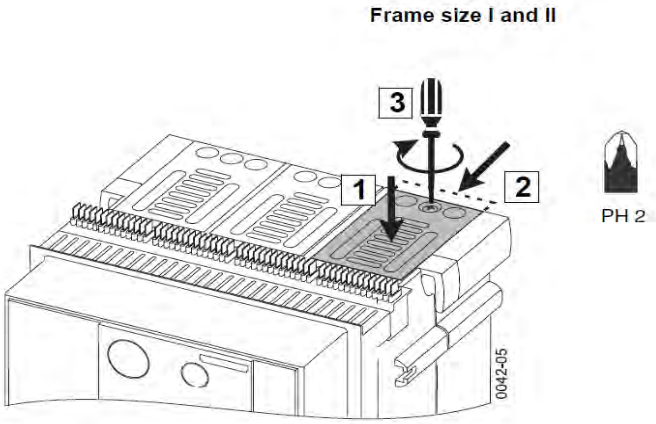
1. Turn out the screw of the angle
2. Remove the angle
3. Turn out the screw about 15 mm, don't take it out (FS III and FS II, C-class: turn out the screw completely)
4. Push the cover back (FS III and FS II, C-class: lift the cover carefully)
5. Remove the cover
6. Take out the arc chute
7. Push the intermediate unit back and remove it

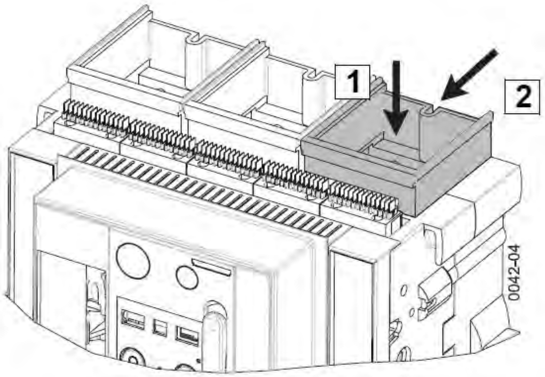
CAUTION
Risk of breaking! Do not place the arc chute vertically on the insulating walls, but lay it on the side.

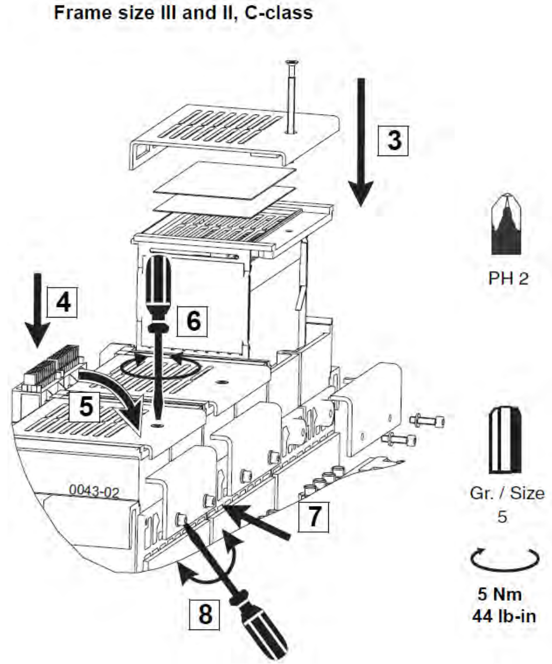
Visual inspection

In the case of heavy wear (burnout on arc splitter plates), replace the arc chutes.

Installing arc chutes



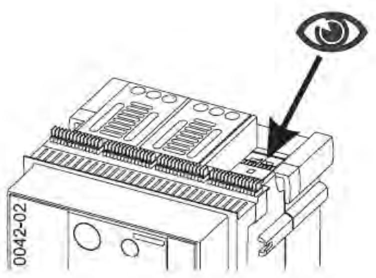


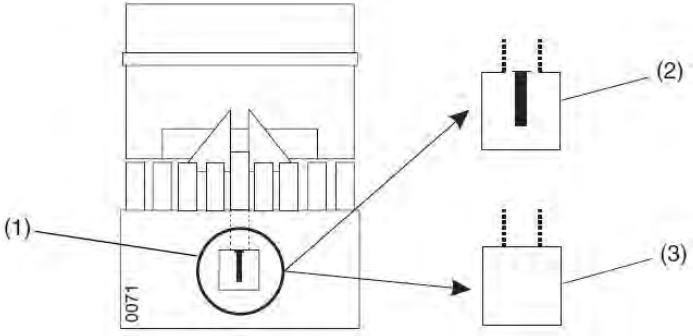


1. Install intermediate unit
2. Shift intermediate unit
3. Insert arc chute, push cover back if necessary
1. Install the cover
1. Hook the cover carefully
2. Tighten the screw
1. Install the angle
2. Tighten the screw

Interrupting class	Frame size	Catalog No.
S, H, L	I	WLARC1UL
S, L	II	WLARC2UL
C	II	WLARC2ULC
L	III	WLARC3UL
C	III	WLARCC3UL

Checking contact erosion





(1) Indicator pin
(2) Indicator pin is visible
(3) Indicator pin is not visible

Visual inspection

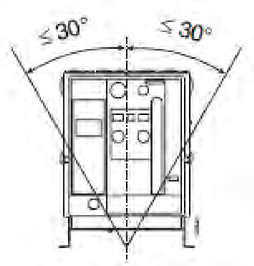
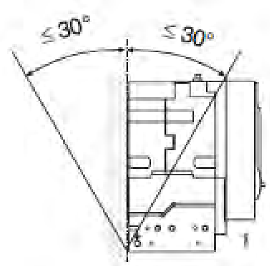
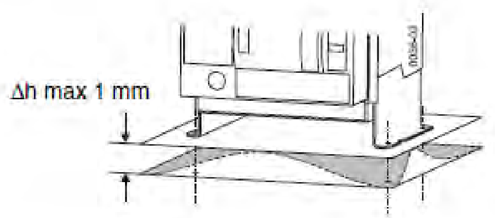
If the indicator pin is not visible, the circuit breaker must be replaced.
For the visual inspection of fixed-mounted circuit breakers, use a mirror if required.

Specifications

WL Circuit Breakers

		Frame Size I		Frame Size II						Frame Size III	
Frame Rating		800	1200	800	1200	1600	2000	2500	3000	4000	5000
Rated Current I_n at 40°C, at 50/60 Hz	A	800	1200	800	1200	1600	2000	2500	3000	4000	5000
Rated Voltage	VAC	600	600	600	600	600	600	600	600	600	600
Permissible Ambient temperature operation (for operation with LCD max 55°C)	°C	-25/+70		-25/+70						-25/+70	
Storage (Observe special conditions for LCD)	°C	-40/+70		-40/+70						-40/+70	
Power Loss at Rated Current I_n (with 3-phase symmetrical load)	W	60	110	40	80	150	230	320	450	580	950
Operating Times											
Make-Break	mS	35	35	35	35	35	35	35	35	35	35
Break-time	mS	34	34	34	34	34	34	34	34	34	34
Make-time, electrical (via closing solenoid)	mS	50	50	50	50	50	50	50	50	50	50
Break-time, electrical (via shunt trip)	mS	40	40	40	40	40	40	40	40	40	40
Break-time, electrical (via instantaneous UVR)	mS	73	73	73	73	73	73	73	73	73	73
Endurance											
Mechanical (without maintenance)	Cycles	7500	7500	10000	10000	10000	10000	10000	10000	5000	5000
Electrical (without maintenance)	Cycles	7500	7500	7500	7500	7500	4000	4000	4000	2000	2000

WL Circuit Breakers

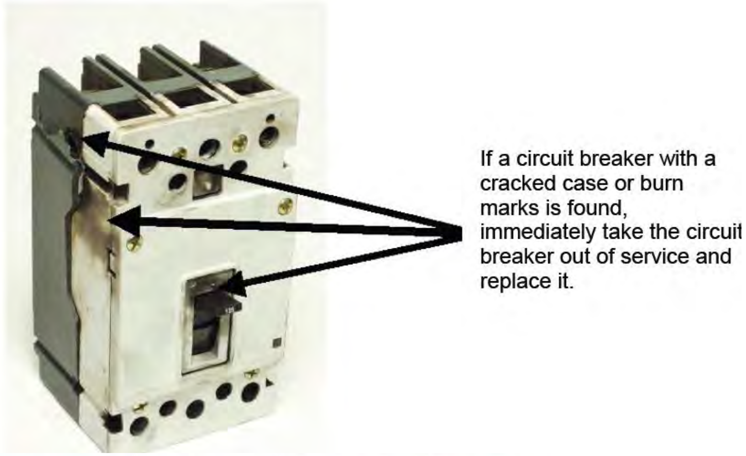
		Frame Size I		Frame Size II						Frame Size III	
Frame Rating		800	1200	800	1200	1600	2000	2500	3000	4000	5000
Switching Frequency	Per Hour	60	60	60	60	60	60	60	60	60	60
Minimum Interval between breaker trip and next closing of circuit (when used with the automatic mechanical reset of the reclosing lockout)	mS	80	80	80	80	80	80	80	80	80	80
Mounting Position											
Weight	Kg/lb	39/86			56/124		59/130	64/141			82/181

For more in-depth information refer to the SIEMENS circuit breaker Operator Manual.

INSPECTION PROCEDURES (From NEMA AB4)

Examine the circuit breaker surfaces for the presence of dust, dirt, soot, grease, or moisture. If such contamination is found, the surfaces should be cleaned. Refer to NEMA AB4 5.2.2.1 for cleaning and precautionary instructions.

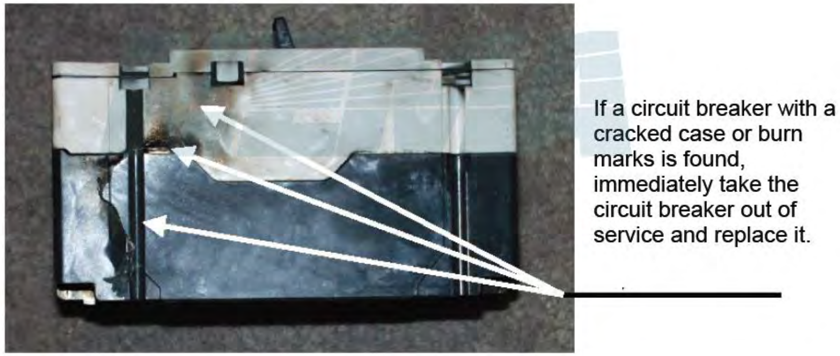
Examine the breaker's molded case for cracks. The integrity of the molded case is important in withstanding the stresses imposed during short circuit interruptions. Breakers should be replaced if cracks are found (See examples).

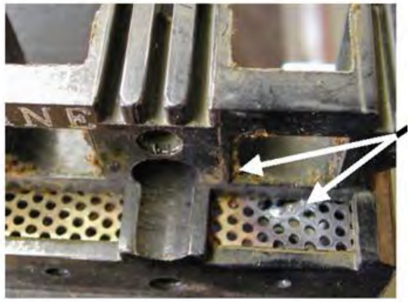


Verify that the conductors are of the correct size and type for the application. Visually check all electrical connections to the circuit breaker to be certain that such connections are clean and secure. Loose or contaminated connections increase electrical resistance, which can damage insulation and conductors and interfere with proper circuit breaker operation. Increased electrical resistance causes overheating of a connection. Such overheating is indicated by discoloration of the breaker's molded case, discoloration or flaking of external metal parts, or melting or blistering of adjacent wire insulation. Pitting or melting of connection surfaces is a sign of arcing due to a loose or otherwise poor connection (See examples).

a. If there is no evidence of looseness, e.g., overheating, do not disturb or tighten the connections.

b. If there is evidence of overheating or arcing, an investigation of the cause should be made and corrective steps taken.





PREVENTIVE MAINTENANCE (From NEMA AB4)

Under normal conditions, properly applied molded case circuit breakers require maintenance only for verification of environmental conditions and that the correct enclosure type for those conditions is being used. However, when inspections determine an abnormal condition and indicate the possibility of damage, it may be necessary to perform certain maintenance steps. These steps cover the only maintenance that should be performed on molded case circuit breakers unless specifically authorized by the circuit breaker manufacturer.

ENVIRONMENTAL EVALUATION

Examine the operating environment and the breaker's physical condition. Preventive maintenance and corrective actions are included as appropriate.

After being properly isolated, examine the circuit breaker surfaces for dust, dirt, soot, grease, or moisture. If grease or evidence of moisture is found, or more than a thin film of dust, dirt or soot is seen, the breaker should be cleaned as suggested below. The insulating surfaces of the breaker should be cleaned using a lint free dry cloth, brush, or vacuum cleaner. Avoid blowing material into the circuit breaker or into surrounding equipment.

CAUTION—Commercial cleaners and lubricants may attack and damage the plastic insulating materials of the breaker. Therefore, such cleaners should not be used. Steps should be taken to eliminate the source of the contamination or to provide an appropriate enclosure that will protect against the future entry of contaminants. With respect to the prevention of moisture, the circuit breaker should be housed in an enclosure appropriate for the environment.

Examine the breaker and terminations for signs of overheating. If such evidence is found, the following maintenance steps should be performed.

Copper circuit breaker terminals and connecting straps (wire connectors and bus bars) can normally be cleaned. They should be carefully disassembled, cleaned, and dressed using fine aluminum oxide paper. All metal and abrasive particles should be removed before reassembling.

CAUTION— when performing this procedure extreme care should be exercised to prevent any damage to plated connections or mechanical disturbance to the circuit breaker and to prevent any particles from entering the breaker. If the damage is extensive, or cannot be corrected by dressing the surfaces, the damaged parts should be replaced if they are intended by the manufacturer to be replaceable. If the damaged parts are not intended to be replaceable, the complete breaker and/or bus connections should be replaced.

Aluminum circuit breaker terminals and connecting straps (wire connectors and bus bars) cannot be cleaned or repaired, and therefore must be replaced.

If wire conductors are damaged, the damaged lengths of the conductors should be cut off. Before reinstalling the conductors, inspect the wire connectors.

INTERCHANGEABLE TRIP UNITS

If the circuit breaker has an interchangeable trip unit, remove the circuit breaker cover and visually check the connections of the trip unit to the circuit breaker frame for evidence of overheating. If there is no evidence of overheating or looseness, do not disturb or tighten the connections. If there is evidence of looseness, overheating, or arcing at any of the trip unit connections, remove the trip unit and visually inspect the connecting surfaces.

If the connecting surfaces show evidence of overheating, the circuit breaker frame and trip unit should be replaced.

If the threaded inserts in the circuit breaker base are stripped or cross-threaded, the circuit breaker frame should be replaced.

If there is no evidence of pitting or melting on the connecting surfaces and the threaded inserts appear to be in good condition, reinstall the trip unit in accordance with the manufacturer's instructions.

WIRE CONNECTORS

If conductors are removed from the wiring connectors, the following steps should be performed:

> Examine wire connectors. If the wire connectors appear to be in good condition, they may be reused. If the connectors, screws, or their plating appear worn or damaged, or there is evidence of cross threading or binding, the connector assembly should be replaced.

If the wire conductors are damaged, the damaged length of the conductors should be cut off.

Appropriate joint compound must be used with aluminum conductors if specified by the circuit breaker manufacturer.

All wire connectors should be torqued in accordance with the nameplate marking or the circuit breaker manufacturer's instructions.

REINSTALLATION PROCEDURE

If the breaker needs to be reinstalled or replaced, follow the safety installation procedures and the manufacturer installation instructions.

TEST PROCEDURES

Some industrial users have indicated that they are required to conduct operational tests of their circuit breakers. The AB 4 Standards Publication is not intended, nor is it adequate, to verify proper electrical performance of a molded case circuit breaker that has been disassembled, modified, rebuilt, refurbished, or handled in any manner not intended or authorized by the original circuit breaker manufacturer. The following non-destructive tests may be used to verify specific operational characteristics of molded case breakers: mechanical operation test, insulation resistance test, individual pole resistance test (millivolt drop test), inverse time overcurrent trip test, instantaneous overcurrent trip test, and rated hold-in test.

MECHANICAL OPERATION TESTS

INSULATION RESISTANCE TEST

INDIVIDUAL POLE RESISTANCE TEST (MILLIVOLT DROP)

INVERSE-TIME OVER CURRENT TRIP TEST

Appendix E Technical Specifications

E-2 Technical Specifications

Specifications	Units	890GTB-1200	890GTB-1450	890GTB-1800	890GTB-2200
Input DC Bus Voltage (nominal)	Volts DC	730	1000	730	1000
Input DC Bus Voltage (max)	Volts DC	800	1200	800	1200
DC Overcurrent Protection		Software Programmable Electronic Trip and PV Fuses			
Overvoltage Protection		Included - Type 2 surge arrestor			
DC Disconnection Method		Options Available			
Surge Protection		Type 2 surge arrestor			
AC					
Rated Output at up to 35C	kVA	1200	1450	1800	2200
Rated Output at 50C	kVA	1080	1305	1620	1980
Nominal Output Voltage	Volts AC	400	480	480	400
Nominal Output Frequency	Hz	50/60	50/60	50/60	50/60
Power Factor Range		+/- 1.0	+/- 1.0	+/- 1.0	+/- 1.0
Current Distortion	%	< 3	< 3	< 3	< 3
Overvoltage Protection		Included - Type 2 surge arrestor			
AC Circuit Breaker		65kA Interrupt Rating			
Performance Data					
Efficiency (Max/CEC) (Estimated)		98.7%			
Auxiliary and Cooling System Losses		< 6 kVA typical, < 9kVA max			
Noise Emission (Audible)		< 80 dBA, typical 87dBA max			
Sensors and User Interface					
User Interface		10.4” TFT LCD Touch-screen			
Communications Protocol Options		Modbus TCP (Optional: Ethernet IP, CanOpen, DNP3, EtherCAT, PROFIBUS)			
Control and Monitoring System		Included			
Stored Data (at 1 sec sample rate)		45 days			
Qty of Monitored Internal Temperatures		112 – Including busbars, ambient, choke, IGBTs			
External Auxiliary Supply		Single Phase or Three Phase			
Control Power Breaker		65kA Interrupt Rating			
Auxiliary Power Breaker		65kA Interrupt Rating			
Mechanical User Interface		EPO Button, On/Off Switch, Local/Remote Switch, Light Switch			
Anti-Condensation Heaters		Included			
Ground Fault Current Monitoring and Protection		Included			

Specifications are subject to change

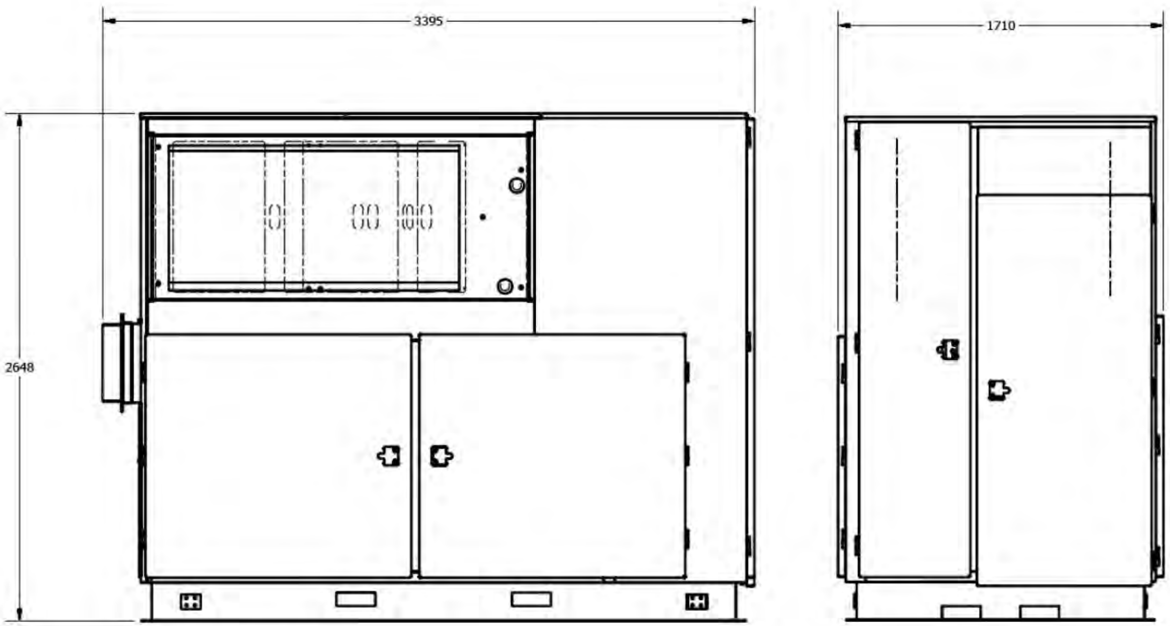
Environmental Ratings

Ambient Temperature Range	-20°C to +55°C, -40°C option available (See AC Output Specifications)
Relative Humidity	0-100% condensing
Max. Altitude Without Derating	1000 meters / 3281 feet
Corrosion Resistance Option	>600 hrs salt fog per ASTM B117-11
Mechanical Data	
Environmental Protection Rating	IP65, EN60529
Size (W x D x H) mm (in)	3395 (133.7) x 1710 (67.3) x 2648 (104.3) See Detail Below
Weight (approximate)	4000kg / 8820 lb
Cooling System	2-phase Parker advanced cooling
Compliance Standards	
European Certifications	CE: LVD, EMC, G5/4 &G59/1 (pending)
North American Certifications	NFPA70, (UL1741 pending)
Harmonics	IEEE 519, IEEE 1547
EMC	EN61000-6-2, EN61000-6-4

Derating:

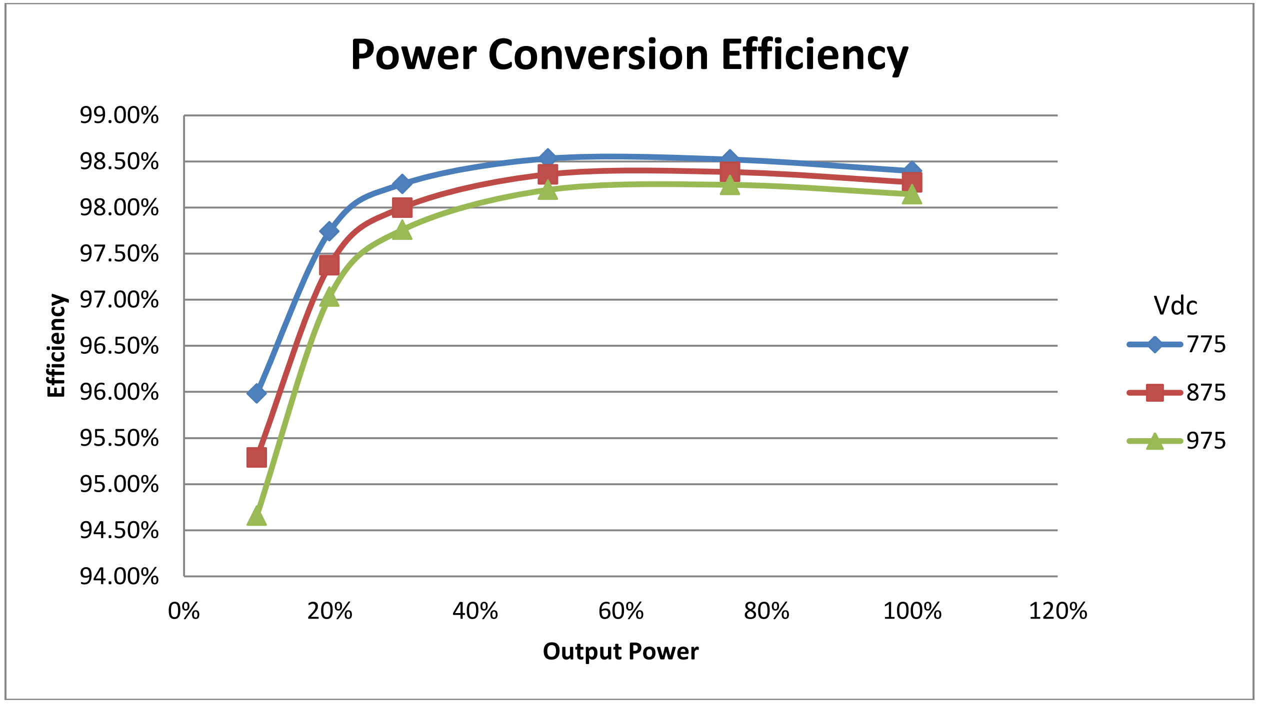
- ***The inverter is capable of providing an additional 10% over rated power at rated power factor when the external ambient temperature is less than 40°C.***
- ***The inverter will apply a linear power Derate from 50°C to 55°C at a maximum slope of 4% power / ° C***
  I.e. 50°C = 100%
  51°C = 96%,
  52°C = 92%
  55°C = 80
  Above 55°C the inverter may shut down
- ***Altitude Derating is 1.5% for every 100m above 1000m up to 2000m,***
  I.e. inverter rating at 1000m = 100%
  1500m = 92.5%
  2000m = 85%
  The inverter is not rated for elevations above 2000m

Dimensions (mm/in)



Dimensions for estimating purposes only.

890GTB-2200 Example Efficiency



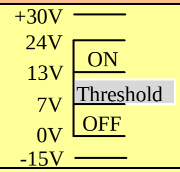
All control and auxiliary power included.

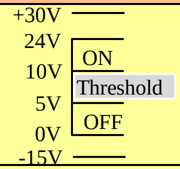
Analog Input / Output Details

Grid-Tie Inverter Analog Inputs/Outputs AIN1 – AIN4, AOUT1 – AOUT2		
	Inputs	Outputs
Range	0-10V, ±10V, 0-20mA, or 4-20mA (Range set in software), Absolute maximum input voltage -15V to +30V	0-10V, ±10V (10mA maximum), (Range set in software)
Impedance	Voltage Range = 47kΩ Current range = 150Ω + series diode	Voltage Range = 100Ω
Resolution	12 bit plus sign	12 bit plus sign
Sample Rate	5ms (one selected input can be 1 ms)	5ms

NI 9205 Analog Inputs 32 Single-ended / 16 Differential Inputs	
Range	±10V, ±5V, ±1V, or ±0.2V, Absolute maximum input voltage -±30V
Impedance	On, 10 GΩ in parallel with 100 pF Off / Overload, 4.7 kΩ min
Resolution	16 bit plus sign
Conversion Time	4.5 µs
Temperature Range	-40 °C to +70 °C
Power Consumption	Active Mode: 625 mW *max* Sleep Mode: 15 mW

Digital Input Details

<table>
<tr><th colspan="3">Grid-Tie Inverter Digital Inputs
DIN1 – DIN9, Conforming to IEC1131-2</th></tr>
<tr><td>Nominal Rated Voltage</td><td>24V DC</td><td rowspan="5">
</td></tr>
<tr><td>Absolute Maximum Input Voltage</td><td>-15V to +30V</td></tr>
<tr><td>Input Threshold</td><td>-15V to +30V</td></tr>
<tr><td>Input Hysteresis</td><td>No</td></tr>
<tr><td>Sample Rate</td><td>1 ms</td></tr>
<tr><td>Input Current</td><td colspan="2">7.3mA ±10% @ 24V</td></tr>
</table>

<table>
<tr><th colspan="3">NI 9425 Digital Inputs
32 Channel, 24V Sinking</th></tr>
<tr><td>Absolute Maximum Input Voltage</td><td>8 chan -60V to +60V
32 chan -30V to +30V</td><td rowspan="3">
</td></tr>
<tr><td>Input Hysteresis</td><td>2Vmin, 60 µA min</td></tr>
<tr><td>Sample Rate</td><td>8 µs</td></tr>
<tr><td>Input Current</td><td colspan="2">On (≥10V, ≥330µA)
Off (≤5V, ≤150 µA)</td></tr>
<tr><td>Power Consumption</td><td colspan="2">Active Mode: 410 mW max (1.45 W @ 70° max)
Sleep Mode: 0.5 mW max (1 W @ 70°C max)</td></tr>
</table>

Digital Output Details

Grid-Tie Inverter Digital Outputs

There are six digital outputs. Two are current sourcing outputs, DINOUT1 and DINOUT2.
The third is a pair of volt-free relay contacts, DOUT3A and DOUT3B

DINOUT1, DINOUT2	
Output High Voltage	≥18V, ≤ 26V, On state, output current = 0 to maximum output currnet
Maximum Output Current	≥160mA Note: the maximum output current is the sum of all 24V sourced outputs, i.e. $i_{DINOUT1} + i_{DINOUT2} + i_{24V\ USER} \leq$ 160mA
Overload/Short Circuit Protection	Indefinite
DOUT3A, DOUT3B	
Rated Voltage	24V DC SELV
Rated Current	1A Resistive load at rated voltage
Resistance	≤ 0.05Ω - on state
Isolation Resistance	$>10^{10}$ Ω - off state
Arc Protection	No
Update Rate	1 ms

NI9476 Digital Outputs

32 Channel, 24V Sourcing

Voltage Range V_{sup}	6 – 36 V
Continuous Output Current	6 – 30V, 250 mA 36V, 200 mA
Output Impedance	0.3Ω *max*
Continuous Overvoltage Protection	40V *max* (Short Circuit Protection indefinite when shorted to COM or V_{sup})
Current Consumption	28 mA *max*
Power Consumption	Active Mode: 250 mW *max (1. 5 W @ 70° max)* Sleep Mode: 25 µW *max (30 mW @ 70°C max)*
Update Rate	20 µs *max*

Relay Output Details

Grid-Tie Inverter Relay Outputs There are three pairs of volt-free relay outputs available on Terminal X16 Rated to 230V 3A resistive load. Alternatively they may be used down to 1mA, 12V levels.	
DOUT4, DOUT5, DOUT6	
DOUT4_A **DOUT4_B**	Normally-open relay contacts. Default function DOUT4 closed = healthy
DOUT5_A **DOUT5_B**	Normally-open relay contacts. Default function DOUT5 closed = running
DOUT6_A **DOUT6_B**	Normally-open relay contacts. No default function

Reference Output Details

Grid-Tie Inverter Reference Outputs There are two reference outputs that provide +10V and -10V. They can be used, for example, to generate -10V to +10V signals via potentiometers for the analog inputs	
Terminal X12/08 & X12/09	
Accuracy	±1% Output current = 0 to maximum, Ambient temperature = 0°C to 70°C
Maximum Output Current	≥10mA
Overload/Short Circuit Protection	Indefinite

Thermocouple Input Details

NI 9213 Thermocouple Inputs 16 Thermocouple Channels, 1 Internal autozero channel, 1 internal cold-junction compensation channel	
Range	TYPE J, K, T, E, N, B, R, S Thermocouple ranges Voltage measurement range +/- 78.125 mV
Impedance	78MΩ
Input Current	50 nA
Resolution	24 bits (Delta-Sigma ADC)
Conversion Time	High-resolution 55 ms High-speed 740 µs
Sample Rate **(Sample rate can be faster if all inputs are not used)**	High-resolution 1S/s High-speed .75S.s
Temperature Range	-40°C to +70°C
Warm-up Time	15 minutes

User 24V Output Details

Grid-Tie Inverter User 24V Output A supply provided for powering external equipment or for providing power to digital inputs.	
Terminal X14/03	
Output Voltage	≥18V, ≤ 26V
Maximum Output Current	≥160mA Note: the maximum output current is the sum of all 24V sourced outputs, i.e. $i_{DINOUT1} + i_{DINOUT2} + i_{24V\ USER} \leq 160mA$
Overload/Short Circuit Protection	Indefinite

Earthing/Safety Details

Earthing/Safety Details	
Earthing	**Each unit must be permanently earthed according to EN 61800-5.** For permanent earthing, EN 61800-5 states that: *A cross-section conductor of at least $10mm^2$ for copper or $16mm^2$ aluminium is required.* Use a copper protective earth conductor of at least $10mm^2$ minimum cross-section. **Conductors must be sized in accordance with Local Wiring Regulations which always take precedence.** As a guide, refer to the Input Current for the drive given in the Electrical Ratings tables.
Input Supply Details (TN) and (IT)	Drives without filters are suitable for earth referenced (TN) or non-earth referenced (IT) supplies. External filters are available for use on earth referenced (TN) supplies only.
Earth Leakage Current	>>100mA (all models)

Pump Control Module (LA471775U001)

The Pump Control Module controls up to three refrigerant pumps and an internal cooling fan (PLG1-4).

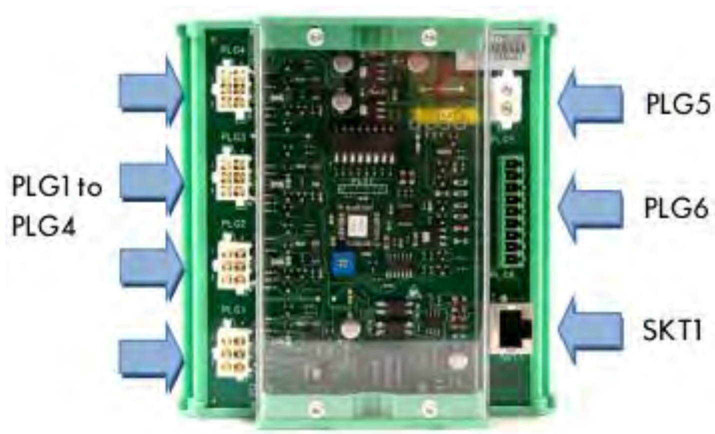
It processes one thermistor input for refrigerant temperature and two digital inputs and provides a fault output and two 0- 10VDC analog outputs for coolant temperature and condenser fan speed (PLG6).

The Digital Output (terminal 7) provides the fault signal. It is ON (cooling fault) when Digital Input 2 (terminal 4) = ON and any of these conditions occur:

- Thermistor input (terminal 1) shorted
- Thermistor input (terminal 1) > 67 °C
- Missing feedbacks on any pin 3 on PLG1, 2, 3, or 4

The module communicates with the PCM via RS485 connection at SKT1.

24 VDC connected to terminal PLG5 powers the module



Pump Control Module

Pump Control Module Setup

The mode switch (SW1) must be set correctly for proper operation. Replacement modules may not be set for your application. The following table shows the typical modes and switch settings (green = ON).

PUMP MODULE NEEDS 1 AND 6 SET FOR GRID TIE INVERTER

Note: ***The mode switch is ON when the paddle is pushed down and OFF when it is up.***

Mode	*CD Modules*	*Pumps*	*Switch Settings* 								*# F/B*	*Pump Spd*
1	*6*	*1*	**1**	2	**3**	4	5	**6**	**7**	8	*2*	*6.0*
2	*9*	*1*	1	**2**	**3**	4	5	**6**	**7**	8	*2*	*7.5*
3	*6*	*2*	**1**	2	3	**4**	5	**6**	**7**	8	*3*	*6.0*
4	*9*	*2*	1	**2**	3	**4**	5	**6**	**7**	8	*3*	*7.5*
Legacy												
******	*6*	*1*	1	**2**	3	4	5	6	7	8	*2*	*6.0*
Grid Tie												
GT-1	*9*	*3*	**1**	2	3	4	5	**6**	7	8	*1*	*Set via DIN1 & DIN2*

Switch Location

20A Supply Fuse

Note: ***Switch settings 1 and 2 set the Pump SP. Set them to OFF/OFF for the minimum setpoint (4.5A) and ON/ON for the maximum (10A).***

Note: ***Switch positions 3 and 4 determine the number of feedbacks.***

Pump Control Module Terminal Definitions

		Function	Signal	Note
PLG 1, 2, 3, 4	1	Common	0V	
	2	+24 VDC Output	+24VDC	10A - Time Delay resettable PTC
	3	Tachometer Input 1	Pulse Tach	
	4	Analog Output 1	0–10 VDC	Pump setpoint 0VDC if PLG6-4=0V or PLG6-1=OPEN or Shorted or >67°C
	5	Analog Output 2	0–10 VDC	Fan setpoint (voltage) 0VDC if PLG6-4=0V 10VDC if PLG6-4=24V
	6	Analog Output 3	5VDC PWM open drain	Fan Setpoint (PWM)

		Function	Signal	Note
PLG 5	1	+24 VDC Input	+24VDC	20A Automotive type fuse
	2	Common	0V	

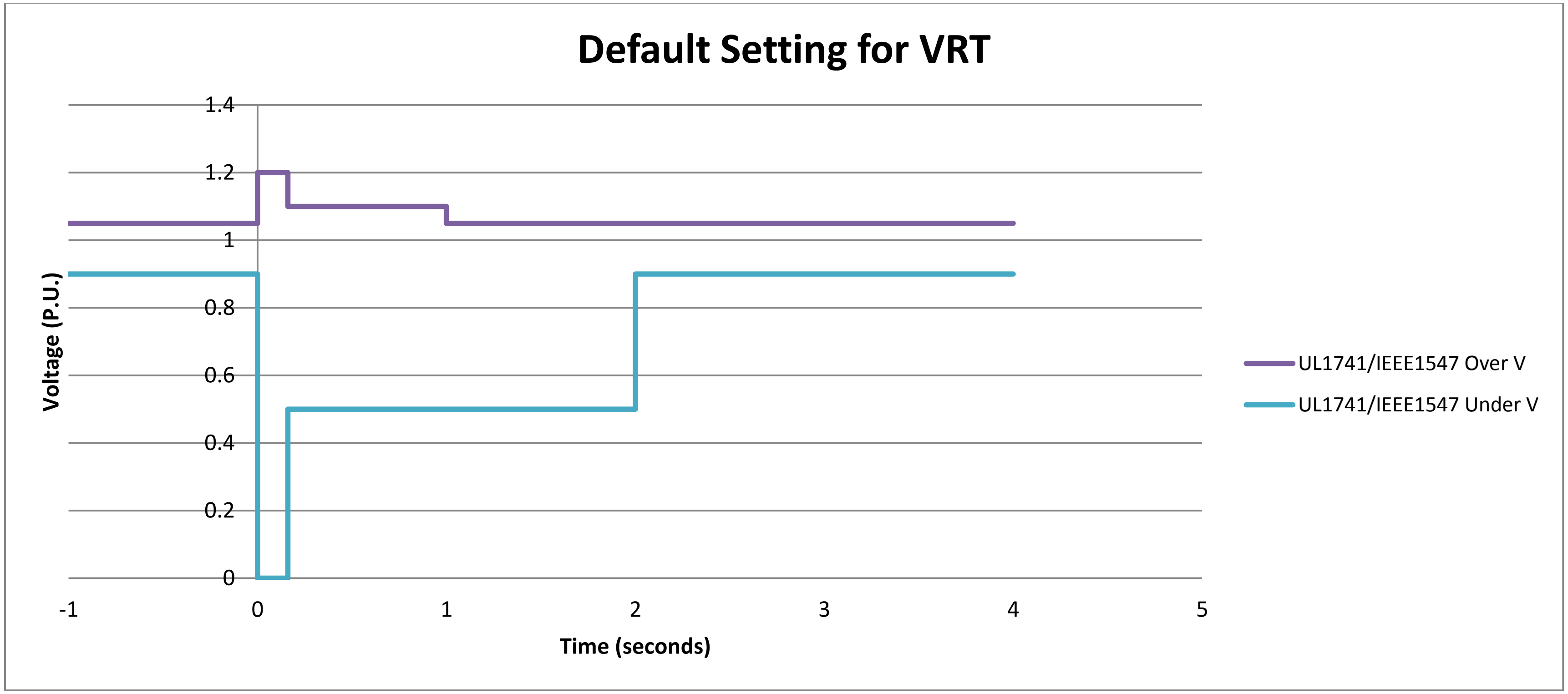
		Function	Signal	Note
PLG 6	1	Thermistor	10kΩ @ 25°C	10kΩ @ 25°C, 2.191kΩ @ 67°C
	2	Thermistor common		
	3	Digital Input 1		Not Used
	4	Digital Input 2	5-24 VDC on, 0.7 VDC off	Off = disable pumps
	5	Common	0V	
	6	+24VDC Output	24VDC	1A fused - resettable PTC
	7	Digital Output	24 VDC max (open drain)	ON = Fault
	8	Analog Output 1	0–10 VDC	Coolant Temperature 0-10VDC for 0 to 100°C
	9	Analog Output 2	0–10 VDC	Condenser Speed Setpoint 1.0 VDC <= 30°C to 10 VDC >= 44°C Linear from 30 to 44 °C

		Function	Signal	Note
SKT1	5	0V (isolated)		
	7	Common	5V self-powered	

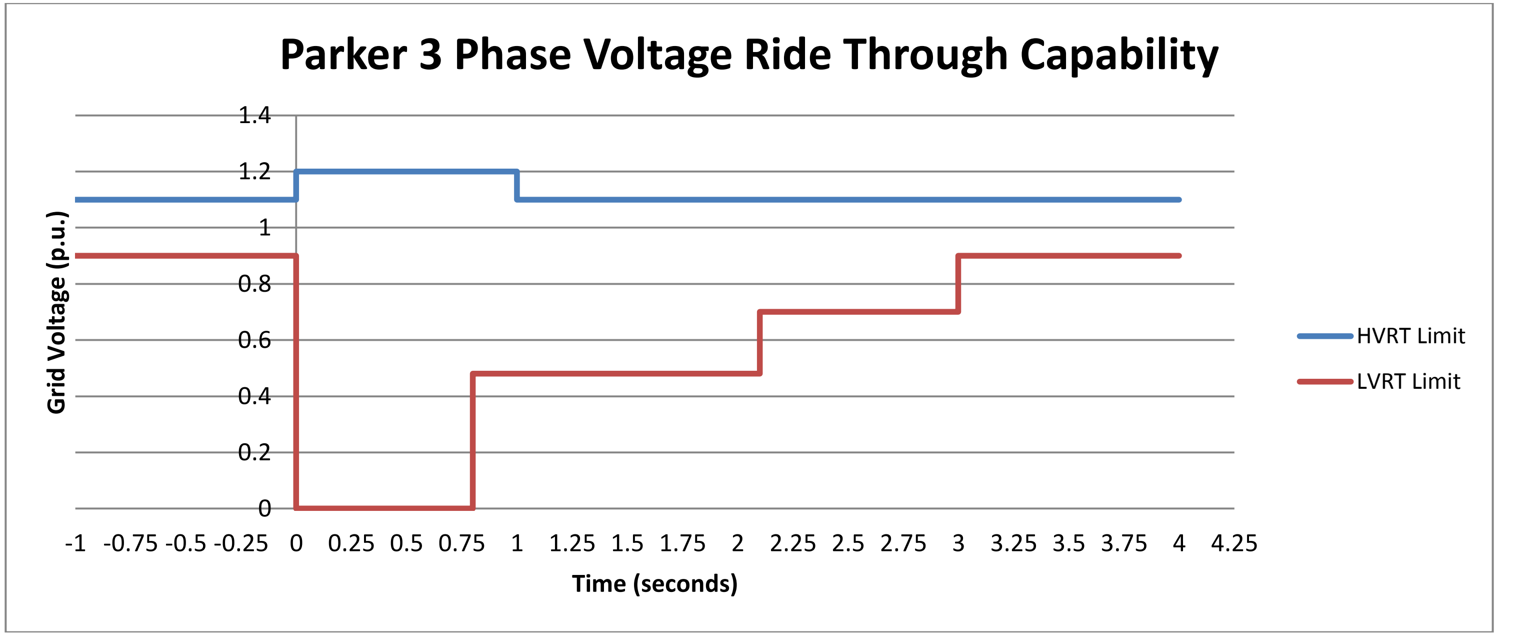
Grid Responses

HVRT and LVRT

As shipped, the 890GT complies with UL1741/IEEE1547 requirements for Voltage Ride Through. The following graph shows the pre-programmed trip times for the 890GT:



The 890GT can also be programmed to withstand HVRT and LVRT magnitude limits and times that meet or exceed the requirements listed in PRC-024-1, the BDEW requirements, and UL1741/IEEE1547. Programming of the thresholds should only be performed by trained maintenance or service personnel. This graph shows the maximum configurable hold-up time of the inverter. For needs outside of these capabilities, consult the factory:


Parker 3 Phase Voltage Ride Through Capability
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Grid Voltage (p.u.)
-1 -0.75 -0.5 -0.25 0 0.25 0.5 0.75 1 1.25 1.5 1.75 2 2.25 2.5 2.75 3 3.25 3.5 3.75 4 4.25
Time (seconds)
HVRT Limit
LVRT Limit

FqRT

The 890GT can maintain grid connection through grid frequency shifts that exceed the requirements of WECC and PRC-024-1. The 890GTB comes pre-programmed to meet the requirements of IEEE 1547 and UL1741. The frequency trip points are:

- Frequency > 60.5 Hz, disconnection within 0.16 seconds
- Frequency < 57.0 Hz, disconnection within 0.16 seconds
- Frequency < 57.5Hz, disconnection within 300 seconds

The above settings and parameters are factory adjustable to meet local grid fault codes, application demands, and 50Hz installations.

Transformer Harmonics

- Nominal frequency = 60 Hz
- Fundamental primary current = 2775 Arms
- Harmonics less than 0.1% not shown
- Current present from inner-harmonics have been included into the closest harmonic
- The above table does not include the effects of distortion of the supply network due to other loads and non-linear effects of the network

Nominal impedance = 5.75% p.u.; +/-7.5%

Rank	frequency (Hz)	current (A)	% of Fund	Rank	frequency (Hz)	current (A)	% of Fund
1	60	2775	100.0	43	2580		0.0
3	180		0.0	45	2700		0.0
5	300		0.0	47	2820		0.0
7	420		0.0	49	2940		0.0
9	540		0.0	51	3060		0.0
11	660		0.0	53	3180		0.0
13	780		0.0	55	3300		0.0
15	900	36	1.3	57	3420		0.0
17	1020		0.0	59	3540		0.0
19	1140		0.0	61	3660		0.0
21	1260		0.0	63	3780		0.0
23	1380		0.0	65	3900		0.0
25	1500		0.0	67	4020	18	0.6
27	1620		0.0	69	4140		0.0
29	1740		0.0	71	4260		0.0
31	1860		0.0	73	4380		0.0
33	1980		0.0	75	4500		0.0
35	2100	46	1.7	77	4620		0.0
37	2220		0.0	79	4740		0.0
39	2340		0.0	81	4860		0.0
41	2460		0.0	83	4980		0.0
				THD (%)	--	--	2.2

Connector Torque Requirements

Bolt Size	Torque (NM)							
	Steel 6/6		Steel 8/8		Steel 4/6		Brass 20T UTS	
	Installation	Inspection	Installation	Inspection	Installation	Inspection	Installation	Inspection
M4	1.9	1.69	3.5	3.0	1.3	1.1	1.8	1.5
8-32	2.2	1.9	3.8	3.2	1.5	1.3	-	-
10-32	3.2	2.7	5.4	4.6	2.1	1.8	-	-
M5	4.0	3.4	7.1	6.0	2.7	2.3	3.6	3.1
M6	6.8	5.8	11.5	9.7	4.5	3.8	5.4	4.6
1/4-20	7.6	6.5	13.0	11.1	5.1	4.3	-	-
5/16-18	15.7	13.3	26.7	22.7	10.4	8.8	-	-
M8	16.5	14.0	28.0	24.3	11.0	9.4	12.3	10.4
3/8-18	27.9	23.7	47.5	40.4	18.6	15.8	-	-
M10	32.8	27.9	55.0	47.5	21.8	18.5	23.7	20.2
M12	91.0	77.4	155.1	130.2	60.6	51.5	66.0	56.1
1/2-12	68.0	57.8	115.8	98.4	45.3	38.5	-	-
M16	142.0	120.7	241.0	208.8	95.0	80.8	101.0	85.9
M20	277.0	235.5	465.1	396.0	185.0	157.3	205.0	174.3

Use the above torques for 6/6 screws for all busbar connections and general use unless the screw material requires lower torque. Use the torques for 8/8 screws only where specified (These torques are generally used for very high loads).

Typical Spare Parts List

QTY	TYP	EGT PART #	DESCRIPTION	MANUFACTURER	NEXT HIGHER ASSY	MIN
1	M	3200A DC 1500V 2P	DC Contactor	EGT	3200A DC 1500V 2P	1
1	A	8903/IM/00/00	ETHERNET MODBUS/TCP TECHBOX 890	EGT	LA473001W260	1
1	A	AH471775	AC890PX Pump Control Module	EGT	LA471775U001	1
4	CT	AH473315U001	PCB_ASSY_TDC_DC_THML_GT3000	EGT	LA472983U001	1
105	A	AH473353W001	PCB_ASSY_70_40_1T6	EGT	LA472983U001	10
1	F	CH352006U020	FUSE CLASS CC T-D 600VAC 2A - FNQ-R-2	BUSSMANN	LB472963	10
3	F	CH352124U025	FUSE D-E T-D 0.41x1.5" 250VAC 2.5A - FNM-2.5	BUSSMANN	LA473303U001	10
6	F	CH352124U050	FUSE D-E T-D 0.41x1.5" 250VAC 5A - FNM -5	BUSSMANN	LA473303U001	10
1	F	CH352124U150	FUSE D-E T-D 0.41x1.5" 250VAC 5A - FNM -5	BUSSMANN	LA473303U001	10
4	F	CH352124U200	FUSE D-E T-D 0.41x1.5" 250VAC 20A - FNM-20	BUSSMANN	LA473303U001	10
1	F	CH352124U300	FUSE D-E T-D 0.41x1.5" 250VAC 5A - FNM -5	BUSSMANN	LA473303U001	10
3	VR	CK473288U240	AC Surge Suppression Strikesorb 240VAC 20kA - SPD-40-B	Raycap	LB472963	1
1	VR	CK473288U400	AC Surge Suppression Strikesorb 400VAC 20kA - SPD-40-D	Raycap	LB472963	2
2	VR	CK473288U600	DC Surge Suppression Strikesorb 600VAC 20kA - SPD-40-F	Raycap	LB472963	1
1	RT	CL473188U001	PXP Thermistor	Omega	LB472963	1
1	L	CM473553	Temperature Sensing Cable	EGT	CM473553	1
2	T	CO473680U001	AC Voltage Transformers 346/120 150VA	Flex-Core	460-346	2
1	T1	CO473686	Transformer 370VAC/220VAC /120VAC 7KVA	Jefferson Electric		1
1	F	CS470754U040	FUSE CLASS-J T-D 600V 40A - AJT40	GOULD	AJT40	1
13	F	CS473297U400	DC Fuses 400A 1000VDC Bolted	Bussmann	PV400A-3L-B	10
1	F	CS473313U010	FS_CLIP_38L_CYL_10D_10A - DCT-10A	Mersen	LA473321U001	5
1	F	CS473548U002	FS_CLIP_127L_CYL_21D_2A0 - GRD-2A	Mersen	LA473321U002	5
4	F	CS473760U100	AC/DC Surge Suppression Fuse 600VAC 100A 200KA	Mersen	AJT100-EI	5
3	F	CS473760U100	FS_BLT_117L_27D_92P_100A_TDC	Parker EGT	CS473760U100	5
3	D	CW047379	RECTIFIER BRIDGE-TYPE 1PH FW 1600PIV	SEMIKRON	LA473303U001	1
2	C	CY473492	LVRT Capacitor 400VDC 220H	Parker EGT	LA473303U001	2
4	R	CZ389853	Dynamic Brake Resistor 460VAC 100Ω 100W	EGT	LA473303U001	2
1	A4	DA473172U200	Power Meter - SHARK-200T-60-10-V2-D2-INP10	Electro Ind	LB472963	1
1	M	DB470805U035	CONTACTOR AC 3P 3O 1O 35A (24VDC COIL) - LP1D1810BD	SQUARE D	LA473303U001	1
1	EPOA	DB470807U001	RLY_PWR_30_2C_24VDC_10A_WSD	SQUARE D	LA473303U001	1
1	DC	DB471832	RL_CHSS_8166_73_1NO_500A_1000VDC_9VCOIL	Parker EGT	LA472983U001	1
1	K	DB473116U040	CONTACTOR_AC_3P_40A_AC1_220V_50/60	Parker EGT	DB473116U040	1
1	EPO	DB473369	RLY_SAFETY_3NO_1NC_24VDC_DIN - 1SAR501331R0001	ABB	LA473303U001	1
1	K	DB473373	LVRT_RLY_240VAC 50/60Hz 15A 20 2C	SQUARE D	LA473303U001	1

QTY	TYP	EGT PART #	DESCRIPTION	MANUFACTURER	NEXT HIGHER ASSY	MIN
1	CB	DC472106U100	AC Circuit Breaker 600VAC 100A	Siemens	NEGB300L	1
1	CB	DC473189U300	AC Circuit Breaker 600VAC 3000A - L2F330WGCJAAAVN	Siemens	LB472963	1
3	CT	DD472426U050	TDC_ASSY_50A_4033_30H	Parker EGT	LA473321U002	3
2	CT	DD473753U400	AC Current Transformers 4000:5 0.3%	Flex-Core	125-402	2
2	M	DL473633U001	Condenser Fan	EGT	DL473633U001	1
1	EPOA	DM353132	TIMER AUX TDD 1O 1C 120VAC 10A	Parker EGT	LA472983U001	1
1	A1	DV473370	PLC TC Input Module 16ch NI 9213	National Instruments	LA473303U001	1
1	A1	DV473371	PLC Analog Input Module 32ch NI 9205	National Instruments	LA473303U001	1
1	A1	DV473372	PLC Digital Input Module 32ch 24VDC NI 9425	National Instruments	LA473303U001	1
1	A1	DV473759	COMP PERIPH CNTLR_8SLOT_W_FPGA_NI_9068	National Instruments	LA473303U001	1
1	A1	DV473881	PLC Analog Input Module 3ch NI 9225	National Instruments	LA473303U001	1
1	A1	DV473880	PLC Analog Input Module 4ch NI 9227	National Instruments	LA473303U001	1
1	A3	DV473488	COMP PERIPH 8 PORT ETHERNET SWITCH – SE-SW8U-WT	Automation Direct	LA473303U001	1
2	PS	DY473588U020	PSU_ASSY_24VDC_20A_1KW	Weidmuller	LA473303U001	1
1	PS	DY473588U040	PSU_ASSY_24VDC_40A_1KW	Weidmuller	LA473303U001	1
1	PS4	DY473379	PSU_ASSY_15VDC_3.4A_50W	PULS	LA473303U001	1
1	PS5	DY473380	PSU_ASSY_15VDC_1A_15W	PULS	LA473303U001	1
1	A	LA471775U001	AC890PX Pump Control Module Assy	EGT	LA473344U001	1
1	A	LA471892U002	AFE SYNCHRONIZATION ATTENUATOR	EGT	LA473344U001	1
9	A	LA472957T790	ASSY_1PHOP_900KW_700V_GTI	EGT	LA473001W260	3
1	A	LA472972X001	ASSY_PDCT_PCM_(cc)	EGT	LA473001W260	1
1	A	LA472974	PCB_ASSY_DIG_INTF	EGT	LA473303U001	1
2	A	LA472975	Analog Board 1	EGT	LA473303U001	1
1	M	LA473050U001	DC Bus	EGT	LA473050U001	1
3	L	LA473332U001	CHK_ASSY_MDLE_45uH_970A_480V_TPPOS	EGT	LA473301U001	1
3	L	LA473332U002	CHK_ASSY_MDLE_45uH_970A_480V_MDPOS	EGT	LA473301U001	1
3	L	LA473332U003	CHK_ASSY_MDLE_45uH_970A_480V_BTPOS	EGT	LA473301U001	1
4	M	LA473347U550	FN_ASSY_220OD_50T8_550CGM_24V	Parker EGT	LA473343U001	1
2	M	LA473353W001	Temperature Sensing Board	Parker EGT	LA473353W001	1
1	P1	LA473375	SKT_ASSY_DUAL_120V_15A_GFI	EGT	LA473303U001	1
1	A	LA473505	Analog Board 2	EGT	LA473303U001	1
17	DC	LA473529U500	RL_ASSY_8166_73_1NO_500A_1000VDC_9VCOIL	Parker EGT	LA473321U001	4
1	A5	LB473272U002	Industrial PC and Touchscreen - IPX10S-D	Parker CTC	LA473304U001	1
1	M	LB473568U003	PUMP_ASSY_3X600LPH	EGT	LA473568U003	1

Appendix F List of Fault Codes

List of Fault Codes

List of annunciated system faults and warnings

Listed in Fault Table			
Inverter Keypad (Page A-18)	PLC I/O (Page 4-23)	PUMP I/O (Page 4-24)	HMI (Page 4-41)

ALARM	MEANING	ACTION
24V FAILURE	The 24V power has dropped below 17V, 24V supply is not regulating properly (FirstTrip == 20)	PLC to autorestart inverter and warning sent to SCADA when the 24V supply is regulating properly.
AC Surge Suppression Fuse Fault	VR1-4 shorted, F8-10 blown, fuse indicator open	Failure Annunciated, Continue running
ANALOG INPUT ERR	Analog input is in 4-20mA mode, current has been detected to be over 22mA, Short circuit of the analog input circuit	Disable output, manual reset reqd – Maintenance reqd.
APP ERROR	The application has ceased execution due to an error (FirstTrip == 51)	Disable output, manual reset reqd – Maintenance reqd.
APP HALTED	The application has been halted by the DSE configuration tool. (FirstTrip == 50)	Disable output, manual reset reqd – Maintenance reqd.
Aux Power CB Area Ambient Temperature Fault	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Aux Power CB Area Ambient Temperature Warning	Measured Temp < -20 C >65 C	Warning Annunciated
Aux Power Transformer Area Ambient Temperature Fault	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Aux Power Transformer Area Ambient Temperature Warning	Measured Temp < -20 C >65 C	Warning Annunciated
AUX SUPPLY LOW	Grid brown-out event occurred	Disable output, autorestart when supply is above requirement. Possible maintenance required
Buffered 24VDC Supply Fault	Power supply present	PLC to autorestart inverter and warning sent to SCADA when the 24V supply is regulating properly.
BYPASS WARN	Maintenance required during normal sleep	Warning only
Cap Door Therminal Temperature Fault 7A1 – 7A15	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Cap Door Therminal Temperature Warning 7A1 – 7A15	Measured Temp < -20 C >135 C	Warning Annunciated
COMMS BREAK	COMMS BREAK parameter is set to True	Check Configuration to determine source of the signal. Disable output, manual reset required
CONDENSER FAIL	Both fans failed.	Disable output, manual reset required, Maintenance required
CONDENSER FAN 1	Condenser fan 2 has failed.	Warning only. Derate output to maintain temperature, Maintenance required

ALARM	MEANING	ACTION
CONDENSER FAN 2	Condenser fan 2 has failed.	Warning only. Derate output to maintain temperature, Maintenance required
Condenser Inlet Temperature Fault	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Condenser Inlet Temperature Warning	Measured Temp < -20 C >65 C	Warning Annunciated
Condenser Outlet Temperature Fault	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Condenser Outlet Temperature Warning	Measured Temp < -20 C >65 C	Warning Annunciated
CONTACTOR FBK	The CONTACTOR CLOSED input in the SEQUENCING LOGIC function block remained FALSE after a run command was issued (FirstTrip == 14)	Disable output, manual reset required
CURRENT BALANCE	Poor current sharing between IGBTs within a CD module, Manufacturing defect in a CD module (FirstTrip == 72)	PLC to autorestart. Maintenance required if more than 1 event occurs in succession.
CURRENT SHARING	Fault indicating paralleled CD modules are not sharing effectively. Fault will indicate which module reported excessive current relative to its paralleled modules. Paralleled output impedances are imbalanced. One of the modules has been disconnected from the load	PLC to autorestart. Maintenance required if more than 1 event occurs in succession.
CUSTOM TRIP	Up to 7 user customizable faults. TBD by customer	Disable output, manual reset required
CUSTOM TRIP 1: PLC Watchdog	PCM Detected Loss of PLC Watchdog (Fieldbus, PLC)	PCM: IGBTs Off, PLC: Annunciate to SCADA
CUSTOM TRIP 2: Overvoltage	PCM Detected Output Overvoltage (Fieldbus, PLC)	PCM: IGBTs Off, PLC: Annunciate to SCADA
CUSTOM TRIP 3: Undervoltage	PCM Detected Output Undervoltage (Fieldbus, PLC)	PCM: IGBTs Off, PLC: Annunciate to SCADA
CUSTOM TRIP 4: Over Frequency	PCM Detected Output Over Frequency (Fieldbus, PLC)	PCM: IGBTs Off, PLC: Annunciate to SCADA
CUSTOM TRIP 5: Under Frequency	PCM Detected Output Under Frequency (Fieldbus, PLC)	PCM: IGBTs Off, PLC: Annunciate to SCADA
CUSTOM TRIP 6: Dc Overvoltage	PCM Detected DC BUS Overvoltage (Fieldbus, PLC)	PCM: IGBTs Off, PLC: Annunciate to SCADA

F-4 List of Fault Codes

ALARM	MEANING	ACTION
CUSTOM TRIP 7: DC Undervoltsge	PCM Detected DC BUS Overvoltage (Fieldbus, PLC)	PCM: IGBTs Off, PLC: Annunciate to SCADA
DC Contactor Failed To Close	DC contactor will not close. Failed coil or contactor	Warning Annunciated indicating which DC contactor will not close
DC Contactor Failed To Open	DC contactor will not open. Welded Contacts, Contactor failure	Warning Annunciated indicating which DC contactor will not open
DC Panel 1 Therminal Temperature Fault 1A1 – 1A14	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
DC Panel Therminal Temperature Warning 1A1 – 1A14	Measured Temp < -20 C >135 C	Warning Annunciated
DC Precharge Contactor (-) / (+) Failed To Close	DC contactor will not close. Failed coil or contactor	Warning Annunciated indicating which DC contactor will not close
DC Precharge Contactor (-) / (+) Failed To Open	DC contactor will not open. Welded Contacts, Contactor failure	Warning Annunciated indicating which DC contactor will not open
DC Supply Area Ambient Temperature Fault	Measured Temp < -40 C >70 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
DC Supply Area Ambient Temperature Warning	Measured Temp < -20 C >65 C	Warning Annunciated
DC Surge Suppression Fuse Fault	DC Line surge, VR4 shorted, 10F20 blown, fuse indicator open	Warning Annunciated
DESAT (OVER I)	Severe instantaneous overcurrent. Short circuit on the output of the Inverter (FirstTrip == 24)	Disable output, manual reset required. Maintenance required.
DRIVE CONFIG ERR	The configuration defined in DRIVE CONFIG doesn't match the actual Inverter configuration (FirstTrip == 63)	Disable output, manual reset required. Maintenance required.
EARTH FAULT	The sum of the phase currents is not equal to 0. There's a short to earth on the output. There's a short to DC link to the output (FirstTrip == 79)	PLC to autorestart if GF circuit did not detect an issue. Maintenance if a GF is detected.
EPO Pushbutton Actuated	EPO Switch Activated	Inverter Stops
EPO Relay Activated	EPO Switch Open, Access panel or door open, EPO failure	Inverter Stops
EVAPORATOR FAN FAIL		
EXTERNAL AMBIENT	Temperature sensor failure, It is too hot outside	Shut down, Wait until external temp < 55C, then autorestart, Maintenance required if external ambient temp is actually <55C

ALARM	MEANING	ACTION
External Ambient Temperature Fault	Measured Temp < -40 C >70 C	Inverter stops. Autorestart when internal temp < 65C
External Ambient Temperature Warning	Measured Temp < -20 C >65 C	Inverter stops. Autorestart when internal temp < 65C
External Temp Requires Inverter De-Rate	Sensor failure, outside Temperature High	Warning only. Derate output to maintain temperatures.
EXTERNAL TRIP	User trip caused via control terminals, +24V not present on external trip (terminal X15/05), Check setting of EXT TRIP MODE parameter (FirstTrip == 5)	Disable output, manual reset required
Filter Busbar Therminal Temperature Fault 6A1 – 6A15	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Filter Busbar Therminal Temperature Warning 6A1 – 6A15	Measured Temp < -20 C >13 C	Warning Annunciated
Filter U1-U2 Current High Fault	Measured Current at High Fault Level	Inverter Stops
Filter U1-U2 Current High Warning	Measured Current at Warning Level	Warning Annunciated
Filter U1-U2 Current Low Warning	Measured Current at Low Fault Level	Inverter Stops
Filter V1-V2 Current High Fault	Measured Current at High Fault Level	Inverter Stops
Filter V1-V2 Current High Warning	Measured Current at Warning Level	Warning Annunciated
Filter V1-V2 Current Low Warning	Measured Current at Low Fault Level	Inverter Stops
Filter W1-W2 Current High Fault	Measured Current at High Fault Level	Inverter Stops
Filter W1-W2 Current High Warning	Measured Current at Warning Level	Warning Annunciated
Filter W1-W2 Current Low Warning	Measured Current at Low Fault Level	Inverter Stops
FIRMWARE ERROR	The firmware in the Inverter has stopped executing (FirstTrip == 52)	Disable output, manual reset required - Maintenance required.
Heater Failed To Turn Off	Command State and AUX do not agree	Disable output, manual reset required. Maintenance required.
Heater Failed To Turn On	Command State and AUX do not agree	Disable output, manual reset required. Maintenance required.
HEATSINK	Module assembly defect (FirstTrip == 4)	Disable output; wait for IGBT temperature to < 70C. Autorestart. Disable if more than 3 successive events. Maintenance required.
HI FREQ FAULT	Excessive line harmonics, Line fault has occurred.	Disable output, manual reset required, Maintenance required
HIGH AC VOLTS AB, HIGH AC VOLTS BC, HIGH AC VOLTS CA	Transformer fault, Line voltage not regulated well by the utility	Disable output, manual reset required. On Severe High AC volts CB2 opens. Maintenance required.
HMI - PLC Comms Loss: Data Logging Suspended	**Watchdog timed out**	
HMI Thermal Shutdown Override	**Thermal Shutdown override**	Warning Annunciated
HMI Thermal Shutdown Pending	**Thermal shutdown immanent**	Warning Annunciated
HMI WARN	Disabled due to extreme interior ambient temp due to climate or cooling system performance	Keep Running, Annunciate Warning, Can force the HMI on when at the inverter

F-6 List of Fault Codes

ALARM	MEANING	ACTION
HMIWATCHDOG FAULT	Ethernet Failure, HMI Failure, HMI Runtime Busy	Inverter continues to run. Maintenance required
INPUT 1 BREAK	I/O TRIPS::INPUT 1 BREAK has gone True, Check configuration to determine the source of the signal (FirstTrip == 6)	Disable output, manual reset required
INPUT 2 BREAK	I/O TRIPS:: INPUT 2 BREAK has gone True, Check configuration to determine the source of the signal (FirstTrip == 7)	Disable output, manual reset required
INTERNAL AMBIENT	Internal heat exchanger fans are blocked, Excessive ambient temp, Condenser fans not spinning	Wait until internal temperatures are < 65C. Autorestart. Maintenance required if more than 1 event occurs in succession.
Internal Ambient Temperature Fault	Measured Temp < -40 C >70 C	Inverter stops. Autorestart when internal temp < 65C
Internal Ambient Temperature Warning	Measured Temp < -40 C >70 C	Inverter stops. Autorestart when internal temp < 65C
INVERSE TIME	The inverse time current limit is in effect, Too much overload current was commanded, Fixed or autoboost levels are too high (FirstTrip == 9)	Disable output, manual reset required - Maintenance required
Inverter Busbar Therminal Temperature Fault 8A1 – 8A11	Measured Temp < -40 C >150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
Inverter Busbar Therminal Temperature Warning 8A1 – 8A11	Measured Temp < -40 C >135 C	Warning Annunciated
LC Filter Choke L21 – L23 Overtemp Switch	Thermal Switch Indicates Temp > 150C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
LC Filter Choke L31 – L33 Overtemp Switch	Thermal Switch Indicates Temp > 150C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
LC Filter Choke L41 – L43 Overtemp Switch	Thermal Switch Indicates Temp > 150C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
LC Filter Choke U1 – U3 Temperature Fault	Measured Temp < -40 C or > 150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
LC Filter Choke U1 – U3 Temperature Warning	Measured Temp < -20 C or > 135 C	Warning Annunciated
LC Filter Choke V1 – V3 Temperature Fault	Measured Temp < -40 C or > 150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
LC Filter Choke V1 – V3 Temperature Warning	Measured Temp < -20 C or > 135 C	Warning Annunciated
LC Filter Choke W1 – W3 Temperature Fault	Measured Temp < -40 C or > 150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
LC Filter Choke W1 – W3 Temperature Warning	Measured Temp < -20 C or > 135 C	Warning Annunciated

ALARM	MEANING	ACTION
LC Filter Contactor Failed To Close	Command State and AUX do not agree	Disable output, manual reset required. Maintenance required.
LC Filter Contactor Failed To Open	Command State and AUX do not agree	Disable output, manual reset required. Maintenance required.
LOCAL MODE	SCADA trying to command the inverter while the inverter is in local mode.	Warning only. Inverter will only respond to local commands.
LOW AC VOLTS AB, LOW AC VOLTS BC, LOW AC VOLTS CA	Brownout event occurred, Line is not energized, Transformer fault, AC voltage measurement problem, AC breaker not functioning properly	Disable output, manual reset required. Maintenance required
LOW FREQ FAULT	Excessive line harmonics, Line fault has occurred.	Disable output, manual reset required, Maintenance required
MCB Busbar Therminal Temperature Fault 5A1 – 5A6	Measured Temp < -40 C or > 150 C	Inverter stops, run cooling system. Autorestart when internal temp < 65C
MCB Busbar Therminal Temperature Warning 5A1 – 5A6	Measured Temp < -20 C or > 135 C	Warning Annunciated
MOTOR STALLED	The motor has stalled (not rotating), Current limit level is set too low, Stall trip duration is set too low, Fixed or auto boost levels are set too high (FirstTrip == 8)	Automatic Restart (5) - Possible maintenance required
OP STATION	Keypad has been disconnected from the Inverter while it was running in local mode (FirstTrip == 12)	Disable output, manual reset required - Maintenance required
OVERCURRENT	The output current being drawn from the Inverter is too high, Short circuit of the output, Excessive line disturbance (FirstTrip == 3)	Automatic Restart (5) - Possible maintenance required
OVERVOLTAGE	The Inverter internal DC link voltage is too high. The supply voltage is too high. Failure to synchronize properly to the line (FirstTrip == 1)	Automatic Restart (5) - Possible maintenance required
PCM WATCHDOG FAULT	Ethernet failure, PCM Failure, 8903/IM Failure, 890 Firmware Update in progress	Disable output, manual reset required. Maintenance required
PLC - PQM Comms Loss	**Watchdog timed out**	
PLC - SDC Comms Loss	**Watchdog timed out**	
PLC Available Memory < 10kBytes	**PLC MEMORY APPROACHING MAXIMUM**	Warning Annunciated
PQM WATCHDOG FAULT	Ethernet media failure, Power Meter Failure / reboot, Meter reconfiguration in progress.	Inverter continues to run. Maintenance required
PUMP FAULT	There's an issue with the cooling system or cooling system controller. No power to the pump board. Refrigerant temp too high. Pump failure. Thermocouple failure. Wiring fault	Disable output, manual reset required - Maintenance required

F-8 List of Fault Codes

ALARM	MEANING	ACTION
R134a Level Fault	**R134a Level below minimum level**	Inverter continues to run, shutdown immanent due to OVERTEMPERATURE
R134a Level Warning	**R134a Level close to minimum level**	Warning Annunciated
R134CNDINLET TEMP	Measured refrigerant temp at condenser inlet is approaching fault limit. The condenser fans are not spinning fast enough or at all. The pump module is not active. The pump module setpoint is too low. Not enough refrigerant in the system. Temperature sensor failure	Disable output, manual reset required - Maintenance required
R134PMPINLET TEMP	Measured refrigerant temp at pump inlet is approaching fault limit. The condenser fans are not spinning fast enough or at all. The pump module is not active. The pump module setpoint is too low. Not enough refrigerant in the system. Temperature sensor failure	Disable output, manual reset required - Maintenance required
Relative Humidity Heating Active	**Heater active due to high Relative Humidity**	Warning Annunciated
SCADA INACTIVE	Inverter is in remote mode and has lost comms with the plant SCADA system, Loss of power to the plant SCADA	Configurable timeout setting. Enter standalone mode and go back to last retained values (if stored) or to 100% and unity PF if last mode was not retained. Maintenance required
SQL Connection Issue	**Watchdog timed out**	Warning Annunciated
STACK MISMATCH	U, V, and W phase CD modules are not the same build. Wrong CD module was assembled or added to the Inverter (FirstTrip == 80)	Disable output, manual reset required - Maintenance required
STACK TRIP	One of the following has occurred but the Inverter was unable to distinguish which event happened: overcurrent, desat, or overvoltage event. Refer to the overcurrent, desat, and overvoltage causes (FirstTrip == 41)	PLC to autorestart inverter. Maintenance required if more than 1 event occurs in succession.
SYSTEM VOLTS	Control and fan supply volts low on a CD module. The supply is overloaded. A fan is shorted. Low voltage supply wiring fault (FirstTrip == 74)	PLC to autorestart inverter when the 24V supply is regulating properly. Autorestart and warning notification sent to SCADA
TEMP DERATE	Temperature sensor failure, It's too hot outside	Warning only. Derate output to maintain temperatures.
TEMP IMBALANCE	Cooling System Issue (FirstTrip == 84)	Disable output, manual reset required, maintenance required

ALARM	MEANING	ACTION
U PHASE MISSING	One or more CD modules in a parallel stack are not responding to comms. Fault will indicate which module is missing. A CD module comms cable has been disconnected. Fault in the CD module comms wiring. Fault in the low voltage power supply to a CD module (FirstTrip == 83)	Disable output, manual reset required
Un-Buffered 24VDC Supply Fault	**The 24V power has dropped below 17V**	Inverter stops
UNDERVOLTAGE	The Inverter internal DC link voltage is too low. The supply voltage is too low. The supply voltage is missing. Array voltage is missing (FirstTrip == 2)	PLC Logic to determine if sleep mode is required or if there's a mains problem. - Possible maintenance required
UNKNOWN	Refer to Parker EGT (FirstTrip == 31)	PLC to autorestart inverter. - Maintenance required if more than 1 event occurs in succession.
V PHASE MISSING	One or more CD modules in a parallel stack are not responding to comms. Fault will indicate which module is missing. A CD module comms cable has been disconnected. Fault in the CD module comms wiring. Fault in the low voltage power supply to a CD module (FirstTrip == 82)	Disable output, manual reset required
VDC RIPPLE	The DC link ripple voltage is too high. DC bus capacitors are missing. Missing input phase (FirstTrip == 25)	PLC to autorestart inverter if line voltage is ok - Maintenance required if line voltage is out of spec or if more than 1 events occurs in succession.
VRTMainsLoss	LVRT Fault(FirstTrip == 90)	PLC to autorestart inverter if line voltage is ok - Maintenance required if line voltage is out of spec or if more than 1 events occurs in succession.

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