

CPS2400U Upstream System – 19”

Remote Power System

48 V_{dc} Input, ±190 V_{dc} Output Converter/Limiter System



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Introduction

This manual is intended as a guide in assisting equipment understanding, installation, testing, and troubleshooting. For additional assistance contact Customer Service or access additional information on-line.

Reference Documents

Document	TITLE
CC848836981	Galaxy Pulsar Edge Product Manual
850035894	Galaxy Pulsar Edge Quick Start Guide
CC848853457	CPS3200U Technical Support Guide – Also applies to CPS2400U Line Power Product Line Brochure – Specifications and Ordering Guide

Customer Service Contacts

Customer Service, Customer Training, Technical Support, Product Repair and Return, and Warranty Service

Services provided include initiating the spare parts procurement process, ordering documents, product warranty administration, and providing other product and service information.

OmniOn phones are staffed from 7:00 am to 5:00 pm USA Central Time Zone (GMT -6), Monday through Friday, on normal business days. At other times, this number is still available, but for emergencies only.

Calling from	Phone Number
• United States, Canada, Puerto Rico, and the US Virgin Islands	1-877-546-3243 (US)
• All other countries	1-972-244-9288

Or contact your local field support center or your sales representative to discuss your specific needs.

On-Line Power Systems Product Manuals and Software

Product manuals, technical support guides, product line brochures, and software are available on-line. Software includes Easy View and SNMP MIB.

omnionpower.com

¹The USA direct country code for the country where the call is originating

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Product Description

The CPS2400U Upstream System delivers power over telephone lines. The primary application is enabling the delivery of video bandwidth data rates to residences over twisted pairs by allowing placement of powered electronics at an acceptable distance from the residence.

The Converter System distributes battery backed up power from existing -48V battery backed up sites such as Central Offices and Remote Terminals to reliably power electronics near the home. It does this by converting the -48V to a UL60950-21 safety approved + and – 190V current limited and ground fault protected sources.

Components and Features

See Line Power Product Line Brochure for details.

- Converter System
 - Up to 24 converter shelves (576 output circuits)
- Converter Shelf - 19" shelf,
 - Front access, mid-mount
 - 12 Converter Card Slots, 24 output circuits
 - Alarm Card
 - Relays - Major and Minor, Form C
 - Output Connector
 - Redundant A and B -48V feeds
- Converter Cards
 - Two independent dc/dc converters per card
 - $\pm 190 V_{dc}$ output, safety limited to 100VA and Ground Fault protected
 - -48 V_{dc} input – Redundant A and B fed
 - Connectorized and insulator shielded
 - Hot swappable
- Fan Shelf
 - Provides cooling air flow for a stack of up to 3 Converter Shelves
 - Houses the system controller (optional)
 - -48 V_{dc} input – Redundant A and B fed
 - Redundant Cooling (optional with 2 Fan Shelves per stack of Converter Shelves)
- Baffle
 - Directs air flow - front intake, rear exhaust.
 - Shields against material dropping into the Converter Shelves
- System Controller Galaxy Pulsar Edge – QS841E (optional)
 - Web and SNMP over TCPIP
 - Front Panel Display, Control, and Status LEDs

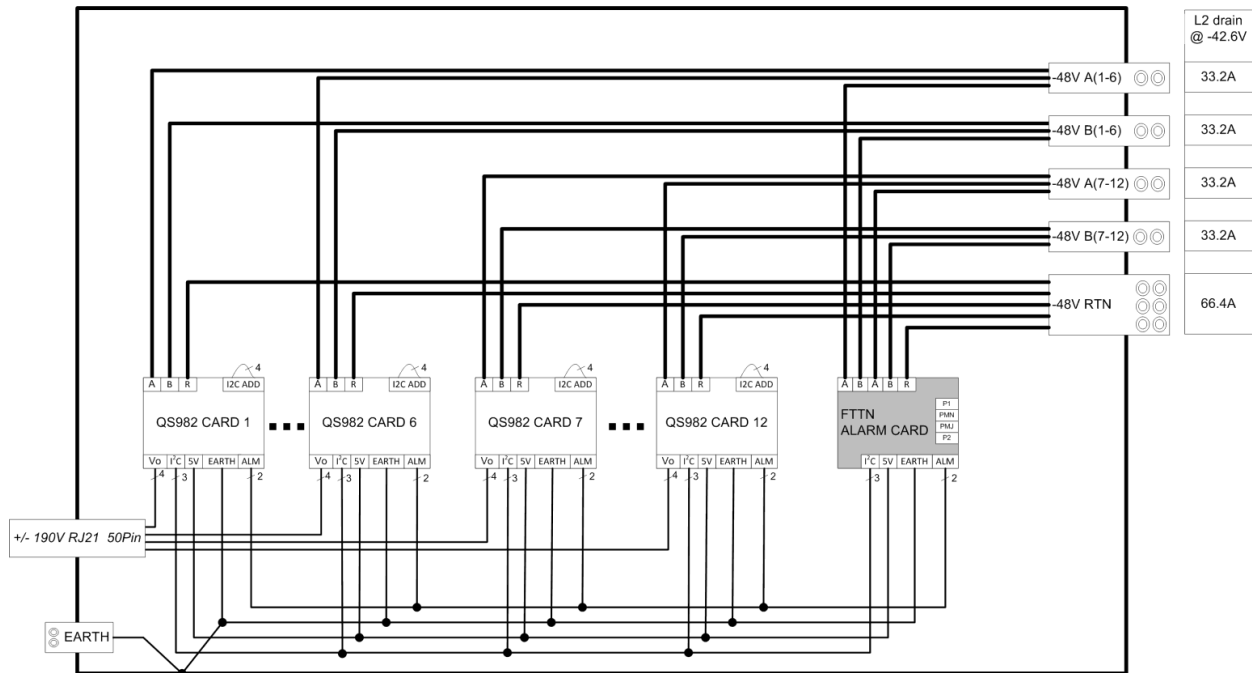


Figure 1 Block Diagram -48V Fed Converter Shelf

Operation

-48V power input is distributed in an A and B redundant fashion to each of the converter cards and the alarm card. There are two +/-190V circuits on each converter card. The circuits both boost the voltage and limit the current as prescribed by UL60950-21 and GR-1089-CORE.

Warning: Ground faults or short circuits on the output do not permanently disconnect the output. The converter circuit tests the line every 4 seconds and will re-energize if the wiring fault is cleared.

A serial communication bus links each converter to an alarm card at the end of each shelf.

The alarm card provides major and minor form C contacts, manages the converters and relays information to an optional system controller using Galaxy Protocol over an RS485 bus. Up to 24 shelves can be controlled and monitored by one system controller. The controller is WEB and SNMP capable.

Configurations

Refer to Line Power System product line brochure for details.

Converter System 1 to 24 Converter Shelves (arranged in Converter Shelf Stacks)
 + 1 Controller (optional)
 Optional Controller is installed in the Primary Fan Shelf.
 Primary Fan Shelf not required in systems without Controller.

Converter Shelf Stack 1 to 3 Converter Shelves
 + 1 or 2 Fan Shelves
 + 1 Baffle

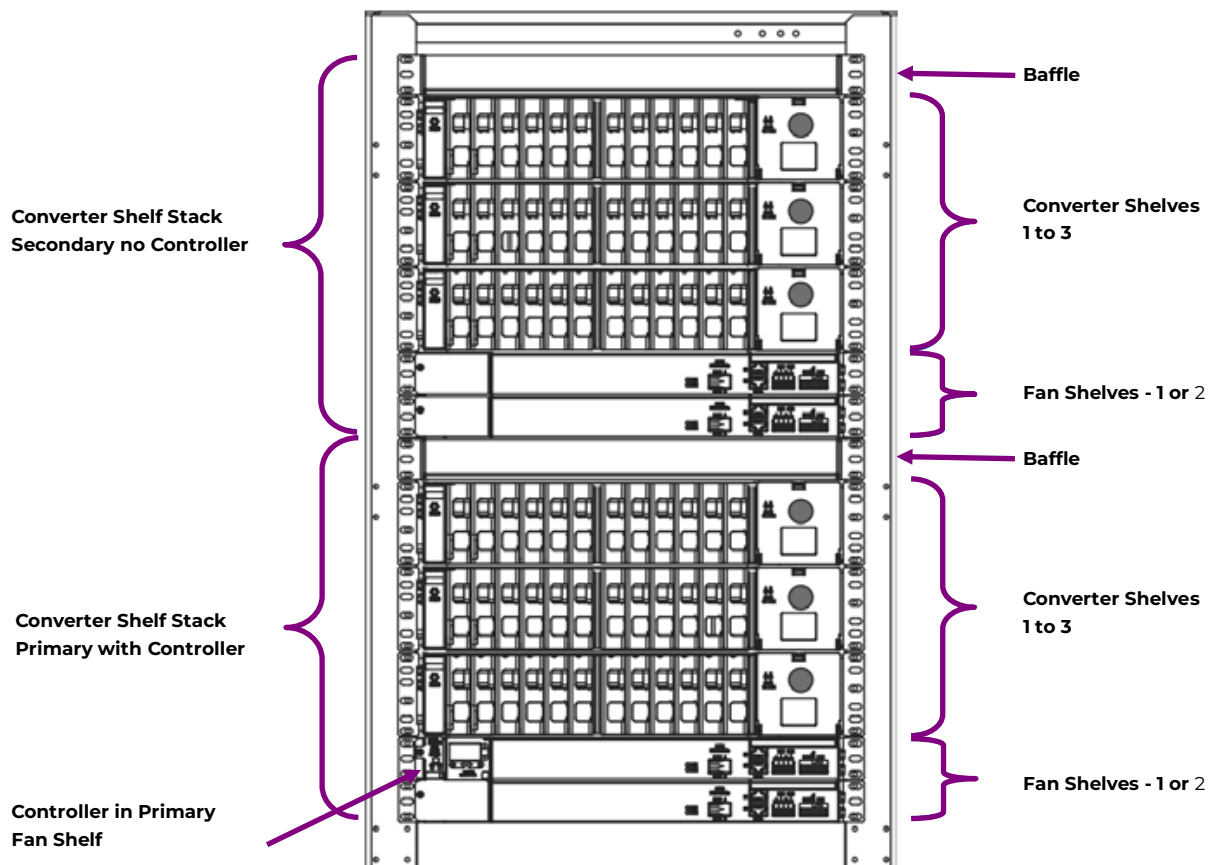


Figure 2 Configuration

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Installation

Prepare for Installation

Safety

Read and follow all safety statements, warnings, and precautions in the **Safety** section and **Specifications** section of this manual and manuals of all other equipment before installing, maintaining or repairing the equipment.

<p>WARNING: Shock Hazard Load outputs are current limited +/-190V.</p>
<p>WARNING: Shock Hazard Outputs re-energize within 4 seconds when ground faults or short circuits are cleared.</p>

Installation Tools

- Complete Standard Insulated tool set
- Wire cutters and strippers
- Heat shrink gun
- Torque wrench (0-240 in-lb / 28 Nm)
- Socket set
- Digital meter, +/- 0.02
- Screw Drivers (flat-blade and Phillips)
- ESD wrist strap

Equipment Identification

Identify the product you have received. Make sure to select procedural steps to match the equipment being installed.

Plan Installation

The system has been designed for mounting in relay racks or in equipment cabinets. It is designed for use with user provided vertical airflow.

- Follow site specific engineering instructions to assure proper airflow for the specific installation.
- Refer to the Vertical Spacing, Airflow, Baffles, and Fan Shelves section for general spacing requirements.

Follow site engineering instructions.

Converter system shelves are installed arranged as one or more Converter Shelf Stacks.

Baffles

- Baffle Required at top of each Converter Shelf Stack in customer premise locations for UL compliance. Baffles not Required in outside plant cabinets, CEVs, or huts.
- Baffles must be oriented to direct air in from the front (aisle) and out to the back of the rack.

Vertical Space Rules:

- Vertical space is permitted below Baffles for future Converter Shelf addition. Baffle may be installed 12.5 inch rack space above a Fan Shelf.
- No vertical space between:
 - Fan Shelves
 - Fan Shelf and Converter Shelf
 - Converter Shelves

Airflow and Fan Shelves

- Upward Airflow – provided by Fan Shelves.
- Fan Shelves provide adequate airflow for specified operating temperatures. Airflow per specification may be provided by other devices.
- A Fan Shelf is required for each Converter Shelf Stack.
- 1 Fan Shelf provides Converter Shelf Stack cooling.
- 2 Fan Shelves provide Converter Shelf Stack cooling with redundancy,
- Primary Fan Shelf
 - Provides Controller support and Controller Display.
 - Required only when the system is equipped with a Controller
 - Maximum 1 per system

Planning Steps

1. Determine arrangement of each Converter Shelf Stack - **Figure 2**.
2. Determine vertical rack space required, including planned space for future expansion.
3. Determine the position of the lowest Fan Shelf.

Unpack Equipment

Make sure the framework has the space and the airflow to provide an acceptable operating environment for the equipment. Then unpack the equipment.

Step	Action
1.	Before opening the packaging, carefully inspect the outside in the presence of shipping personnel for signs of damage.
2.	Carefully open the packaging to verify that the contents are complete and undamaged.
3.	If damaged, follow the shipping carrier's procedure for filing a damage claim.
4.	Save the shipping packaging until all parts are operating within specifications. If the equipment must be returned, it should be repacked in the original shipping packing.

Mount Shelves

Step	Action
	Notes: <ol style="list-style-type: none"> 1. Secure shelves with as many screws as possible. 2. Torque each shelf mounting screws to 35 in-lb 3. Leave no vertical space between shelves 4. Follow site engineering instructions for shelf positioning and order. See Plan Installation Section. <ol style="list-style-type: none"> 5. Baffle –Orient to direct air in from the front (aisle) and out to the back of the rack.
1.	Mount Lowest Fan Shelf in a position allowing space above for all planned shelves.
2.	Mount the remaining shelves and baffles above the lowest shelf, working from bottom to top.

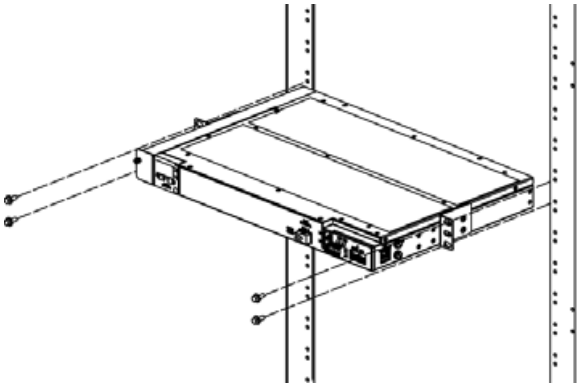


Figure 3 Fan Shelf Mounting

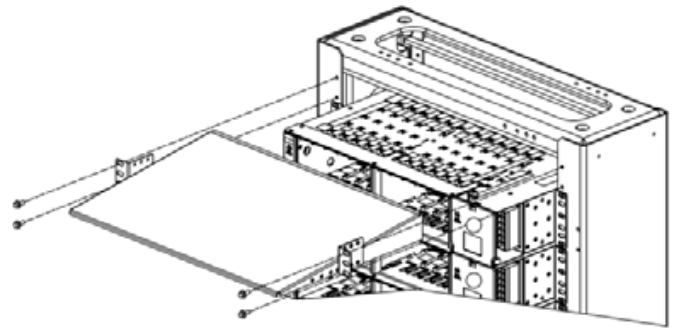


Figure 4 Baffle Mounting

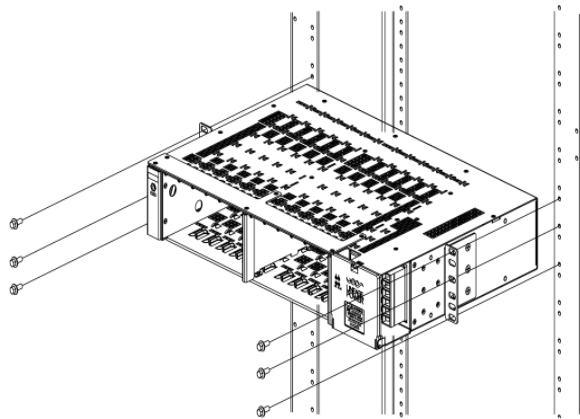
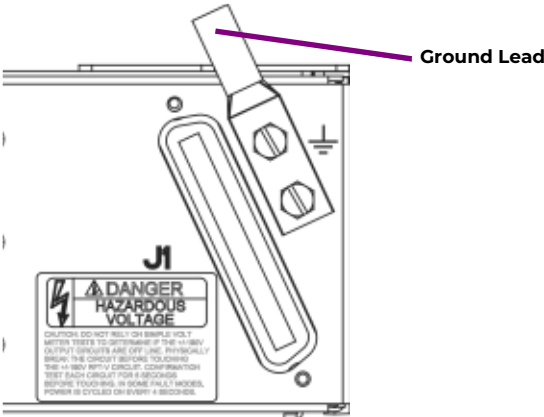


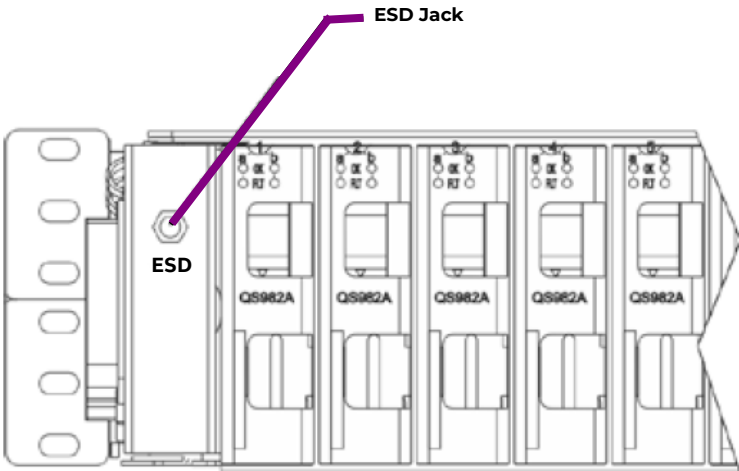
Figure 5 Converter Shelf Mounting

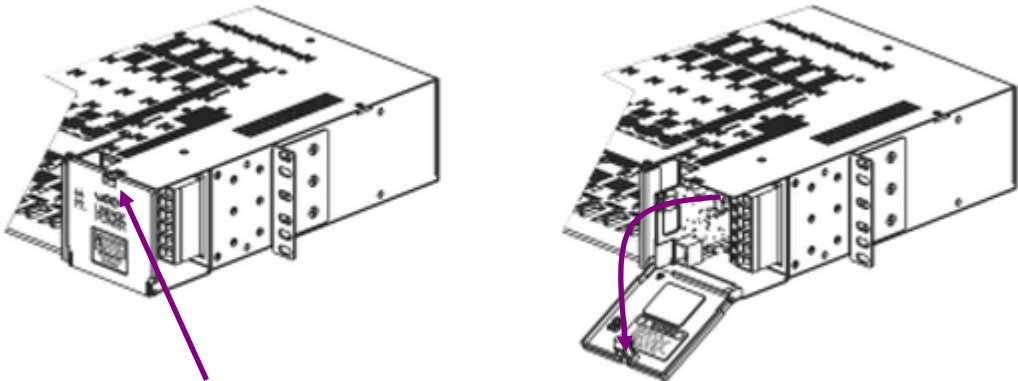
Ground Converter Shelves

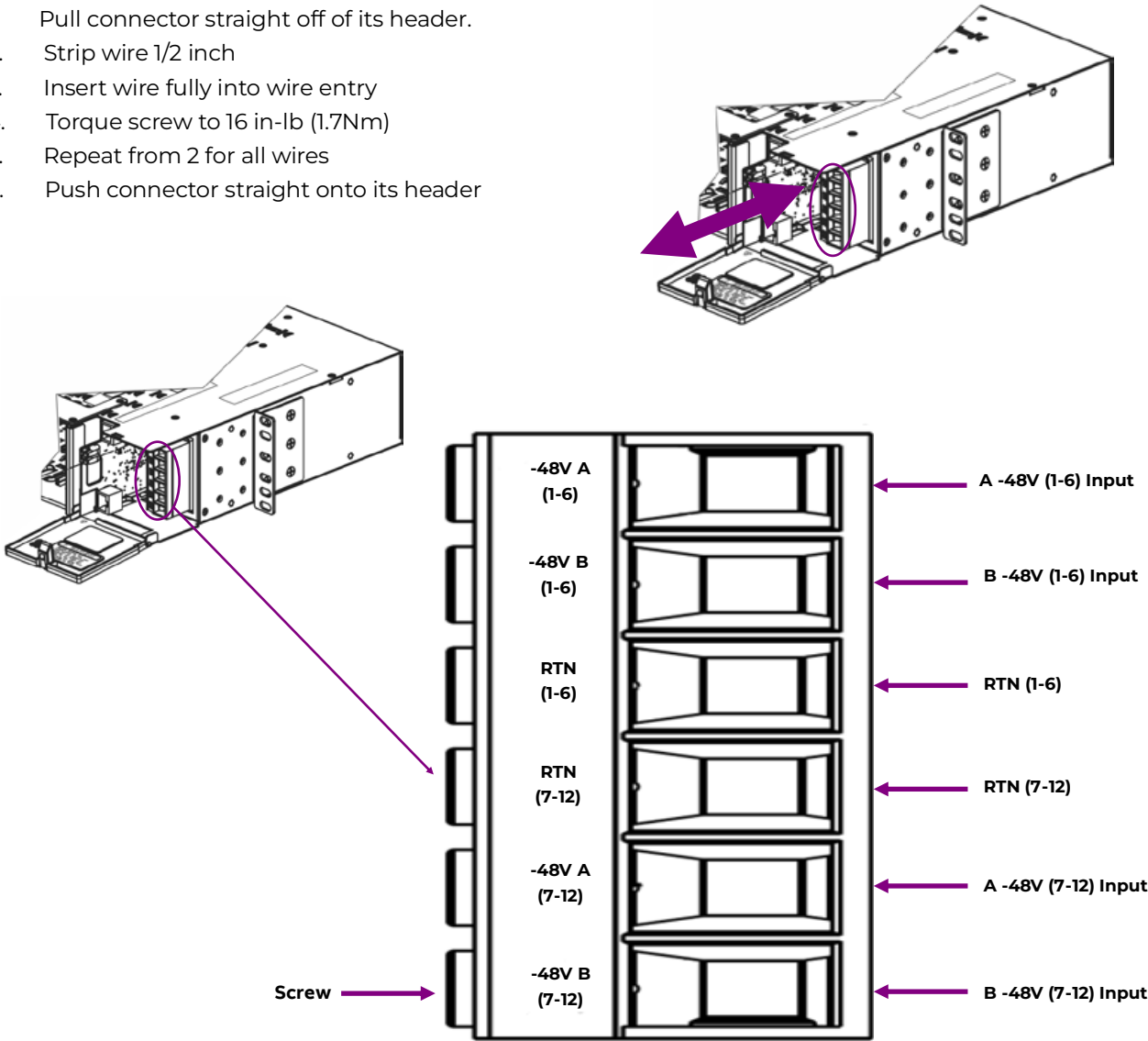
Fan shelves will be grounded when connecting input power.

Step	Action
1.	<p>Run and connect the framework ground lead to safety grounding point (frame ground, or main ground bar) per local practice. 6 AWG minimum</p> <p>Apply NO-OX ID to all bare metal connections if required by local practice. Torque to 35 in-lb (4 Nm).</p>  <p style="text-align: center;">Figure 6 Converter Shelf Ground</p> <p>Lugs landings - 1/4" studs on 5/8" centers. Lugs for 6AWG conductor - T&B 6STR30W , Burndy YAV6C-L2TC14-FX or available equivalent:</p>
2.	Repeat from for remaining Converter Shelves.

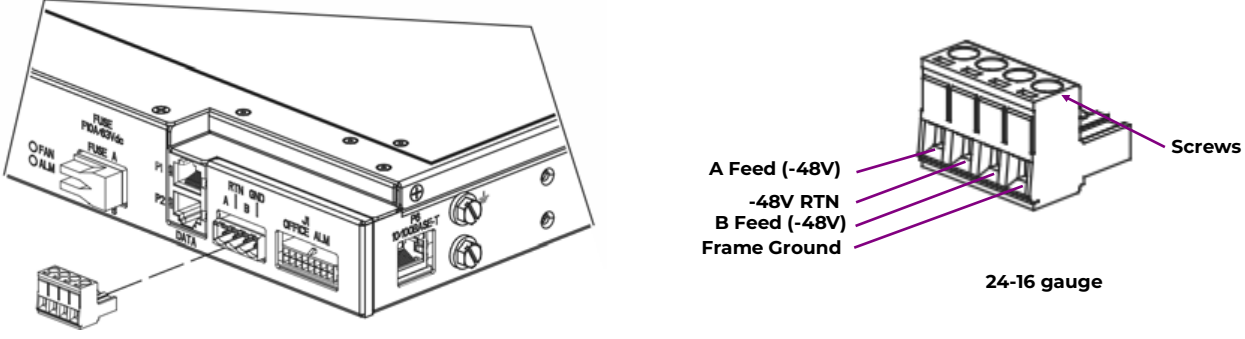
Connect Input Power

Step	Action
Converter Shelves Connect Power	
1.	<p>Connect your personal ESD strap to the ESD jack on the left of a converter shelf before proceeding.</p>  <p style="text-align: center;">Figure 7 ESD Jack</p>
2.	Verify voltage and polarity of each wire before connecting. Use a Volt meter.

Step	Action
3.	Remove power from all DC connections to be installed. Turn off circuit breakers and remove fuses. Verify with a Volt meter.
4.	Turn OFF circuit breakers assigned to this frame and verify with an volt meter
5.	<p>Open the distribution panel door on the right end of the shelf.</p>  <p style="text-align: center;">Figure 8 Converter Shelf DC Connections Access</p>

Step	Action
6	<p>Connect Four -48V_{DC} branch circuits to the DC source</p> <p>Notes:</p> <ol style="list-style-type: none"> Each feed supplies half of the shelf. A&B feeds for side 1 and A&B feeds for side 2. Size each circuit to support 35 Amp List 2 Drains – 18-6AWG 2. Verify minimum loop cable length per Table 9. -48V Returns (RTN) connections must be grounded. <ol style="list-style-type: none"> Pull connector straight off of its header. Strip wire 1/2 inch Insert wire fully into wire entry Torque screw to 16 in-lb (1.7Nm) Repeat from 2 for all wires Push connector straight onto its header  <p style="text-align: center;">Figure 9 Converter Shelf Input Power Connections</p>
7	Close the distribution door.
	Repeat from Step 2 for each Converter Shelves.

² Reference NEC Table 310-16 for applications of not more than three conductors in a raceway and correction factors for Ambient Temperatures over 30°C. Each installation will vary and the installer should review NEC cabling requirements as well as local practice to ensure proper cable sizing is achieved for the local conditions.

Step	Action
8	<p align="center">Fan Shelves Connect Power</p> <p>Connect Input Power and Frame Ground</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. Each feed supplies half of the shelf. A&B feeds for side 1 and A&B feeds for side 2. 2. Power feeds should be derived from a fuse or breaker panel using discrete cabling which is independent from the converter shelf. 3. Fuse externally at 10 Amps. 4. Use ring lugs or alternate per local practice. 5. Returns for the A and B feeds are shared on the -48V_{dc} RTN. 6. The right position on the terminal block is the frame ground for the Fan Shelf. 7. Connect de-energized DC cabling (typically 16 AWG) as shown here. 8. Connect Frame Ground wire. <div style="text-align: center;">  <p>Figure 10 Fan Shelf Input Power Connections</p> </div>
	Repeat from Step 8 for remaining Fan Shelves.

Connect Load Wiring

Provide a circuit from each converter into the designated network telephone pairs.

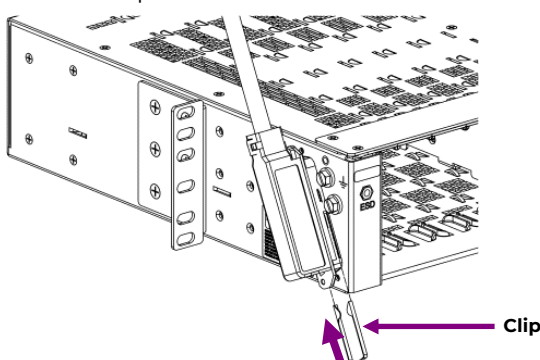
The wiring assignment information in **Table 6** provides the appropriate connections for each circuit. Cables should be provided with this pinout configuration to terminate the J1 output connector on each Converter Shelf.

NOTE: Compliance Requirements

- **Connect only to UL60950-21 RFT-V Circuits.**
- **Do not connect to UL60950-21 RFT-C circuits.**
- **Output voltage (+/-190V) meets UL60950-21 RFT-V requirements.**
- **Use minimum 26AWG 200V rated wire between the converters and primary protectors.**

Wireset Connector: RJ-21 type 50 pin plug:

- 22 AWG solid or stranded AMP 552173-1 or equivalent.
- 24 AWG solid or stranded or 26 AWG solid AMP 229974-1 or equivalent.
- The connector must be arranged with a right angle housing such that the cable exits to the pin 1 side.

Step	Action
1.	Verify rating of all wire between the equipment and the primary protectors: <ul style="list-style-type: none"> • 26 AWG minimum • 200V rated minimum
2.	Verify primary protection consistent with UL 497 is installed on all the telecommunication line cable.
3.	Mark or tag the load cable and load circuit panel. <ol style="list-style-type: none"> 1. Mark the Converter Shelf load cable with the Shelf number. 2. Mark each load circuit at the panel converter number (including the shelf number). <p>Note: The panel may be a cross-connect panel or the 5-pin protector block near the building entrance.</p>
4.	Run the load cable down the frame and attach as shown. <ol style="list-style-type: none"> 1. Seat the cable connector to the shelf connector. 2. Secure the connector with the clip.  <p style="text-align: center;">Figure 11 Converter Shelf Load Connector</p>
5.	Use Screw to secure.
	Repeat for remaining Converter Shelves.

Inspect the Network

Check and Mark Wiring Compliance

The system is classified as an A2 circuit tested according to GR-1089-CORE Issue 3. As such, each location in the network where the output is available to be touched must be protected and marked as an A2 voltage.

Step	Action																
1.	Is accessibility to the circuit throughout the network consistent with A2 requirements? Table 7-1 Accessibility to Continuous Class-A Voltages																
	<table border="1"> <thead> <tr> <th>Voltage Class</th> <th>General Public</th> <th>Employees</th> <th>Crafts persons</th> </tr> </thead> <tbody> <tr> <td>A1</td> <td>Restricted Access</td> <td>Exposed</td> <td>Exposed</td> </tr> <tr> <td>A2</td> <td>Inaccessible</td> <td>Restricted Access</td> <td>Exposed</td> </tr> <tr> <td>A3</td> <td>Inaccessible</td> <td>Inaccessible</td> <td>Restricted Access (Exceptions)</td> </tr> </tbody> </table>	Voltage Class	General Public	Employees	Crafts persons	A1	Restricted Access	Exposed	Exposed	A2	Inaccessible	Restricted Access	Exposed	A3	Inaccessible	Inaccessible	Restricted Access (Exceptions)
	Voltage Class	General Public	Employees	Crafts persons													
	A1	Restricted Access	Exposed	Exposed													
A2	Inaccessible	Restricted Access	Exposed														
A3	Inaccessible	Inaccessible	Restricted Access (Exceptions)														
2.	Is the 5-pin protector marked as a special circuit?																
3.	Does the 5-pin protector protect each pair to a level corresponding to a CommScope 3C*EW Gas tube primary protector? This protector has a voltage breakdown range of 265-465 Volts and an impulse spark over range of <265-700 Volts. Protectors with a lower voltage breakdown rating will be problematic.																

Verify UL Installation Compliance

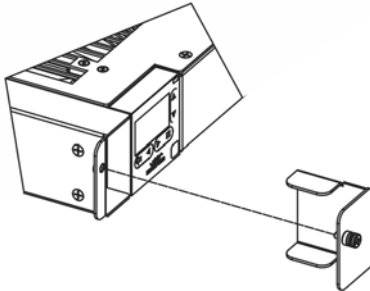
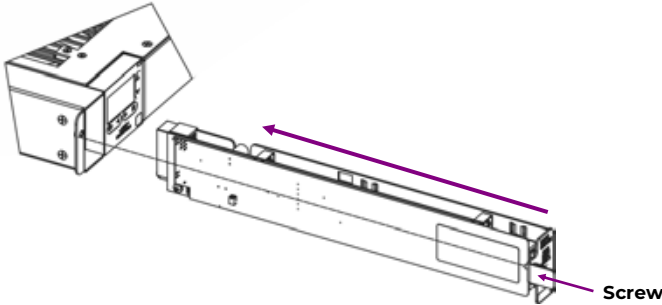
- This verification is required at the time of installation to meet UL60950-21.
- Perform this verification before power is distributed in the network.

Normally the final step is performed by closing the circuit using a 5-pin protector after DC power is applied to the system.

Step	Action
1.	Recognize that the Remote Feed Telecommunication Voltage limited (RFT-V) circuit is voltage limited to +190V and -190V from ground.
2.	Is the total capacitance to ground on each line of the circuit less than 10 μ F? The QS982 introduces 4.4 μ F. The remote electronics and line must introduce less than 5.6 μ F of capacitance. .
3.	Is the total capacitance line to line of the circuit less than 40 μ F? The QS982 introduces 2.2 μ F. The remote electronics and line must introduce less than 37.2 μ F of capacitance from tip to ring.
4.	Is the remote equipment also a RFT-V voltage limited circuit? Both ends of the circuit must be designed to the same standard. This must be verified before the equipment is connected together.
5.	Is the voltage rating of the Network Wiring sufficient to support 190V to ground?
6.	Is the wire between the converters and primary protectors minimum 26AWG 200V rated?
7.	Is the chassis of the system bonded to ground? Verify by both observation and measurement before powering the system. Measurement from the exterior of the Converter Shelf to the cabinet ground bus should indicate continuity as determined vi a meter providing an audible beep or the standard method of continuity verification used in the network. Many network providers use a maximum value of 10 ohms.

Step	Action
8	<p>Test each circuit by powering an open circuit at the remote end of the wire with a QS982 output. If red lights do not flash, there is no leakage path to ground at operating voltage. If the FLT light does not blink yellow, there is no hard short between tip and ring.</p> <p>Note:</p> <ol style="list-style-type: none"> 1. This step is shown here only for completeness. It is to be performed after the Apply DC Power section is completed. 2. Circuit powering is usually accomplished by closing the circuit using a 5-pin protector after DC power applied to the system.

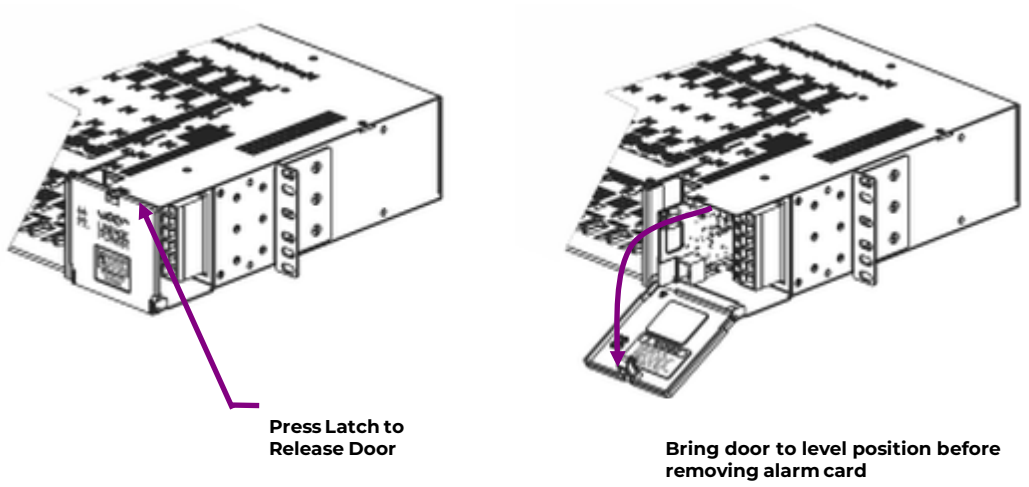
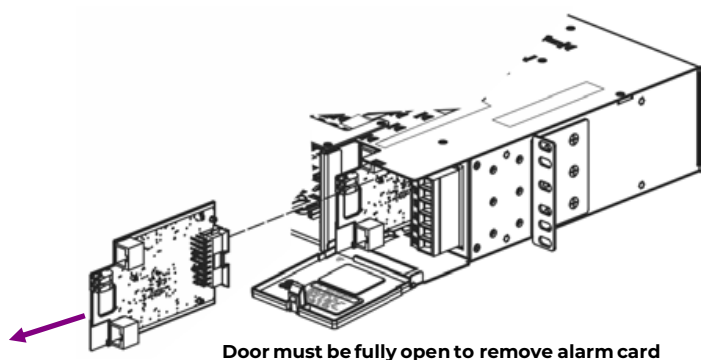
Install Controller

Step	Action
1.	<p>Remove the cover from the left hand end of the Primary Fan Shelf (with the display).</p>  <p style="text-align: center;">Figure 12 Fan Shelf Controller Cover</p>
2.	<p>Insert controller into slot on the left of the Fan Shelf. Secure with captive screw.</p>  <p style="text-align: center;">Figure 13 Controller Installation</p>

Set Shelf ID

Systems Equipped With Controller - Set ID (address) of each shelf to a unique value.

Systems Without Controller –ID (address) not used.

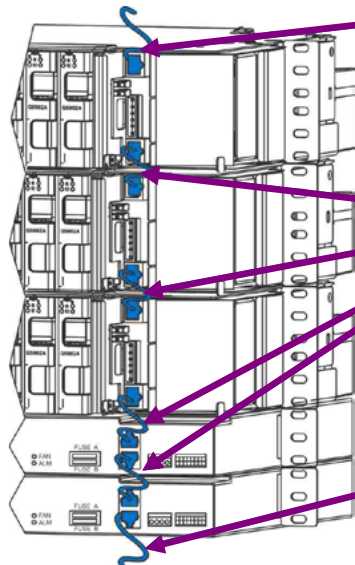
Step	Action
1.	<p>Open the distribution door.</p>  <p style="text-align: center;">Figure 14 Alarm Card Access</p>
2.	<p>Remove the alarm card.</p>  <p style="text-align: center;">Figure 15 Alarm Card Removal</p>

Step	Action
<p>3.</p>	<p>Set the shelf address rotary switch to indicate a shelf ID (0, 0 if not equipped with a controller). Use a small Phillips screw driver.</p> <p>Start with shelf ID1 at the bottom and progress up the frame to higher numbers. Settings for shelf 1 and shelf 6 shown in Figure 16.</p> <p>Note: "Cards per Shelf" is factory set to the unit digit of the number of card slots per shelf, set to 2 for 12 cards per shelf.</p> <div data-bbox="479 525 1274 1270" style="text-align: center;"> </div>
<p>4.</p>	<p>Insert alarm card and close door.</p>
	<p>Repeat for each remaining Alarm Card.</p>

Figure 16 Shelf ID Setting

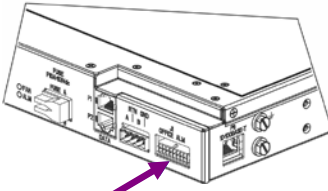
Install Inter-Shelf Signal Cables

Each Converter Shelf Alarm Card communicates with the Fan Shelf and Controller via daisy chained cables.

Step	Action
1.	<p>Install Inter-Shelf cables between all shelves in the system.</p> <p>Note: Install RJ-45 cables as shown. Top (P1) and Bottom (P2) connectors have different signals.</p> <p>Cable from the top RJ45³_connector of each shelf to the bottom RJ45³_connector of the shelf above.</p>  <p>Inter-Shelf Cable to Bottom Fan Shelf of Converter Shelf Stack above, if present</p> <p>Inter-Shelf Cables Install only as shown.</p> <p>Top (P1) and bottom (P2) shelf connectors have different signals.</p> <p>Inter-Shelf Cable to Top Converter Shelf of Converter Shelf Stack below, if present</p> <p>Converter Shelf doors not shown.</p> <p style="text-align: center;">Figure 17 Inter-Shelf Cables</p>

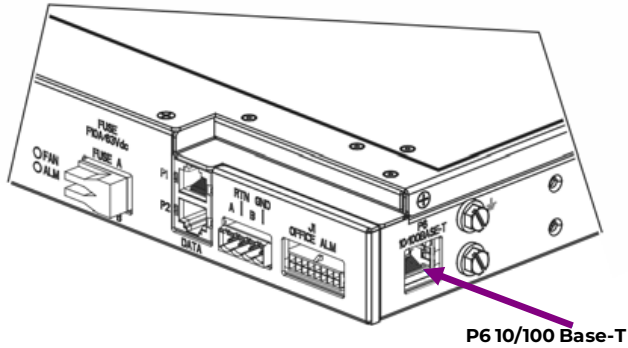
Connect Office Alarms

See Appendix C: Operation without a Controller - Alarm Wiring for systems without a controller.

Step	Action
1.	<p>Install Controller Office Alarm Cable⁴</p> <ol style="list-style-type: none"> Connect office alarm cable to J1 Office Alarm Connector on the Primary Fan Shelf (Fan Shelf with Controller). Dress cable out to alarm block and terminate alarms per site engineering instructions - Table 5.  <p style="text-align: center;">J1 Office Alarm Connector</p> <p style="text-align: center;">Figure 18 Controller Office Alarm Connector</p>

See footnote on page 26

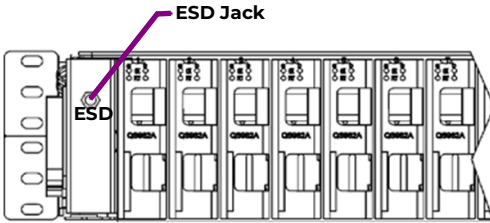
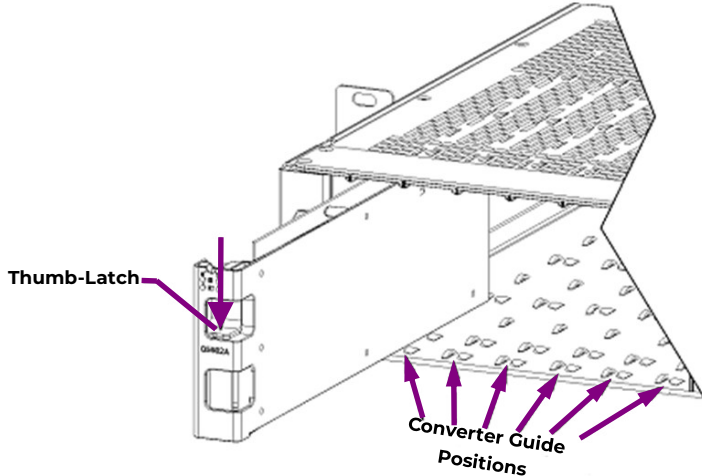
Connect Local Network

Step	Action
1.	<p>Connect local network wiring to Fan Shelf connector P6 (RJ-45).</p>  <p style="text-align: center;">Figure 19 Controller Network Wiring Connection</p>
2.	<p>Check the network connection IP address assigned to the controller.</p> <ol style="list-style-type: none"> 1. Press the square key, ■, on the upper right hand corner of the keypad to display the menu. 2. Press the down arrow key, ▾, 2 times to scroll down to the “Status” item on the menu. 3. Press the right arrow, ▸, to advance to the “Status” menu. 4. Press the down arrow key, ▾, repeatedly to scroll down to the “Network Settings” item and select by pressing the right arrow key. 5. Press the right arrow, ▸, to advance to the “Network Settings” menu. 6. Press the right arrow, ▸, to select Port 1. The P6 connector is Port 1. 7. Read and record the network address for Port 1. <p>When an IP address is listed connection to the server is confirmed.</p>

³ RJ45 connectors of Converter Shelves are located on their Alarm Cards.

⁴ Office Alarm Cable is separately ordered. For available cables see Line Power Product Line Brochure.

Install Converters

Step	Action
1.	<p>Connect your personal ESD strap to the ESD jack on the left of a converter shelf before removing the Converters from their anti-static wrap:</p>  <p style="text-align: center;">Figure 20 ESD Jack</p>
2.	Remove the Converter from its shipping container.
3.	<p>Install the Converter into the Shelf.</p> <ol style="list-style-type: none"> Align the plastic converter housing on the right with the card guides at the top and bottom of the slot. Slide the converter into the slot. Push firmly seat the converter until the converter latch engages.  <p style="text-align: center;">Figure 21 Converter Installation</p>
4.	Repeat from Step 2 for remaining Converters.
5.	Install empty slot fillers into all unused slots of multi-shelf Converter Shelf Stacks.

Apply DC Power

Fault LEDs will flash red until communications is established between the system components. – see **Verify Normal States** for details.

Step	Action
1.	Apply DC power by turning on circuit breakers and inserting fuses feeding both Fan Shelves and the Converter Shelves.

Verify Normal States

The Controller display and LEDs on Converters, shelf Alarm Cards, and Fan Shelves will illuminate when power is applied to the system.

Step	Action
1.	<p>System Self Check</p> <p>Check for normal operation</p> <ol style="list-style-type: none"> Green Controller Display backlight Green LEDs on each Alarm Card, each Converter, and each Fan Shelf Every LED labeled “A”, “B”, “OK”, “FAN”, “a”, and “b” No Red LEDs or displays. <p style="text-align: center;">Figure 22 Normal LEDs</p>
2.	Follow the Troubleshooting section to resolve any alarm states

Verify UL Installation Compliance

Complete the final step to verify UL installation compliance.

Step	Action
1.	<p>Test each circuit by powering an open circuit at the remote end of the wire with a QS982 output. If red lights do not flash, there is no leakage path to ground at operating voltage. If the FLT light does not blink yellow, there is no hard short between tip and ring.</p> <p>Note: Circuit powering is usually accomplished by closing the circuit using a 5-pin protector with DC power applied to the system.</p>

Configure Controller

Refer to Galaxy Pulsar Edge Quick Start Guide.

Verify and edit controller parameters per site engineering instructions.

Basic Configuration:

Installation Tab:

Site ID, Site Description, System Date, System Time, and Shelf J-Code or Product Code

Network page (Settings tab, Communications group):

DHCP Client / Fixed IP Address

FTTN page (Settings tab, System group):


Alarm parameters

Complete Configuration:

Verify and edit any additional controller parameters per site engineering instructions.

Confirm Operation of Alarm Wiring

After the converters are recognized to be in a normal state, one should confirm the proper operation of the alarm contact closures. If alarm wiring is correct:

1. The loss of A or B input power should result in the assertion of a Power Minor.
2. The loss of both A and B input power, which will result in a loss of service, should result in a Power Major and a Power Minor.
3. If a controller is installed in the system then it will indicate an alarm state by red display backlight. Using the buttons on the keypad specific alarms can be retrieved by pressing the Back Arrow,  When the system returns to normal function the display will be green.

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Troubleshooting

Only Remote Power System specific alarms are included in this section. See Galaxy Pulsar Edge Product Manual for details of other controller alarms.

Many alarms are best processed at the converter shelf alarm card and converter card level.

LAN port or Craft port access provides additional information – see Galaxy Pulsar Edge Product Manual for details

System

Controller			Alarm Card		Converter Card		Possible Problem	Possible Solution
Alarm Display	Back light	Relay State	Alarm LED State	Relay State	OK LED State	Alarm LED State		
Normal	Green				Green		none	
Various	Yellow or Red		Green		Green		Latched Controller Alarm for Removed Equipment	Execute Controller commands "Clear Events" and "Uninstall Equipment". Controller – Control/Operations Web Pages – Maintenance tab.
Circuit Fail	Yellow	Min	Yellow	Min	Green	Flashing Yellow	Short + to -	Make sure each converter has an independent isolated send and return path.
Circuit Fail	Yellow	Min	Yellow	Min	Flashing Red	Flashing Red	Short to Ground	Make sure each converter has an independent isolated send and return path.
Communication Fail	Yellow	Min	Yellow	Min	Green	Off	1 Card Removed	Check to see that all cards are seated. Replace non-functioning cards.
Communication Fail	Red	Maj					2 Cards Removed	Check to see that all cards are seated. Replace non-functioning cards.
Communication Fail	Red	Maj	Flashing Red		Green	Off	Communication Cable Removed	Check communication path from alarm cards to Controller. If controller is not present, set alarm card rotary switch to Shelf ID 0,0 for contact closures only communication.
Communication Fail	Red	Maj			Green	Flashing Red	Alarm Card Removed	Replace Alarm card.
None	Green		Green			Yellow	Standby	Remove unit from standby if desired using Controller or web page interface
Circuit Fail	Yellow	Min	Yellow	Min	Green	Flashing Yellow	Open Fuse	Replace Converter. Note: Replacing a Converter storing will interrupt service to the other line served by the Converter.

Table 1 System Troubleshooting

Controller			Alarm Card		Converter Card		Possible Problem	Possible Solution
Alarm Display	Back light	Relay State	Alarm LED State	Relay State	OK LED State	Alarm LED State		
Circuit Fail	Yellow	Min	Yellow	Min		Flashing Yellow	Under Voltage	Replace Converter. Note: Replacing a Converter storing will interrupt service to the other line served by the Converter.
Fan Fail	Yellow	Min	Yellow	Min	Green	Off	1 Fan Tray Failed	Replace fan shelf or tray.
Fan Fail	Yellow	Min	Yellow	Min	Green	Off	1 of 6 fans Failed on one Fan Shelf or Tray	Replace fan shelf or tray.
Fan Fail	Red	Maj	Red	Maj	Green	Off	2 Fan Shelves or Trays Failed	Replace fan shelves or trays.
Input Power	Yellow	Min	A Red	Min	Green	Off	A1-6 Power Fail	Restore DC input power to the A1-6 input terminal.
Input Power	Yellow	Min	B Red	Min	Green	Off	B1-6 Power Fail	Restore DC input power flowing to the B1-6 input terminal
Input Power	Yellow	Min	A Red	Min	Green	Off	A7-12 Power Fail	Restore DC power to the A7-12 input terminal
Input Power	Yellow	Min	B Red	Min	Green	Off	B7-12 Power Fail	Restore DC power to the B7-12 input terminal.
Input Power Mul Circuit Fail	Red	Maj	A Red B Red	Maj	Green	Off	A1-6 & B1-6 Power Fail	Restore DC power to the A1-6 input terminal and Restore DC power to the B1-6 input terminal
Input Power Mul Circuit Fail	Red	Maj	A Red B Red	Maj	Green	Off	A7-12 & B7-12 Power Fail	Restore DC power to the A7-12 input terminal. Restore DC power to the B7-12 input terminal.
Load Drop	Yellow	Min	A, B & OK Green		Green	Off	Load Drop	Check the integrity of the circuits going to the load.Or Adjust load drop threshold to 0 to disable this feature.
Load Share	Yellow	Min	A, B & OK Green		Green	Off	As set of circuits assigned to one remote destination are not sharing current as would be expected.	Check the integrity of the circuits going to the load. Or Adjust load share threshold to disable this feature.
Line Test			A, B & OK Green		Green	Off	OK, Fail or Aborted	Estimated line resistance has increased since last measurement.
Loss Of Redundancy	Yellow	Min	A, B & OK Green		Green	Off		The loss of n additional circuits will causecustomers to lose service. Check redundancy threshold in the configuration.

Table 1 System Troubleshooting

Alarm Card

The Alarm Card aggregates alarms from shelf Converter Cards, shelf -48V dc input feeds, and Fan Shelves connected to its P2 connector. Alarm Card LEDs and Relays present the aggregated Alarm Card State - Table 3.

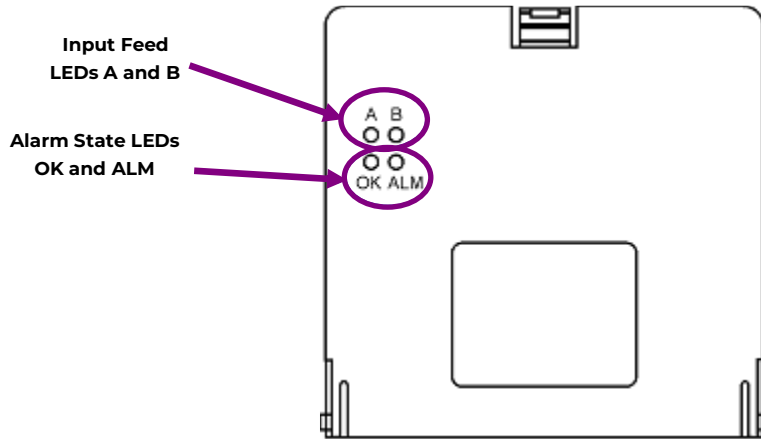


Figure 23 Alarm Card LEDs

Alarm Card LEDs and Relays

- **A** and **B** LEDs indicate the alarm state of each of the -48V Input Feeds to the shelf (see **Table 2**).
- **OK** and **ALM** LEDs and **Relays** indicate the combined alarm state of the shelf, including Converter Cards and -48V input voltage feeds.

-48 V Input Feeds ⁵				A / B LEDs (Alarm Card)		-48V Input Feed Alarm State
A ₁₋₆	B ₁₋₆	A ₇₋₁₂	B ₇₋₁₂	A	B	
				Green	Green	OK
Low				Red	Green	Minor
	Low			Green	Red	Minor
		Low		Red	Green	Minor
			Low	Green	Red	Minor
Low	Low			Red	Red	Major
Low		Low		Red	Green	Major
Low			Low	Red	Red	Major
	Low	Low		Red	Red	Major
	Low		Low	Green	Red	Major
		Low	Low	Red	Red	Major
Low	Low	Low		Red	Red	Major
Low	Low		Low	Red	Red	Major
Low		Low	Low	Red	Red	Major
	Low	Low	Low	Red	Red	Major
Low	Low	Low	Low			Unpowered

Table 2 -48V Input Feed Alarm State and LEDs

⁵ Empty cells indicate: OK for inputs, OFF for LEDs, and non-alarm for relays.

Converter State	Alarm States		LEDs ⁶		Relays ^{7, 6}	
	-48 V Feed State	Fan Shelf State	OK LED	ALM LED	PMN	PMJ
OK	OK	OK	Green			
Minor	OK or Minor	OK or Minor		Amber	PMN	
OK or Minor	Minor	OK or Minor		Amber	PMN	
OK or Minor	OK or Minor	Minor		Amber	PMN	
Major	any	any		Red		PMJ
any	Major	any		Red		PMJ
any	any	Major		Red		PMJ
any	Unpowered ⁸	any			PMN	PMJ

Table 3 Alarm Card State LEDs and Relays

Alarm Card Alarm States

Alarm states are ranked from low severity to high severity.

Alarm State	Severity
Major or PMJ.....	Highest
Minor or PMN.....	Medium
None or OK.....	Lowest (no alarm)

Alarm states are aggregated and combined into successively larger representations:

Converter circuit states are aggregated into a Converter Card state.

Converter Card states and -48V Input Feed states are aggregated and combined into a Converter Shelf state.

Converter Shelf states and Fan Shelf states are aggregated and combined into a Converter system state.

- **System Alarm State** - the highest alarm state within the system, including Converter Shelves and Fan Shelves.
- **Shelf Alarm State** - the highest alarm state within the shelf, including Converter Cards and -48V Input Feeds, Fan Shelf state (if wired), and Alarm Card I²C to RS-485 communication processor.

OK	No alarms are active – all OK
PMN	Minor alarms only are active
PMJ	Major – at least one major alarm is active

- **Fan Shelf Alarm State** – the alarm state of the connected Fan Shelves. Each Fan Shelf has a single alarm that is active when one or more fans have failed or when Fan Shelf DC voltage is low.

OK	No Fan Shelves have alarms are active – all OK
Minor	One Fan Shelf has alarm active
Major	Two Fans Shelves have alarms active

- **Converter Card Alarm State** - the highest alarm state of all Converter Cards within the shelf

OK	No Converter alarms are active – all OK
Minor	at least one Minor Converter alarms only is active
Major	at least one Major Converter alarm is active

- **-48V Input Feed Alarm State** – the alarm state of the four -48V shelf feeds: - Table 2.

OK	None
Minor	One input feed Low
Major	Multiple input feeds Low

See footnote on page 36

Converted LEDs

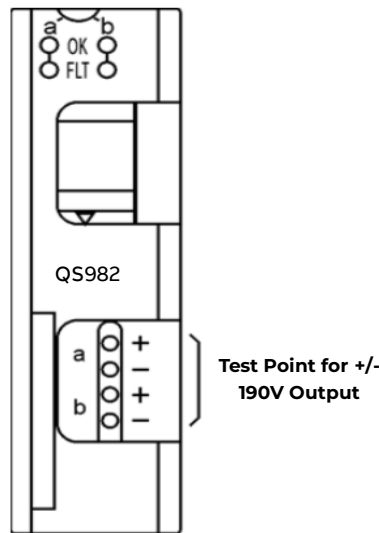


Figure 24 Converter LEDs and Test Points

Note: Test points work best if each voltage is measured with respect to ground.

Action Required	OK LED	Fault LED	Conditions	Notes
None	Green	Off	All OK	
Verify circuit configuration	Off	Yellow	Standby	Standby can be set using the Controller display or remotely using a web browser.
Check seating on Alarm card and converter card	Green	Blink Red On ½ second, Off ¼ second	Loss of comm.	
Check 5 pin protectors and faults to ground	Red Blink	Red Blink	Ground fault	
Check output lines for shorts to each other	Green	Yellow Blink	Overcurrent or undervoltage	
Replace unit	Red Blink	Off	OV or internal failure	
Solve Thermal problem	Off	Red Blink	Thermal Alarm	Latch off after 3 retry cycles
Check source voltage	Off	Off	card not powered or input fuse failure	
Observe Lamp Test	Bi-Color: 4.5 seconds on, 4.5 seconds on and 1 second off	Bi-Color: 4.5 seconds on, 4.5 seconds on and 1 second off	Lamps test requested from controller	

Display Examples

LED Display ⁹	Conditions	Action Required
	All OK	None
	Circuit Placed in Standby	None depending on desired state of the circuit Standby state can be set using the controller or web browser.

See footnote on page 36

Action Required	OK LED	Fault LED	Conditions	Notes
<p>Green Red Blinking</p>			Loss of communication with controller	Check seating on Alarm card and converter card
<p>Red Blinking Red Blinking</p>			Ground fault	Check 5 pin protectors and faults to ground
<p>Green Yellow Blinking</p>			Overcurrent or Under voltage	Check output lines for shorts to each other
<p>Red Blinking Off</p>			Overvoltage or Internal failure	Replace Converter Card
<p>Off Red Blinking</p>			Thermal Alarm Latch alarm after 3 retry cycles.	Solve thermal problem
<p>Off Off</p>			Card not powered or input fuse failure	Check source voltage
<p>Red/Green Alternating Red/Yellow Alternating</p>			Lamp test requested from controller	Observe Lamp Test

Table 4 Converter LEDs

⁶ Empty cells indicate: OK for inputs, OFF for LEDs, and non-alarm for relays.

⁷ Alarm relays are energized (powered) in the non-alarm state.

⁸ The Alarm card is redundantly powered by all four -48V input feeds.

⁹ Examples in the table are shown for conditions on the B circuit of the QS982A card. The same Conditions and Actions apply for the A circuit when A circuit LEDs are illuminated.

Locating Failed Fans

This information is for reference only. Fan replacement is by Fan Shelf replacement.

The fail LED on the Fan Shelf indicates the position of the failed fan by the number of LED flashes.

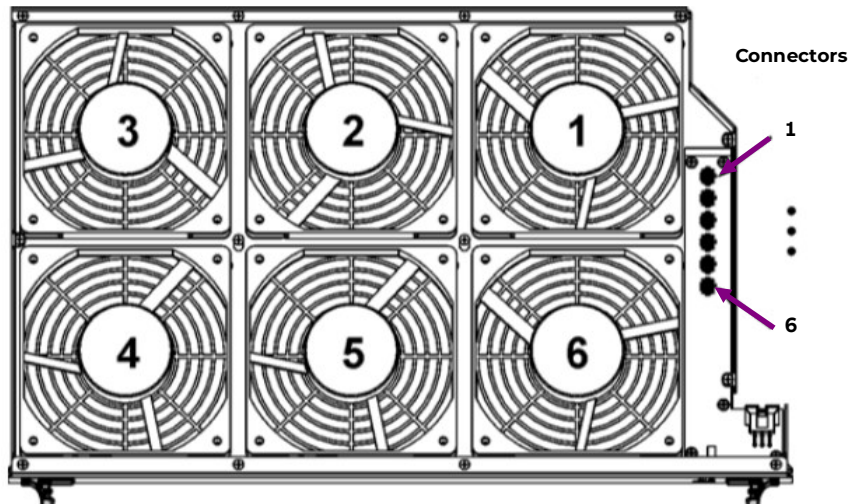


Figure 25 Fan Locations

Reference Information

This section contains additional information (connector pin designations, etc.) that may be required for making, customizing, or troubleshooting system connections.

Connections

Controller Office Alarm Connections

See **Appendix C: Operation without a Controller - Alarm Wiring** for systems without a controller.

Controller Office Alarm Connector is located on the front of the Primary Fan Shelf - **Figure 28**.

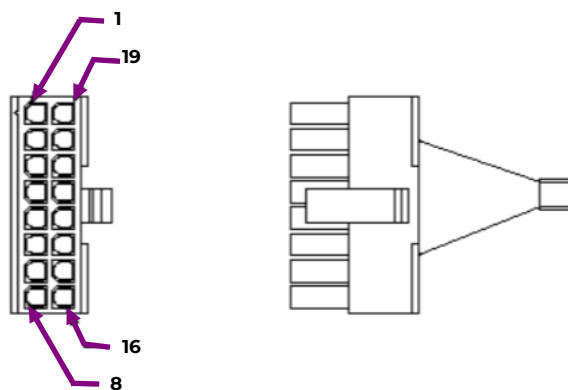


Figure 26 Office Alarm Connections with Controller

Pin	Color	Signal	Factory Default	Software Default
1	BLK	Input Alarm 5 (Closure to pin 3)		
2	W	Input Alarm 3 (Closure to pin 3)		
3	R/BLK	System -48V for Input Alarms ABS		
4	OR	Alarm Relay 5 Return		PMJ Return
5	OR/BLK	Alarm Relay 6 Return		PMN Return
6	R/WHT	Alarm Relay 1 Return		
7	WHT/BLK	Alarm Relay 2 Return		
8	BL/R	Alarm Relay 3 & 4 Return		
9	R	Input Alarm 8 (Closure to pin 3)		
10	GR	Input Alarm 4 (Closure to pin 3)		
11	BL	Alarm Relay 4	Open on Alarm	
12	GR/BK	Alarm Relay 5	Open on Alarm	PMJ
13	BL/BK	Alarm Relay 6	Open on Alarm	PMN
14	GR/WHT	Alarm Relay 1	Open on Alarm	
15	WHT/R	Alarm Relay 2	Open on Alarm	
16	OR/R	Alarm Relay 3	Open on Alarm	

Table 5 Controller Office Alarm Cable

Converter Outputs

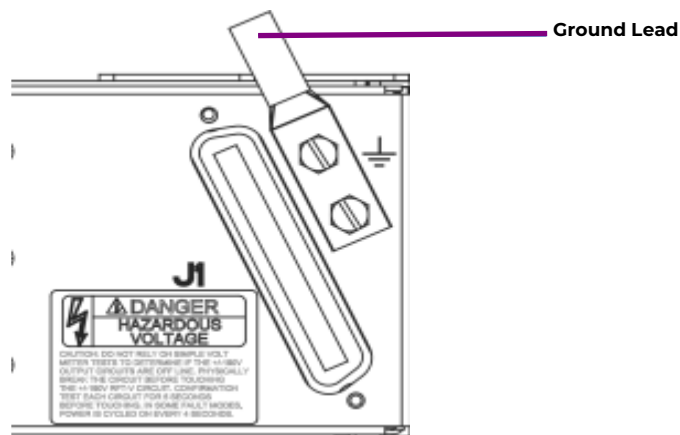


Figure 27 Converter Shelf Output Connector

Wireset Connector: RJ-21 type 50 pin plug:

- 22 AWG solid or stranded AMP 552173-1 or equivalent.
- 24 AWG solid or stranded or 26 AWG solid AMP 229974-1 or equivalent.
- The connector shall be arranged with a right angle housing such that the cable exits to the pin 1 side.

Converter Out	Pin	Color	Converter Out	Pin	Color
1a-	1	BL/W	1a+	26	W/BL
1b-	2	O/W	1b+	27	W/O
2a-	3	G/W	2a+	28	W/G
2b-	4	BR/W	2b+	29	W/BR
3a-	5	SL/W	3a+	30	W/SL
3b-	6	BL/R	3b+	31	R/BL
4a-	7	O/R	4a+	32	R/O
4b-	8	G/R	4b+	33	R/G
5a-	9	BR/R	5a+	34	R/BR
5b-	10	SL/R	5b+	35	R/SL
6a-	11	BL/BK	6a+	36	BK/BL
6b-	12	O/BK	6b+	37	BK/O
7a-	13	G/BK	7a+	38	BK/G
7b-	14	BR/BK	7b+	39	BK/BR
8a-	15	SL/BK	8a+	40	BK/SL
8b-	16	BL/Y	8b+	41	Y/BL
9a-	17	O/Y	9a+	42	Y/O
9b-	18	G/Y	9b+	43	Y/G
10a-	19	BR/Y	10a+	44	Y/BR
10b-	20	SL/Y	10b+	45	Y/SL
11a-	21	BL/V	11a+	46	V/BL
11b-	22	O/V	11b+	47	V/O
12a-	23	G/V	12a+	48	V/G
12b-	24	BR/V	12b+	49	V/BR
*FR GRD	25	SL/V	*FR GRD	50	V/SL

Table 6 Converter Shelf Output Connector Pinout

*EMI performance is enhanced when the output cable shield is grounded only at the CPS2400 end of the shield.

⁶ Empty cells indicate: OK for inputs, OFF for LEDs, and non-alarm for relays.

⁷ Alarm relays are energized (powered) in the non-alarm state.

⁸ The Alarm card is redundantly powered by all four -48V input feeds.

⁹ Examples in the table are shown for conditions on the B circuit of the QS982A card. The same Conditions and Actions apply for the A circuit when A circuit LEDs are illuminated.

Fan Shelf

See the Controller Office Alarm Connections section for Office Alarm detail.

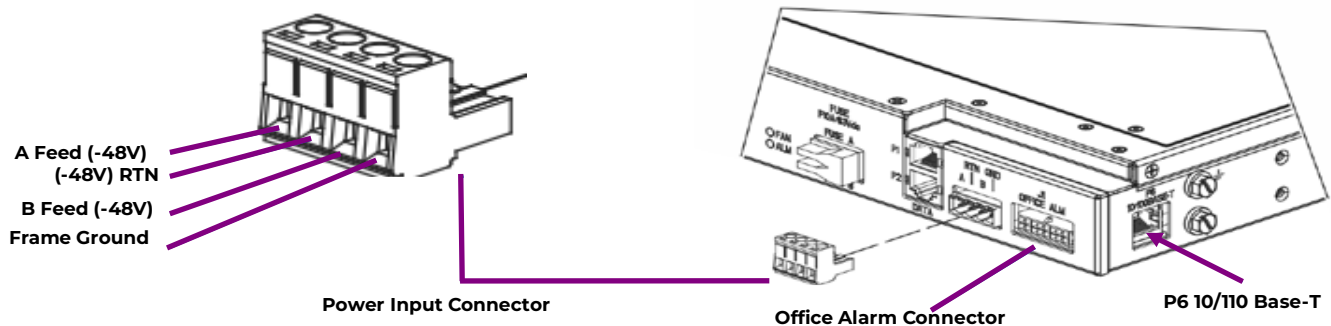


Figure 28 Fan Shelf Connections

Note: Returns for A and B feeds are shared on the -48V RTN terminal.

Vertical Spacing, Airflow, Baffles, and Fan Shelves

Overview

The Converter System has been designed for mounting in relay racks or in equipment cabinets.

- It is designed for use with user provided vertical airflow cooling of at least 175 linear feet per minute over the entire flow cross-section of the shelf.
- Equipment may be placed on top of the CPS2400U provided airflow is not impeded or sufficient spacing is provided.

Outdoor Cabinet Application

The Converter System is rated to work to 65°C in stacks of two shelves in outdoor cabinets without baffles.

Note: where the air entering the second shelf may be heated above 65C inlet temperature, additional airflow beyond the minimum 175 linear feet per minute is required. These cases require an engineered solution.

Central Office Application

Converter Shelf Stacks (Figure 2) are rated to operate in 55°C environments.

- Up to 2 Converter Shelf Stacks may be mounted in a single frame.
- No vertical space between:
 - Fan Shelves
 - Fan Shelf and Converter Shelf
 - Converter Shelves
- A 3 inch minimum horizontal space is required to the rear of the baffle. Specific testing is required If the space available is less than 3 inches.
- Slot covers must be installed used on all empty Converter slots when more than one Converter shelf is being cooled by a Fan Shelf. These covers prevent cooling air from bypassing the Converters. See Figure 29.

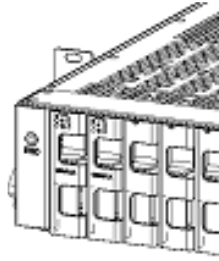


Figure 29 Converter Slot Covers

Lugs

Lugs are not provided with the equipment. This information is provided as a convenience.

GA	Description	WP-91412 List	Part #	Burndy Equivalent	Panduit Similar ¹⁰	T&B Similar ¹⁰
2	Straight, STR	54	405348202	YA2CL-2TC14	LCD2-14A-Q	54207 (STR)
2	Straight, FLEX	8	405347683	YAV2C-L2TC14-FX	LCDX2-14A-E	54208 (Flex)
2	45°, STR	-	-	YA2CL-2TC14-45	LCD2-14AH-Q	54207UF (STR)
2	45°, FLEX	193	408210524	YAV2C-L2TC14-FX-45	LCDX2-14AH-E	54208UF (Flex)
4	Straight, STR / FLEX	5	405347576	YAV4C-L2TC14-FX	LCDX4-14A-L (FLEX) LCD4-14A-L (STR)	54206 (STR) 54206 (FLEX)
4	45°, STR / FLEX	-	-	YAV4C-L2TC14-FX-45	LCDX4-14AH-L (FLEX) LCD4-14AH-L (STR)	54206UF (STR) 54206UF (FLEX)
6	Straight, STR / FLEX	3	405347519	YAV6C-L2TC14-FX	LCDX6-14A-L (FLEX) LCD6-14A-L (STR)	54205 (STR) 54205 (FLEX)
6	45°, STR / FLEX	-	-	YAV6C-L2TC14-FX-45	LCDX6-14AH-L (FLEX) LCD6-14AH-L (STR)	54205UF (STR) 54205UF (FLEX)
8	Straight, STR / FLEX	75	406021626	YA8CL2TC14	LCDX8-14A-L (FLEX) LCD8-14A-L (STR)	542040410 (STR) 542040410 (FLEX)
8	45°, STR / FLEX	-	-	YA8CL2TC14-45	LCDX8-14AH-L (FLEX) LCD8-14AH-L (STR)	N/A

Table 7 Lugs

¹⁰ These similar lugs may have different dimensions from WP-91412 lugs.

Specifications

Electrical and Thermal					
Parameter	Symbol	Min	Typical	Max	Unit
Input Voltage					
Operating Continuous	V_I	-40	-52.8	-60	V_{dc}
Non-operating, No Damage		0		-40	
Transient (@ duration =)					
5 seconds	V_{tr}			-65	V
10 ms (rise and fall rate of 10V/ms)	V_{tr}			-75	
10 μ s	V_{tr}			-100	
1 μ s	V_t			-200	
Input Current per half shelf ¹¹					
at 97.7W on all circuits					
$V_{IN} = 54.4V$	I_{IN}			26.0	A_{dc}
$V_{IN} = 52.1V$	I_{IN}			27.2	A_{dc}
$V_{IN} = 42.6V$	I_{IN}			33.2	A_{dc}
$V_{IN} = 40.0V$	I_{IN}			35.4	A_{dc}
-48V Input Short Circuit Current Limit ¹²				10,000	A
Power per Converter Card					
at -42.6 V_{dc} input					
Input Power	P_{in}			240 ¹³	W
Power Dissipation	P_{diss}			40 ¹³	W
Output Power	P_{out}		21	200	W
Output					
Output Voltage (line to line)	V_O	378	380	382	V_{dc}
Output Power (per circuit)	P_O	95.0	97.7	100	W
Output Current	I_{OUT}	251	257	262	mA
Isolation Input to Output				1500	V_{dc}
Temperature Ambient					
Operating at airflow ¹⁴					
at 150 lfm airflow	T_A	-40		50	$^{\circ}C$
at 175 lfm airflow	T_A	-40		65	$^{\circ}C$
at higher (TBD) airflow	T_A	-40		75	$^{\circ}C$
Cold Start Temperature	T_A	-40			$^{\circ}C$
Storage Temperature	T_{stg}	-55		85	$^{\circ}C$
Grounding / Bonding Network: Connect to an Isolated Ground Plane (Isolated Bonding Network) or an Integrated Ground Plane (Mesh-Bonding Network or Common Bonding Network).					
Equipment and subassembly ports:					
1. are suitable for connection to intra-building or unexposed wiring or cabling;					
2. can be connected to shielded intra-building cabling grounded at both ends.					
Physical					
Parameter	Symbol	Min	Typical	Max	Unit
Horizontal Clearance behind Shelves and Baffles		3			Inch
Component	Height	Width	Depth	Weight	
Converter Shelf	3.3 in (84mm)	17.2 in (437mm)	11.9 in (303mm)	30 lb (13.6kg)	
Fan Shelf	1.73 in (44mm)	17.2 in (437mm)	11.9 in (303mm)	20 lb (9.0kg)	
1U Baffle	1.73 in (44mm)	17.2 in (437mm)	11.9 in (303mm)	5 lb (2.2kg)	

Table 8 Specifications

See footnote on page 44

AWG	Minimum Loop Length
10	5 ft
8	8 ft
6	12 ft
4	19 ft
2	30 ft

Table 9 Minimum feed Loop Length¹⁵ for 10,000 A Short Circuit Current

Dimensions

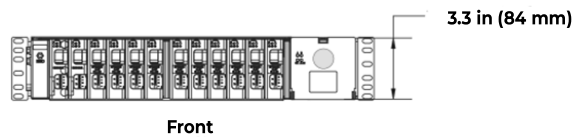
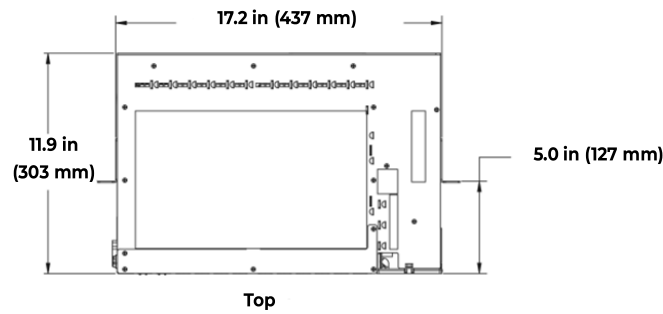


Figure 30 Converter Shelf Dimensions

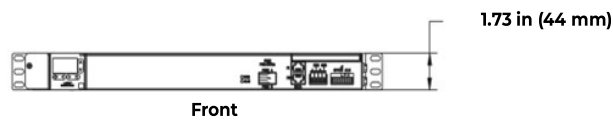
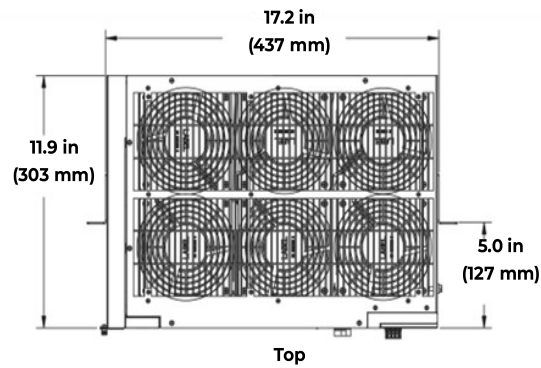


Figure 31 Fan Shelf Dimensions

See footnote on page 44

Standards Compliance

- The equipment meets the applicable requirements of these North American product standards: UL62368-21, UL62368-1, Telcordia GR-3108-CORE, GR-1089-CORE, GR-487-CORE (converter shelf), and GR-063-CORE.
- Baffle Required at top of each Converter Shelf Stack in CO and customer premise locations for UL compliance (Baffles not Required in outside plant cabinets, CEVs, or huts).
- For multi-shelf systems (up to 3), this equipment has been evaluated for continuous use in ambient temperature from -40°C to 65°C¹⁶.
- The main output voltage (+/-190V) meets UL60950-21RFT-V requirements. DO NOT CONNECT TO RFT-C CIRCUITS.

Installation Area

Install only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) in accordance with articles 110-16, 110-17, and 110-18 of the U.S. National Electric Code (NEC), ANSI/NFPA No. 70, and pursuant to applicable local codes.

Installation Environment

This equipment is to be used in controlled environments (an area where the humidity is maintained at levels that cannot cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified).

Installation Category

- Output circuits are suitable for connection to telephone lines that are equipped with primary lightning protectors consistent with UL 497.
- Each copper pair must be provided with protection external to this equipment to a level equivalent to a CommScope 3C*EW Gas tube primary protector [For example: 3C3EW provides the part in a red color]. This protector has a voltage breakdown range of 265-465 Volts and an impulse spark over range of <265-700 Volts. Protectors are provided by the telco customer.
- The 5-Pin protector must be marked as a “special circuit” consistent with the marking protocol in the users network.
- Network equipment and components along the powering circuit shall have suitable insulation resistance at 200 V_{dc} from each conductor to ground and a total insulation resistance suitable for 400 V_{dc} from line to line.

¹¹ Each shelf has 4 feeds: redundant A and B feeds for each side of the shelf (half shelf). Each feed must be sized to fully power the half shelf in the event of failure of the other redundant feed.

¹² -48V feeds must be wired to limit short circuit current - Table 9.

¹³ These are maximum situations with each circuit loaded to 100W. No actual or engineered application would load every circuit to this level. In the absence of detailed information about the network we would recommend using the typical dissipation value of 21 W per card for most applications and 30W per card for highly loaded networks.

¹⁴ Airflow across the entire cross section of the warmest converter shelf.

¹⁵ Loop Length is the total length of -48V and -48V Return conductors.

¹⁶ -40°C to 55°C for 3 converter shelves and 2 Fan Trays when equipped with QS982A Converters.

Safety

Safety Statements

Read and follow all safety statements, precautions and warnings before installing, maintaining, or repairing the equipment.

See the Specifications section for installation and environmental limitations.

- Grounding
 - Connect the equipment chassis directly to ground. In enclosed equipment cabinets connect to the cabinet ac service ground bus. In huts, vaults, and central offices connect to the system bonding network.
 - Ground per National Electrical Code, local building codes, and customer standards, practices, and requirements.
- Load outputs are hazardous
 - current limited +/-190V
 - Automatically re-energize within 4 seconds when ground faults or short circuits are cleared.
- Do not install this equipment over combustible surfaces.
- Follow all national and local rules and regulations when making field connections.
- Compression Connectors
 - U. S. or Canada installations - use Listed/Certified compression connectors to terminate Listed/Certified field-wire conductors where required.
 - All installations - apply the appropriate connector to the correct size conductor as specified by the connector manufacturer, using only the connector manufacturer's recommended or approved tooling for that connector.
- Torque electrical connections to the values specified on labels or in the product documentation.
- Dress cables to avoid damage to the conductors and undue stress on the connectors.
- Size protectors (fuses or circuit breakers) as required by the National Electric Code (NEC) and/or local codes. Refer to the equipment ratings to assure current does not exceed:
 - Continuous Load (List 1) - 6% of protector rating
 - Maximum Load (List 2 - typically end of discharge) - 80% of protector rating.
- Field-wired Conductors - Follow all National Electric Code (NEC) and local rules and regulations when making field connections.
 - Size field-wired conductors based on listed recommendations, National Electric Code (NEC) and/or local codes based on 70°C ampacity.
 - Insulation rating: 90°C minimum; 105°C (minimum) if internal to enclosed equipment cabinets.
- Provide accessible AC and DC input disconnect/protection devices to remove input power in an emergency.
- Provide external current limiting protection for alarm contacts. Rating 60V, 0.5A unless otherwise noted.
- Use only specified fuses and circuit breakers.
- Use only GMT fuses provided with safety caps.

Design Capacitance Safety Limit

The designed capacitance between +/-190V RFT-V conductors is 2.2 μ F and the measured capacitance between +/-190V and earth is 4.4 μ F.

DO NOT add capacitance to the system to reach values that exceed safety limits per the following figure:

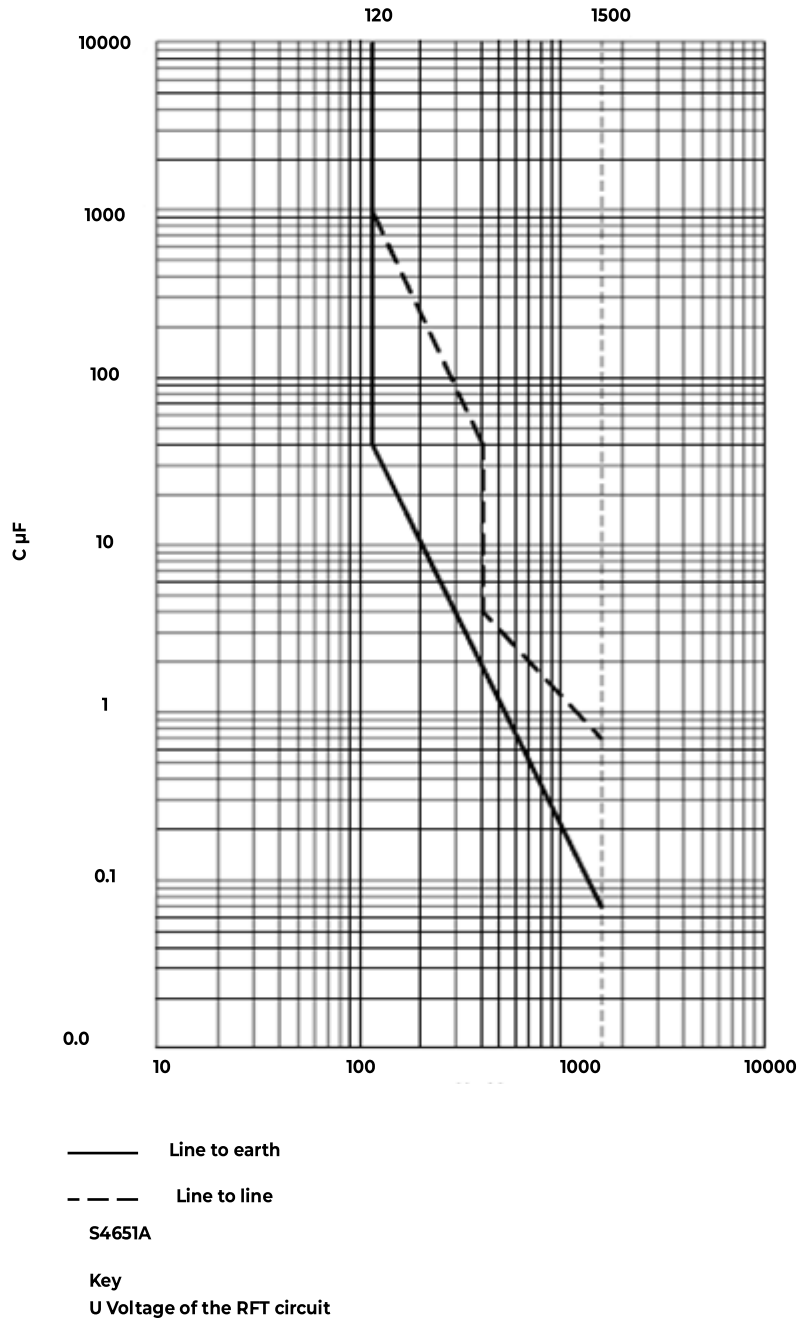


Figure 32 Design Capacitance Safety Limit

Precautions

- Install, service, and operate equipment only by professional, skilled and qualified personnel who have the necessary knowledge and practical experience with electrical equipment and who understand the hazards that can arise when working on this type of equipment.
- Disconnect batteries from outputs and/or follow safety procedures while working on equipment. Batteries may be connected in parallel with the output of the rectifiers. Turning off the rectifiers will not necessarily remove power from the bus.
- Do not disconnect permanent bonding connections unless all power inputs are disconnected.
- Verify that equipment is properly safety earth grounded before connecting power. High leakage currents may be possible.
- Exercise care and follow all safety warnings and practices when servicing this equipment. Hazardous energy and voltages are present in the unit and on the interface cables that can shock or cause serious injury. When equipped with ringer modules, hazardous voltages will be present on the ringer output connectors.
- Use the following precautions in addition to proper job training and safety procedures:
 - Use only properly insulated tools.
 - Remove all metallic objects (key chains, glasses, rings, watches, or other jewelry).
 - Follow Lock Out Tag Out (LOTO) procedures: customer specified, site specific, or general as appropriate. Disconnect all power input before servicing the equipment. Check for multiple power inputs.
 - Wear safety glasses.
 - Follow Personal Protective Equipment requirements: customer specified, site specific, or general as appropriate.
 - Test circuits before touching.
 - Be aware of potential hazards before servicing equipment.
 - Identify exposed hazardous electrical potentials on connectors, wiring, etc.
 - Avoid contacting circuits when removing or replacing covers.
 - Use a personal ESD strap when accessing or removing electronic components.
 - Follow procedures for working at heights more than 4ft above the floor: customer specified, site specific, or general as appropriate.
- Personnel with electronic medical devices need to be aware that proximity to DC power and distribution systems, including batteries and cables, typically found in telecommunications utility rooms, can affect medical electronic devices, such as pacemakers. Effects decrease with distance.

Appendix A: Operating Temperature Measurement and Vertical Spacing

Overview

The CPS2400U has been designed for mounting in relay racks or in equipment cabinets. It is designed for use with user provided vertical airflow cooling of at least 175 linear feet per minute over the entire flow cross-section of the shelf. Equipment may be placed on top of the CPS2400U provided airflow is not impeded or sufficient spacing is provided. A 1U Baffle is required above the highest converter shelf; this baffle provides sufficient vertical spacing. Direct the airflow into a 3 inch minimum space. If the spacing is less than 3 inch spacing application specific testing is required.

Operating Temperature

The CPS2400U is rated to work to 65 C in stacks of two shelves in outdoor cabinets without baffles. Note: in outdoor cabinets where the air entering the second shelf may be heated above 65°C inlet temperature, additional airflow beyond the 175 linear feet per minute is required. These cases require an engineered solution.

In Central Office environments when baffles are required for safety reasons, a three shelf system is rated to operate in 55°C environments.

Baffles and Fan Trays

For Central Office applications, baffles are used between every set of three Converter shelves. Fan Shelves are required for every set of three Converter shelves. No more than 6 shelves may be located in a particular frame. Slot covers must be used on all empty slots when more than one shelf is being cooled by a particular airflow device.

Always mount converter shelves above the fan tray that cools them.

Leave no space between the top of a fan tray and the converter shelf above it. The Fan Shelf draws air down through whatever equipment is located directly above it. If a gap is left above a fan tray, air will be drawn into the fan tray from the aisles rather than from the converter shelf above the fan tray. This will result in service effecting problems due to insufficient cooling air flowing through the active converters.

The Fan Shelf forces air up through whatever equipment is located directly above it. If a gap is left above a fan tray, air will escape into the aisles rather than flowing into the converter shelf above the fan tray. This will result in service effecting problems due to insufficient cooling air flowing through the active converters.

Always mount a converter shelf immediately above a fan shelf or above a converter shelf stacked on a fan shelf. Any gaps between converter shelves, or absence of slot covers, can cause service effecting problems.

Note: All unpopulated converter slots must be filled with slot fillers. For example the figure below shows a shelf with operational converters in the first two slots and slot fillers in the remaining 10 slots:

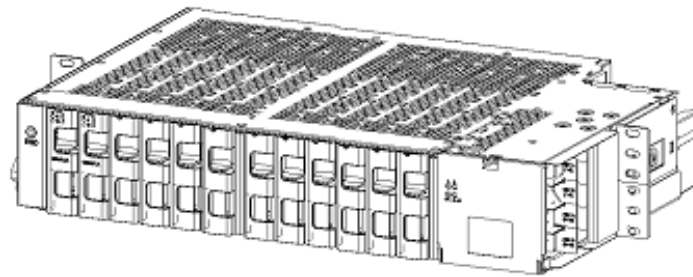


Figure 33 Converter Slot Fillers

Appendix B: Alarm Reference Table

This Alarm Table shows how FTTN Alarms are categorized by the Controller. Details of non-FTTN Alarms can be found in the Plant Level product manuals. Many alarms are best processed at the converter shelf alarm card and converter card level.

Alarm Display	What it means	Controller		Alarm Card		Converter Card		Corrective Action
		LED State	Relay State	Alarm LED State	Relay State	OK LED State	Alarm LED State	
Circuit Fail	Short + to -	Yellow	Min	Yellow	Min	Green	Flashing Yellow	Make sure each converter has an independent isolated send and return path.
Circuit Fail	Short to Ground	Yellow	Min	Yellow	Min	Flashing Red	Flashing Red	Make sure each converter has an independent isolated send and return path.
Communication Fail	1 Card Removed	Yellow	Min	Yellow	Min	Green	Off	Check to see that all cards are seated. Replace non-functioning cards.
Communication Fail	2 Cards Removed	Red	Maj					Check to see that all cards are seated. Replace non-functioning cards.
Communication Fail	Communication Cable Removed	Red	Maj	Flashing Red		Green	Off	Check communication path from alarm cards to Controller. If no controller is present, set alarm card rotary switch to position 0 for contact closures only communication.
Communication Fail	Alarm Card Removed	Red	Maj			Green	Flashing Red	Replace Alarm card.
None	Standby	Green		Green			Yellow	Remove unit from standby if desired using Controller or Ethernet interface
Circuit Fail	Open Fuse	Yellow	Min	Yellow	Min	Green	Flashing Yellow	Replace unit. Note: Restoring service to one line will interrupt service to the other line served by that card.
Circuit Fail	Under Voltage	Yellow	Min	Yellow	Min		Flashing Yellow	Replace unit. Note: Restoring service to one line will interrupt service to the other line served by that card.
Fan Fail	1 Fan Tray Failed	Yellow	Min	Yellow	Min	Green	Off	Replace fan tray.
Fan Fail	1 of 6 fans Failed on one Fan Tray	Yellow	Min	Yellow	Min	Green	Off	Replace fan tray.
Fan Fail	2 Fan Trays Failed	Red	Maj	Red	Maj	Green	Off	Replace fan trays.

Table 10 Alarm Reference Table

Alarm Display	What it means	Controller		Alarm Card		Converter Card		Corrective Action
		LED State	Relay State	Alarm LED State	Relay State	OK LED State	Alarm LED State	
Input Power	A1-8 Power Fail	Yellow	Min	A Red	Min	Green	Off	Reconnect DC input power flowing to the A1-8 input terminal.
Input Power	B1-8 Power Fail	Yellow	Min	B Red	Min	Green	Off	Reconnect DC input power flowing to the B1-8 input terminal
Input Power	A9-16 Power Fail	Yellow	Min	A Red	Min	Green	Off	Reconnect DC input power flowing to the A9-16 input terminal
Input Power	B9-16 Power Fail	Yellow	Min	B Red	Min	Green	Off	Reconnect DC input power flowing to the B9-16 input terminal.
Input Power Mul Circuit Fail	A1-8 & B1-8 Power Fail	Red	Maj	A Red B Red	Maj	Green	Off	Reconnect DC input power flowing to the A1-8 input terminal and Reconnect DC input power flowing to the B1-8 input terminal
Input Power Mul Circuit Fail	A9-16 & B9-16 Power Fail	Red	Maj	A Red B Red	Maj	Green	Off	Reconnect DC input power flowing to the A9-16 input terminal. Reconnect DC input power flowing to the B9-16 input terminal.
Load Drop	Load Drop	Yellow	Min	A, B & OK Green		Green	Off	Check the integrity of the circuits going to the load. Or Adjust load drop threshold to 0 to disable this feature.
Load Share	As set of circuits assigned to one remote destination are not sharing current as would be expected.	Yellow	Min	A, B & OK Green		Green	Off	Check the integrity of the circuits going to the load. Or Adjust load share threshold to disable this feature.
Line Test	OK, Fail or Aborted			A, B & OK Green		Green	Off	Estimated line resistance has increased since last measurement.
Loss Of Redundancy		Yellow	Min	A, B & OK Green		Green	Off	The loss of n additional circuits will cause customers to lose service. Check redundancy threshold in the configuration.

Table 10 Alarm Reference Table

Appendix C: Operation without a Controller - Alarm Wiring

Each converter shelf provides alarm contact closures for Power Major and Power Minor independently of a controller. Wire these relays into the alarm network in deployments where a controller is not utilized. When a controller is installed then an alarm cable can be attached to the controller – see the Connect Office Alarms section.

Step	Action
1.	<p>Attach the required alarm leads to the office alarm screw terminals (TB1 on the alarm card) as designated.</p> <p style="text-align: center;">Figure 34 Office Alarm Pin Outs - Alarm Cards</p>
2.	Reinstall Alarm card and close distribution door.

Converter Shelf Alarm Card State Table

This section shows Alarm and LED response for the Alarm Card LEDs and Relays:

The Converter Shelf contains a pair of A bus feeds and a pair of B bus feeds. The use of dual A and B feeds is to not exceed the 48 AMPS L2 input current per feed. The A bus feeds are designated A1-6 and A9-12, and power shelf slots 1-6 (left side) and 7-12 (right side) respectively. The B bus feeds are also designated in an identical fashion. The alarm card monitors the -48v on each of these four feeds, and asserts alarms and indicators - **Table 11**.

	-48 V Input Bus				Vin LEDs		Status LEDs		Alarm Relays ¹⁷	
	A ₁₋₆	B ₁₋₆	A ₇₋₁₂	B ₇₋₁₂	A LED	B LED	OK LED	ALM LED	PMN	PMJ
1	OK	OK	OK	OK	GRN	GRN	GRN	OFF	E	E
2	LOW	OK	OK	OK	RED	GRN	OFF	YEL	D	E
3	OK	LOW	OK	OK	GRN	RED	OFF	YEL	D	E
4	OK	OK	LOW	OK	RED	GRN	OFF	YEL	D	E
5	OK	OK	OK	LOW	GRN	RED	OFF	YEL	D	E
6	LOW	LOW	OK	OK	RED	RED	OFF	RED	E	D
7	LOW	OK	LOW	OK	RED	GRN	OFF	RED	E	D
8	LOW	OK	OK	LOW	RED	RED	OFF	RED	E	D
9	OK	LOW	LOW	OK	RED	RED	OFF	RED	E	D
10	OK	LOW	OK	LOW	GRN	RED	OFF	RED	E	D
11	OK	OK	LOW	LOW	RED	RED	OFF	RED	E	D
12	LOW	LOW	LOW	OK	RED	RED	OFF	RED	E	D
13	LOW	LOW	OK	LOW	RED	RED	OFF	RED	E	D
14	LOW	OK	LOW	LOW	RED	RED	OFF	RED	E	D
15	OK	LOW	LOW	LOW	RED	RED	OFF	RED	E	D
16	LOW	LOW	LOW	LOW	OFF	OFF	OFF	OFF	D	D

Table 11 Converter Shelf Alarm Card States

Alarm Card Logical Operation of LEDs and Alarm Relays

The Alarm Card contains a pair of form C relays to provide shelf PMN and PMJ isolated closures.

Both PMN and PMJ relays will signal alarm if both A and B input fail. Relays coils are energized to signal normal (no-alarm) and are redundantly powered by both the A & B input buses.

The relay circuit interfaces to a pair of parallel buses connected to each of the 16 Converter/Limiter Cards. Each Converter has an open collector output on the bus, and pulls the bus low to chassis ground when it is asserting an alarm. The PMN/PMJ circuit on the Alarm card recognizes the bus state change and denenergizes the associated alarm relay, signaling alarm. The alarm card separately monitors both the PNM and PMJ bus. When the PMN bus is active (pulled low), the Alarm card asserts a PMN relay and lights the ALM LED Yellow. When the PMJ bus is active (pulled low), the Alarm card asserts a PMJ relay and lights the ALM LED Red.

The Alarm Card ignores the state of the PMN bus (and does not assert a PNM relay/LED action) while an active PMJ is present. This is necessary since a single LED is used for both Minor (Yellow) and Major (Red) visual indication.

The Alarm Card also monitors the -48V dc inputs and asserts PNM/PMJ for conditions as described in the earlier section dealing with input voltage monitoring.

The Alarm Card also monitors the two fan tray alarms. When either of the two fan tray alarms is active, the Alarm Card asserts a PMN relay and Yellow ALM LED. When both of the fan tray alarms are active, the Alarm Card shall assert a PMJ relay and Red ALM LED.

The Alarm Card shall also monitor its internal I²C to RS-485 conversion processor. A failure of this processor shall constitute a PMN condition.

Alarm Card Office Alarms

Each Shelf provides alarm contact closures for Power Major and Power Minor. Wire these relays into the alarm network if desired.

Systems equipped with a controller provide all alarms via the controller alarm connector and require no office alarm wiring to alarm cards.

Inter-Shelf Signal Cables are only required between Fan Shelves and the adjacent Converter Shelf in systems without a Controller.

Step	Action
1.	<p>Install Alarm Card Cables Attach the office alarm leads to the office alarm screw terminals of alarm card TB1 per site engineering instructions.</p> <div data-bbox="373 714 1274 1018" data-label="Diagram"> </div> <p style="text-align: center;">Figure 35 Alarm Card Pin Out</p> <div data-bbox="673 1134 1453 1743" data-label="Diagram"> </div> <p style="text-align: center;">Figure 36 Alarm Card Cables</p>
2.	Reinstall Alarm card and close distribution door.
	Repeat for each shelf.

Appendix D: Installationsanleitung

Eingangsspannung (Voltage) : -40V - -59V DC Eingangsstrom (Current) : max. 4.5 – 5.8 A Eingangsleistung (Watts) : -

Nennfrequenz (Frequency) : -

Seriennummer (Assembly No.) :--

Modellnummer (Modell No.) : QS982ATEZ

Abmessungen sind nur zur Referenz : Netzteil zum einschieben in ein Rack

Max. Umgebungstemperatur : max. 75 °C (Max. Operation temperature)

Achtung: Das Netzteil darf nur in Räumen mit beschränktem Zutritt verwendet werden.

Das System ist ein Gerät der Schutzklasse I / Überspannungs Kategorie II

Ausgangsspannungen und -ströme:

DC 190V /max 100W bei IEC 60950-21

- Das Gerät hat keinen eigenen Ausschalter, es muß daher mit einem Ein- und Ausschalter im Versorgungskreis versehen sein.
- Das Gerät hat kein Brandschutzgehäuse es darf daher nur auf nicht brennbaren Untergrund aufgestellt werden. (Beton, Metall usw.)
- Beim Aufstellen des Gerätes ist darauf zu achten das alle Anforderungen gemäß EN60950 eingehalten werden.

Revision

Revision	Description	Date Dept./Init.
r01	Initial release	
r02	Minor Revisions	
r03	Update Install Inter-Shelf Signal Cables, page 20; add reference to Galaxy Pulsar Edge Quick Start Guide	
r04	Corrected fan shelf DC wire gage and maximum temperature of 3 shelf system (Standards Compliance section). Added Appendix D: Installationsanleitung (German notes)	
4.2	Updated as per template	02/08/2022
4.3	Updated as per OmniOn template	11/08/2022

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