Installation Guide

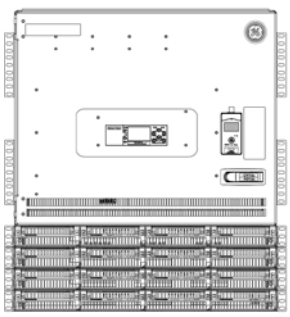
H5692448 Power Systems

Infinity *M*[1] (*NE-M*)

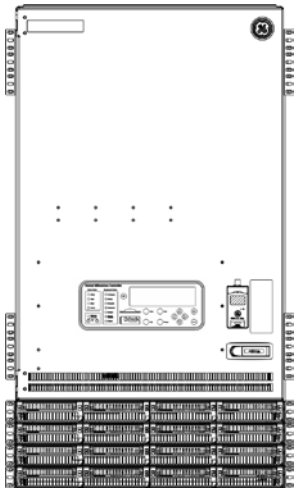
High Capacity

With

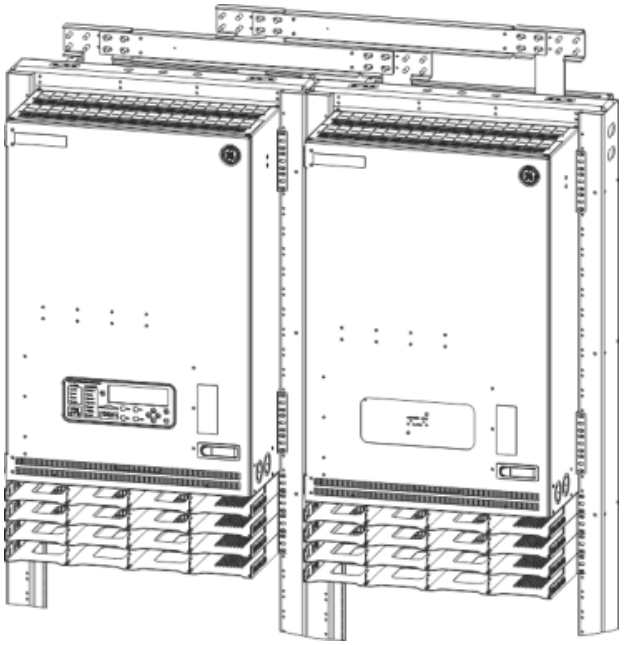
Horizontal Distribution



13 U System with Galaxy Pulsar Plus Controller



22U System with Galaxy Millennium II Controller



Initial Frame **Supplemental Frame**

22U System with Supplemental Frame and Galaxy Millennium II Controller

NE-M systems with left and right vertical distribution use installation guide document CC848815325.

[1] Trademark of General Electric Company

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Introduction

This manual is intended as a guide in assisting equipment understanding, installation, testing, and troubleshooting.

For additional assistance contact Technical Support or access additional information on-line.

Reference Documents

Document	Title
	Infinity M Product Line Brochure – Specifications and Ordering Guide
H5692448-AD	NE System, 24V and/or 48V Assembly Drawing
CC848815341	Galaxy Pulsar Plus[2] Family Product Manual
108994645	Galaxy Millennium II[3] Installation and User's Guide
107570517	RPM J85501G-1 Product Manual

Contact Information

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Email: PE.TechSupport@ge.com

Web site: www.gecriticalpower.com

[2] Referred to as "Pulsar Plus" throughout this document.
[3] Referred to as "Millennium II" throughout this document.

Product Description

Infinity M (*NE-M*) is available in multiple system arrangements. Block diagram - **Figure 1**.
Refer to the *Infinity M Product Line Brochure* for detail description.

Single or Dual Output Voltage

Primary DC Voltage (Battery and Rectifiers)	Secondary DC Voltage (dc/dc Converters)
24V	none
24V	48V
48V	none
48V	24V

Battery Connections

- Direct connection to *NE-M* system bus
- Through a Low Voltage Battery Disconnect (LVBD)
- Through battery maintenance switches or circuit breakers located at the battery

DC Distribution

- Panel Positions: 2, 3, or 4 (13U, 18U, or 22U systems)
- Panels: Bullet Positions, Selectable Bullet Positions, Bolt In Breakers / Fuses
- DC Voltage: Primary only or Primary and Secondary
- Selectable distribution options

Universal Power Shelf

- Accepts rectifiers or converters interchangeably in any power slot
- Can be installed with no AC connected, as a converter only shelf

AC Feeds

- Front accessible terminal blocks
- One or two rectifier positions per feed

Controller

The controller monitors and controls system operation.

- Pulsar Plus (Eco features included)
- Millennium II

Framework

- 84 inch, 72inch, or 42 inch frame
- Sub-frame - mount in customer provided 23 inch frame

Supplemental Frame

The optional Supplemental Frame and adds DC distribution, power shelves, and battery connections.

- Millennium II controller required in Initial Frame.

Eco Capable Systems - Pulsar Plus only

Eco capable systems (Eco systems) add support for multiple power inputs of multiple types, including PV (photo voltaic or solar) arrays.

Power Input

- PV (photo voltaic or solar) arrays
- AC generators
- AC mains

Rectifiers

NE Eco Rectifiers[4]

- Input - AC or DC (PV or solar) input
- MPPT (Maximum Power Point Tracking) maximizes power harvested from PV arrays
- Recommended for all rectifier positions in *Eco* systems

Controller

- Pulsar Plus
  - Eco features included (PV, Gen Set, etc.)

[4] **REQUIRED** – Eco rectifiers in all DC (PV or solar) powered rectifier positions.
RECOMMENDED – Eco rectifiers in all Eco system rectifier positions.
NOT RECOMMENDED – non-Eco rectifiers in Eco systems.
Non Eco rectifiers will not function properly when powered by DC (PV or solar) input in Eco systems.
Use of non-Eco rectifiers in Eco systems increases the risk of improperly filling all system rectifier positions.
Non Eco rectifiers may be installed in AC powered rectifier positions of Eco systems.

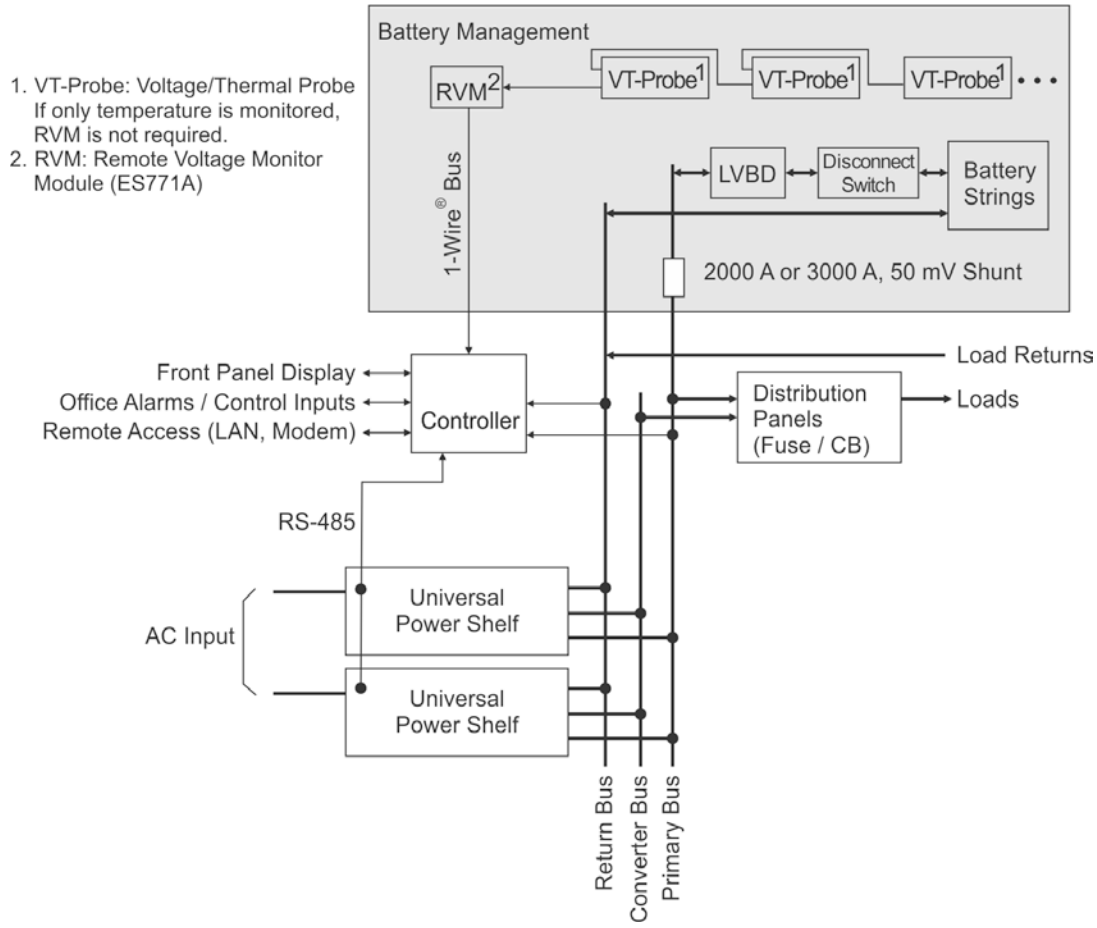


Figure 1 Block Diagram

Components

- Systems (with 4 rectifier shelves)
  - 13 U with 2 distribution panel positions
  - 18 U with 3 distribution panel positions
  - 22 U with 4 distribution panel positions
- Frameworks:
  - Full-Height Frame
  - Half-Height Frame
  - Sub-frame
    with frame mounting brackets
- Pulsar Plus or Millennium II controller
- NE830 Redundant Voltage Monitor
- NE-Series Rectifiers and Converters
- Front accessible AC terminal blocks
- Battery Options and Monitoring:
  - Battery Trays with Disconnect Breakers or Anderson PowerPole® disconnects
  - LVBD Contactors
  - Thermal/Voltage Probes
  - External Ambient Temperature Probes
  - Battery Shunt
- DC distribution options:
  - Bullet Terminal Panels – 26 position
    - Fit in 1 distribution position
    - Single Voltage (24V or 48V) or Selectable Voltage per position
    - Integrated return bar
    - Bullet terminal breakers up to 250A
    - TPS fuses up to 70A
    - GMT module fuses up to 15A – 6 position
    - Shunt option
  - Bolt-in breaker Panel – 12 position
    - Mounted in
      - Bottom 2 distribution positions with integrated return bar

      or
      - Bottom distribution position with top of frame return bar.
    - KS22012 breakers up to 600A
    - TPL-C Fuse holders

- Additional Power shelves
  9 shelves maximum
  7 AC powered shelves maximum

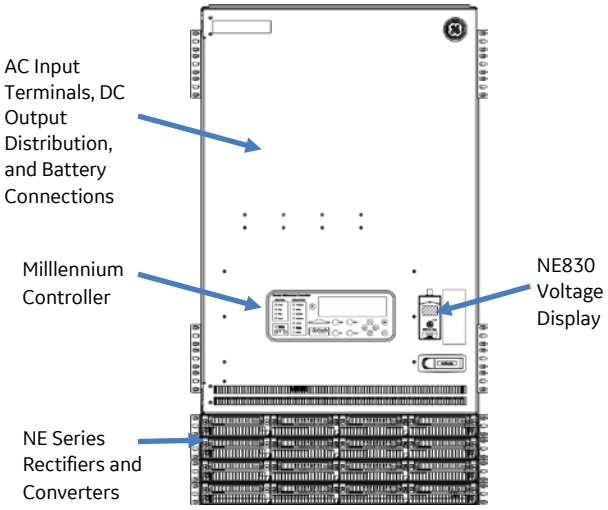


Figure 2 *NE-M* Components

Controller – Pulsar Plus

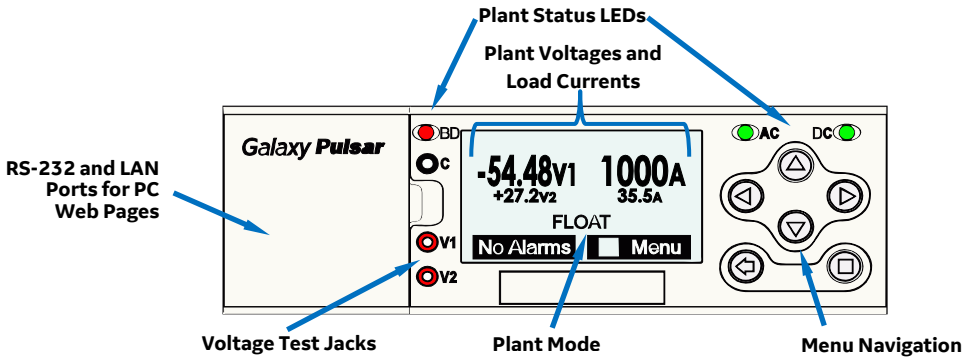


Figure 3 Pulsar Front Panel

- Local or remote viewing and configuration of system parameters, alarm thresholds, and user-definable alarm inputs and relays
- Extensive rectifier/converter Monitoring and Control
- Advanced Battery Management to maximize and manage battery health
- Emergency Power Off (EPO) to meet local emergency services code requirements
- System voltage and current monitoring
- LVBD and LVLD Low Voltage Disconnect contactor control and monitoring
- dc Distribution monitoring
- Standard and Programmable Alarms
- Extensive Voltage, Current, Temperature, and Binary Input monitoring
- Standard and programmable Office Alarm relays
- Digital communications to all system devices

See the *Pulsar Plus Controller Family Product Manual* for further detail.

Controller – Millennium II

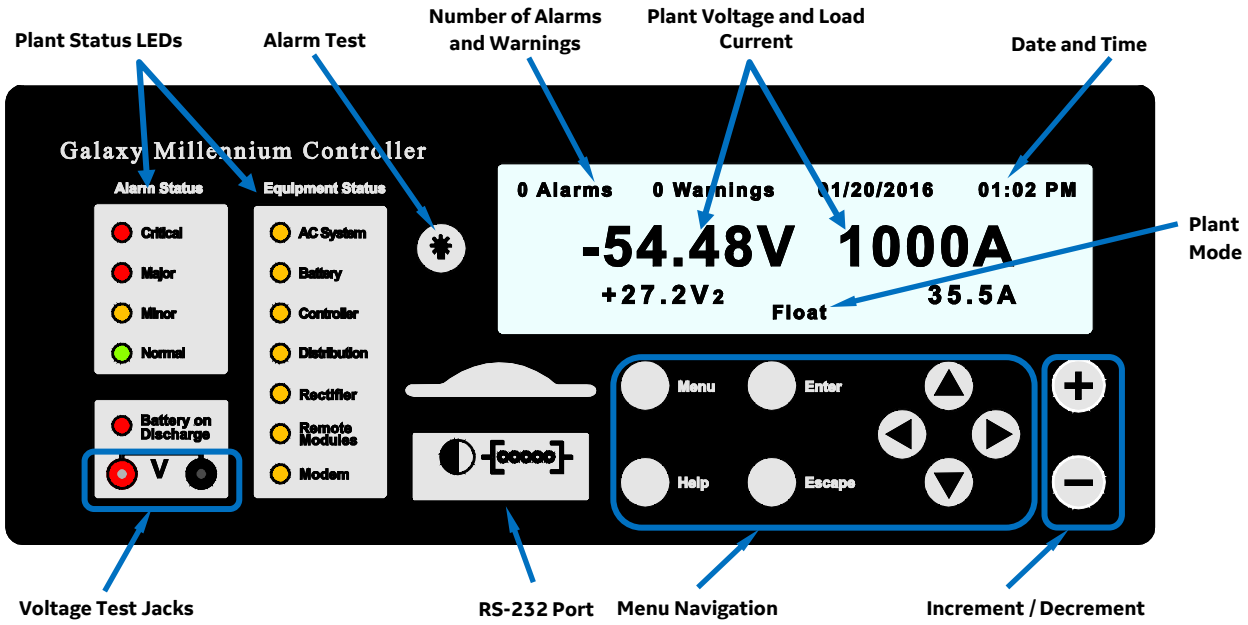


Figure 4 Millennium II Controller Front Panel

- Local or remote viewing and configuration of system parameters, alarm thresholds, and user-definable alarm inputs and relays
- Extensive rectifier/converter Monitoring and Control
- Advanced Battery Management to maximize and manage battery health
- Emergency Power Off (EPO) to meet local emergency services code requirements
- System voltage and current monitoring
- LVBD and LVLD Low Voltage Disconnect contactor control and monitoring
- dc Distribution monitoring
- Standard and Programmable Alarms
- Extensive Voltage, Current, Temperature, and Binary Input monitoring
- Standard and programmable Office Alarm relays
- Digital communications to all system devices
- Remote Peripheral Modules (RPMs)

See the *Galaxy Millennium II Installation and User's Guide* for further detail.

Aux Display - NE830A (Optional)

The Aux Display is a voltage monitor that alarms when the voltage of the power system is out of the normal operating range. It is mounted on the door of the distribution box.

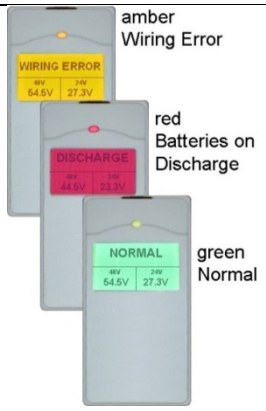
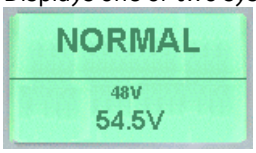
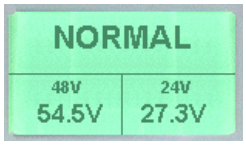


Figure 5 NE830 Display

- Fully independent of the main system controller
  - Displays one or two system voltages and battery state:





  - Single voltage systems, -48V, +24V
  - Dual voltage systems, -48V and +24V with common return
- The display and LED color indicates battery charge state and wiring errors:
  - Green display = batteries are not discharging
  - Red display = batteries are discharging
  - Amber display = wiring error
- A Battery on Discharge alarm relay with form-C contacts is provided
- Can be panel, wall or frame rail mounted within 150 ft. of the power system

Rectifiers and Converters

*NE-*Series rectifiers and converters are hot-pluggable for quick, simple, plug-and-play installation without tools.

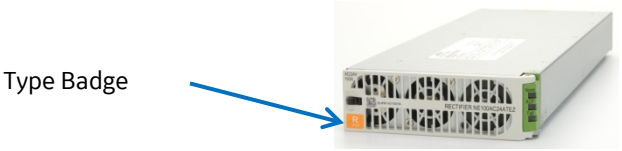


Figure 6 Rectifier and Converter Type Badge

NE Eco Rectifiers

Input	AC or DC (PV or solar)
Compatibility	All *Infinity* Rectifier Positions
Eco Feature	MPPT (Maximum Power Point Tracking) maximizes power harvested from PV arrays

NE Non-Eco Rectifiers

Input	AC only
Compatibility	All AC powered *Infinity* Rectifier Positions[5]

[5] Non Eco rectifiers will not function properly when powered by DC (PV or solar) input in Eco systems.

Table 1 Rectifiers and Converters				
Rectifier/Converter		Input	Output	Eco Compatible
Eco Rectifier  blue	NE050ECO48ATEZ	ac 110/200-240 Vac dc 60Vdc (+/-30V) to 310Vdc (+/-150) 11A max	**48V**, 50A[10]	**Yes**[6]
Eco Rectifier  orange	NE100ECO24TEZ	ac 110/200-240 Vac dc 60Vdc (+/-30V) to 310Vdc (+/-150) 11A max	**24V**, 100A[7]	**Yes**[6]
Converter  blue	NE040DC48ATEZ	24 Vdc	**48V**, 40A	**Yes**
	NE030DC48A		**48V**, 30A	**Yes**
Converter  orange	NE075DC24A	48 Vdc	**24V**, 75A	**Yes**
Rectifier  blue	NE075AC48ATEZ	110/200-277 Vac	**48V**, 75A[8]	**AC Only**[9]
	NE055AC48ATEZ	110/200-277 Vac	**48V**, 55A[10]	
	NE050AC48ATEZ	110/200-277 Vac	**48V**, 50A[10]	
	NE050AC48A[12]	200-240 Vac	**48V**, 50A[12]	
Rectifier  orange	NE100AC24ATEZ	110/200-277 Vac	**24V**, 100A[11]	**AC Only**[9]
	NE100AC24A[12]	208/200-240 Vac		
	NE850 Slot Filler			

[6] **REQUIRED** – Eco rectifiers in all DC (PV or solar) powered rectifier positions.
RECOMMENDED – Eco rectifiers in all Eco system rectifier positions.
NOT RECOMMENDED – non-Eco rectifiers in Eco systems.
Non Eco rectifiers will not function properly when powered by DC (PV or solar) input in Eco systems.
Use of non-Eco rectifiers in Eco systems increases the risk of improperly filling all system rectifier positions.
Non Eco rectifiers may be installed in AC powered rectifier positions of Eco systems.

[7] 44A with 120Vac input

[8] 22A with 120Vac input

[9] **NOT RECOMMENDED for use in Eco systems** - Non Eco rectifiers will not function properly when powered by DC (PV or solar) input in Eco systems.
Use of non-Eco rectifiers in Eco systems increases the risk of improperly filling system rectifier positions.

[10] 25A with 120Vac input

[11] 50A with 120Vac input

[12] Non-TEZ rectifiers are no longer orderable and have lower efficiency than TEZ rectifiers

Power Input Panel

Power Input

Terminal blocks in a front access panel at the bottom of the distribution box.

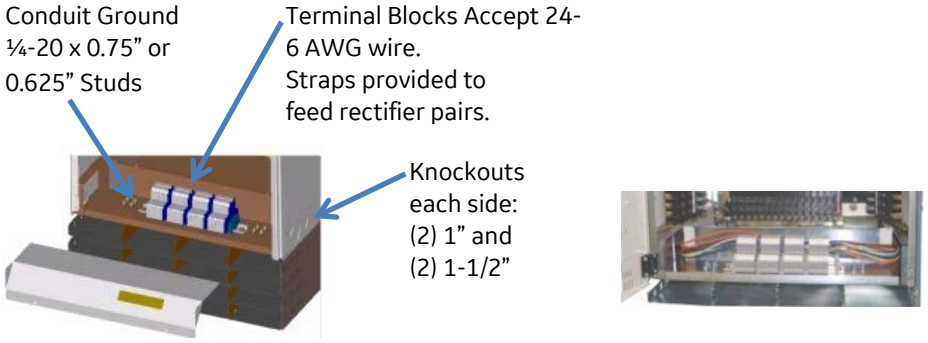


Figure 7 Power Input Panel

Battery Options and Monitoring Features

Figure 8 Battery Stand

Battery Options

- Designed for operation with GE flooded, VRLA and Durathon™ Sodium batteries, as well as other vendors' batteries.
- Battery trays are available for 100Ahr to 170Ahr batteries with Anderson PowerPole® connectors or circuit breaker disconnects.
- Half-height and third-height systems can be mounted on floor-mounted VRLA strings or on GE Universal Battery Stands.

Battery Monitoring Features

- Open String (OS) Alarms
- Emergency Power Off (EPO) for disconnecting batteries from the system
- Temperature/voltage probes (up to 16) used in Battery Management options
  - Slope Thermal Compensation – High and Low Temperature
  - Battery High Temp Disconnect
  - Mid-String Voltage Monitoring
- Battery Discharge Test
- Battery Shunt
- Low Voltage Battery Disconnect/Reconnect Contactor (LVDB) with Emergency Power Off (EPO)

DC Distribution and Battery Termination

Distribution panels are factory installed.

Examples	Features

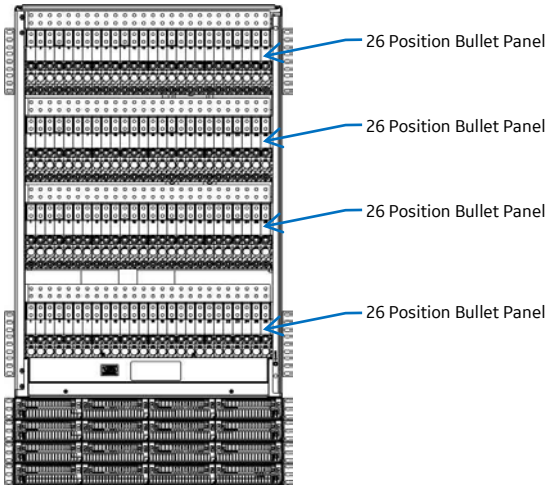


Figure 9 DC Distribution 4 Bullet Panels

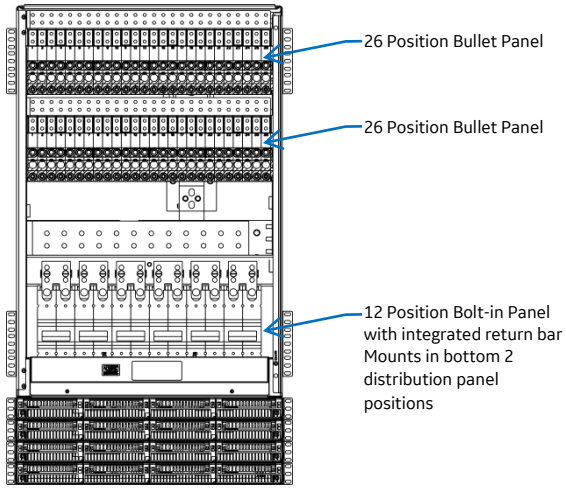


Figure 10 DC Distribution – Bolt In Panel with return bar

22U System Examples

- 11 pair Battery and Return bus landings for battery cables
- LVBD Contactor option
- 26 Bullet Distribution positions per panel arranged for:
  - Bullet terminal breakers to 250A
  - TPS fuse holders for fuses to 70A
  - GMT Fuse Module - 6 position
- 12 Bolt-in positions
  - KS22012 circuit breaker
  - TPL-C Fuse holders

- Distribution Panel Positions

System	Distribution Panel Positions
13U	2
18U	3
22U	4

- Universal Power Shelves

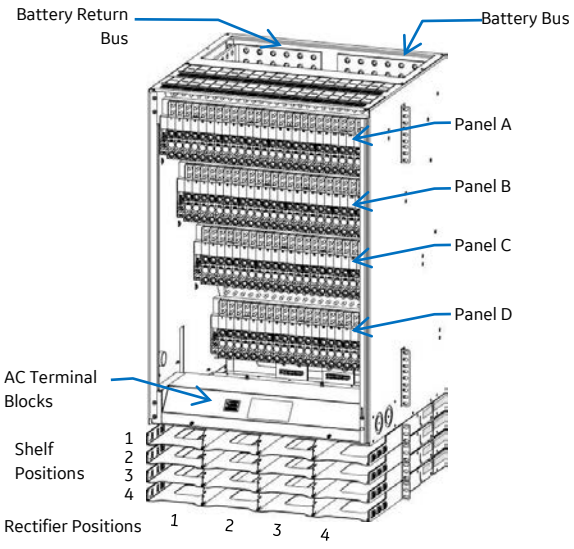


Figure 11 NE-M System – 22U

Installation

Follow all site engineering instructions. This section is provided only as a guide.

Preparation

Safety

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

Installation Tools

You will need the following tools.

- Wire cutters and strippers
- Heat shrink gun
- Digital meter with an accuracy of ±0.02%
- Screw drivers (flat-blade and Phillips)
- ESD wrist strap
- 24 or 48V test load
- Calibrated clamp-on dc current meter (0.1 ADC sensitivity)
- Torque wrench
- Sockets -: SAE and metric 5/16”, 7/16”, 9/16”, 19 mm, etc.
- 12" extension for socket
- Masonry drill kit as required
- Compression tool for installation of various compression lugs
- Protective canvas
- Insulating rubber mat
- Standard insulated installation tools, screwdrivers, etc.
- Windows-based personal computer laptop (PC) and cable to connect the PC communications port to the local port of the controller or a CAT5 LAN cable. (Optional. See the controller manual for more information).

Equipment Identification

Identify the equipment you have received. Follow procedural steps which match the equipment being installed.

Anchor Frame

Ventilation space is required to the rear of the equipment: 4” to solid surface, 6” to heat producing surface.

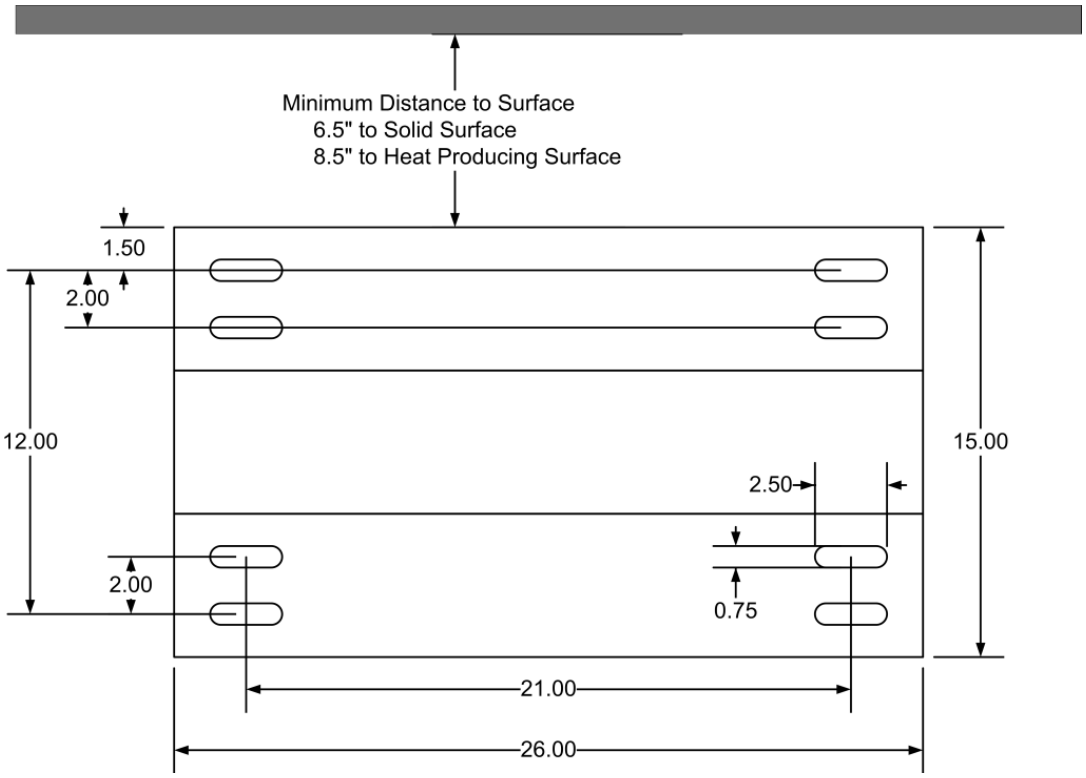
Floor Mounted Frame

Using the 847135688 Floor Anchor Kit (recommended):

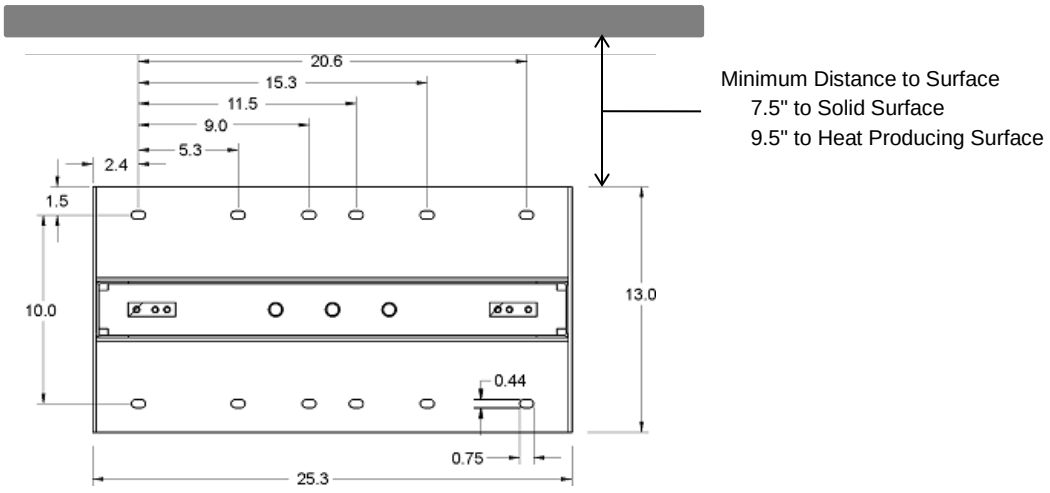
Anchor Type (Hilti)	Wrench	Torque
(4) 12 mm Cap Bolts	19 mm	720 in-lb 60 ft-lb 82 Nm

Note: If using Equivalent Floor Anchors, make sure the floor anchors are rated for this application.

Note: An optional Supplemental Frame (without controller) may be located on either side of the Initial Frame (with Millennium II controller).

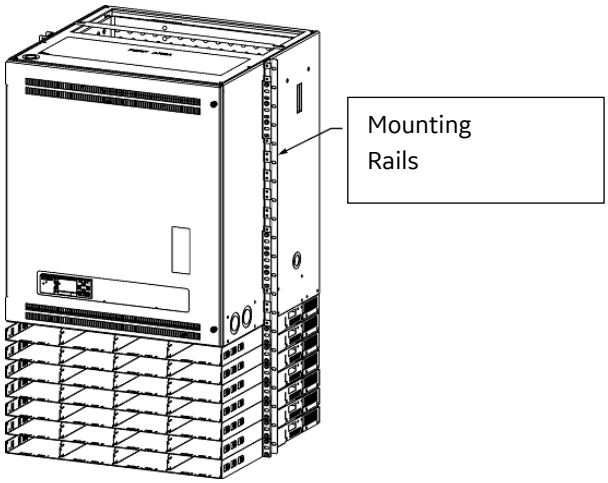
Step	Action
	 Figure 12 Frame Mount Footprint 6 ft. and 7ft Frames
CAUTION: Health Hazard **Follow safe floor drilling procedures to prevent possible asbestos exposure.**	
1	Drill anchor holes.
2	Place frame and install floor anchors per manufacturer requirements.
3	Repeat for Supplemental Frame, if it is to be installed.

Battery or Battery Stand Mounted Frame

Step	Action
1	Verify that battery or battery stand is positioned to provide adequate ventilation space to the rear of the equipment: 4" to solid surface, 6" to heat producing surface. Figure 13 shows the placement of the base of the floor mounted frame to meet ventilation space requirements Place and secure frame to battery or battery stand per instructions provided with the battery stand or adapter.  Figure 13 Battery Stand Mount

Sub-frame Mounted Systems:

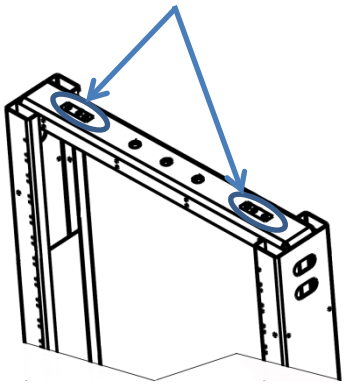
Sub-frame mounted systems can be mounted in any standard 23" equipment mounting rack or frame with EIA-310 standard 1-3/4" rack spaces or 1" standard rack spaces. The brackets are 36.75" (21U) tall. Comcode CC848819607 kit provides two brackets and 20 12-24 mounting screws.

Step	Action
1	Verify that the rack is positioned to provide adequate ventilation space to the rear of the equipment: 4" to solid surface, 6" to heat producing surface. Distance required to rear of mounting rails: 16.5" to solid surface, 18.5" to heat producing surface. Position the sub-frame system in the rack as desired. Secure the sub-frame system into the rack with at least (12) frame mounting screws, 6 screws per side. Torque to 35 in-lb – 5/16 socket.  Figure 14 Mount Sub-Frame

Ground Frame

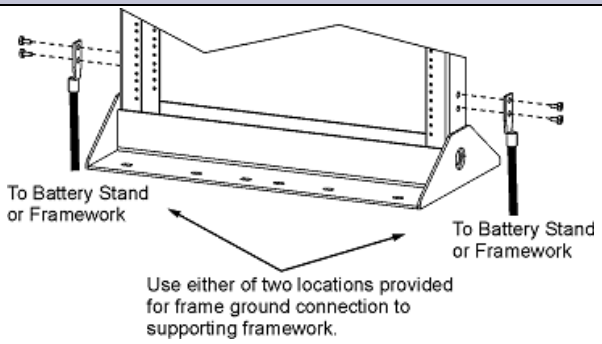
Floor Mounted Frame

Select a Frame Ground landing on the top of the frame and clean.

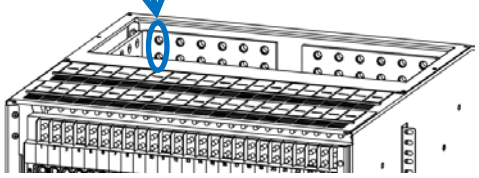
Step	Action	
1	Secure Frame Ground connection with provided hardware: (2) ¼-20 x ¾" HH Bolt (2) ¼-inch lock washer (2) ¼-inch flat washer If required by local code or practice, treat with an oxidation inhibitor such as NO-OX. 6 AWG minimum recommended. Torque to 65 in-lb - 7/16" socket.	Use either of two frame ground lug landing locations.  Note: Lug landings are 1/4" on 5/8"and 1" centers. Figure 15 Ground Frame

Battery or Battery Stand Mounted Frame

If required by local code or practice, battery or battery stand mounted frames may be grounded to the frame or chassis of the other equipment. Select a Frame Ground landing at the side of the frame and clean.

Step	Action	
1	Secure Frame Ground connection with provided hardware: (2) ¼-20 x ¾" HH Bolt (2) ¼-inch lock washer (2) ¼-inch flat washer If required by local code or practice, treat with an oxidation inhibitor such as NO-OX. 6 AWG minimum recommended. Torque to 65 in-lb - 7/16" socket.	 Note: Lug landings are 1/4" on 5/8" centers. Figure 16 Ground Short Frame

Connect Central Office Ground (COG)

Step	Action	
1	Secure COG connection with provided hardware: (2) 3/8-16 nut (2) 3/8-inch lock washer (2) 3/8-inch flat washer If required by local code or practice, treat with an oxidation inhibitor such as NO-OX. Torque to 240 in-lb - 9/16" socket.	CO Ground Lug Landing  Figure 17 CO Ground Landing Lug landings are 3/8" on 1" centers Lugs not provided.

Connect Supplemental Frame

This section applies only to installations with an Initial and a Supplemental Frame.

The Initial Frame must be equipped with a Millennium II controller.

Interconnecting bus bars, hardware, and cables are shipped loose with the Supplementary Frame.

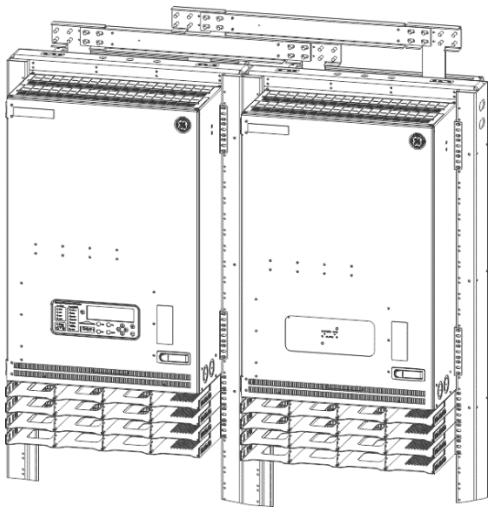
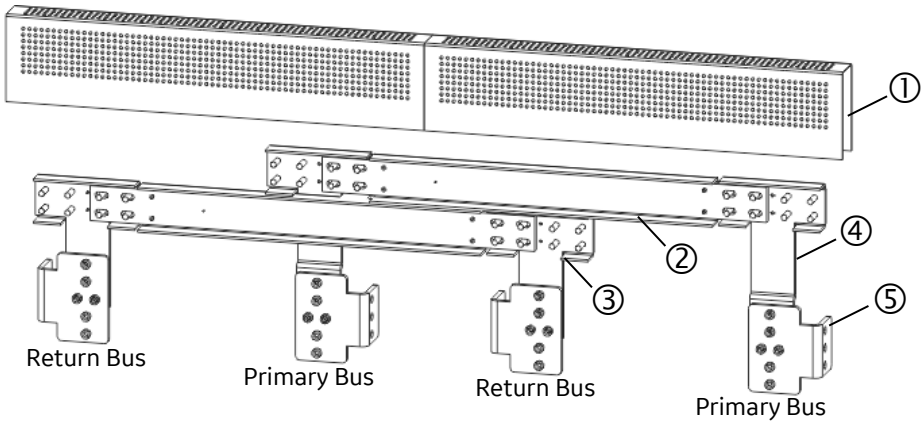


Figure 18 Supplemental Frame

Connect Interframe Bus Bars

Step	Action



① 848414611 Lexan Cover (2)
② 8500051755 Interframe Bus (2
③ 847760204 T-Bus Return (2)
④ 847760196 T-Bus -48V (2)
⑤ 850046677 Link Bus (4)

Interframe Buses - Front View

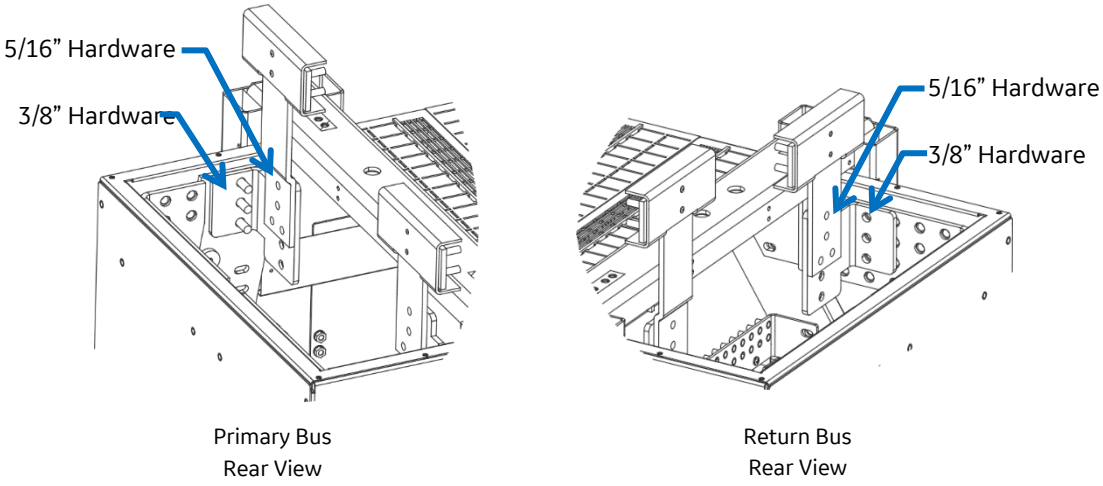


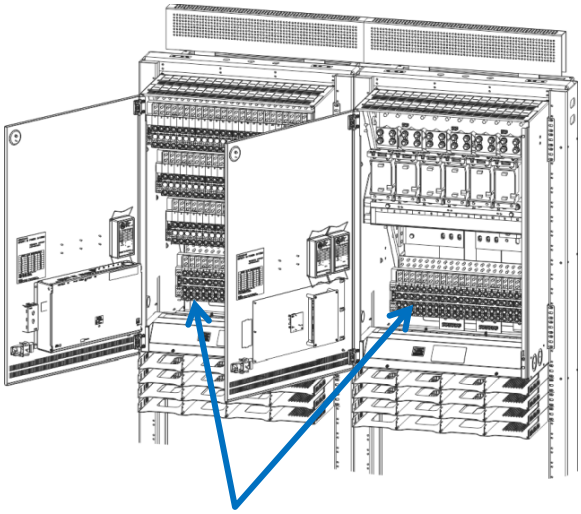
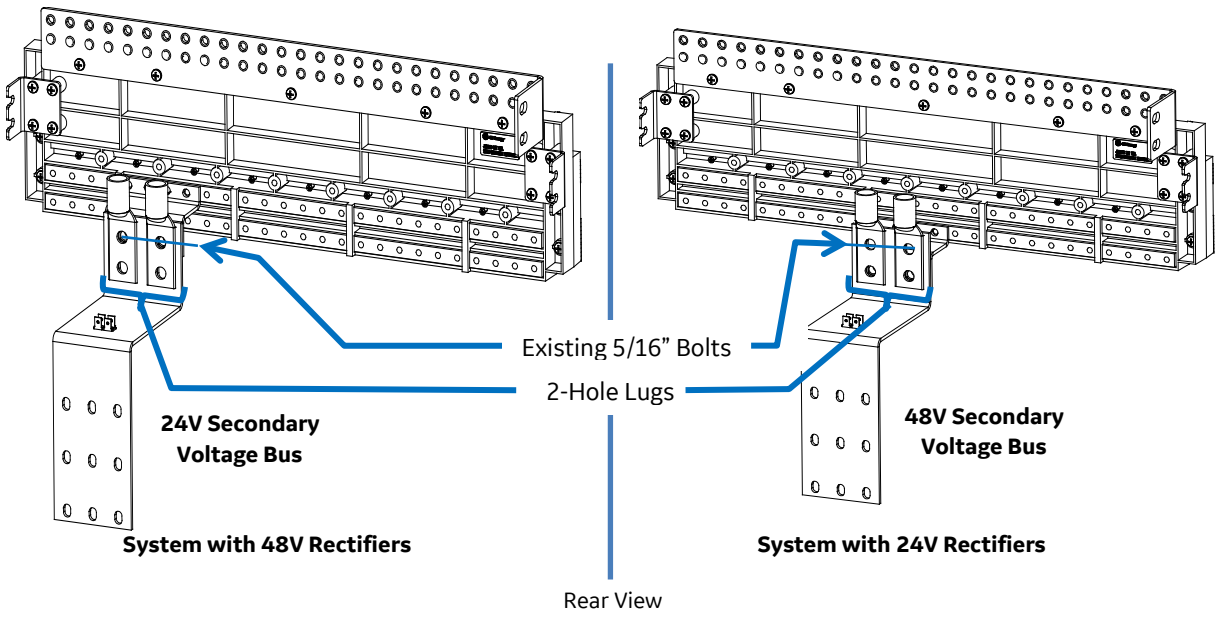
Figure 19 Interframe Bus Bars

WARNING: Energy

Bus bars of systems with powered rectifiers or batteries connected provide hazardous electrical energy.

	Are Initial Frame rectifiers ON or batteries connected?	
	Yes – go to Step 1.	No – go to Step 2.
1	Verify AC power is OFF and Batteries are disconnected. Use appropriate lock-out tag-out procedures before continuing. • Turn all AC breakers off and lock-out tag-out. • Disconnect all batteries.	
2	Attach 850046677 Link Buses ⑤ to Primary voltage-buses and Return buses in both cabinets (4 places). Secure with 3/8" hardware provided – Torque to 240 in-lb (27 Nm) – 9/16" socket.	
3	Attach T-Bus bars ③ & ④ as shown (4 places). Secure with 5/16" hardware provided – Torque to 160 in-lb (18 Nm) – 1/2" socket.	
4	Attach Interframe Bus bars ② as shown (2 places). Secure with M8 hardware provided – Torque to 160 in-lb (18 Nm) – 1/2" socket.	
5	Cover Interframe Bus bars with two 848414611 Lexan Covers ①. Remove paper covering on covers before installing.	

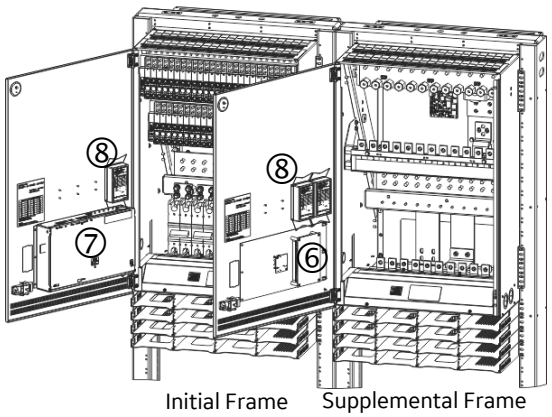
Connect Interframe Secondary Voltage Cables

Step	Action
	WARNING: Energy **Bus bars of systems with powered rectifiers or batteries connected provide hazardous electrical energy.**
	 L635L Dual Voltage Panels Figure 20 L635L Dual Voltage Panel Location Are Initial and Supplemental Frames both equipped with L635L Dual Voltage Distribution Panels in their bottom shelf positions?
	Yes – go to step 1. | No – go to next section.
1	Two 4/0 AWG cables will be installed between the two frames, connecting their secondary buses together. **Systems with 24V rectifiers - install the cables on the 48V secondary buses.** **Systems with 48V rectifiers - install the cables on the 24V secondary buses.**  Figure 21 Secondary Voltage Bus

Step	Action
2	Verify AC power is OFF and Batteries are disconnected. Use appropriate lock-out tag-out procedures before continuing. • Turn all AC breakers off and lock-out tag-out. • Disconnect all batteries.
3	Remove the rear covers of the cabinets in both frames.
4	Connect two 4/0 cables to the Secondary Voltage bus of the Supplement Frame. a. Remove the existing 5/16 bolts connecting the vertical bus link to the L635L panel at the bottom position of the secondary frame. b. Apply 2-hole lugs to both 4/0 cables – lugs provided. Apply heat shrink to the lug shanks. c. Connect the cables to the hole sets. Apply No-Ox. Usethe bolts removed in a. and the 5/16 hardware supplied. d. Torque to 135 in-lbs.
5	Route both new 4/0 Flex cables up through the rear of the secondary frame, across and down to the same positions within the primary frame.
6	Connect two 4/0 cables to the Secondary Voltage bus of the Primary Frame. a. Remove the existing 5/16 bolts connecting the vertical bus link to the L635L panel at the bottom position of the secondary frame. b. Apply 2-hole lugs to both 4/0 cables – lugs provided. Apply heat shrink to the lug shanks. c. Connect the cables to the holes with the cables routing up. Apply No-Ox. Usethe bolts removed in a. and the 5/16 hardware supplied. d. Torque to 135 in-lbs.
7	Replace the rear covers of the cabinets in both frames.

Connect Interframe Signal Cables

Step	Action



⑥ BIC 10
⑦ Millennium II Controller
⑧ Shunt RPM

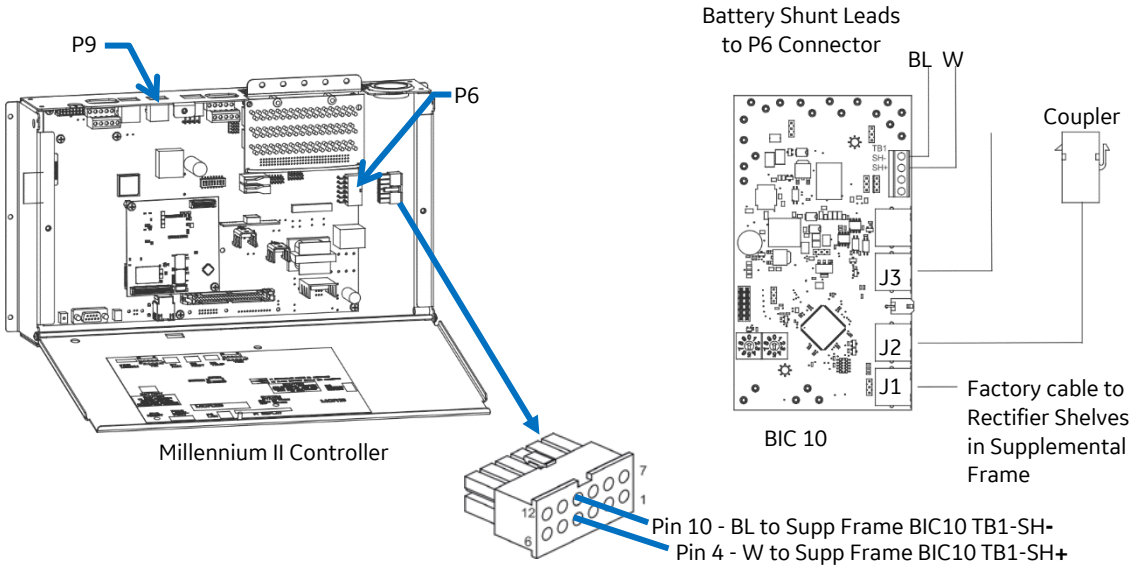


Figure 22 Interframe Cables

Connect RJ45 Cables	
1	Connect 10 ft. RJ45 cable (847690799) into J2 on BIC 10. Route to Millennium II Controller in Initial Frame. Disconnect Factory RJ-45 cable from P9 and insert into Coupler.
2	Connect 10 ft. RJ45 cable (847690799) into J3 on BIC 10. Route to Millennium II Controller in Initial Frame, insert in P9 connector of Millennium II Controller.
Connect Battery Shunt Cable	
3	Connect 20 ft. 2-wire cable (850052873) bare ends to BIC 10 TB1: BL to SH**-**, W to SH**+**.
4	Route cable to Millennium II Controller P6.
5	Connect wires to butt splices on leade of P6 wire set – W to W-BL & BL to BL.
6	After applying power, configure Second battery shunt – see ***Configure Millennium II Controller*** section.

Step	Action

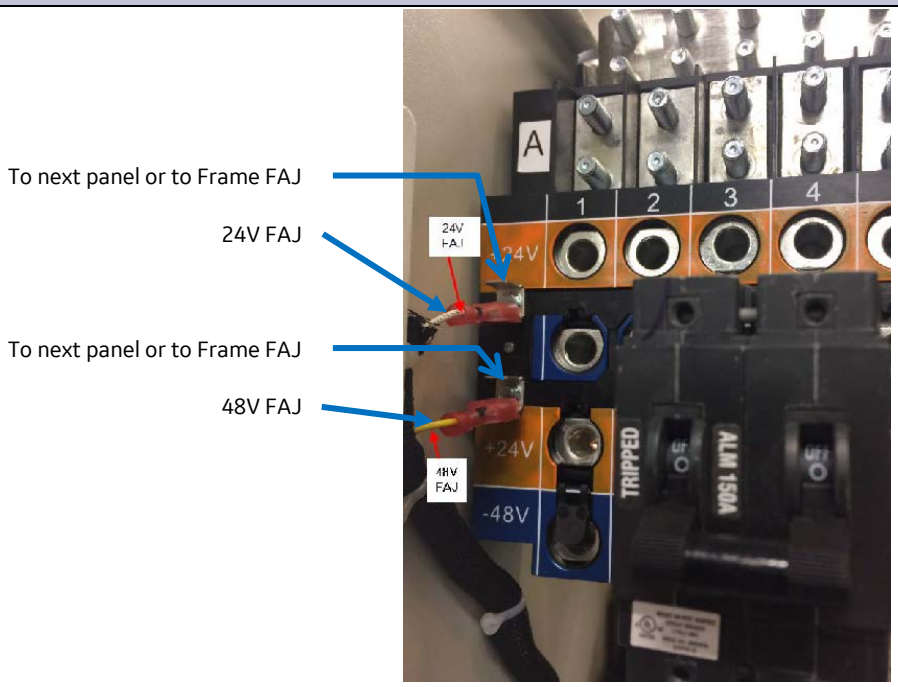


Figure 23 Breaker Panel Alarm Connections

Connect Breaker Panel Alarms	
Each Breaker panel has FAJ Faston® connections on the left side of the panel. Single voltage panels have a either a 24V or a 48V FAJ pin and the selectable panel (if present) has both. Alarms for the Primary voltage in the both frames should be factory jumpered together.	
7	a. Verify that all supplemental frame breaker panel Primary voltage FAJ alarms are jumpered together. b. Connect them to the same FAJ connection on the initial frame (white wire).
8	Connect Secondary voltage FAJ alarm from supplemental frame breaker panel to the same FAJ connection in the Initial frame (yellow wire).

Step	Action

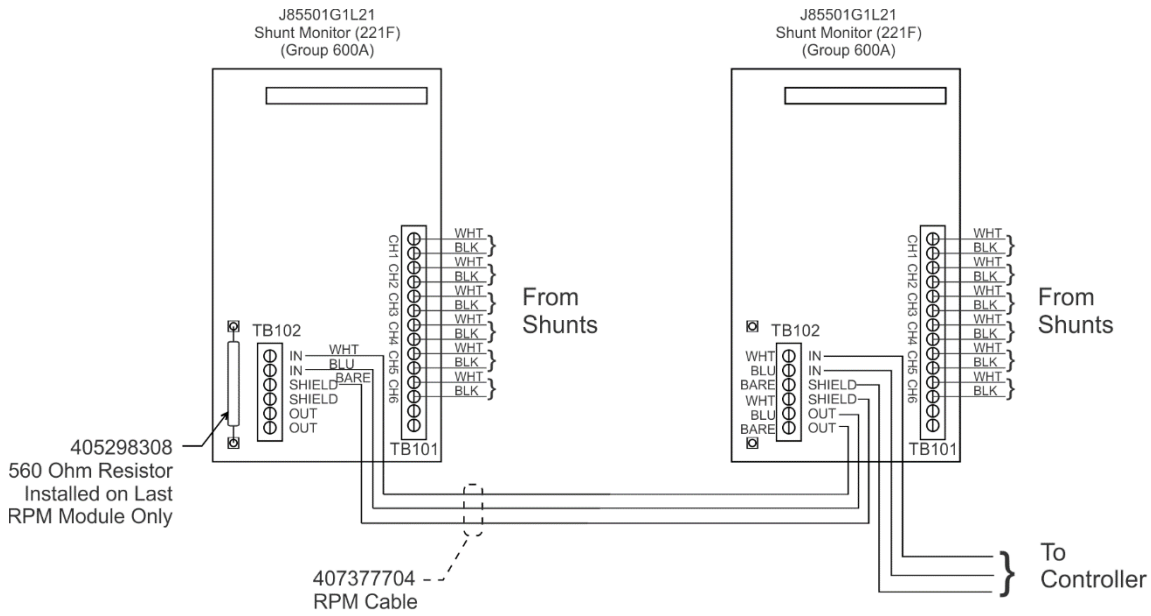
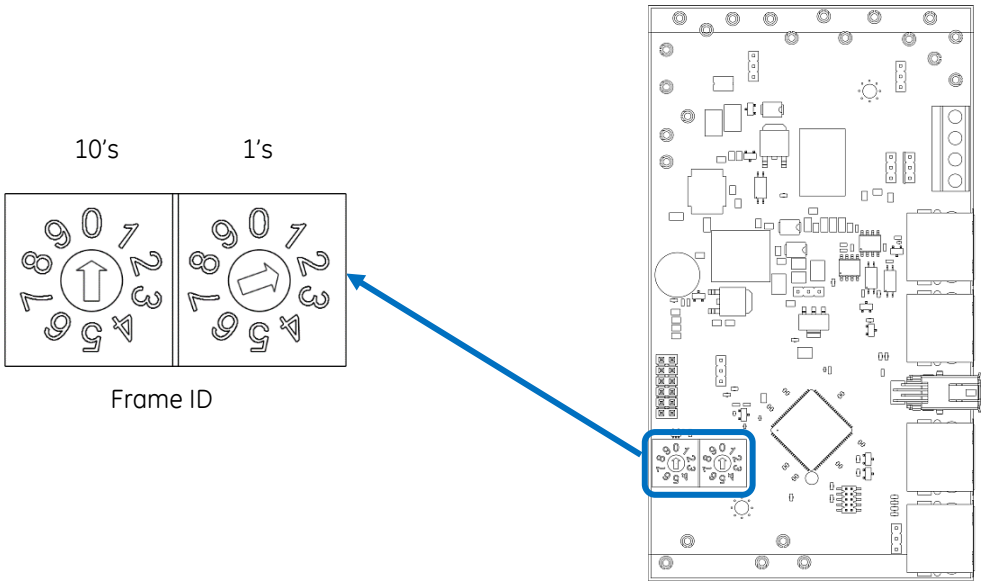


Figure 24 RPM Connections

Connect RPMs		
	RPMs in Supplemental Frame?	
	Yes – go to Step 9.	No – go to next section.
9	Connect 407377704 RPM cable between RPMs as shown.	
10	Set RPMs to unique addressed using RPM SW1 and DW2 rotary switches (refer to RPM manual).	
11	Move 560 Ohm resistor from RPM in Initial frame to the last RPM in the daisy chain in the Supplemental frame. Only the last RPM in the daisy chain should have the resistor.	
12	After applying power a. Configure Plant Shunt 2 for Supplemental Frame -see ***Configure Millennium II Controller*** section. b. Configure the RPM channels per site installation instructions – refer to RPM manual.	

Set Supplemental Frame ID on BIC 10

Step	Action
	
	Figure 25 Set Frame ID on BIC 10
1	Verify Supplemental frame ID is set to 2. (Factory default is Frame 2.)

Install PV/AC Partition Kit – *NE-M Eco* systems only

This section applies only to *NE-M Eco* systems.

NE-M Eco systems power some rectifiers from PV (photo voltaic or solar array) and others from ac, typically a generator.

Each terminal block powering rectifiers can be connected to either PV or ac, but not both.

The PV/AC Partition Kit (150028727) divides the Input panel into separate input sections for PV and AC fed terminal blocks.

The position of the partition is site specific. Follow all site engineering instructions. This position indicated in this section is only an example.

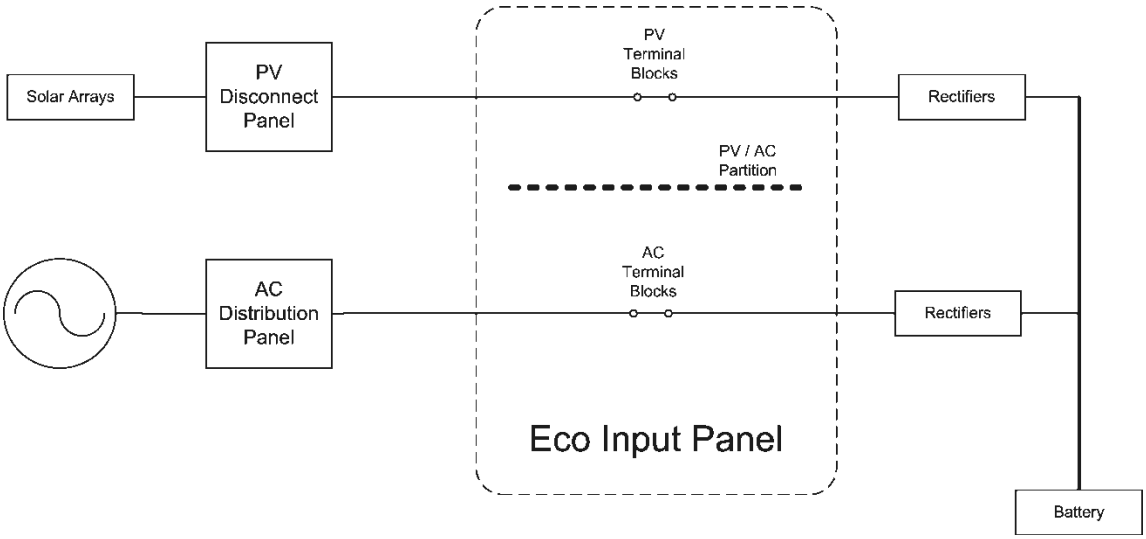
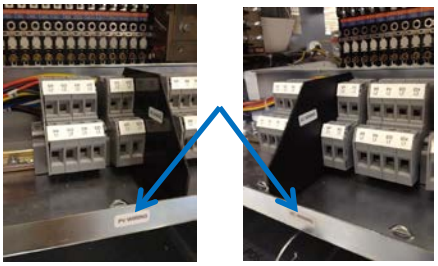


Figure 26 *Eco* Input Panel

CAUTION: Personal injury and Equipment Damage
PV Disconnect Panel with disconnects rated at 300Vdc on each PV conductor is required for use with Solar Arrays (PV sources).

Step	Action	
1	Remove the Input Panel cover (4 captive screws).	 Figure 27 Input Panel Screws
2	Apply labels onto PV/AC Partition as shown. • Place "PV WIRING" label on the left (PV) side of partition. • Place the "AC WIRING" label on the right (AC) side of partition.	 Figure 28 Partition Labels
3	Make space for the PV/AC Partition - Separate DIN rail Terminal Blocks to make space for the PV/AC Partition. Loosen screws securing all DIN spacer blocks to the left of the Partition location specified in the site engineering instructions.	

Step	Action	
4	Slide Terminal Blocks and spacer to the left of the Partition location to the left to allow installation of the PV/AC Partition.	 Figure 29 Partition Insert
5	Install PV/AC Partition in the location specified in the site engineering instructions. Snap the Partition onto the DIN rail.	
6	Slide the loosened Terminal Blocks and spacer block to the right snugly against the Partition. The Partition lower edge will be under the Terminal Block on its left.	
7	Tighten screws securing all DIN spacer blocks s to the left of the Partition.	
8	Apply labels to the Input Panel chassis. • Place "PV Wiring" label on the left (PV) side of partition. • Place the "AC Wiring" label on the right (AC) side of partition.	 Figure 30 Label Input Panel
9	Replace the Input Panel cover and secure fasteners.	
10	Apply 2 labels to Input Panel cover in any available space. • Warning label • Max Power-Point label	 Figure 31 Label Input Panel Cover

Connect Input Power

WARNING: Shock Hazard
Disconnect all input branch circuits prior to making input connections to the system. When connecting to any source, ensure compliance to all local and national wiring rules.

CAUTION: Equipment Damage
PV inputs must be current limited to 11A maximum.

Terminal Block are arranged to allow addition of shelves (to the bottom) and terminal blocks (from the inside out).
Shelves 1 through 7 may be rectifier shelves.
Additional converter only shelves may be added as needed – no AC power provided.

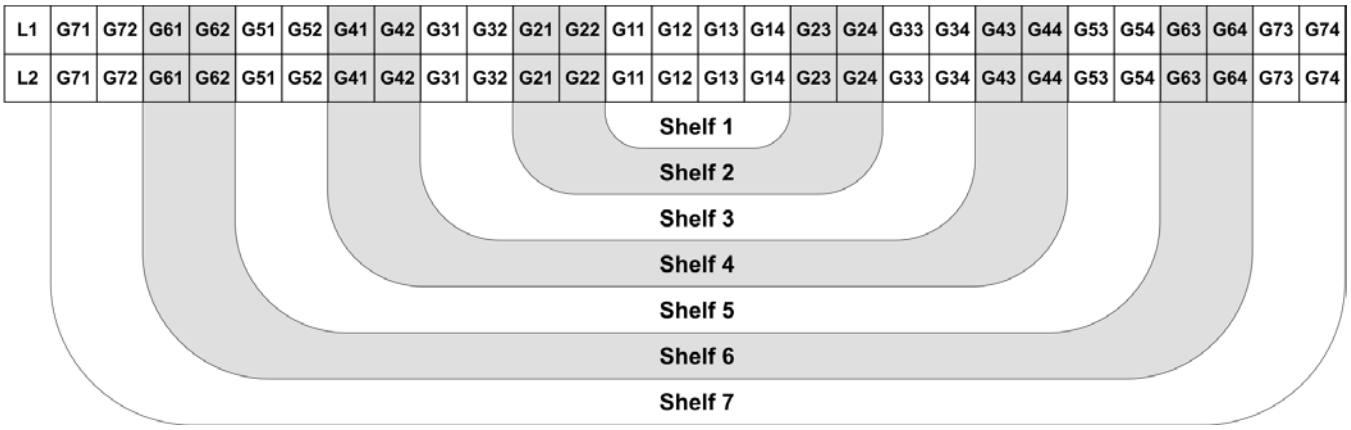


Figure 32 Input Power Terminal Block Positions

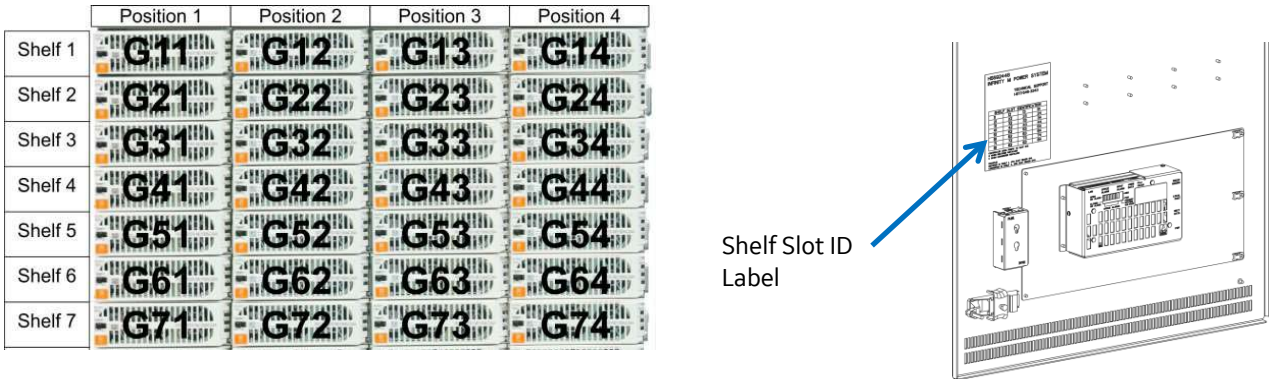


Figure 33 Rectifier / Converter and Shelf Numbering

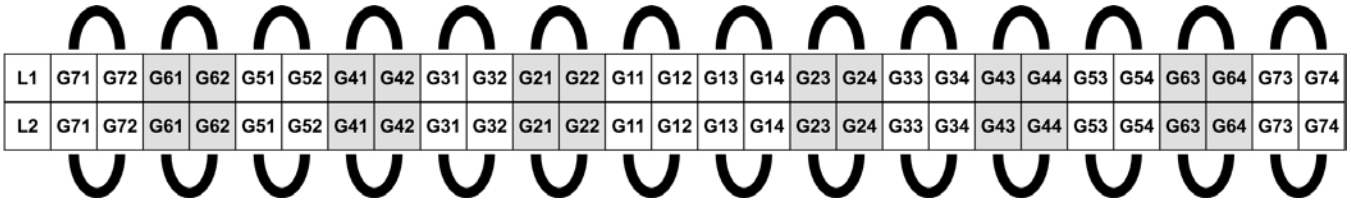


Figure 34 Rectifier Dual Feed Jumper Positions – ac feeds only

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>1</td><td>Route and attach conduit or other commercial fittings.

Input power is connected to terminal blocks located within the Input Panel. Terminal blocks for up to 7 rectifier shelves may be present.

AC Bridging jumpers[13]
• AC inputs – jumpers may be installed to power two rectifier positions with one AC feed.
• PV inputs - Do not apply AC bridging jumpers. Each PV feed must power a single rectifier.

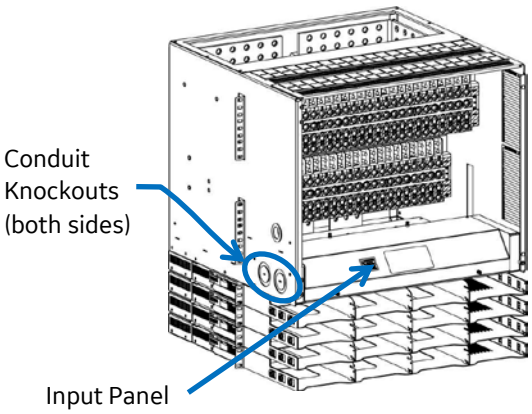
Figure 32 shows Input Power Terminal Block Positions.</td><td> 

Figure 35 Input Conduit Locations</td></tr>
<tr><td></td><td colspan="2">AC input feeds to rectifier pairs?</td></tr>
<tr><td></td><td>Yes – go to Step 2.</td><td>No – go to Step 4.</td></tr>
<tr><td>2</td><td>Snap loose L1 and L2 plastic dividers on Input terminal blocks for each single fed rectifier pair.

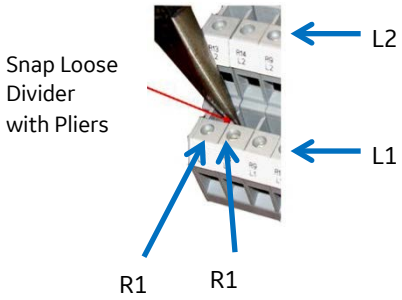
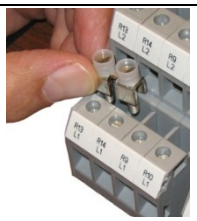
Figure 34 shows rectifier AC dual feed jumper positions.</td><td> 

Figure 36 Input Jumper Dividers</td></tr>
<tr><td>3</td><td>Install AC bridging jumpers connecting each AC fed rectifier pair L1 positions.

Install AC bridging jumpers to connect each AC fed rectifier pair L2 positions.

Torque to 10 in-lb.</td><td> 
R13 and R14
L1 Bridging Jumper

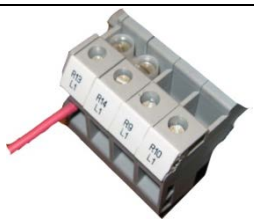
 
R13 and R14
L1 AC feed

Figure 37 AC Bridging Jumper</td></tr>
<tr><td></td><td colspan="2">CAUTION: Equipment Damage or Malfunction
NE-M Eco systems must keep PV input feeds separate from AC input feeds.
The PV/AC partition separates PV inputs from AC inputs.
Connect PV input feeds only to the PV section of the Input Panel.
Connect AC input feeds only to the AC section of the Input Panel</td></tr>
<tr><td></td><td colspan="2">CAUTION: Equipment Damage or Malfunction
NE-M Eco systems PV input feeds must be connected as follows:
Positive PV to L1
Negative PV to L2.</td></tr>
</table>

[13] shipped with each system

Step	Action	
4	Pull and terminate input feed wires to the terminal blocks in the Input Panel. • ac input feeds to the AC section of the Input Panel • PV input feeds to the PV section of the Input Panel Positive PV to L1 Negative PV to L2. Torque to 10 in-lb. ***Figure 33*** shows rectifier and shelf numbering.	 PV Section *NE-M* Eco only ac Section *NE-M* Eco only PV/AC Partition *Eco* only Figure 38 Input Panel Sections

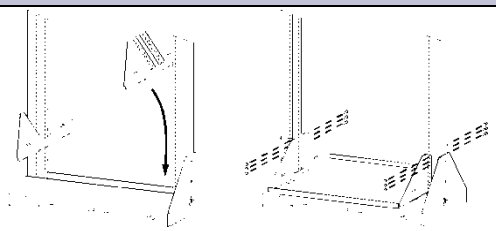
Table 2 Conduit Size - Input Feed

#[14] of AC Feeds	Rectifiers per Conduit	Rectifiers per feed	Min. External Breaker	Wire Gage	Minimum Conductor Rating[15]	Conductors per Conduit[16, 17]	Conduit Size (minimum)
AC Feeds NE075AC48xxxx at 200-240V~ or 200-277V~, 22A							
(16)	4	1	30A (4)	8	33.5A (55A*0.87*0.7)	9 (70% derated)	1”
(28)	7	1	30A (7)	6	32.6A (75A*0.87*0.5)	15 (50% derated)	1-1/2”
(24)	6	2	60A (3)	6	52.2A (75A*0.87*0.8)	7 (80% derated)	1”
AC Feeds NE0100AC24xxxx and NE050AC48xxxx at 200-240V~ or 200-277V~, 15A NE055AC48xxxx at 200-240V~ or 200-277V~, 16A							
(28)	7	1	20A (7)	10	17.4A (40A *0.87*0.5)	15 (50% derated)	1”
(28)	15	1	20A (15)	10	15.7A (40A *0.87*0.45)	31 (45% derated)	1-1/2”
(28)	10	1	20A (10)	8	23.9A (55A *0.87*0.5)	21 (50% derated)	1-1/2”
(24)	6	2	40A (3)	8	38.3 (55A*0.87*0.8	7 (80% derated)	1”
(28)	8	2	40A (4)	6	45.7A (75A*0.87*0.7)	9 (70% derated)	1-1/2”
PV Feeds							
(28)	7	1	15A/300Vdc (7)	12	17.4A (40A*0.87*0.5)	15 (50% derated)	1”
(28)	10	1	15A/300Vdc (10)	12	17.4A (40A*0.87*0.4)	21 (50% derated)	1-1/2”

[14] 28 power units maximum in 7 power shelves maximum.
[15] Based on NEC: 90°C Conductor, 45°C Ambient, and Number of Wires in Conduit.
[16] Includes 1 ground per conduit - not considered in derating.
[17] AC and PV feeds must be in separate conduits.

Install Battery Trays

Optional battery trays are suitable for use with general trade batteries such as Northstar Battery NSB110FT and NSB170FT.

Step	Action	
1	Position the battery tray in the frame with frame mounting brackets on both front and back of frame as shown. Secure with provided screws. Torque to 35 in-lb – 5/16" socket.	 Figure 39 Battery Trays

Install Batteries

WARNING: Energy and Chemical Burn
All batteries contain hazardous electrical energy.
Lead-acid batteries contain sulfuric acid and explosive hydrogen gas.
Follow all precautions noted in the literature accompanying the batteries.
Use only insulated tools.

CAUTION: Equipment Damage
Equipment frame anchoring, load rating, and seismic zone rating should be verified before field installing trays and batteries.

Tray Mounted Batteries

The system can be configured with battery trays sized for various batteries and may include optional factory installed battery disconnect or battery mid-string voltage and temperature monitoring units. Compatible batteries include:

- Power Battery CSL-12100
- GE East Penn 12AVR100-3ET
- Equivalent 100 AH front-terminal batteries
- North Star NSB110
- North Star NSB170
- GE East Penn 12AVR150-3ET
- Equivalent 110-170AH front-terminal batteries

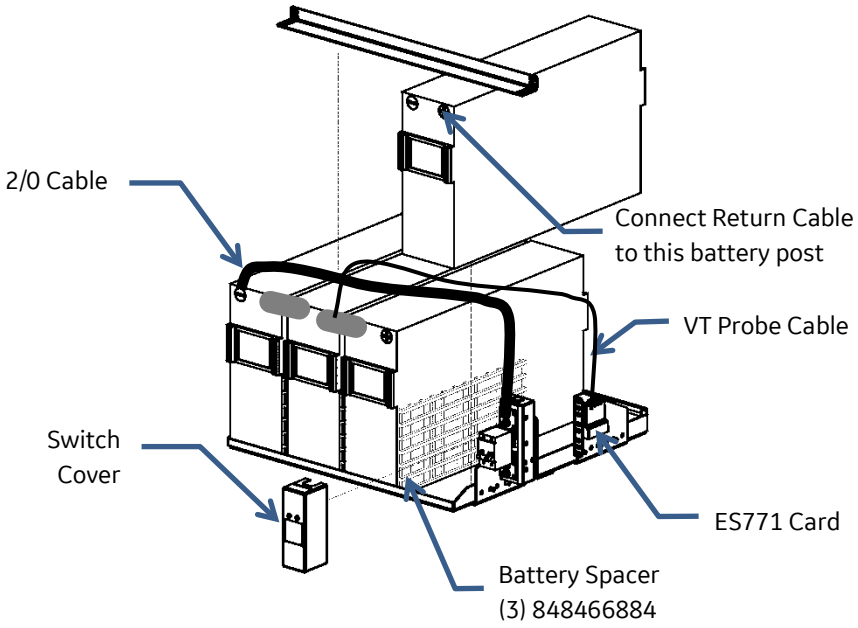


Figure 40 Batteries in Tray – 48V

Step	Action
	Notes: 1. Steps show four 12V batteries per shelf – one string of -48V batteries. 2. 1 Battery Disconnect Switch per shelf shown. Other options • 2 Battery Disconnect Switches per shelf (left and right) (two 24V battery strings per shelf) • 1 or 2 Anderson Disconnects per shelf • No Battery Disconnect Switches or Anderson Disconnects - Battery cables shipped loose.
1	Place four batteries on each battery tray.
2	Position three Battery Spacers between the batteries.

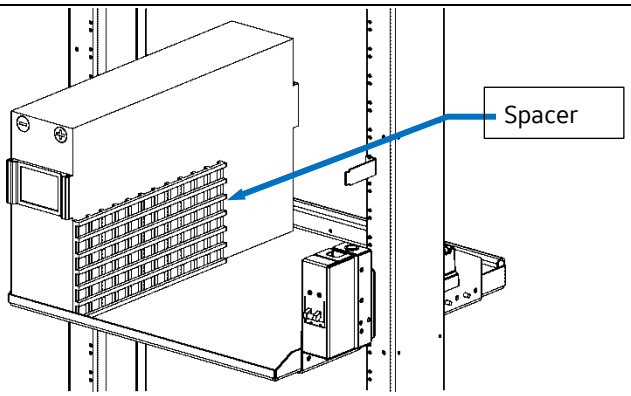


Figure 41 Place Batteries

3	**48V Battery Strings:** Interconnect three inter-cell bus bars to configure one 48V battery string per the battery manufacturer's instructions. **24V Battery Strings:** Interconnect two inter-cell bus bars to configure two 24V battery strings per the battery manufacturer's instructions.
4	Attach the battery securing top rail.

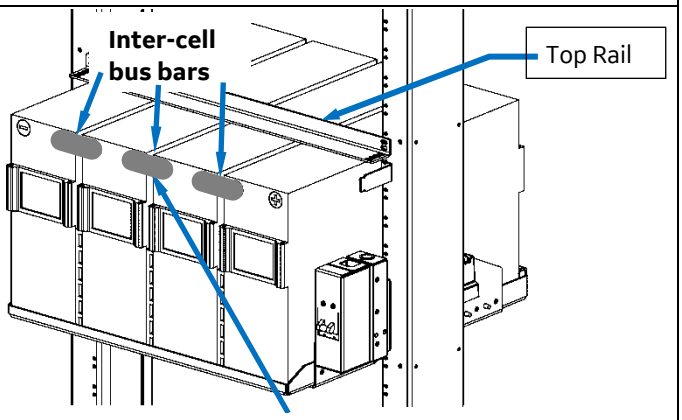


Figure 42 Battery Inter-Cell Bus Bars

External Batteries

Step	Action	
1	Place batteries on battery trays, battery stands, or other satisfactory supporting surface and interconnect per manufacturer's instructions to create 24V or 48V strings as required.	
	Is an external disconnect switch being used?	
	Yes – go to Step2.	No – Finished.
2	Physically mount switch to an appropriate place and ensure it is in the OFF position prior to making any connections	
3	Connect the battery hot conductor(s) to the line side of the disconnect switch and torque connection per manufacturer's specification.	
4	Connect the load side conductor to the disconnect switch and torque connection per manufacturer's specification.	

Connect Batteries

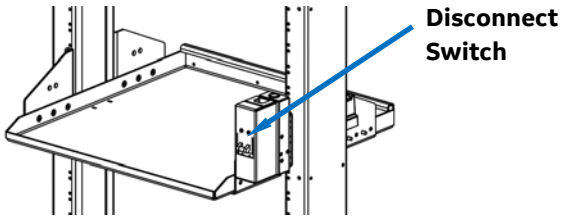
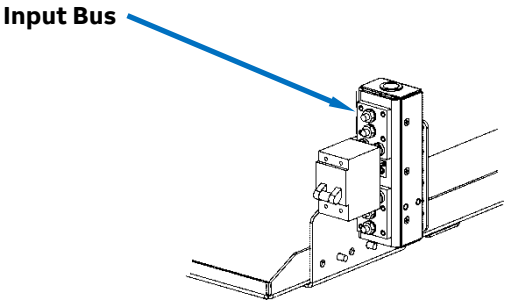
Connect Tray Mounted Batteries

Go to the procedure for the disconnect method provided on the trays:

- ***Battery Disconnect Switch Connection***
- ***Anderson Connector Connection***
- ***Direct to Battery Bus Connection***

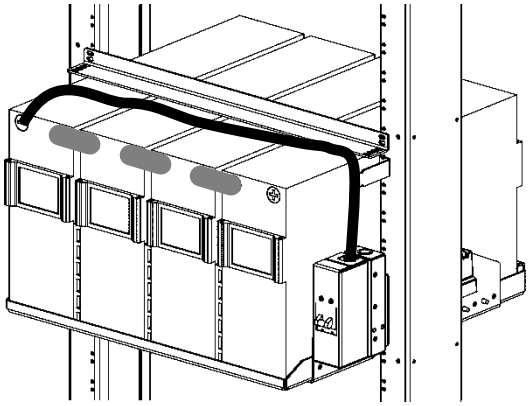
Battery cables from factory mounted battery trays are factory installed and terminated to the distribution panel.

Battery Disconnect Switch Connection

Step	Action	
1	Ensure disconnect switch is in the OFF position (downward) prior to making any connections. Remove the two 6/32 screws to remove the plastic cover.	 Figure 43 Battery Disconnect Switch
2	Connect one end of the 2/0 cable to the input bus of the disconnect switch with 1/4-20 hex nuts provided. Torque to 65 in-lb – 7/16" socket.	 Figure 44 Batt Disconnect Switch Input Bus
3	Re-attach clear plastic cover to disconnect switch and secure with 6-32 screws.	

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td rowspan="3">4</td><td colspan="2">Connect Battery Cable (hot side)</td></tr>
<tr><td>48V Battery Strings

Connect the 2/0 cable between the V- post of the left-most battery and the input bus of the disconnect switch.

Torque to battery manufacturer’s specification.</td><td> 
Figure 45 Battery Cable -48V</td></tr>
<tr><td>24V Battery Strings

Connect the 2/0 cable between the V+ post of the right-most battery of the left string and the input bus of the left disconnect switch.

Connect the 2/0 cable between the V+ post of the right-most battery of the right string and the input bus of the right disconnect switch.

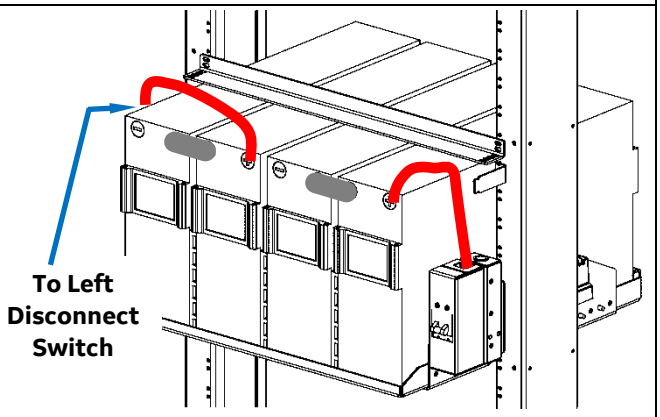
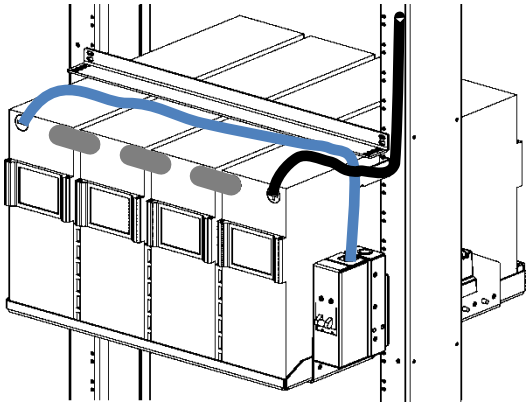
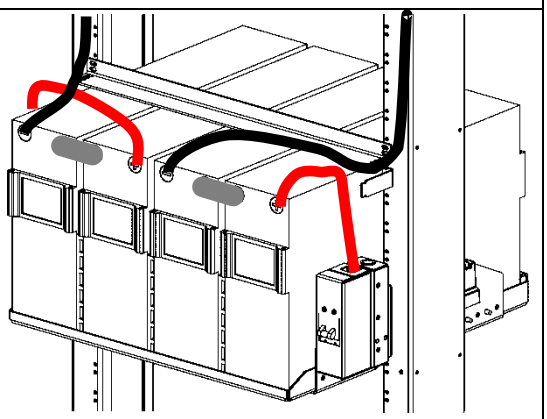
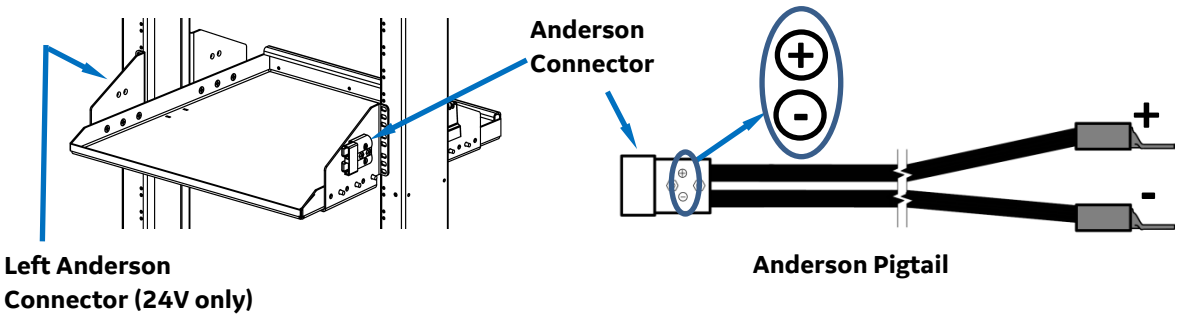
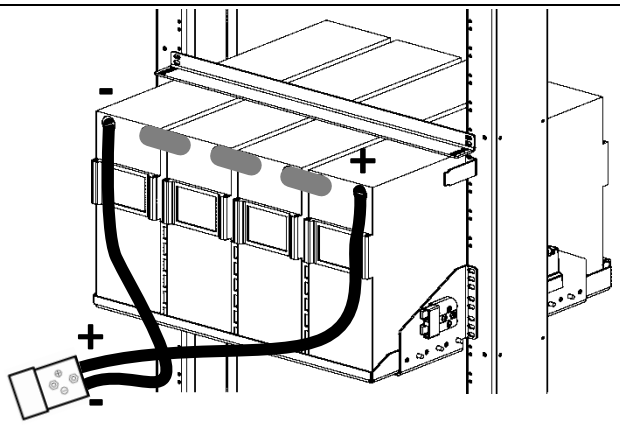
Torque to battery manufacturer’s specification.</td><td> 

Figure 46 Battery Cable +24V</td></tr>
</table>

Step	Action	
5	Connect Battery Return Cable (ground side)	
	48V Battery Strings Connect the factory-wired battery return cable to the V+ post of the right-most battery. Torque to battery manufacturer's specification.	 Figure 47 Battery Return Cable -48V
	24V Battery Strings Connect the factory-wired battery return cables to the V- posts (left most posts) of both strings. Torque to battery manufacturer's specification.	 Figure 48 Battery Return Cable +24V
	Battery installation is complete. Follow site engineering instructions regarding when to turn the disconnect switches ON.	

Anderson Connector Connection

Step	Action
	 Figure 49 Anderson Battery Connector
1	Connect Anderson pigtail terminals to battery string positive and negative terminals. **Positive** Anderson Pigtail terminal to the **Positive** (right-most) battery terminal **Negative** Anderson Pigtail terminal to the **Negative** (left-most) battery terminal. Torque to battery manufacturer's specification.
	Battery installation is complete. Follow site engineering instructions regarding when to mate the Anderson connectors.



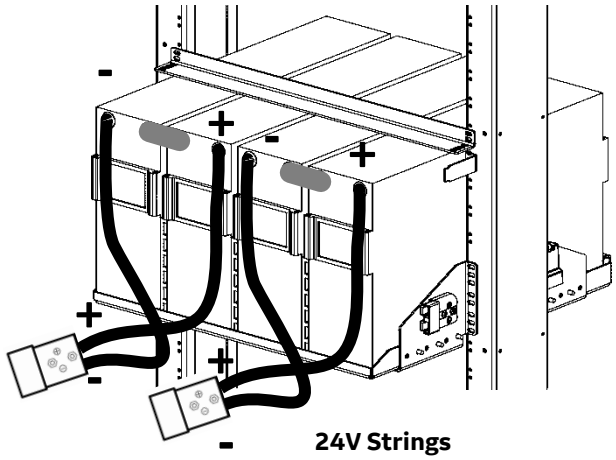
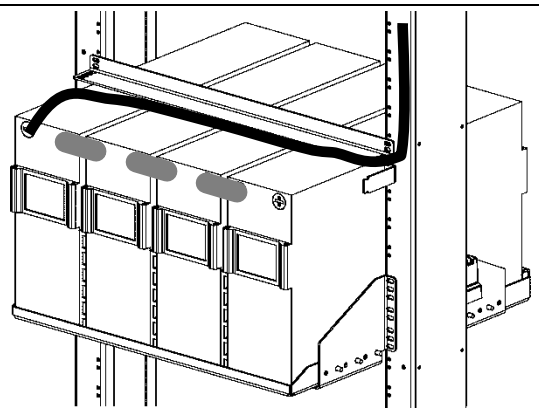
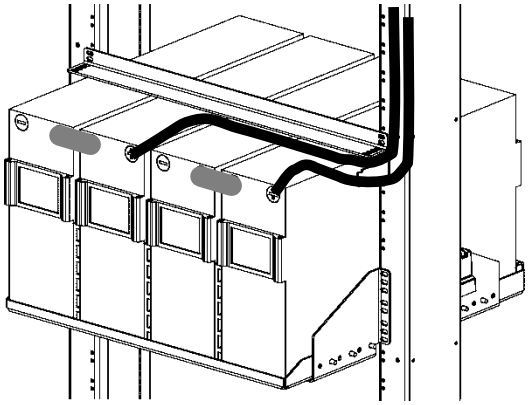
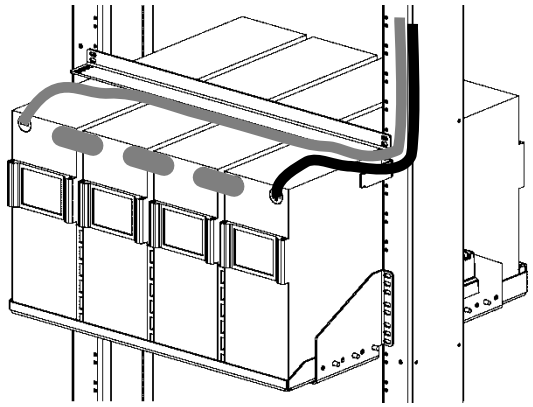
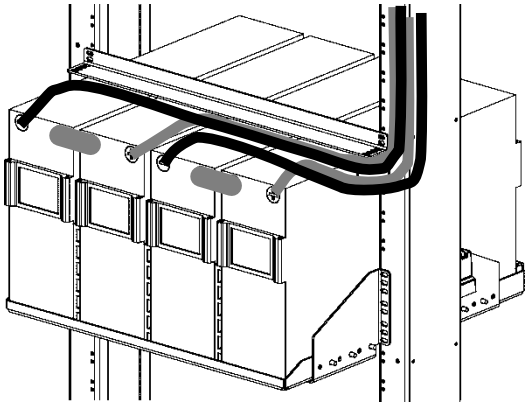


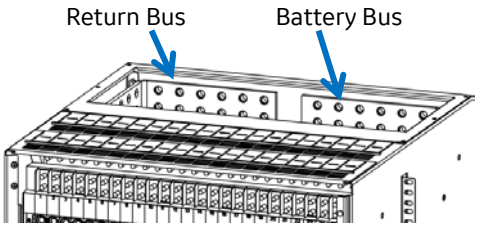
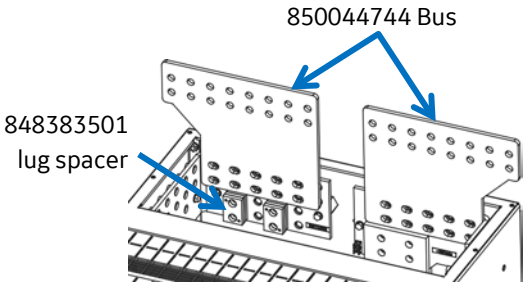
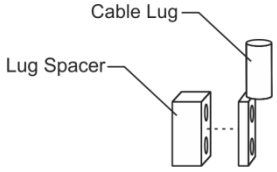
Figure 50 Battery Connections - Anderson

Direct to Battery Bus Connection

Step	Action	
	Direct battery bus connections are not factory installed.	
1	Run cables from the battery buses to the tray mounted battery strings. Insulate the battery end of the cable.	
2	Make battery cable connections to the system battery bus per the procedure in the ***Connect External Batter*** section.	
3	Connect Battery Cable (hot side)	
	48V Battery Strings Connect the 2/0 cable between the V- post of the left-most battery and the input bus of the disconnect switch. Torque to battery manufacturer's specification.	 Figure 51 Battery Cable Direct -48V
	24V Battery Strings Connect the 2/0 cable between the V+ post of the right-most battery of the left string and the input bus of the left disconnect switch. Connect the 2/0 cable between the V+ post of the right-most battery of the right string and the input bus of the right disconnect switch. Torque to battery manufacturer's specification.	 Figure 52 Battery Cable Direct +24V
4	Connect Battery Return Cable (ground side)	
	48V Battery Strings Connect the factory-wired battery return cable to the V+ post of the right-most battery. Torque to battery manufacturer's specification.	 Figure 53 Battery Return Cable Direct -48V

Step	Action	
	24V Battery Strings Connect the factory-wired battery return cables to the V- posts (left most posts) of both strings. Torque to battery manufacturer's specification.	 Figure 54 Battery Return Cable Direct +24V
	Battery installation is complete.	

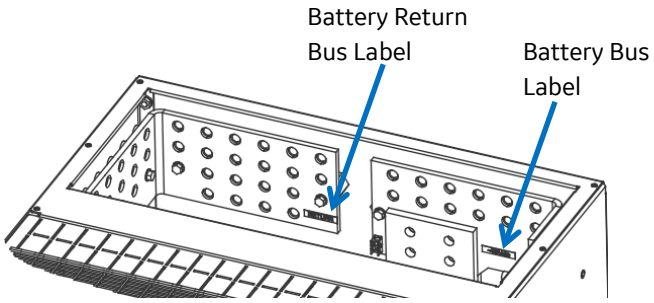
Connect External Batteries

Step	Action	
1	**Battery and Return Cable Connections** Secure Battery Cable lugs with hardware (per cable): (2 sets) 3/8-16 bolt, lock washer, and flat washer. If required by local code or practice, treat with an oxidation inhibitor such as NO-OX. Torque to 240 in-lb - 9/16" socket. **Notes**: Lug Landings are 3/8" on 1" centers spaced 1.30" apart. For lugs wider than 1.25", use every other connection (6 total battery connections). For additional battery landings, install two 850044744 bus bars as shown. Additional return connections can also be made by installing 848383501 lug spacers on the lower row of landings as shown (8 total).	 Figure 55 External Battery Connections (Lower row of landings not visible.)  Figure 56 Battery Additional Landings Lug landings are 3/8" on 1" centers Lugs not provided.  Figure 57 Battery and Return Bus Lug Spacers

Connect Battery Probes

Battery probes are optional controller peripherals.
See the controller manual and instructions accompanying the probes.

Verify Battery Bus Voltage and Polarity

Step	Action
CAUTION: Equipment Damage **Do not install rectifiers before battery bus voltage and polarity has been verified.** **Rectifiers and system damage will result from incorrect battery bus polarity.** **The damage may not be immediately evident.**	
1	Verify that the measured voltage matches the bus label using a meter.  Figure 58 Battery Bus Labels

Connect Load Wiring

WARNING: Shock Hazard and Equipment Damage
Do not install circuit breakers or load fuses until the load equipment is ready to be energized.

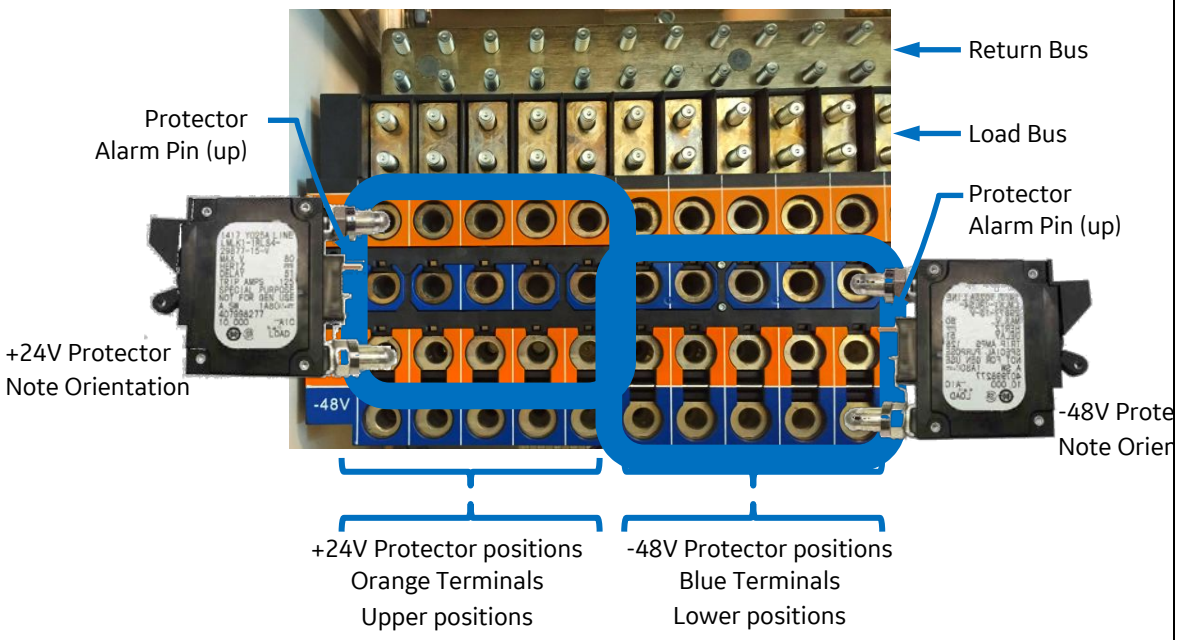
When a load is ready to be energized

1. **Connect the load to the distribution panel.**
2. **Install the circuit breaker of fuse.**

CAUTION: Equipment Damage
Ensure Circuit Breakers are in the OFF position prior to installation.
Ensure Fuse Holders are empty prior to installation.

Notes:

1. Connect the Load Return cable before the Load cable for each load.
   The Load Return connection is blocked by the Load cable, if installed.
2. Follow steps of each section below as appropriate to breakers and fuses to be installed.
3. Repeat steps of each section as appropriate.
4. Bolt-in breakers/fuse holders may be factory installed.
5. Bullet Terminal distribution panels accept Bullet Terminal Circuit Breakers, TPS Fuse Holders, and GMT Fuse Modules.
6. GMT Modules must be installed before loads are connected to the GMT Module.

1-Pole Breakers and TPS Fuse Holders (bullet)	
	• **+24V protectors install into ORANGE positions** • **-48V protectors install into BLUE positions** Bullet Distribution Panels are either Single Voltage or Selectable Voltage: • Single Voltage Panels – all positions of the panel are +24V (Blue) or -48V (Orange). • Selectable Voltage Panels – each position of the panel may be either +24V or -48V.  Figure 59 Bullet Distribution Panel - Selectable Voltage
1	Lug Landings – 1/4" on 5/8" centers. Secure Load and Return Cable connections with provided 1/4-20 nuts. Torque to 65 in-lb - 7/16" socket.
2	Verify voltage and polarity between the Return bus and each distribution input bus using a voltmeter.
3	Verify wiring polarity at the input of the load equipment.
4	Install breaker or fuse holder as shown above. Leave breaker switches in the OFF position and do not install load fuses until the load equipment is ready to be energized.

2-Pole and 3-Pole Breakers (bullet)	
	 Figure 60 2-Pole and 3-Pole Breaker Install
1	Install adapter buses on Return bus with studs facing to rear to all proper clearance. Secure Two-Pole or Three-Pole adapter buses to the distribution Load and Return buses with provided 1/4-20 nuts. Torque to 65 in-lb - 7/16" socket.
2	Secure Load Cable connections with provided hardware (per cable): Adapter with Lug Landings 1/4" on 5/8" centers (2)1/4-20 nut (2)1/4-inch lock washer (2)1/4-inch flat washer Torque to 65 in-lb - 7/16" socket. Adapter with Lug Landings 3/8" on 1" centers (2)3/8-16 nut (2)3/8-inch lock washer (2)3/8-inch flat washer Torque to 240 in-lb - 9/16" socket.
3	Verify voltage and polarity between the Return bus and each distribution input bus using a voltmeter.
4	Verify wiring polarity at the input of the load equipment.
5	Install breaker as shown above. Leave breaker switches in the OFF position and do not install load fuses until the load equipment is ready to be energized.

GMT6A Style Fuse Module (bullet)	
	 Figure 61 GMT Fuse Module
1	GMT6A Module must be installed before load connection is made. Install GMT Module into specified bullet positions: -48V (Blue) or +24V (Orange). Secure GMT Module Return bus bar to the distribution panel Return bus bar with provided nuts. Note: Return bus on GMT Module is adjustable for -48V or for +24V installation – see GMT Module Installation Guide. Torque to 65 in-lb - 7/16" socket.
2	Strip Load and Load Return wires 3/8" and secure in the GMT module terminal block. Torque to 13 in-lb - screw driver.
3	Dress and wire tie with service loop to provide strain relief.
4	Verify voltage and polarity between the Return bus and each distribution input bus using a voltmeter.
5	Verify wiring polarity at the input of the load equipment.
	Do not install load fuses until the load equipment is ready to be energized.

Bolt-In Breakers or TPL-C Fuse Holders

- Bolt-in breakers must be installed before load connection is made.
- Bolt-in breakers can either be factory installed or field installed.
- Breaker kits include mounting hardware, load bus bars, and signal cables (alarm and shunt monitoring).
- Load Return bar may be at the top of the bolt-in panel or at the top of the frame.
- Kits include a load shunt that must be wired to an RPM Shunt Module to monitor the current (Millennium II Controller only).
- Breaker kits are 1-pole, 2-pole, or 3-pole depending on the ampacity of the breaker.

Discard any excess hardware.

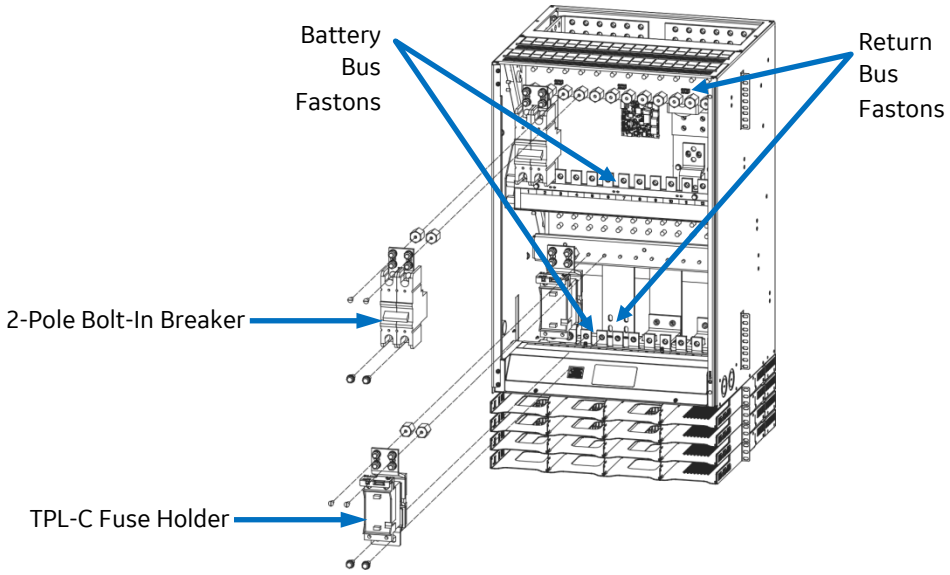


Figure 62 Bolt-In Breaker or Fuse Holder Mounting

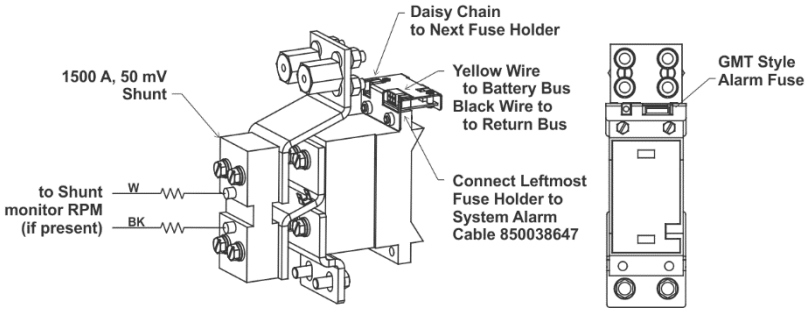


Figure 63 Bolt-in TPL-C Fuse Holder Wiring

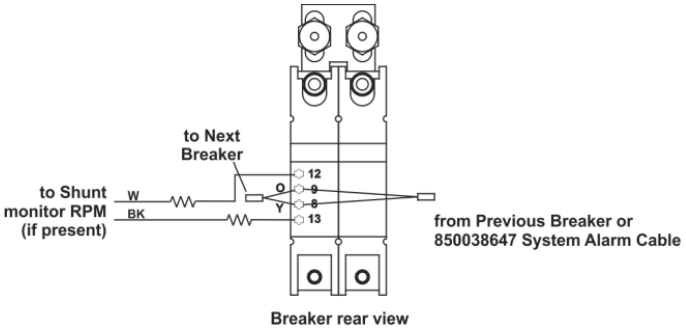
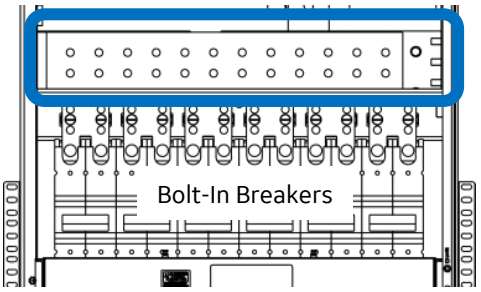


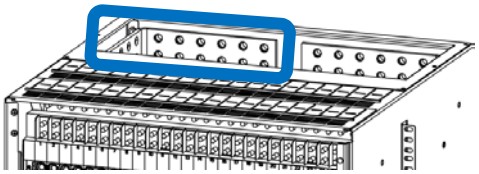
Figure 64 Bolt-in Breaker Wiring

<table>
<tr><th colspan="3">Bolt-In Breakers or TPL-C Fuse Holders</th></tr>
<tr><td>1</td><td colspan="2">For bolt-in breakers only (skip this step for fuse holders)
Assemble load bus bar to breaker using provided screws, nuts, and washers.

Torque nuts to 240 in-lb – 9/16” socket.</td></tr>
<tr><td>2</td><td colspan="2">Install shunt monitor cable and alarm daisy chain cable and to breaker or fuse holder.
Alarm cables daisy-chain from 850038647 cable through all bolt in breakers.
1. Connect alarm cable to pins 8 & 9.
2. Connect shunt monitor cable to pins 12 & 13 (if equipped with shunt monitor RPM).</td></tr>
<tr><td>3</td><td colspan="2">Install Bolt-in breaker(s) into specified position using provided hardware.
1. Install standoffs - torque to 65 in-lb.
2. Secure load bus to standoffs with flat head screws - torque to 65 in-lb.
3. Secure breaker to load bus with 3/8” bolt, lock washer, and flat washer – torque to 240 in-lb – 9/16” socket.</td></tr>
<tr><td>4</td><td>Secure Load Cable connections with provided hardware (per cable):
(2) 3/8-16 nut or bolt
(2) 3/8-inch lock washer
(2) 3/8-inch flat washer

Torque to 240 in-lb - 9/16” socket.

Note: Load Return bar for bolt-in panel may be at the top of the bolt-in panel or at the top of the frame.</td><td> 

Top of Panel Return Bus
 
Top of Frame Return Bus
Figure 65 Bolt-in Position Return Bar</td></tr>
<tr><td>5</td><td>Connect breaker or fuse holder alarm to the system.

Cabinets come equipped with an 850038647 alarm cable for each bolt-in protector panel. Pull the 2-pin connector from the wiring bundle along the left side of the cabinet.

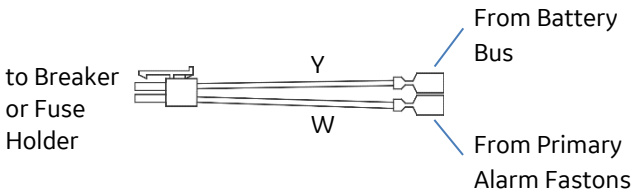
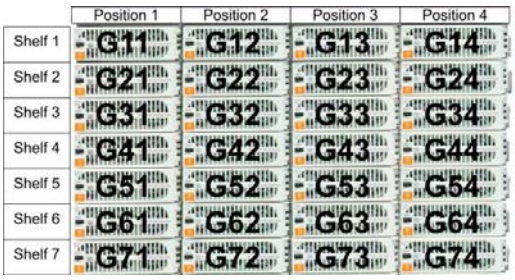
Connect the leftmost (first) breaker or fuse holder to the 2-pin connector of the 850038647 cable.
Daisy chain alarms between additional breakers and fuse holders.</td><td>Connects to leftmost breaker of fuse holder of each panel.
 

Figure 66 850038647 Alarm Cable</td></tr>
<tr><td>6</td><td colspan="2">Connect breaker or fuse holder shunt wires to a shunt monitor RPM (if equipped) – ***Figure 64***
1. Route black and white shunt monitoring wires to a shunt monitor RPM on the front door.
2. Identify the shunt wire pair for labeling RPM channels.
3. Connect shunt monitor cable to a shunt monitor RPM.</td></tr>
</table>

Bolt-In Breakers or TPL-C Fuse Holders	
7	Configure Millennium II controller RPM Shunt Channels per site installation instructions (if equipped with RPMs) – refer to RPM manual. Shunts: Fuse Holders 50 mV, 1500 A Breakers 25 mV, amp rating same as breaker rating, e.g. 600 A breaker has 600 A, 25 mV shunt. Configure RPM channel descriptions, A, and mV in Millennium II controller for each load shunt.
8	Verify polarity (using a voltmeter) of the voltage between the Return bus and the distribution input bus.
9	Verify wiring polarity at the input of the load equipment.
	Leave breaker switches in the OFF position until the load equipment is ready to be energized.

Verify Installation

Perform the following verification checklist after installation of batteries and wiring:

Step	Action	
1	Verify cabinet is properly grounded (using Digital Multimeter (DMM)).	
2	Verify the AC equipment ground is properly connected.	
3	Verify the correct ground cable gauge is used. Use the standard grounding principles for the office.	
4	Verify the AC voltage supplied matches the AC input voltage of the rectifiers.	
5	Verify all cables are properly installed for the distribution and labeled as 48 V or 24 V.	
6	Examine to assure no sharp corners are in contact with dressed wires. Modify to correct any problems found.	
7	Check for conductor clearance within the frame associated with high power.	
8	Check that all breakers are OFF and all fuses not inserted.	
9	Verify the battery contactors (LVBD) are open, if equipped. Manually operate them to the open position, if necessary, by pushing the contacts apart.	
10	Verify the polarity of all battery cables (using DMM).	
11	Verify no shorts are present between frame ground and the AC service. Measure resistance from each AC input line terminal block position to frame ground.	
12	Verify shelves and rectifier positions are properly identified. Label positions as necessary. Example is for 7-shelf (row) system (front view).	 Front View Figure 67 Rectifier Positions
13	Verify battery negative cables are connected to the appropriate bus bar.	
14	Verify battery positive cables are connected to the appropriate bus bar.	
15	Visually verify cables the RS485 cables are properly installed and that shelf ID settings at the rear of the frame are: [Shelf 1, Shelf 2, Shelf 3, etc.] from top to bottom.	

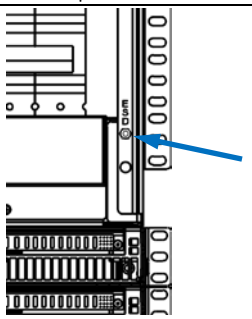
Install Controller

Follow the procedures for the controller present in the system.

Install Pulsar Plus

Note: The controller is factory installed and connected to the *NE-M* equipment. Connections to the controller made during installation are described here.

CAUTION: Equipment Damage
ESD NOTE: You must protect against ESD prior to configuring and installing the following circuit cards.

Step	Action – Pulsar Plus	
	Configuring Individual Alarm Output Contact Type – "Close" on or "Open" on alarm The factory default configuration for all alarm outputs is "Open On Alarm" on alarm. Is this acceptable?	
	Yes – go to Step 4.	No – go to Step 1.
1	Attach an ESD wrist strap or equivalent to the ESD grounding connector on right hand side of the inside of the frame.	 Figure 68 ESD Grounding Connector
2	Locate configuration jumpers for alarm relays on the controller. Jumpers for each of the 10 output alarms are visible on the back of the door-mounted controller.  Figure 69 Alarm Relay Jumpers – Pulsar Plus	

<table>
<tr><th>Step</th><th colspan="2">Action – Pulsar Plus</th></tr>
<tr><td>3</td><td colspan="2">
Configure alarm relays to “Open On Alarm” or “Close On Alarm” as specified in site engineering instructions.

Each Alarm Relay Jumper select “Open On Alarm” or “Closed On Alarm” for one alarm signal and each signal output can be configured independently.

Carefully move each Alarm Relay Jumper to select “Open On Alarm” or “Close On Alarm” position as per site engineering instructions with an insulated tool.

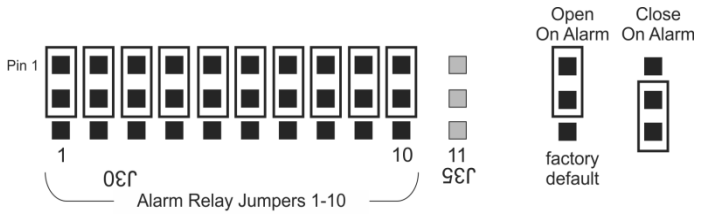
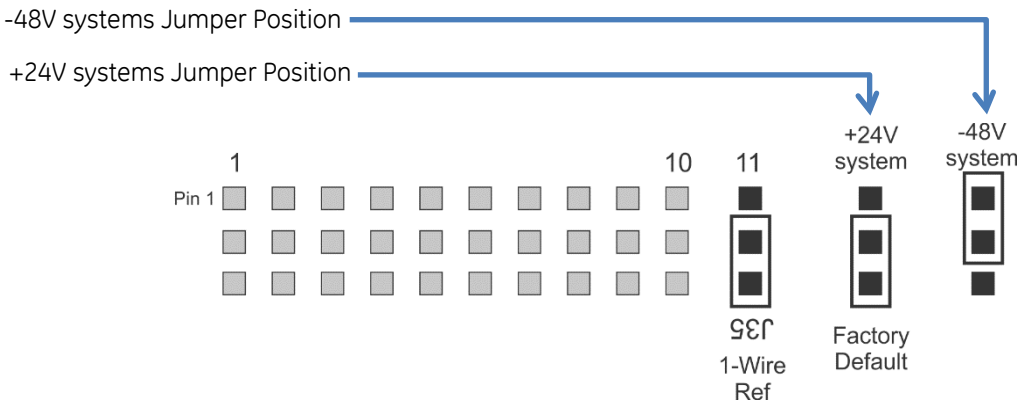


Figure 70 Alarm Relay Jumper Positions - Pulsar Plus

The following table contains the alarms along with the factory default alarm assignments to user relays R1-R7.

Utilize the web interface to change any of the alarm user relay alarm assignments.

<table>
<tr><th colspan="3">Table 3 Alarm Defaults – Standard Pulsar Plus</th></tr>
<tr><td>Jumper Number</td><td>Signal Name</td><td>Standard Defaults</td></tr>
<tr><td>1</td><td>PCR</td><td>Power Critical Alarm severity indicator</td></tr>
<tr><td>2</td><td>PMJ</td><td>Power Major Alarm severity indicator</td></tr>
<tr><td>3</td><td>PMN</td><td>Power Minor Alarm severity indicator</td></tr>
<tr><td>4</td><td>R1</td><td>BD - Battery on Discharge alarm</td></tr>
<tr><td>5</td><td>R2</td><td>VLV - Very Low Voltage alarm</td></tr>
<tr><td>6</td><td>R3</td><td>FAJ - External Fuse Major alarm</td></tr>
<tr><td>7</td><td>R4</td><td>ACF – single rectifier input (AC or DC) Fail alarm</td></tr>
<tr><td>8</td><td>R5</td><td>RFA - single Rectifier Fail alarm</td></tr>
<tr><td>9</td><td>R6</td><td>MRFA - multiple Rectifier Fail alarm</td></tr>
<tr><td>10</td><td>R7</td><td>HV - High Voltage shutdown alarm</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">4</td><td colspan="2">Using optional ES771 Mid-String Voltage Modules?</td></tr>
<tr><td>Yes – go to Step 5.</td><td>No – Go to next section.</td></tr>
</table>

Step	Action – Pulsar Plus
5	**Configure the 1-Wire serial bus reference** The ES771 modules must be referenced to the most negative potential of the DC bus. This reference is achieved by the proper setting of Jumper 11 (System Voltage) next to the relay configuration jumpers. Following are the appropriate settings for negative and positive power plants. The jumper is set in the factory for positive systems unless the controller is shipped with an assembled system that has a pre-determined primary output bus. It is suggested that an insulated tool be used to set the jumpers. See ***Figure 69***.  Figure 71 1-Wire Jumper - Pulsar Plus

Connect Controller Wiring – Pulsar Plus

All connections to the controller are made through appropriate cable assemblies. The controller has been designed to separate outputs, inputs, communication, and plant specific items onto to individual connectors.

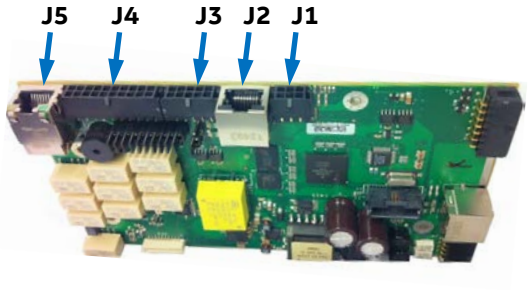


Figure 72 Controller Connections

Many systems are shipped with the appropriate controller connections wired by the factory. The following provides a brief description of how and what to connect to the controller. Use only those sections that apply to the system configuration.

<table>
<tr><th>Step</th><th>Action – Pulsar Plus</th></tr>
<tr><td>1</td><td>Analog Interface Connector
Connect and wire to shunt and alarms.

J1 is a 6-pin connector provided for analog interface to a plant shunt, distribution alarms, and open battery string alarms. Typically, a factory installed plant wire harness plugs into this connector. This wire set has a purple wire with a Faston ® receptacle for connecting the Open String Alarm from field installed battery disconnect breakers.

<table>
<tr><th colspan="2">Table 4 Analog Interface Connector Signals – Pulsar Plus</th></tr>
<tr><td>Pin</td><td>Signal</td></tr>
<tr><td>1</td><td>Shunt+</td></tr>
<tr><td>2</td><td>Shunt Reference</td></tr>
<tr><td>3</td><td>Shunt-</td></tr>
<tr><td>4</td><td>Fuse Alarm Major +24V</td></tr>
<tr><td>5</td><td>Open String</td></tr>
<tr><td>6</td><td>Fuse Alarm Major -48V</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>1-Wire Peripheral Connector
Connect and wire to VT-Probe, external ambient probe, or Remote Voltage Monitor.

J2 is an RJ-45 receptacle for connecting to 1-Wire devices.</td></tr>
</table>

Step	Action – Pulsar Plus
3	**Auxiliary Input Connector** Connect and wire auxiliary inputs as required to Connector **J3**. **J3** is an auxiliary input connector. Utilize cable as necessary to obtain the desired connections to the inputs shown below. Input Alarm Cable comcodes for **J3** are: 50 ft.: CC848817651, 150 ft.: CC848817668.

Table 5 Auxiliary Input Connector Signals - Pulsar Plus

Pin	Wire	Signal Name[18]	Description[18]
1	BK	Aux Input 1 (Aux1)	Auxiliary input to monitor a contact closure or open to its respective return on pin 8, Auxiliary Input Return.
2	BR	Aux Input 2 (Aux2)	Auxiliary input to monitor a contact closure or open to its respective return on pin 8, Auxiliary Input Return.
3	R	Aux Power Major Input (AMJ)	Auxiliary input to monitor a contact closure to the non-grounded side of a dc bus (±24V/-48V) to create the standard Auxiliary Power Major alarm. Generator Running in *Eco* applications.
4	O	Plant Battery Test/ Group Standby/TR (GSTR)	Dedicated input to be monitored for a contact closure to its respective return on pin 9, Plant Battery Return. This signal is used for the Plant Battery Test and Group Standby Feature.
5	Y	Emergency Power Off (EPO)	Dedicated EPO input to be monitored for a contact closure to its respective return on pin 10, Emergency Power Off Return.
6	G	Aux Input 3 (Aux3)	Auxiliary input to monitor a contact closure or open to its respective return on pin 8.
7	BL	Aux Input 4 (Aux4)	Auxiliary input to monitor a contact closure or open to its respective return on pin 8.
8	V	Aux Input Return (Aux_R)	Return for Auxiliary Inputs 1-4.
9	S	Plant Battery Test/Group Standby/TR Ret.(GSTR_R)	Return for Plant Battery Test and Group Standby.
10	W	Emergency Power Off Ret. (EPO_R)	Return for EPO input.

[18] Inputs are reconfigured for specific use for specific Eco applications.

<table>
<tr><th>Step</th><th>Action – Pulsar Plus</th></tr>
<tr><td>4</td><td>

Output Alarm Connector

Connect and wire remote alarm output circuits to Connector **J4**. **J4** is output alarm connector.

Utilize cable as necessary to obtain the desired connections to the outputs shown below.
Output Alarm Cable comcodes for **J4** are: 50ft: CC848817635, 150ft: CC848817643.

<table>
<tr><th colspan="7">Table 6 Alarm Signals - Pulsar Plus</th></tr>
<tr><td rowspan="2">Pin</td><td rowspan="2">Wire</td><td rowspan="2">Signal Name[19]</td><td rowspan="2">Pin</td><td rowspan="2">Wire</td><td rowspan="2">Signal Name[19]</td><td>Defaults</td></tr>
<tr><td>Standard</td><td>Eco</td></tr>
<tr><td>1</td><td>BL</td><td>PCR</td><td>11</td><td>BL/BK</td><td>PCR_C</td><td>PCR
(Power Critical)</td><td></td></tr>
<tr><td>2</td><td>O</td><td>PMJ</td><td>12</td><td>O/BK</td><td>PMJ_C</td><td>PMJ
(Power Major)</td><td></td></tr>
<tr><td>3</td><td>G</td><td>PMN</td><td>13</td><td>G/BK</td><td>PMN_C</td><td>PMN
(Power Minor)</td><td></td></tr>
<tr><td>4</td><td>W</td><td>UR1</td><td>14</td><td>W/BK</td><td>UR1_C</td><td>BD
(Battery on Discharge)</td><td></td></tr>
<tr><td>5</td><td>BK</td><td>UR2</td><td>15</td><td>BK/W</td><td>UR2_C</td><td>VLV
(Very Low Voltage)</td><td></td></tr>
<tr><td>6</td><td>BL/W</td><td>UR3</td><td>16</td><td>BL/R</td><td>UR3_C</td><td>FAJ
(External Fuse Major)</td><td></td></tr>
<tr><td>7</td><td>O/R</td><td>UR4</td><td>17</td><td>R</td><td>UR4_C</td><td>ACF
(rectifier input AC or DC) Fail)</td><td>Generator Start/Stop</td></tr>
<tr><td>8</td><td>G/W</td><td>UR5</td><td>18</td><td>R/G</td><td>UR5_C</td><td>RFA
(Rectifier Fail)</td><td></td></tr>
<tr><td>9</td><td>W/R</td><td>UR6</td><td>19</td><td>R/W</td><td>UR6_C</td><td>MRFA
(Multi Rectifier Fail)</td><td></td></tr>
<tr><td>10</td><td>BK/R</td><td>UR7</td><td>20</td><td>R/BK</td><td>UR7_C</td><td>HV
(High Voltage)</td><td>Generator Maintenance</td></tr>
</table>

</td></tr>
<tr><td>5</td><td>

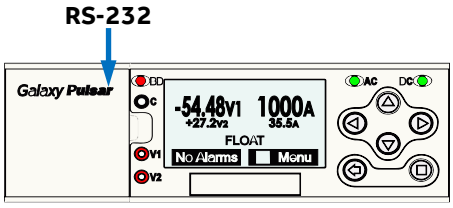
Network (LAN) Connection (Optional)

Connect to network.

The controller provides an Ethernet connection for a LAN and or Craft port connection. Connector **J5** provides a standard RJ45 shielded receptacle connection for a standard Cat-5 connection to the controller's 10/100Base-T port. This port has two main modes of operation: Server mode, LAN mode (Static and DCHP Client). In server mode, the port can be used as a local Craft interface. In this mode, a local laptop can be connected through **J5** and its standard web browser used to directly access the controller by typing in network address http://192.168.2.1. A connection should never be made between the controller and LAN while the controller is in Server mode.

</td></tr>
<tr><td></td><td>Is the controller equipped with the Modem Option?</td></tr>
<tr><td></td><td>Yes – go to Step 6.</td><td>No – go to Step 7.</td></tr>
</table>

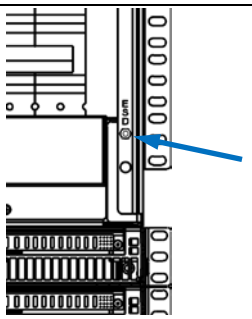
[19] Relays are reconfigured for specific use for specific Eco applications.

Step	Action – Pulsar Plus	
6	**Telephone Line Connection (Optional).** Door-mount MODEM option provide their own RJ11 connection for the telephone line. Use appropriate routing techniques to connect the controller respective RJ11 to the telephone line.	Modem is mounted on door above the controller.
7	**Local RS232 Serial Port Connector** Connect notebook computer, PC or external modem to RS232 port. The Local RS232 and future Craft Ethernet connectors are located inside the door on the front of the controller. RS-232 is DCE (Data Communication Equipment).	 Figure 73 Local Port - Pulsar Plus

Install Millennium II

Note: The controller is factory installed connected to the *NE-M* equipment. Connections to the controller made during installation are described here.

CAUTION: Equipment Damage
ESD NOTE: You must protect against ESD prior to configuring and installing the following circuit cards.

1	**Attach an ESD wrist strap or equivalent to the ESD grounding connector on right hand side of the inside of the frame.**	 Figure 74 ESD Grounding Connector

Install Circuit Cards

CAUTION: Equipment Damage
ESD NOTE: You must protect against ESD prior to configuring and installing the following circuit cards.

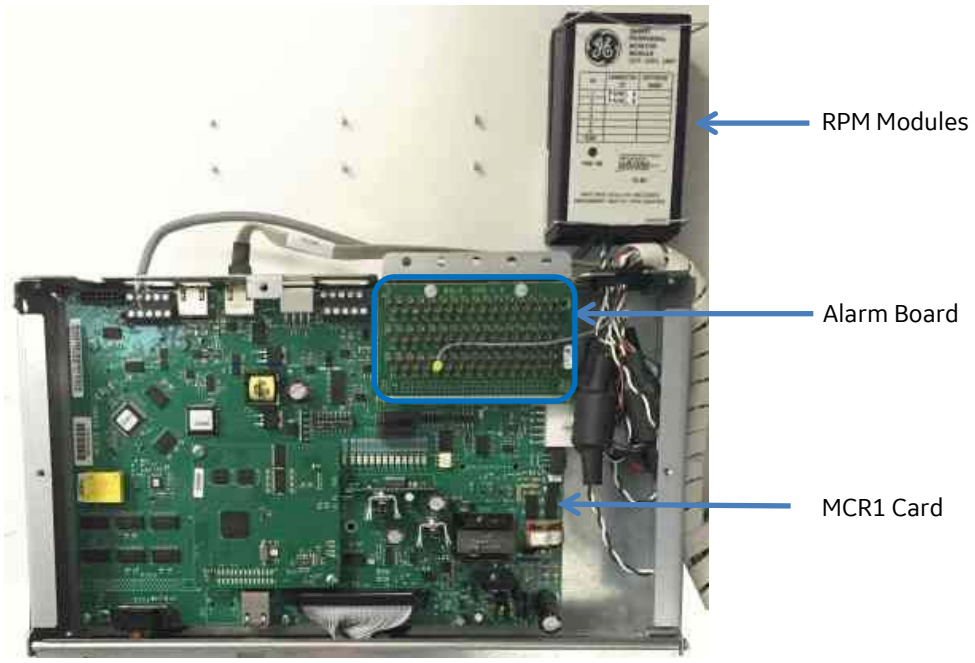


Figure 75 Millennium II Circuit Card

BSL Alarm Termination Board

An insulation displacement (punch down) type alarm terminal board (BSL3, 848741711) is provided with the system. For a wire wrap type terminal board, order BSL4 (848749507) and perform the following steps:

Step	Action – Millennium II
1	In the upper right hand corner of the MCR1 board, find the alarm board already installed.
2	Remove the two screws holding the board at the top.
3	Holding the board on both sides, slowly, but firmly, remove the alarm board from the **P8** connector.
4	Connect the new alarm board to **P8** and press down firmly, until the board is seated.
5	Secure the alarm board at the top using the two screws removed earlier.

Connect Controller Wiring – Millennium II

All connections to the controller are made through appropriate cable assemblies. The controller has been designed to separate outputs, inputs, communication, and plant specific items onto to individual connectors.

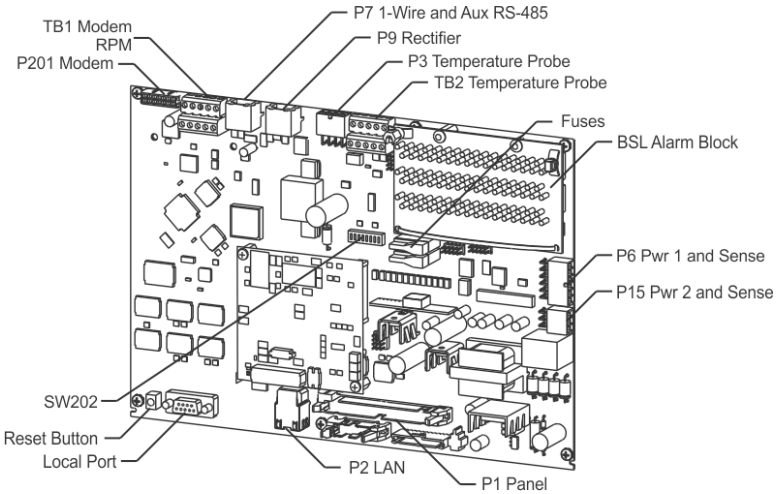


Figure 76 Controller Connections

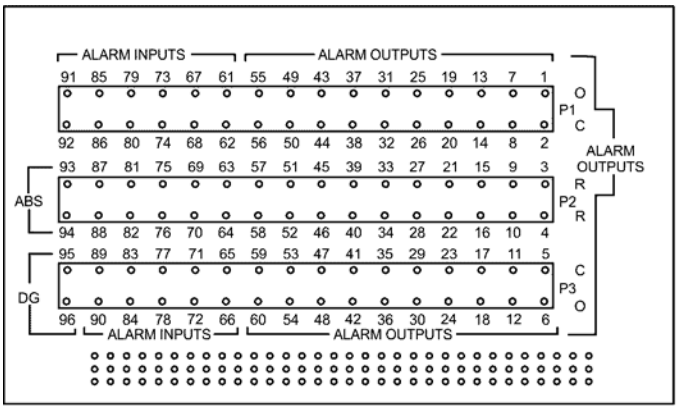
Many systems are shipped with the appropriate controller connections wired by the factory. The following provides a brief description of how and what to connect to the controller. Use only those sections that apply to the system configuration.

<table>
<tr><th>Step</th><th>Action – Millennium II</th></tr>
<tr><td>1</td><td>
Power and Sense Connector
Connect and wire to shunt and alarms.

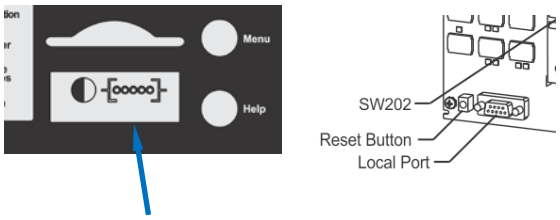
P6 is a 6-pin connector provided for analog interface to a plant shunt, distribution alarms, and open battery string alarms. Typically, a factory installed plant wire harness plugs into this connector. This wire set has a purple wire with a Faston ® receptacle for connecting the Open String Alarm from field installed battery disconnect breakers.

Table 7 Power and Sense Signals - Millennium II
<table>
<tr><th>Pin</th><th>Wire</th><th>P6 – Primary Voltage Signal</th></tr>
<tr><td>1</td><td>BR</td><td>Return</td></tr>
<tr><td>2</td><td>S</td><td>1-Wire Reference</td></tr>
<tr><td>3</td><td>GR</td><td>Ground</td></tr>
<tr><td>4</td><td>W/BL</td><td>SH2+ (Second Battery Shunt)</td></tr>
<tr><td>5</td><td>W/BR</td><td>Return</td></tr>
<tr><td>6</td><td>W/BK</td><td>SH1+ (Battery Shunt)</td></tr>
<tr><td>7</td><td>O</td><td>Primary Voltage</td></tr>
<tr><td>8</td><td>W</td><td>FAJ (Primary)</td></tr>
<tr><td>9</td><td>O/BK</td><td>Primary Voltage</td></tr>
<tr><td>10</td><td>BL</td><td>SH2- (Second Battery Shunt)</td></tr>
<tr><td>11</td><td>W/O</td><td>Primary Voltage</td></tr>
<tr><td>12</td><td>BK</td><td>SH1- (Battery Shunt)</td></tr>
</table>
<table>
<tr><th>Pin</th><th>Wire</th><th>P15 – Secondary Voltage Signal</th></tr>
<tr><td>1</td><td>BL</td><td>Secondary Voltage</td></tr>
<tr><td>2</td><td>BR</td><td>Return</td></tr>
<tr><td>3</td><td>BL/W</td><td>Secondary Voltage</td></tr>
<tr><td>4</td><td>Y</td><td>FAJ (Secondary)</td></tr>
<tr><td>5</td><td>-</td><td>-</td></tr>
<tr><td>6</td><td>BR/W</td><td>Return</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>
1-Wire Peripheral Connector
Connect and wire to VT-Probe, external ambient probe, or Remote Voltage Monitor.

P7 is an RJ-45 receptacle for connecting to 1-Wire devices.
</td></tr>
</table>

Step	Action – Millennium II	
3	**Alarm and Control Connections** Connect and wire alarm and control signals to the BSL card as specified in site engineering instructions. See ***Millennium II Alarm & Control Signals*** section for details.  Figure 77 Alarm Connections Millennium II **NOTE**: Wire Wrap Use 24 to 30 AWG wire. Strip approximately 1 inch of insulation from wire. Use a standard wire wrap tool to connect each wire to its terminal. Punch Down Use 18 to 22AWG (if less than 18AWG, use multi-conductor cable for mechanical integrity). Secure wires to terminals using a punch down tool or Phillips #1 or #2 screwdriver inserted into a punch down insulating cap[20].	
4	**Network (LAN) Connection (Optional)** Connect to network. The controller provides an Ethernet connection for a LAN and or Craft port connection. Connector **P2** provides a standard RJ45 shielded receptacle connection for a standard Cat-5 connection to the controller's 10/100Base-T port. This port has two main modes of operation: Server mode, LAN mode (Static and DCHP Client). In server mode, the port can be used as a local Craft interface. In this mode, a local laptop can be connected through **J5** and its standard web browser used to directly access the controller by typing in network address http://192.168.2.1. A connection should never be made between the controller and LAN while the controller is in Server mode.	
	Is the controller equipped with the Modem Option?	
	Yes – go to Step 6.	No – go to Step 7.
5	**Telephone Line Connection (Optional).** Door-mount MODEM option provide their own RJ11 connection for the telephone line. Use appropriate routing techniques to connect the controller respective RJ11 to the telephone line.	Modem is mounted on door near the controller.

[20] Punch down caps are furnished with the controller.

Step	Action – Millennium II	
6	**Local RS232 Serial Port Connector** Connect notebook computer, PC or **external** modem to RS232 port. The Local Port connector is at the lower left of the controller card. This connector is factory cabled to the Local Port connector on front right of the front panel, for convenient local connection of a laptop PC. If connecting to a modem or other device which is connected permanently, use the Local Port connector on the controller card. Connect to the RS-232 connector as Data Circuit-terminating Equipment (DCE).	 Front RS-232 Port Figure 78 RS232 Connection - Millennium II

Install BSM6 Modem

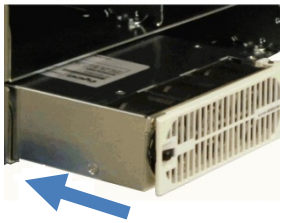
The optional BSM6 Modem is field installed. Instructions accompany the modem.

Install Optional Controller Peripherals

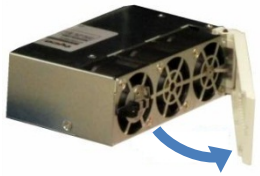
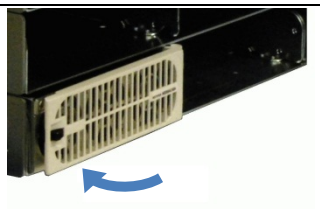
Optional Controller Peripherals are field installed. See the controller manual and instructions accompany the options.

Install Rectifiers/Converters

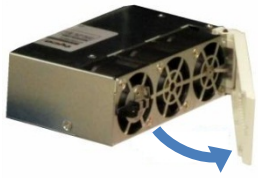
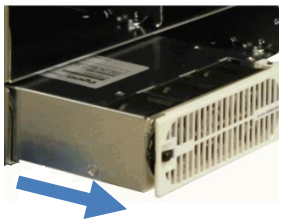
Rectifier/Converter Installation Procedure

Step	Action	
	CAUTION: Improper Operation **Install only *Eco* rectifiers in *Eco* system DC (PV or solar) powered positions.**[21] **Eco systems require *Eco* rectifiers in all DC powered positions.** **Eco rectifiers have unique badge symbols - *Table 1*.**	
	CAUTION: Equipment Damage **Do not install rectifiers before battery bus voltage and polarity has been verified.** **Rectifiers and system damage will result from incorrect battery bus polarity.** **The damage may not be immediately evident.**	
	Is this a DC (PV or solar) powered rectifier position in an *Eco* system?	
	Yes – Proceed.	No – go to Step 2.
1	Verify rectifier is ***Eco*** type by examining the rectifier type badge - ***Table 1***.	
2	Verify rectifier **Output Voltage** by examining the rectifier type badge - ***Table 1***.	
3	Slide the rectifier/converter part way into a slot.	 Figure 79 Insert Rectifier

[21] Non-Eco rectifiers may be installed in AC powered position – **NOT RECOMMENDED**.

Step	Action	
4	Open the faceplate by sliding the black latch to the left to release the faceplate.	 Figure 80 Open Rectifier Door
5	Push the unit firmly into the shelf until seated.	
6	Air Filter (If supplied) Install optional air filter by placing it inside the faceplate.	
7	Swing the faceplate closed until it is secured by the latch.	 Figure 81 Close Rectifier Door
8	Verify green LED and only green LED is on. If this isn't the case, see the **Troubleshooting** section.	

Rectifier/Converter Removal Procedure

Step	Action	
1	Open the faceplate to disengage the rectifier/converter.	 Figure 82 Open Rectifier Door
2	Remove the unit from the shelf.	 Figure 83 Remove Rectifier

Install Rectifiers

- Refer to the controller manual for details of controller operations.
- Use the above rectifier/converter installation and removal procedures as needed in the following steps.

Step	Action
CAUTION:	**Improper Operation** **Install only *NE Eco* rectifiers in *Eco* systems DC (PV or solar) powered positions.**[22] **Eco systems require *Eco* rectifiers in all DC powered positions.** **Eco rectifiers have unique badge symbols - *Table 1*.**
CAUTION:	**Equipment Damage** **Do not install rectifiers before battery bus voltage and polarity has been verified.** **Rectifiers and system damage will result from incorrect battery bus polarity.** **The damage may not be immediately evident.**
1	Turn on input power circuit breakers[23] to apply power to the system rectifier positions.
2	Install a rectifier in an available rectifier position.
3	Wait until the rectifier establishes communications with the controller (the red Fail LED stops flashing).
4	Verify rectifier green Norm LED is lit.
5	Apply 10 amperes of load to the system.
6	Verify the contactor closes and connects the battery strings (if equipped).
7	If an audible alarm is present, press the ENTER key to MUTE the audible alarm.
8	Verify all LEDs are green on the controller and the display is visible with the proper voltage shown.
9	Increase the system load current to 20 amperes.
10	Install rectifier in the next position.
11	Wait until the rectifier establishes communications with the controller (the red Fail LED stops flashing).
12	Verify green rectifier Norm LED is lit.
13	Verify that each rectifier is present and verify the rectifier output currents by using the controller front panel (**Menu > Status > Rectifiers > Rectifier Currents**).
14	Repeat from Step 10 for to install each rectifier.
	Continue after installing all rectifiers.
15	Increase the system load current to 50 amperes.
16	Verify the rectifiers share the load and the voltage regulation is correct. Rectifiers should load share after 2 minutes to within 2% of the total average output.
17	Verify front panel display voltage is within 0.5% of the Float Setpoint.
18	Remove a rectifier and ignore the request to remove missing equipment.
19	Verify the controller identifies the rectifier as missing to verify that the Minor Communication Fail alarm is operational.
20	Re-install the rectifier and verify that the alarm clears.

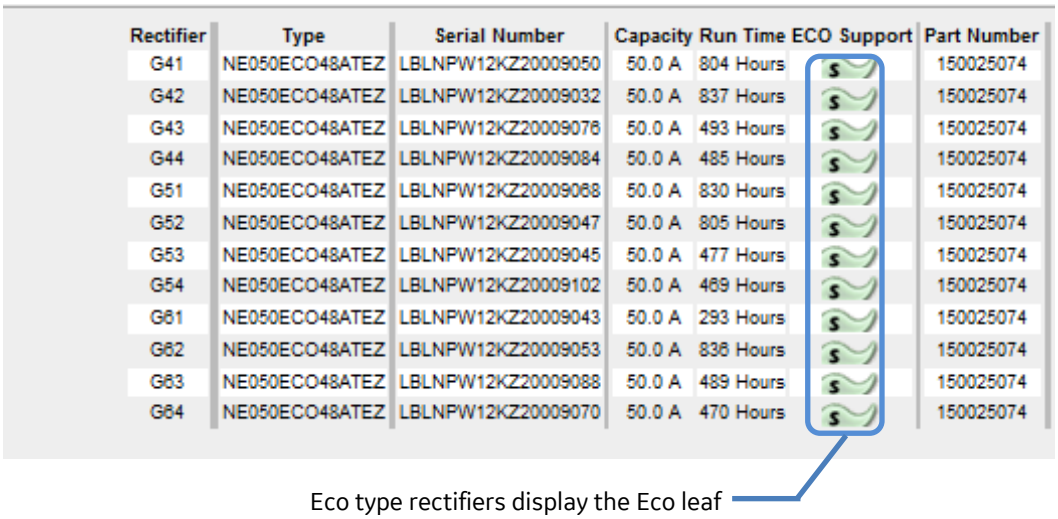
[22] Non-Eco rectifiers may be installed in AC powered positions of Eco systems – **NOT RECOMMENDED.** Use of non-Eco rectifiers in Eco systems increases the risk of improperly filling system rectifier positions.

[23] AC and PV input power circuit breakers for Eco systems.

Verify Rectifier Positions

Refer to site engineering instructions for rectifier type per position.

Step	Action
1	Verify that proper rectifiers are installed in all powered rectifier positions.
2	Verify that rectifiers in all DC powered positions have *Eco* type badges[24] - ***Table 1***.
3	Verify that rectifiers in all DC powered positions are displayed with the *Eco* leaf in the ECO Support column on the controller web Inventory report screen – Figure 84.
4	Verify that rectifiers in all DC powered positions are displayed with the "*Eco* leaf" in the controller web main screen[25] – Figure 85.



Rectifier	Type	Serial Number	Capacity	Run Time	ECO Support	Part Number
G41	NE050ECO48ATEZ	LBLNPW12KZ20009050	50.0 A	804 Hours	S	150025074
G42	NE050ECO48ATEZ	LBLNPW12KZ20009032	50.0 A	837 Hours	S	150025074
G43	NE050ECO48ATEZ	LBLNPW12KZ20009076	50.0 A	493 Hours	S	150025074
G44	NE050ECO48ATEZ	LBLNPW12KZ20009084	50.0 A	485 Hours	S	150025074
G51	NE050ECO48ATEZ	LBLNPW12KZ20009068	50.0 A	830 Hours	S	150025074
G52	NE050ECO48ATEZ	LBLNPW12KZ20009047	50.0 A	805 Hours	S	150025074
G53	NE050ECO48ATEZ	LBLNPW12KZ20009045	50.0 A	477 Hours	S	150025074
G54	NE050ECO48ATEZ	LBLNPW12KZ20009102	50.0 A	469 Hours	S	150025074
G61	NE050ECO48ATEZ	LBLNPW12KZ20009043	50.0 A	293 Hours	S	150025074
G62	NE050ECO48ATEZ	LBLNPW12KZ20009053	50.0 A	836 Hours	S	150025074
G63	NE050ECO48ATEZ	LBLNPW12KZ20009088	50.0 A	489 Hours	S	150025074
G64	NE050ECO48ATEZ	LBLNPW12KZ20009070	50.0 A	470 Hours	S	150025074

Figure 84 Inventory Screen

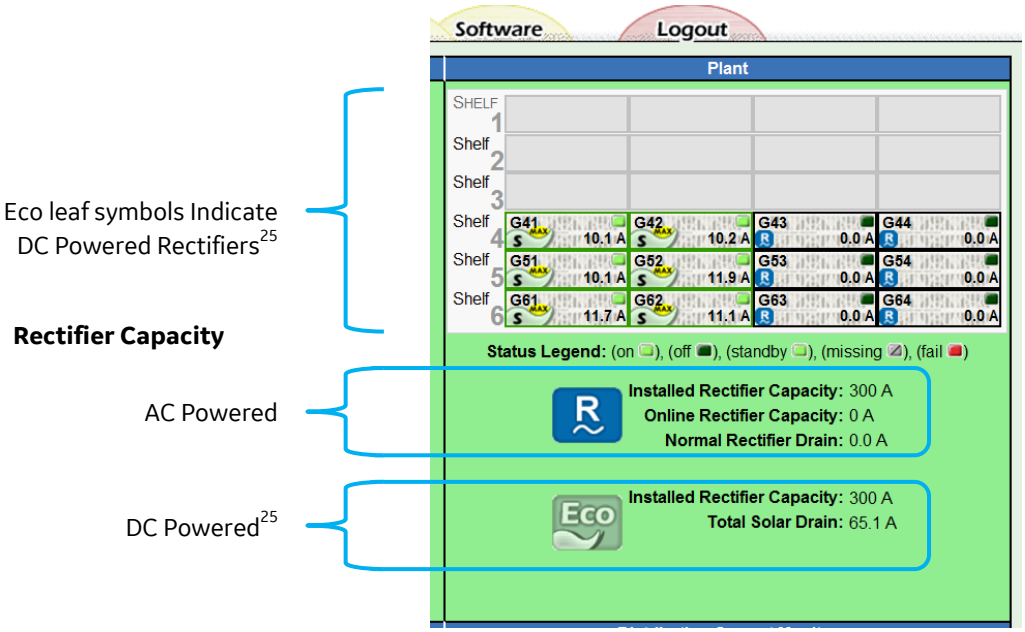


Figure 85 Main Screen - web

[24] **RECOMMENDED** – Eco rectifiers in all Eco system rectifier positions (AC and DC powered).
NOT RECOMMENDED – Non-Eco rectifiers may be installed in AC powered positions of Eco systems.

Use of non-Eco rectifiers in Eco systems increases the risk of improperly filling system rectifier positions.

[25] The "Eco leaf" displays for rectifier positions after being DC powered while connected to the controller. All populated rectifier positions are reported as AC powered until DC input is applied.

Install Converters

Repeat the above steps for converters; use converter-only slots first if provided. These are the lowest mounted shelves and labeled “Converter Only”.

For more information on rectifiers and converters, see the Troubleshooting section.

Install Battery Voltage Temp (VT)-Probes

QS873A VT Probes can be used with or without mid-string voltage monitoring. Only one probe is required to allow the battery slope thermal compensation function to be utilized.

Refer to the *Galaxy Pulsar Plus Family Product Manual* for installation instructions.

Install Aux Display (NE830A) Alarm Cable (Optional)

The optional NE830 Aux Display, when ordered separately, will require field installation. To do so, perform the following steps:

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td></td><td colspan="2">Is the NE830A factory installed?</td></tr>
<tr><td></td><td>No – go to Step1.</td><td>Yes –no action required. Go to next section.</td></tr>
<tr><td>1</td><td colspan="2">Connect and wire to field installed NE830A.</td></tr>
<tr><td>2</td><td colspan="2">Install wiring per NEC and local rules for Class 3 circuits.
Note: Cable supplied with NE830A is suitable for Class 3 circuits.</td></tr>
<tr><td>3</td><td colspan="2">Apply appropriate terminals (if necessary) to the cable after removing the supplied had 1/4 inch Faston ® terminals:

<table>
<tr><th colspan="4">Table 8 Power Connections - NE830</th></tr>
<tr><td>Pin</td><td>Wire</td><td>Signal Name</td><td>Connect to:</td></tr>
<tr><td>1</td><td>Green</td><td>Earth Ground</td><td>Frame Ground</td></tr>
<tr><td>2</td><td>White</td><td>24V+/-</td><td>24V point to be monitored (+24V or -24V)</td></tr>
<tr><td>3</td><td>Red</td><td>48V-</td><td>-48V point to be monitored (-48V only)</td></tr>
<tr><td>4</td><td>Black</td><td>Common Return</td><td>Return for signals on pins 2 & 3</td></tr>
</table></td></tr>
<tr><td>4</td><td colspan="2">Connect and wire connection to NE830A. Alarm cable comcodes are
15ft: CC847922101, 150 ft.: CC848804765.

<table>
<tr><th colspan="3">Table 9 Alarm Connections - NE830</th></tr>
<tr><td>Pin</td><td>Wire</td><td>Signal Name</td></tr>
<tr><td>1</td><td>Black</td><td>Common</td></tr>
<tr><td>2</td><td>Brown</td><td>Open On Alarm</td></tr>
<tr><td>3</td><td>Bare</td><td>Close On Alarm</td></tr>
</table>

Alarm Cable Connector
 
Figure NE830 Alarm Cable Connector</td></tr>
</table>

Configure Controller – Minimum

This section covers the basic operations that must be performed so that the controller is minimally configured. See the controller manual for further detail.

Configure Pulsar Controller

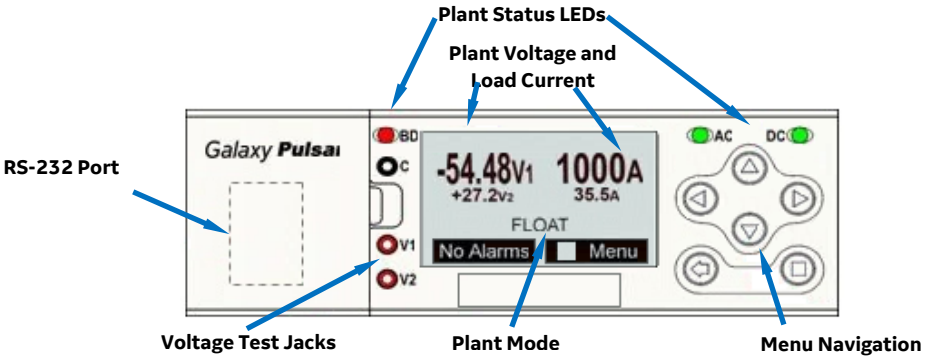
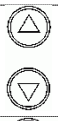
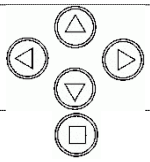
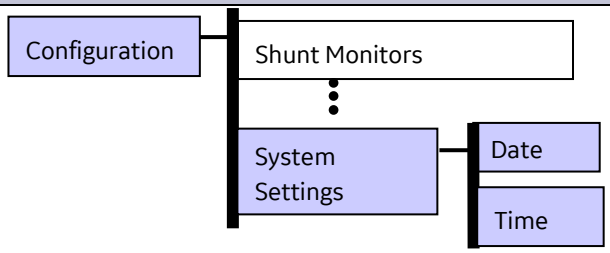


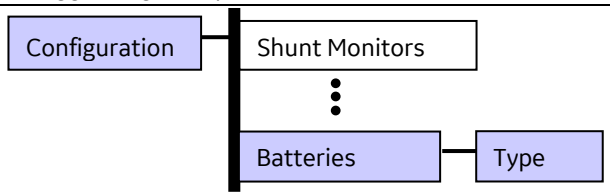
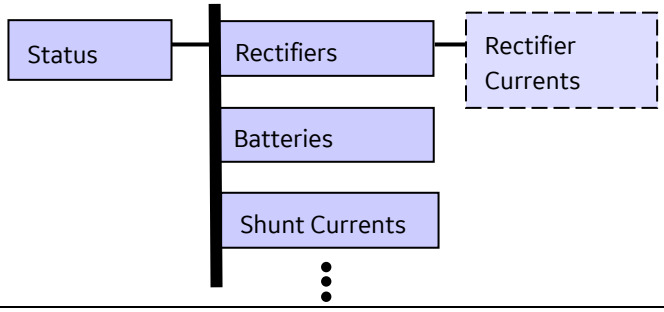
Figure 86 Front Panel - Pulsar Plus Controller

This display shows the front panel display for a system with both rectifiers and converters. The display (V1 versus V2) correlates with test jacks. The large font indicates the "Primary" or rectifier dc bus; the smaller font shows the "Secondary" or converter dc bus.

Menu Navigation Buttons

	Parameter Change	Increase or decrease the value of the selected parameter.
	Navigate	Navigate menus – move to different selected menu item.
	Enter Button	Enter a sub-menu or confirms a parameter change. Go to the Main Menu from the Normal display.
	ESC Button	Go up one menu level or exits a parameter change without saving.

Step	Configuration Attribute to Change	Menu Path/Action - Pulsar
1		
	Date Format	This field allows you to select one of the following date formats: MM/DD/YY, DD/MM/YY, YY/MM/DD, MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD. Use the <+> or <-> key to select the desired format and press <ENTER> to save the change.
	Month	Use this field to change the month; the possible value is from 1 to 12.
	Day	Use this field to change the day of the month; the possible value is from 1 to 31.
	Year	Use this field to change the year; the possible value is from 1992 and up.
	Note: The system will validate the entries before the system date is modified.	
2	**Time**	

Step	Configuration Attribute to Change	Menu Path/Action - Pulsar
	Time Format	This field allows you to select one of the following time display formats: 12 or 24 hour. Use the <+> or <-> key to select the desired format and press <ENTER> to save the change.
	Time	Allows you to change/set the time.
	Daylight	Enables or Disables Daylight Savings per the new standards created by the *Energy Policy Act of 2001*. (Started in 2007.)
3	**Batteries**	
4	Type	The configuration of this field selects the battery type, Flooded or Valve Regulated (sealed). This parameter is used in reserve time prediction and enhanced battery test features. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.
	Shunt Monitors	Plant Shunt Monitors: Menu **>** Configuration **>** Shunt Monitors **>** Plant Shunt Type - Battery Menu > Configuration **>** Shunt Monitors **>** Plant Shunt Rating: **2000** (13U systems) **3000** (18U & 22U systems)
5	**Confirm Equipment Installed**	Use the STATUS menu to confirm the equipment installed: Rectifiers: **Menu > Status > Rectifiers** Distribution Modules: **Menu > Status > Shunt Currents** Thermal Probes: **Menu > Status > Batteries** 

Configure Millennium II Controller

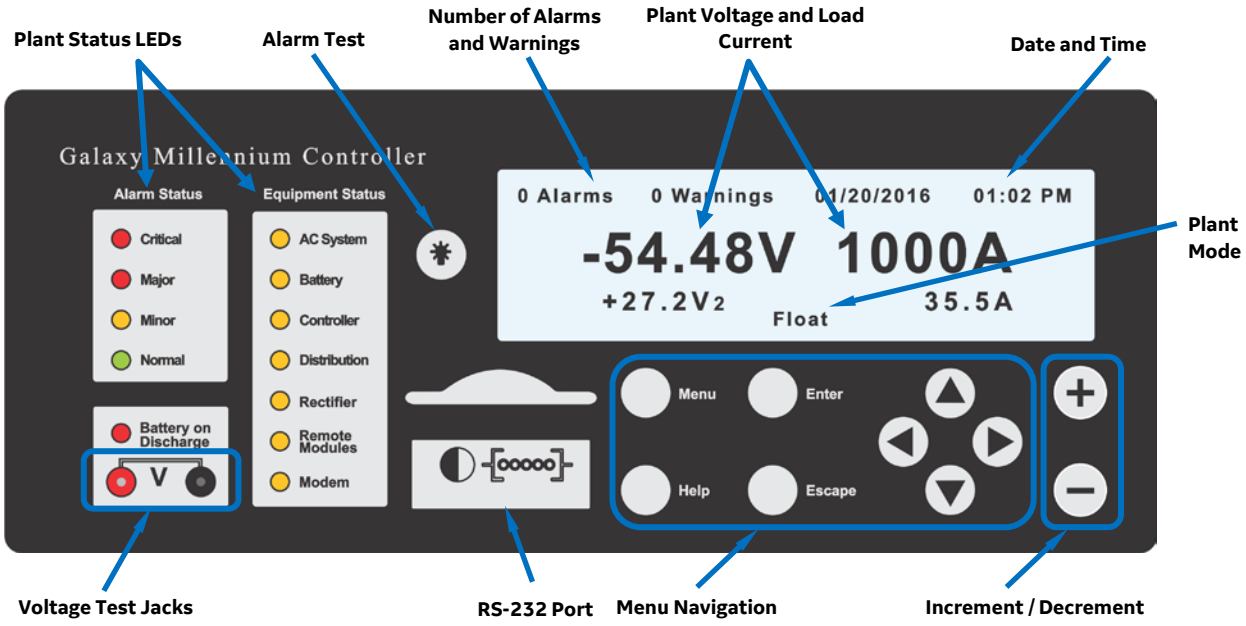
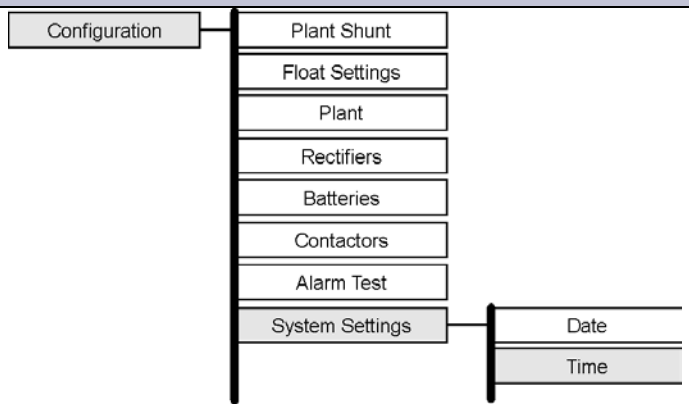
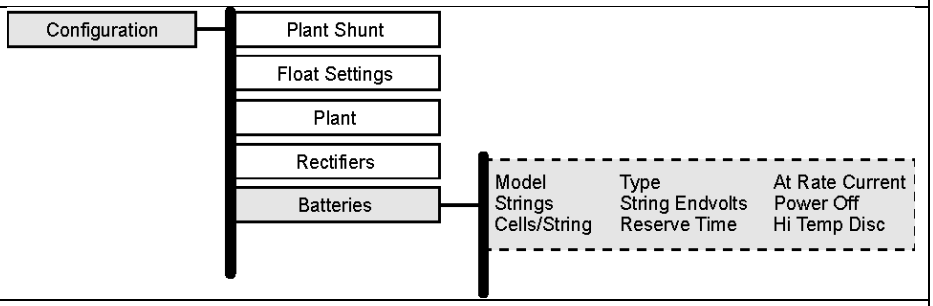


Figure 87 Front Panel - Millennium II Controller

Table 10 Push Buttons - Millennium II

Button	Function	Action
+	Display Contrast	Increase or decrease the display contrast (in Main Display).
–	Parameter Change	Increase or decrease the value of the selected parameter.
▲ ◄ ► ▼	Navigate	Navigate menus – move to different selected menu item.
Enter	Enter	Enter a sub-menu or confirms a parameter change.
ESC	Escape	Go up one menu level or exits a parameter change without saving.
Menu	Menu	Go to the Main Menu.
Help	Help	Display available Help information.

The Millennium II controller's primary user interface is the front panel, which includes a backlit LCD, and an array of pushbutton controls. SW202-8 must be set to ENABLED for changes to be made from the front panel. This section covers the basic operations that must be performed so that the controller is minimally configured.

Step	Configuration Attribute to Change	Menu Path/Action = Millennium II
1		
	Date Format	This field allows you to select one of the following date formats: MM/DD/YY, DD/MM/YY, YY/MM/DD, MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD. Use the <+> or <-> key to select the desired format and press <ENTER> to save the change.
	Month	Use this field to change the month; the possible value is from 1 to 12.
	Day	Use this field to change the day of the month; the possible value is from 1 to 31.
	Year	Use this field to change the year; the possible value is from 1992 and up.
NOTE	**Please note that the system will validate the entries before the system date is modified.**	
2		
	Time Format	This field allows you to select one of the following time display formats: 12 or 24 hour. Use the <+> or <-> key to select the desired format and press <ENTER> to save the change.
	Time	Allows you to change/set the time.
	Daylight	Enables or Disables Daylight Savings per the new standards created by the Energy Policy Act of 2005. (Started in 2007.)
3	**Batteries**	
	Model	The configuration of this field selects the installed battery type from a list of pre-defined battery types used in reserve time prediction and enhanced battery test features. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.
	Strings	The configuration of this field selects the number of battery strings in the system. This parameter is used in reserve time prediction and enhanced battery test features. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.
	Cells/String	The configuration of this field selects the number of installed cells in the battery strings. This parameter is used in reserve time prediction and enhanced battery test features. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.
	Type	The configuration of this field selects the battery type, Flooded or Valve Regulated (sealed). This parameter is used in reserve time prediction and enhanced battery test features. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.

4	Plant Shunt – Supplemental Frame (if equipped)	Menu ▶ Configuration ▶ Shunt ▶ Plant Shunt
	Shunt2	Set to **Battery**
	AMP2	Set to **2000** (13U systems) or **3000** (18U & 22U systems)
	MV2	Set to **50**

Acceptance Testing

NOTE: The controller may report a limited recharge alarm during these tests.
NOTE: At any time you encounter difficulty with these steps, refer to the **Troubleshooting** Section.

Communication with Rectifiers and Converters

Step	Action	
1	Place external battery disconnect switches in the ON (connected) position if equipped.	
2	Turn on all circuit breakers supplying rectifiers.	
3	Adjust the contrast (if needed) for the site's ambient condition (**Menu > Configuration > System Settings > Display Contrast**). Millennium II only: use the up and down arrow keys at the Main Menu.	
	Wait 30 seconds. Are all lit LEDs on all components including rectifiers, the controller, LVD control boards, and Aux Displays green?	
	Yes – Go to Step 7.	No – go to Step 4.
4	Initiate the **Clear Events** and **Uninstall Equipment** operations (in **Menu > Control / Operations)**. Non-existent alarm conditions should clear. Refer to the controller manual as needed.	
5	If the controller appears not to be powered or not responsive, remove and reseat the controller.	
6	If all lit LEDs still aren't green, review the installation procedure or refer to the **Troubleshooting** section in this manual. The controller display should indicate "NO ALARMS". The system float voltage, total load current, and system operating mode should be observable as indicated and the controller's back-light shall be illuminated green for no alarms and the system rectifier voltage should be displayed.	
7	If Slope Thermal Compensation (STC) is active disable STC: (**Menu > Configuration > Batteries > Batt Temp Management > Temperature Comp**)	
8	Check the voltage readings on the controller display. The controller is factory configured with a rectifier Float voltage set-point of -54.50V for -48V rectifier systems and ±27.25V for ±24V rectifier systems. If converters are present, the display shows their voltage and current in smaller font. The controller is factory configured with a converter output voltage set-point of -54.50V for -48V converters and +27.25V for +24V converters. **Note:** If Slope Thermal Compensation (STC) is active or if the connected batteries are not fully charged, the bus voltage may be different than the set-point. If possible, open the external battery disconnect prior to making measurements to eliminate these effects. If QS873 VT probes are installed in the system. STC may be active. This will be indicated by the Plant Mode "FLOAT – TEMP COMP".	
9	Enable Slope Thermal Compensation (STC) **if it was disabled in Step 7:** (**Menu > Configuration > Batteries > Batt Temp Management > Temperature Comp**)	
Remove and Replace Rectifier and Verify Results:		
10	Remove a rectifier from its slot.	
11	Verify the controller LED and display are light amber which indicates a missing rectifier condition.	
12	When the controller prompts to remove, equipment press enter ■.	
13	Verify the controller LED and display are light green.	
14	Replace the removed rectifier in its original slot.	
15	Verify the controller LED and displays remain green.	
	Repeat **Steps 9-14** for converters, if equipped.	

Miscellaneous Alarms

(Batteries must be connected)

Distribution Alarms

Step	Action
1	Manually connect a piece of wire from the circuit breaker feed bus to the distribution alarm strip.
2	Verify an FAJ – Fuse Alarm Major is reported by the controller.
3	Remove the wire. Verify the alarm clears.
	Repeat test for each distribution panel or sub-system.

ac Fail Alarms[26]

Step	Action
1	Turn off AC circuit breaker feeding a single rectifier.[27]
2	Verify ACF – AC Fail Minor is reported for the correct rectifier ID.
3	Restore input and verify alarms clear and the controller returns to Normal.
4	Remove input from two or more rectifiers.
5	Verify MACF – Multiple AC Fail Major is reported for the correct rectifier IDs.
6	Turn on input circuit breaker turned off in Step 1 and verify alarms clear and the controller returns to Normal.

Battery On Discharge Alarms[28]

Step	Action
1	Change BD alarm to 2 volts below float voltage (**Menu > Configuration > Float Settings > Voltage Alarms > BD**).
2	Adjust the load to 50 amperes.
3	Verify the BD alarm occurs when the system voltage decreases to BD threshold.
4	Verify the BD alarm clears once the voltage has exceeded 0.5V above the BD alarm threshold.
5	Restore the BD alarm threshold to its previous setting.

High Voltage Alarms

Step	Action
1	Confirm the HV alarm threshold (**Menu > Configuration > Float Settings > Voltage Alarms > High Minor**).
2	Adjust the float voltage to a value greater than this threshold **(Menu > Configuration > Float Settings > Set Point).**
3	Verify an HV alarm is reported by the controller.
4	Restore the float voltage back to its original setting.
5	Restore the HV setting back to its original setting.
6	Verify the alarms clear and the controller returns to Normal.

[26] **Rectifier Input Fail Controller Alarms:** is displayed and labeled “ACF” and “MACF”.
Input Fail Rectifier LED: non-Eco rectifiers LED is labeled “ACF”. Eco rectifiers LED is labeled “INF” (INput Fail).
[27] DC fed Eco rectifiers do not report a failure (INF) when DC input is removed.
[28] Eco systems do not alarm for battery discharges and may have BD thresholds settings different than non-Eco systems.

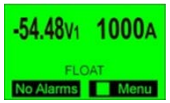
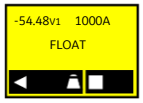
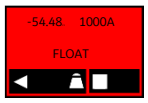
Manual Contactor Control and Alarms[29]

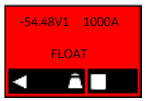
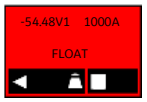
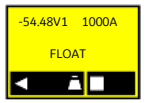
Step	Action
1	Open the contactor by controller command (**Menu > Control / Operations > Disconnects**).
2	Verify the controller reports a Contactor Open alarm.[30]
3	Close the contactor by controller command.
4	Verify the alarms clear and the controller returns to Normal.

[29] Skip if contactors are not present.
[30] Contactor Open Alarm may be delayed by imminent LVD Alarm delay if enabled and configured.

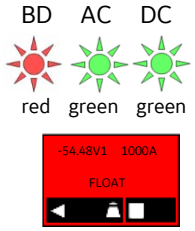
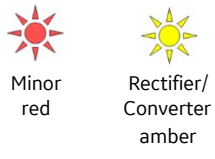
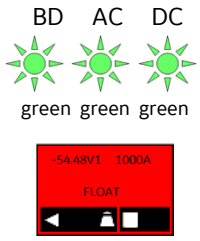
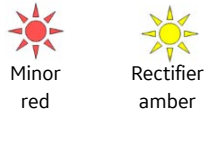
Troubleshooting

System

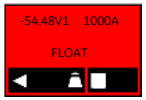
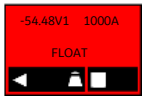
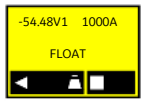
Pulsar Controller Status Display	Millennium Controller Status Display	Rect/ Conv LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
No Alarms BD AC DC green green green  Display green	Normal green	Norm green	green	**Normal Operation**	
MIN AC Fail BD AC DC `green amber green  Display Amber	Minor amber AC System amber	ACF amber (one Unit)	green	• Single rectifier not receiving AC power. • ac input circuit breaker has opened. • ac input voltage is out of range.	1. Verify rectifier input circuit breaker is closed. 2. Verify AC power to rectifier is available and in range. 3. If problem not corrected, replace rectifier.
		Norm green	green	A rectifier has been removed from the system while it is unpowered.	Issue the **Menu > Control / Operations > Uninstall Equipment** command for any rectifier that was removed while unpowered.
MAJ Multiple AC Fail BD AC DC green red green  Display Red	Minor red AC System amber	ACF amber (Multiple Units)	green	• Multiple rectifiers not receiving AC power. • ac input circuit breakers have opened. • ac input voltage is out of range.	1. Verify rectifier input circuit breakers are closed. 2. Verify AC power to rectifiers is available and in range. 3. If problem not corrected, replace rectifiers.
		Norm green	green	One or more rectifiers have been removed from the system while it is unpowered.	Issue the **Menu > Control / Operations > Uninstall Equipment** command for any rectifier that was removed while unpowered.

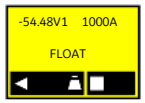
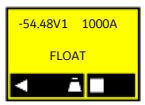
Pulsar Controller Status Display	Millennium Controller Status Display	Rect/ Conv LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
MAJ Battery on Discharge BD AC DC red green green  Display Red	Major red Battery on Discharge red	Norm green	green	System voltage has fallen below the battery on discharge threshold set by the user.	1. Investigate other alarms that may be present such as rectifier related problems. 2. If AC power is present but the system voltage remains low, call your local field representative.
	Major red Battery on Discharge red	Norm amber	green	Rectifier is in current limit.	
MAJ Battery on Discharge and AC Fail BD AC DC red amber green  Display Red	Major red AC Sys amber Battery on Discharge red	ACF amber	green	• Rectifier not receiving ac power. • ac input voltage is out of range.	
MIN Rectifier Fail BD AC DC green green green  Display Amber	Minor amber Rectifier/ Converter amber	Fail red (one Unit)	green	• Rectifier output has dropped below 18V (36V), rectifier has shut down[31]. • Excessive ambient temperature, rectifier has shut down. • A rectifier or rectifier fan has failed. • A rectifier high voltage shut down[31].	1. Verify that there is no obstruction of the airflow path and fans are turning. 2. Reset the rectifier by removing the rectifier, waiting approximately 30 seconds, and replacing the rectifier. 3. If problem persists, replace the rectifier. 4. If problem persists, call your local field representative.

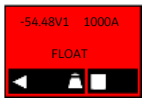
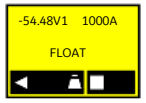
[31] When a rectifier or converter senses an over- or under-voltage condition it will shutdown, wait 4 seconds, and then attempt to restart. If the over- or under-voltage condition remains it will cycle again. If the over- or under-voltage condition remains after 3 restart attempts the unit will lock out, and user intervention is required to restart.

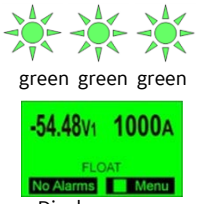
Pulsar Controller Status Display	Millennium Controller Status Display	Rect/ Conv LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
MAJ Multiple Rectifier Fail, MAJ Battery on Discharge  	 	 Fail red (multiple Units)	 green	Multiple rectifier outputs have dropped below 18V (36V); rectifiers have shut down[32].	1. Reset the rectifiers by removing the rectifiers, waiting approximately 30 seconds, and replacing the rectifiers. 2. If problem not corrected, replace rectifiers.
				• Excessive ambient temperature; multiple rectifiers have shut down[32]. • Multiple rectifiers have failed.	1. Verify that there is no obstruction of the vertical airflow path and fans are turning. 2. Reset rectifies by removing them, waiting approximately 30 seconds, and replacing them. 3. If problem persists, replace the rectifiers. 4. If problem persists, call your local field representative.
		 Fail red (all Units)	 green	• All rectifier outputs have dropped below 18V (36V); all rectifiers have shut down[32]. • Defective controller.	1. Remove controller and reset the rectifiers by removing the rectifiers, waiting approximately 30 seconds, and replacing the rectifiers. 2. If output voltage does not go to set-point previously set by user, call your local field representative.
MAJ High Voltage  	 	 Fail red (multiple Units)	 green	• High output voltage from rectifier(s). • Rectifier(s) high voltage shut down[32]. • Internal rectifier(s) failure. • VHV threshold set below float set point.	1. Check and adjust VLV threshold to above float set point. 2. Reset the rectifier(s) by removing the rectifier(s), waiting approximately 30 seconds, and replacing the rectifier(s). 3. If problem persists, replace rectifier(s). 4. If problem persists, call your local field representative.

[32] When a power unit senses an over- or under-voltage condition it will shutdown, wait 10 seconds, and then attempt to restart. If the over- or under-voltage condition remains it will cycle again. If the over- or under-voltage condition remains after 3 restart attempts the power unit will lock out, and user intervention is required to restart.

Pulsar Controller Status Display	Millennium Controller Status Display	Rect/ Conv LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
MAJ Fuse Major BD AC DC green green red  Display Red	Minor red Distribution amber	Norm green	red	One or more output circuit breakers or fuses have opened.	1. Clear circuit fault(s). 2. Reset circuit breaker(s) or replace fuse(s).
MAJ Contactor Open BD AC DC green green red  Display Red	Minor red Battery amber	Norm green	Red	One or more LVD contactors are manually forced open.	Place disconnect switch(s) in ON position.
MIN Battery High Temperature BD AC DC green green green  Display Amber	Minor amber Battery amber	Norm green	green	Batteries have exceeded temperature threshold set by user.	1. Check the threshold setting. 2. Call your local field representative.

Pulsar Controller Status Display	Millennium Controller Status Display	Rect/ Conv LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
MIN Thermal Probe Fail BD AC DC green green green  Display Amber	Minor amber Battery amber	Norm green	green	Battery thermal probe failed.	1. Ensure thermal probe is properly connected to thermal probe cable. 2. Ensure cable is properly connected to the rear of the Distribution Module. 3. If problem persists, replace thermal probe. 4. If problem persists, call your local field representative.
No response BD AC DC off off off Display blank	Display blank	Fail red blink	red blink	Controller failure, all devices on the communication bus reporting loss of communication with controller.	1. Check controller to ensure it is properly inserted into its slot. If so, perform the following steps: 2. Remove the controller input power connector for 1 minute and then reset. 3. If problem persists, replace controller with new controller board. 4. If problem persists, call your local field representative.
MIN Minor Communication Fail BD AC DC green green green  Display Amber	Minor amber	Fail red blink (one Unit)	green	Rectifier lost communication with controller.	1. Reset the rectifier by removing the rectifier, waiting approximately 30 seconds, and replacing. 2. If problem persists, replace the rectifier. 3. If problem persists, call your local field representative.
		Norm green	green	Rectifier removed from a running system, but not uninstalled.	Issue the **Menu > Control / Operations > Uninstall Equipment** command for any rectifier that was removed.

Pulsar Controller Status Display	Millennium Controller Status Display	Rect/ Conv LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
MAJ Major Communication Fail BD AC DC green green green  Display Red	 Major Red	 Norm green	 red blink	• LVD Board lost communication with the controller. • Multiple devices no longer communicating with the controller.	1. Clear blinking red LEDs on all devices. See other conditions with blinking red LEDs. 2. Correct communication with each device. 3. Issue the **Menu > Control / Operations > Uninstall Equipment** command. (This only removes this alarm for unconnected devices.) 4. Replace Distribution Module Board. 5. If problem persists, call your local field representative.
MIN Clock Battery Low BD AC DC green green green  Display Amber	 Minor amber  Controller amber	 Norm green	 green	Controller Clock Battery Is Low.	1. Replace the Controller Clock Battery. 2. If problem persists, call your local field representative

Pulsar Controller Status Display	Millennium Controller Status Display	Rect/ Conv LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
No Alarm, but individual Shunt Currents are displayed at or above their maximum display values (≥600A for loads, ≥800A for battery) BD AC DC green green green  Display green	 Normal green	 Norm green	 green	One or both QS871A shunt inputs is open-circuit.	1. Verify that the respective shunt has its green and yellow wire connections attached used for the current measurements. 2. Verify the shunt connection to the QS871A is good by verifying the green and yellow wire connections from the shunt follows through to the 10-pin connector at the respective QS871A.

Rectifiers/Converters

Status of a rectifiers and converters is provided by LEDs on their faces, and by extensive real time data, alarm and event history accessible through the system controller.

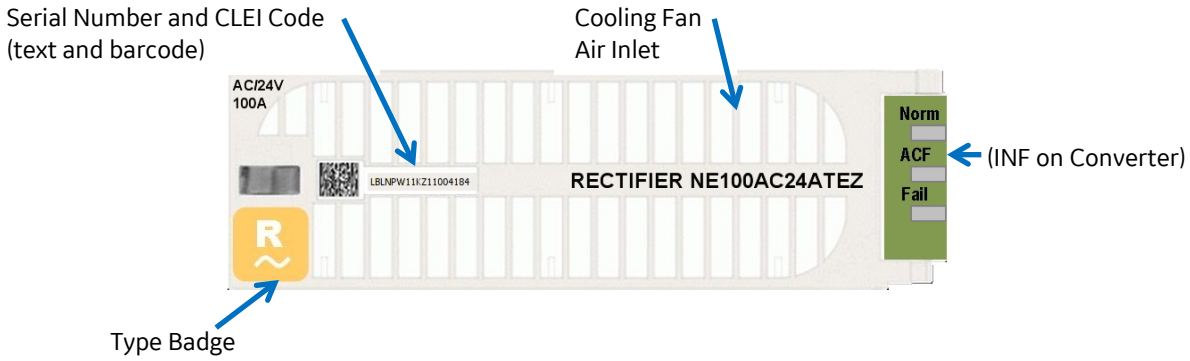


Figure 88 Rectifier Face Plate

Non-Eco rectifiers powered by PV (solar) panels will not operate properly.

- Under some conditions their LEDs may indicate normally operation: Norm LED ON.
- Various other LED conditions and rectifier status (observed via the controller) may occur with variations in DC input and load.

Rectifier/Converter Troubleshooting

1. Verify rectifier positions per the procedure in the ***Verify Rectifier Positions*** section.
2. Observe and compare Rectifier/Converter Status LEDs with Controller Status information.
3. Use the table below as a troubleshooting guide.

Rectifier/Converter LEDs

Table 11 Rectifier/Converter LEDs

LEDs[33]	Condition
Norm green ACF off Fail off	**Normal operation:** No alarms, inputs and outputs are in their normal range, communicating with the system controller.
Norm off ACF off Fail off	**Unpowered:** No input or output voltage present. 1. Remove and reinsert unit. 2. Check input voltage with a voltmeter; if input voltage is present, replace unit. 3. Check output bus voltage with a voltmeter; if output bus voltage is present, replace unit.
Norm green blink ACF off Fail off	**Standby:** The unit is okay, but has been placed in Standby by the controller and is not delivering power. **Note:** If a unit in standby loses communications with the controller it will exit Standby mode and deliver power

[33] ACF LED on rectifiers is replaced by INF LED on Converters.

Table 11 Rectifier/Converter LEDs	
Norm amber ACF off Fail off or red blink	**Output Limit:** The unit is okay and delivering maximum output: • At max rated output • At configured current limit • At thermal limit 1. If rectifiers/converters are equipped with optional air filters and reporting thermal limiting, check air filters. Clean or replace all filters if necessary. 2. View unit currents: **Status > Rectifiers > Rectifier Currents** or **Status > Converters > Converter Currents**
Norm off ACF amber Fail off or red blink	**ACF - ac Fail:** Rectifier input is missing or out of range. Correct AC fault. **INF**[34] **- Input Fail:** Converter input is out of range. Correct converter input fault.
Norm off ACF off or amber Fail red	**Shutdown**[35]**:** The unit cannot deliver output. • High Voltage Shutdown • Thermal Shutdown • Under Voltage Protect • Component failure 1. Check rectifier or converter status on controller display to determine cause of shutdown 2. Correct system output short, high temp, etc. 3. Remove and reinsert unit. If fault remains and other units are functioning correctly, replace unit.
Norm any ACF off or amber Fail red blink	**Communication Fail:** Blinks to indicate the unit is not communicating with a system controller. Remove and reinsert unit. If fault remains and other units are communicating correctly, replace unit.

Voltage Temp (VT)-Probes

Checking for Defective VT-Probes

(If a Voltage Channel Failure and/or Thermal Probe Failure alarm occurs)

Step	Action	
1	Disconnect the first probe from its RJ-45 terminal block.	
2	Run the command: **Menu > Control / Operations > Uninstall Equipment**.	
	Is the system controller green Normal LED lit?	
3	Yes – Install new probe. Finished.	No – Reinstall the removed probe. go to Step 4.
4	Remove the next probe.	
5	Go to Step 2. Repeat steps for all probes.	

[34] INF LED on converters replaces ACF on rectifiers.

[35] When a rectifier or converter senses an over- or under-voltage condition, it will shutdown, wait 4 seconds, and then attempt to restart. If the over- or under-voltage condition remains it will cycle again. If the over- or under-voltage condition remains after 3 restart attempts the unit will lock out, and user intervention is required to restart.

Specifications and Application

- Specifications and ordering information are in the *Infinity M Product Line Brochure* available at www.gecriticalpower.com
- External Surge Protective Device (SPD) is required on all AC inputs.
- 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.
- Grounding / Bonding Network – Connect to an Isolated Ground Plane (Isolated Bonding Network) or an Integrated Ground Plane (Mesh-Bonding Network or Common Bonding Network).
- Installation Environment - Install in Network Telecommunication Facilities, OSP, or where NEC applies.
- Battery return may be either Isolated DC return (DC-I) or Common DC return (DC-C).

Millennium II Alarm & Control Signals

In a standard Galaxy Power System (GPS) configuration, plant level alarms are sent to the controller via the Bay Interface Card (BIC) through serial data communication. The following alarm inputs are provided for discretionary use in other applications.

Table 12 Alarm and Control - Signal Names and BSL Pins

Pin Number	Signal Name	Pin Number	Signal Name	Pin Number	Signal Name
1	PCRAO	33	MJFR	65	FAN
2	PCRAC	34	MNFR	66	AMN
3	PCRAR	35	MNFC	67	TFLT
4	PCRVR	36	MNFO	68	TBST
5	PCRVC	37	BDO	69	TRTN
6	PCRVO	38	BDC	70	PBTR
7	PCREO	39	BDR	71	PBT
8	PCREC	40	ACFR	72	OS
9	PCRER	41	ACFC	73	TR1
10	PMJAR	42	ACFO	74	TEQ
11	PMJAC	43	RFAO	75	IN-5
12	PMJAO	44	RFAC	76	IN5-R
13	PMJEO	45	RFAR	77	RO
14	PMJEC	46	HVR	78	ROR
15	PMJER	47	HVC	79	TR2
16	PMJVR	48	HVO	80	TR4
17	PMJVC	49	UR1O	81	RBRPO
18	PMJVO	50	UR1C	82	IN-1
19	PMNAO	51	UR1R	83	IN-2 / BTP
20	PMNAC	52	CTLRR	84	LVD1
21	PMNAR	53	CTLRC	85	TR3
22	PMNVR	54	CTLRO	86	-
23	PMNVC	55	UR2O	87	4-20mA
24	PMNVO	56	UR2C	88	4-20mA-R
25	*5V*	57	UR2R	89	IN-3/ BTPFLT
26	-	58	UR3R *Now VLVR*	90	LVD3/ BTMJ
27	-	59	UR3C *Now VLVC*	91	EXT-V
28	PMNER	60	UR3O *Now VLVO*	92	EXT-VR
29	PMNEC	61	LVD2	93	ABS
30	PMNEO	62	LVD2R	94	ABS
31	MJFO	63	FAJ	95	DG
32	MJFC	64	AMJ	96	DG

Table 13 Alarm - Descriptions, BLS Pins, and Signal Names		
Description	**BSL Pin Number**	**Signal Name**
Critical-Audio	1	PCRAO
	2	PCRAC
	3	PCRAR
Critical-Visual	4	PCRVR
	5	PCRVC
	6	PCRVO
Critical-External	7	PCREO
	8	PCREC
	9	PCRER
Power Major-Audio	10	PMJAR
	11	PMJAC
	12	PMJAO
Power Major –External	13	PMJEO
	14	PMJEC
	15	PMJER
Power Major –Visual	16	PMJVR
	17	PMJVC
	18	PMJVO
Power Minor-Audio	19	PMNAO
	20	PMNAC
	21	PMNAR
Power Minor –Visual	22	PMNVR
	23	PMNVC
	24	PMNVO
Power Minor –External	28	PMNER
	29	PMNEC
	30	PMNEO
Major Fuse	31	MJFO
	32	MJFC
	33	MJFR
Minor Fuse	34	MNFR
	35	MNFC
	36	MNFO
Battery On Discharge	37	BDO
	38	BDC
	39	BDR
AC Fail	40	ACFR
	41	ACFC
	42	ACFO
Rectifier Fail	43	RFAO
	44	RFAC
	45	RFAR
High Voltage	46	HVR
	47	HVC
	48	HVO
	49	UR1O
User Relay 1	50	UR1C
	51	UR1R
	52	CTLRR
Controller Fail	53	CTLRC
	54	CTLRO

Table 13 Alarm - Descriptions, BLS Pins, and Signal Names		
Description	**BSL Pin Number**	**Signal Name**
	55	UR2O
User Relay 2	56	UR2C
	57	UR2R
	58	VLVR
Very Low Voltage	59	VLVC
	60	VLVO

Table 14 Alarm and Control Inputs - Descriptions, BLS Pins, and Signal Names		
Description	**BSL Pin Number**	**Signal Name**
Low Voltage 2 Disconnect State Detect	61	LVD2
Fuse Alarm Major	63	FAJ
Fuse Alarm Minor	65	FAN
Auxiliary Alarm Major	64	AMJ
Auxiliary Alarm Minor	66	AMN
Timer Float Control	67	TFLT
Timer Boost Control	68	TBST
Plant Battery Test	71	PBT
Open String Detect	72	OS
Transfer Rectifier 1	73	TR1
General Purpose Input 4 Previously TEQ	74	IN-4 Previously TEQ
General Purpose Input -5 Previously Engine Transfer	75	IN-5 Previously ETR
General Purpose Input -5 RTN Previously Engine Transfer Return	76	IN-5R Previously ETRR
Reserve Operation	77	RO
Reserve Operation RTN	78	ROR
Transfer Rectifier 2	79	TR2
Transfer Rectifier 4	80	TR4
Reserve Battery-Emergency Power Off	81	RBRPO
General Purpose Input 1	82	IN-1
BTP or General Purpose Input 2	83	IN-2/BTP
Low Voltage 1 Disconnect State Detect	84	LVD1
Transfer Rectifier 3	85	TR3
General Purpose 4-20mA Measuring Circuit	87	4-20mA
General Purpose 4-20mA Measuring Circuit-RTN	88	4-20mAR
BTPFLT or Generic Input 3	89	IN-3/ BTPFLT
Low Voltage 3 Disconnect State Detect Also Battery Thermal Protect Major	90	LVD3/ BTMJ
External Voltage Input	91	EXT-V
External Voltage Input -RTN	92	EXT-VR

Fuse Alarm Major (FAJ) - BSL-63

A battery potential input is required, which must use an external 1K ohm 2W current limiting resistor at the source. A Fuse Alarm Major is generated when battery potential is received.

Fuse Alarm Minor (FAN) - BSL-65

A battery potential input is required, which must use an external 1K ohm, 2W current limiting resistor at the source. A Fuse Alarm Minor is generated when battery potential is received.

Open String Alarm (OS) - BSL-72

A battery potential input is required, which must use an external 1K ohm 2W current limiting resistor at the source. This circuit is used to signal the controller that a battery string protective device or switch is in the open position. An Open String Alarm is generated when battery potential is received.

Aux Major (AMJ) - BSL-64

A battery potential input is required, which must use an external 1K ohm, 2W current limiting resistor at the source. This circuit is used to allow the controller to monitor another power device and provide alarms for it. An Aux Major Alarm is generated when battery potential is received.

Aux Minor (AMN) - BSL-66

A battery potential input is required, which must use an external 1K ohm, 2W current limiting resistor at the source. This circuit is used to allow the controller to monitor another power device and provide alarms for it. An Aux Minor Alarm is generated when battery potential is received.

Low Voltage Disconnect Active (LVD1) - BSL-84

A battery potential input is required, which must use an external 1K ohm, 2W current limiting resistor at the source if not using standard Lineage Power LVD circuit cards or controller. This circuit is used to inform the controller that the monitoring circuit of a Low Voltage Disconnect device has failed. In standard Galaxy Power Systems, the Bay Interface Card (BIC) monitors these alarms and informs the Controller through the serial interface connection.

Low Voltage Disconnect Active (LVD2/LVD2R) - BSL-61/62

A closure between these points or a ground signal into LVD2/ BSL-61 is used to inform the controller that a Low Voltage Disconnect device has opened. In standard Galaxy Power Systems, the Bay Interface Card (BIC) monitors these alarms and informs the Controller through the serial interface connection.

External Boost Option (TFLT/TBST/PBT) - BSL-67-69

A variety of external devices may be used to initiate boost in the controller. Wiring is required from positions 67/68/69 on the BSL card for operation of this feature. Providing a contact closure between TBST and TRTN initiates the boost feature. A contact closure between TFLT and TRTN returns the plant to float. Additional information on External Boost can be found in the User's Guide for Millennium II Controller Advanced Features manual.

Rectifier Hold OFF on Engine Option (RO/ROR) - BSL-77-78

The controller accepts a contact closure between RO/ROR (BSL-77-78) to hold OFF rectifiers configured as "Remote Group Standby"

These controller inputs hold OFF individual rectifiers or groups of rectifiers under external control.

Internal Sequencing - The controller can hold OFF individual rectifiers when AC is being provided by emergency generator. Internal Rectifier Sequencing requires external wiring to RO/ROR on BSL pin numbers 77/78, to function.

Rectifier External Sequence Option (TR1-TR4) - BSL-73/79/85/80

The controller accepts ground signals on TR1 to TR4 (BSL 73/79/ 85/80) from an external device to control the sequencing of plant rectifiers by holding them OFF in groups as follows:

Table 15 TR Leads and Associated Rectifiers

TR Signal	**Rectifiers Held OFF by TR Signal**
TR1	G01, G02, G09, G10, G17, G18, G25, G26, G33, G34, G41, G42, G49, G50, G57, G58
TR2	G03, G04, G11, G12, G19, G20, G27, G28, G35, G36, G43, G44, G51, G52, G59, G60
TR3	G05, G06, G13, G14, G21, G22, G29, G30, G37, G38, G45, G46, G53, G54, G61, G62
TR4	G07, G08, G15, G16, G23, G24, G31, G32, G39, G40, G47, G48, G55, G56, G63, G64

Additional information on the Rectifier Sequence Options can be found in the User's Guide for Millennium II Controller Advanced Features manual.

Safety

Safety Statements

See equipment specifications for installation and environmental limitations.

- Do not install this equipment over combustible surfaces.
- Rules and Regulations - 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.
  - 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.
- Electrical Connection Securing: Torque to the values specified on labels or in the product documentation.
- Cable Dress - dress to avoid damage to the conductors and undue stress on the connectors.
- Circuit Breakers and Fuses
  - Use only those specified in the equipment ordering guide.
  - Size as required by the National Electric Code (NEC) and/or local codes.
    Safety Tested Limits - Refer to the equipment ratings to assure current does not exceed:
    Continuous Load (List 1) - 60% of protector rating
    Maximum Load (List 2 - typically end of discharge) - 80% of protector rating.
  - GMT Style Fuses - Use only fuses provided with safety caps.
- Field-wired Conductors - Follow all National Electric Code (NEC) and local rules and regulations.
  - Insulation rating: 90°C minimum; 105°C (minimum) if internal to enclosed equipment cabinets.
  - Size AC field-wired conductors with 75°C ampacity (NEC) equal to or greater than their panel board circuit breaker rating.
  - Size DC field-wired conductors with 90°C ampacity (NEC) equal to or greater than circuit breaker/fuse rating.
- AC and DC input disconnect/protection - Provide accessible devices to remove input power in an emergency.
- Alarm Signals - Provide external current limiting protection. Rating 60V, 0.5A unless otherwise noted.
- 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.

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.

Special Installation Notes

Deutsch

Installationsanleitung

Eingangsspannung (Voltage) :+24, -48
Eingangsstrom (Current) : Max 1200A
Eingangsleistung (Watts) :
Nennfrequenz (Frequency) : 50 / 60 Hz

Seriennummer (Assembly No.):--

Modellnummer (Model No.) : Infinity *NE*

Abmessungen sind nur zur Referenz : 660mm x 533.4mm x 2133.6mm
(Dimensions are for reference only)

Max. Umgebungstemperatur : max. 45 deg. C
(Max. Operation temperature)

Achtung: Für kontinuierlichen Feuerschutz sollte die Sicherung nur mit einer des gleichen Types ersetzt werden.
Sicherungswert :
(Warning: For continued protection against fire replace with same type and rating of fuse)

Das System ist ein Gerät der Schutzklasse I / Überspannungs Kategorie II
(Power Supply is a Class I equipment / overvlotage category II)

Ausgangsspannungen und -stöme: DC 58 V / SELV
(Output Voltage and Current)

--Das Gerät darf nur in Räumen mit beschränktem Zutritt aufgestellt werden.
(Install only in limited access rooms)
(Nur ausgebildetes Personal)

--Nur für Aufstellung auf Boden oder einer anderen brennbaren Oberfläche geeignet.

--Das Gerät hat keinen eigenen Ausschalter, es muß daher mit einem Ein- und Ausschalter im Versorgungskreis versehen sein.

--Das Gerät ist für den Einbau in IT- Geräte in einem Rahmen bestimmt (siehe weitere Anleitung)

--Beim Einbau des Gerätes ist daraf zu achten das alle Anforderungen gemäß EN60950 eingehalten werden.

ACHTUNG: HOHER ABLEITSTROM
VOR ANSCHLUSS AN DEN VERSORGUNGSSTROMKREIS
UNBEDINGT ERDUNGSVERBINDUNG HERSTELLEN

Español

Notas especiales para instalaciones en países que hablan español.

- Instrucciones de instalación
  (Installation Instructions)
- Voltaje (Voltage):
  +24, -48
- Corriente (Current):
  Max 1200 A
- Frecuencia (Frequency):
  50/60Hz
- Voltaje y corriente de salida (Output Voltage and Current):

- Temperatura máxima de operación (Maximum Operation Temperature):
  45°C (113°F)
- Sin cabina contra incendios, suelo no combustible
  (No fire enclosure, non-combustible floor)
- Evaluado en EN60950
  (Evaluated to EN60950)

Revision History

Issue	Date	Comment
1	2016 April	Initial release
2	2016 June	Updated Table 2
3	2017 August	Add Supplemental Frame; update battery connections and load wiring.