



## ***Ferro Retrofit Power System (FRPS)***



Product Manual  
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## Table of Contents

Customer Service Contacts .....	3
Ferro Retrofit Power System (FRPS) Overview .....	5
Rectifier selection matrix .....	7
Safety .....	9
Getting Started.....	13
Floor mounting and optional earthquake bracing.....	15
Serial Bus Connection .....	23
Power up and Installation .....	27
Specifications .....	31

## **Customer Service Contacts**

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-THE-1PWR (1-800-843-1797). This number is staffed from 7:00 am to 5:00 pm Central Time (zone 6), Monday through Friday, on normal business days. At other times this number contacts an answering service with on-call personnel for out of service emergencies.

### Customer Training

Lineage Power offers customer training on many Power Systems products. For information call 1-877-LINEAGE (1-877-546-3243). This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

### Downloads and Software

To download the latest product information, visit our web site at <http://www.lineagepower.com>

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## **Ferro Retrofit Power System (FRPS) Overview**

Lineage Power, Tyco electronics, Lucent Technologies, Lorain and PECO offered stand-alone 200 to 800 amp Ferroresonant rectifiers throughout the 1980s and 1990s. Most Ferroresonant rectifiers have since been discontinued. The Ferro Retrofit Power System allows these legacy ferroresonant rectifiers to be upgraded to modern switchmode rectifiers and controller technology. These new systems utilize Lineage's 595LT series rectifiers. The 595LT rectifiers are Lineage Power's newest generation of high efficiency rectifiers continuing the legacy of 595 rectifiers which have been in service since the mid-1990s. These rectifiers are managed by the modern Galaxy SC, Millennium and Millennium 2 controllers.

The 200 amp, 400 amp and 800 amp Ferroresonant rectifiers are replaced by a drop-in FRPS cabinets which will utilize existing DC and AC connections and cabling. Note, cabling should always be inspected for integrity before being reused. Floor bolting patterns in the FRPS cabinets are also duplicated such that existing anchor bolts can also be reused. This retrofit solution provides a cost-effective means of modernizing the installed base of ferroresonant rectifiers. For most applications the retrofit process can take place in a single shift.

Note: Galaxy SC or Millennium controller must be available to control the 595LT rectifiers.

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## Rectifier selection matrix

Existing Rectifier			Replacement options			
Manufacturer	Model	Size	List	Style	Input Voltage	AC Breaker Option
AT&T/Lucent/Tyco/ Lineage	J85503C2 J85503C3	400A	101	S x S	208/240 or 480VAC	No internal AC CB
			101A	S x S	208/240VAC	(4) 208/240VAC CB's
			101B	S x S	480VAC	(4) 480VAC CB's
			102	B x B	208/240 or 480VAC	No internal AC CB
			112	B x B	208/240VAC	(4) 208/240VAC CB's
			113	B x B	480VAC	(4) 480VAC CB's
			103	Single	208/240 or 480VAC	No internal AC CB
			103A	Single	208/240VAC	(2) 208/240VAC CB's
			103B	Single	480VAC	(2) 480VAC CB's
	J85503C1	400A	131	S x S	208/240 or 480VAC	No internal AC CB
			131A	S x S	208/240VAC	(4) 208/240VAC CB's
			131B	S x S	480VAC	(4) 480VAC CB's
			132	B to B	208/240 or 480VAC	No internal AC CB
			132A	B to B	208/240VAC	(4) 208/240VAC CB's
			132B	B to B	480VAC	(4) 480VAC CB's
			133	Single	208/240 or 480VAC	No internal AC CB
			133A	Single	208/240VAC	(4) 208/240VAC CB's
	J85503B1	200A	151	S x S	208/240 or 480VAC	No internal AC CB
			152	B to B	208/240 or 480VAC	No internal AC CB

## Rectifier selection matrix (continued)

Existing Rectifier			Replacement options			
Manufacturer	Model	Size	List	Style	Input Voltage	AC Breaker Option
Lorain	RH M400	400A	201	S x S	208/240 or 480VAC	No internal AC CB
			201A	S x S	208/240VAC	(4) 208/240VAC CB's
			201B	S x S	480VAC	(4) 480VAC CB's
			202	B to B	208/240 or 480VAC	No internal AC CB
			202A	B to B	208/240VAC	(4) 208/240VAC CB's
			202B	B to B	480VAC	(4) 480VAC CB's
			203	Single	208/240 or 480VAC	No internal AC CB
			203A	Single	208/240VAC	(2) 208/240VAC CB's
			203B	Single	480VAC	(2) 480VAC CB's
Lorain	RHM800	800A	283	Single	208/240 or 480VAC	No internal AC CB
			283B	Single	480VAC	(4) 480VAC CB's
Lorain	RL400	400A	301	S x S	208/240 or 480VAC	No internal AC CB
			301A	S x S	208/240VAC	(4) 208/240VAC CB's
			301B	S x S	480VAC	(4) 480VAC CB's
			302	B to B	208/240 or 480VAC	No internal AC CB
			302A	B to B	208/240VAC	(4) 208/240VAC CB's
			302B	B to B	480VAC	(4) 480VAC CB's
			303	Single	208/240 or 480VAC	No internal AC CB
			303A	Single	208/240VAC	(2) 208/240VAC CB's
			303B	Single	480VAC	(2) 480VAC CB's



# Safety

## ***Safety Statements***

Read and follow all safety instructions and warnings before installing, maintaining, or repairing the equipment. Refer to individual equipment product manuals for additional safety statements specific to equipment being installed, removed, or replaced.

See the Specifications section for equipment specific

- Safety Compliance information
- Installation Area Limitations
- Environmental Limitations
- Do not install this equipment over combustible surfaces.
- For installations in the U. S. or Canada, use Listed/Certified compression connectors to terminate Listed/Certified field-wire conductors where required. For 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.
- If the proper connector for the country of installation is not provided, obtain appropriate connectors and follow manufacturer's requirements and all local requirements for proper connections.
- Follow all national and local rules and regulations when making field connections.
- Torque electrical connections to the values specified on labels or in the product documentation.
- DC output cables must be dressed to avoid damage to the conductors (caused by routing around sharp edges or routing in areas where wires could get pinched) and undue stress on the connectors.
- External protectors (fuses or circuit breakers) must be sized as required by the National Electric Code (NEC) and/or local codes. Refer to the equipment ratings to assure current does not exceed:
  - Continuous Load (List 1) - 64% of protector rating
  - Maximum Load (List 2 - typically end of discharge) - 80% of protector rating.
- Insulation on field-wired conductors must be rated no less than 90°C. Size conductors based on listed recommendations. Wiring internal to enclosed equipment cabinets must be rated at 105°C (minimum).
- Provide an accessible AC disconnect/protection device to remove AC power from the equipment in the event of an emergency. This device must open all poles and be connected together.
- Alarm contacts are not fused within the equipment. Current limiting protection for these contacts must be provided by external circuits. Exceeding these maximum ratings could result in fire or damage to the unit. See the Specifications section for alarm contacts ratings.
- In enclosed equipment cabinets, the equipment chassis must be connected directly to the cabinet ac service ground bus. For applications in huts, vaults, and central offices, the equipment chassis must be connected to the system bonding network.
- Use only GMT fuses provided with safety caps.

## Warning and Safety Symbols

The symbols may sometimes be accompanied by some type of statement; e.g., “Hazardous voltage/energy inside. Risk of injury. This unit must be accessed only by qualified personnel.” Signal words as described below may also be used to indicate the level of hazard

**DANGER** Indicates the presence of a hazard that will cause death or severe personal injury if the hazard is not avoided.

**WARNING** Indicates the presence of a hazard that can cause death or severe personal injury if the hazard is not avoided.

**CAUTION** Indicates the presence of a hazard that will or can cause minor personal injury or property damage if the hazard is not avoided.



This symbol identifies the need to refer to the equipment instructions for important information.



These symbols (or equivalent) are used to identify the presence of hazardous ac mains voltage.



This symbol is used to identify the presence of hazardous ac or dc voltages. It may also be used to warn of hazardous energy levels.



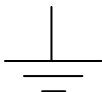
One of these two symbols (or equivalent) may be used to identify the presence of rectifier and battery voltages. The symbol may sometimes be accompanied by some type of statement, for example: “Battery voltage present. Risk of injury due to high current. Avoid contacting conductors with uninsulated metal objects. Follow safety precautions.”



One of these two symbols may be used to identify the presence of a hot surface. It may also be accompanied by a statement explaining the hazard. A symbol like this with a lightning bolt through the hand also means that the part is or could be at hazardous voltage levels.



This symbol is used to identify the protective safety earth ground for the equipment.



This symbol is used to identify other bonding points within the equipment.



This symbol is used to identify the need for safety glasses and may sometimes be accompanied by some type of statement, for example: “Fuses can cause arcing and sparks. Risk of eye injury. Always wear safety glasses.”



## **Precautions**

Precautions and proper methods for handling related equipment is in their manuals.

The following precautions apply when working on or using this type of equipment:

- The equipment must be installed, serviced, and operated 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.
- The equipment may be powered by multiple AC inputs. Ensure that the appropriate circuit protection device for each AC input being serviced is disconnected before servicing the equipment.
- Do not disconnect permanent bonding provisions unless all ac inputs are disconnected.
- Batteries may be connected in parallel with the output of the rectifiers. Turning off the rectifiers will not necessarily remove power from the bus. Make sure the battery power is also disconnected and/or follow safety procedures while working on any equipment that contains hazardous energy/voltage.
- High leakage currents may be possible on this type of equipment. Make sure the equipment is properly safety earth grounded before connecting power.
- 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).
  - Wear safety glasses. Fuses can produce sparks. High energy levels on buses and distribution components can produce severe arcing.
  - Test circuits before touching.
  - Lock out and tag circuit breakers/fuses when possible to prevent accidental turn on.
  - Be aware of potential hazards before servicing equipment.
  - Identify exposed hazardous electrical potentials on connectors, wiring, etc. (note the condition of these circuits, especially wiring).
  - Use care when removing or replacing covers; avoid contacting circuits.
  - Use a personal ESD strap when accessing or removing electronic components.
- Electricity produces magnetic fields that can affect implanted medical electronic devices, such as pacemakers. The strength of the magnetic field depends on the amount of current in the circuit, as well as other conditions (such as number of conductors, placement, and distance from the conductor). DC power and distribution systems, including batteries, which are typically used in telecommunications utility rooms, can operate at high current levels. Personnel with electronic medical devices need to be aware of their restrictions when working around electricity.

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## Getting Started

### Tools and Hardware

You will need the following tools and hardware to install the Ferro Retrofit Power System:

- Material-handling equipment to unload the cabinet at the installation site, remove from shipping container, and set in final position [minimum lifting capacity: 900 lbs. (410Kg)]  
Note: Use the equipment weights and dimensions as a guideline for choosing material-handling equipment.
- Digital multimeter (DMM) with 0.05% accuracy on dc scale
- Laptop loaded with Windows
- 3/16-inch (5mm) Allen-head wrench (provided)
- **Insulated** hand tools
- Wire cutters and stripper
- Torque wrenches (see Table 3-A) 25-240 in·lbs
- Sockets:

<u>English Equivalent</u>	<u>Hardware</u>
3/8"	#10-32 FRPS-200/400 AC Connections
7/16"	1/4"-20 FRPS 800 AC Connections and Cabinet Ground
9/16"	3/8"-16 DC Connections

### Torque Setting for Hardware

English		
Screw Size	Torque (N-m)	Torque (in-lbs)
10-32	2.8	30
1/4"-20	7.3	65
3/8"-16	27	240

## ***Unpacking***

Before opening the packaging, carefully inspect the outside in the presence of shipping personnel for signs of damage. Carefully open the packaging to verify that the contents are complete and undamaged. If damaged, follow the shipping carrier's procedure for filing a damage claim. If the equipment must be returned, it should be repacked in the original shipping packaging.

Before continuing, verify that the following conditions exist at the installation site:

- Floor is conditioned and clean (refers to removal of any combustible flooring, e.g., carpet, wood, etc.).
- Job Site Documentation details cabinet locations.

## Floor mounting and optional earthquake bracing

Cabinets are available to replace back to back, side to side or single rectifier(s).

The Ferro Retrofit Power System (FRPS) mounts to the floor using the existing anchor bolts. There are four to eight anchor bolt holes available.

Zone 3 and 4 earthquake braces are optional for back to back cabinets  
Earthquake braces are included for all side to side cabinets.

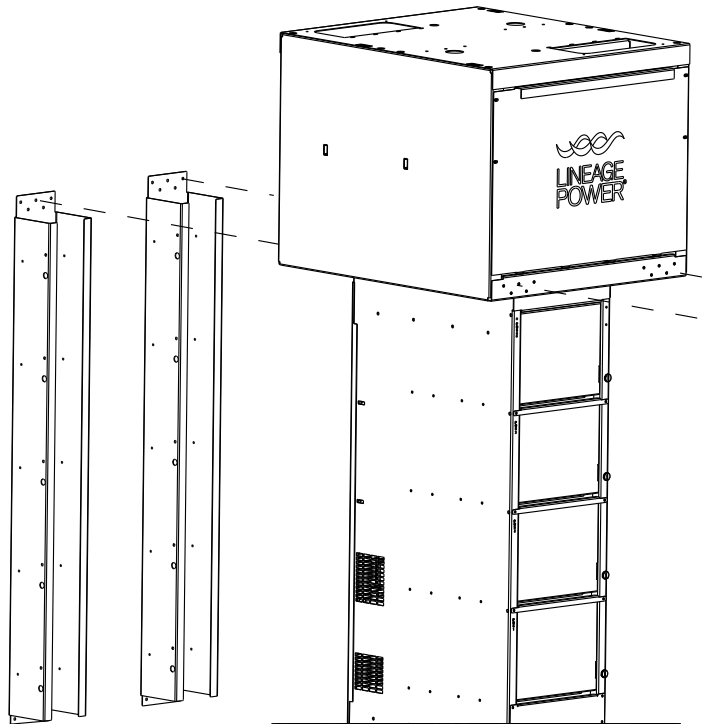


Figure 3-1 Zone 3 and 4 Earthquake bracing

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# AC and DC Connection and Wiring



## Safety

Read *Safety* section carefully before connecting AC to the Ferro Retrofit Power System (FRPS)

## AC Input and DC Output Cabling

This FRPS is designed to utilize the existing AC and DC connections supplied during the initial Ferro rectifier installation. Ensure the existing AC protectors and wiring meets national and local codes before beginning work. All existing wiring and connectors must be inspected for integrity before being reused.

Figure 4-1A, B, C and D show typical AC and DC wire termination points for the FRPS-400.

Figure 4-2A shows typical AC and DC wire termination points for the FRPS-200.

Figure 4-3A shows typical AC and DC wire terminations points for the FPRS-800.

The table below indicates the minimum AC and DC wiring and protectors required when replacing the ferros with the FRPS units. The protectors, wiring and conduit should already be in place to meet these requirements. If it does not, contact engineering.

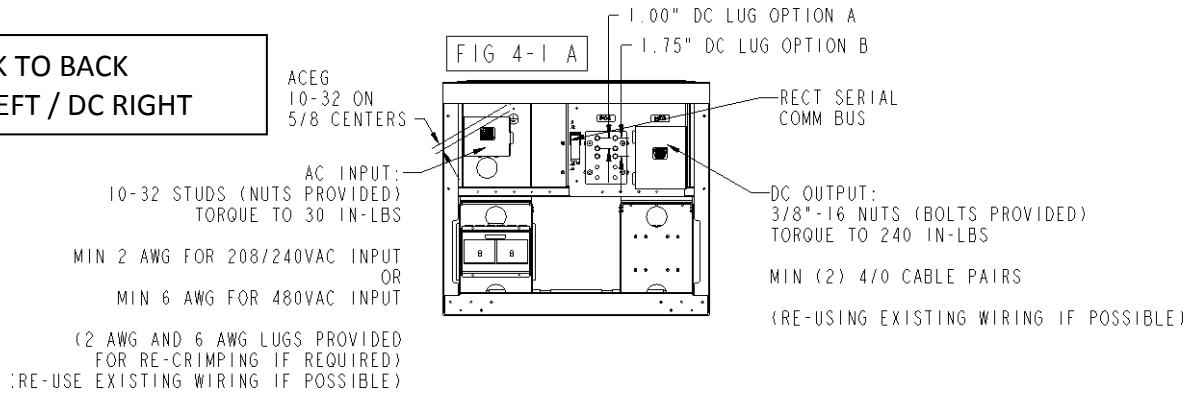
AC Volts	Amps/Rect Group	AC Input Protector/Rect Group	AC input (# wires) gauge/Rect Group	DC Output (# wires) gauge/Rect Group
<b>FRPS-800</b>				
208/240	Not available	Not available	Not available	(3) 350MCM pairs
480	80	100A	(3) #3AWG (1) #6AWG (ACEG)	
<b>FRPS-400</b>				
208/240	80	100A	(3) #2 AWG (1) #8AWG (ACEG)	(2) 4/0 pairs
480	40	50A	(3) #6AWG (1) #8AWG (ACEG)	
<b>FPRS-200</b>				
208/240	40	50A	(3) #6 AWG (1) #10 AWG (ACEG)	(1) 4/0 pair
480	20	25A	(4) #10 AWG	

## Connection and Wiring (See Fig 4-1, 4-2 or 4-3)

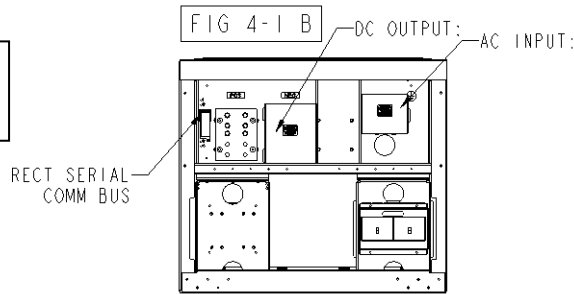
**Danger:** Verify AC power is OFF. Use appropriate lock-out tag-out procedures before continuing.

Step	Action
1.	Verify there are no alarms present on the controller. If alarms are present troubleshoot and clear before proceeding.
2.	Verify there is sufficient rectifier capacity available to power the system load prior to turning any rectifier off.
3.	Locate and turn off the AC power to the Ferro rectifier(s) being replaced.
4.	After verifying the AC power is off. Remove the AC wiring and conduit. Tag the removed wires. Do not remove the lugs from AC wires as they will be reused. Inspect the AC cables, connectors and crimps and verify they are in good condition. If not contact engineering before proceeding. Insulate any metallic exposed ends of the lugs/wire and conduit fittings
5.	Remove only the DC Return (+) output cable from the rectifier being replaced. Inspect the DC cables, connectors and crimps and verify they are in good condition. If not contact engineering before proceeding. Do not remove the lugs from the output cabling as they will be reused. Insulate the cable end(s) with a minimum of two layers of electrical tape or other appropriate insulator.
6.	Danger: DC Battery (-) output cable may be energized by the batteries. Use extreme caution to prevent the cable contacting any surface during this procedure. Remove the Battery (-) output cable from the rectifier being replaced. Inspect the DC cables, connectors and crimps and verify they are in good condition. If not contact engineering before proceeding. Do not remove the lugs from the output cabling as they will be reused. Insulate the cable end(s) with a minimum of two layers of electrical tape or other appropriate insulator.
7.	Remove the control cable from the rectifier to the controller and discard.
8.	Remove the anchor bolt hardware while guarding the anchor bolt studs or inserts, keep the anchor bolt hardware for reuse. Remove the rectifier.
9.	Place the FRPS over the existing anchor studs or inserts and attach to the floor using the hardware removed in the previous step.
10.	Remove the covers over the FRPS top section to expose the AC and DC connection points.
11.	Reattach the AC conduit to the FRPS. In some cases a Greenlee punch may be required
12.	Connect the AC ground conductor to the FRPS. See Figure 4-1 , 4-2 or 4-3
13.	Connect the AC input power wiring to the FRPS. See Figure 4-1 4-2 or 4-3
14.	Connect the DC Return (+) output cable(s) to the FRPS. See Fig 4-1 , 4-2 or 4-3
15.	Connect the DC Battery (-) output cable(s) to the FRPS .See Fig 4-1 , 4-2 or 4-3
16.	Connect the Rect Serial Comm Bus cable to the previous FRPS (daisy chain) Fig 4-1, 4-2 or 4-3 or to the Controller if this is the first FPRS cabinet. See Section 5.
17.	Label TO/FROM AC input circuit protector information on both the rectifier position location label and inside the FRPS near the AC input terminal block.
18.	Replace ALL covers/guards removed in the above steps
19.	DO NOT close AC CB or reinstall AC FUSE at this time (see Section 6)
20.	DO NOT install the rectifiers a this time (See Section 6)

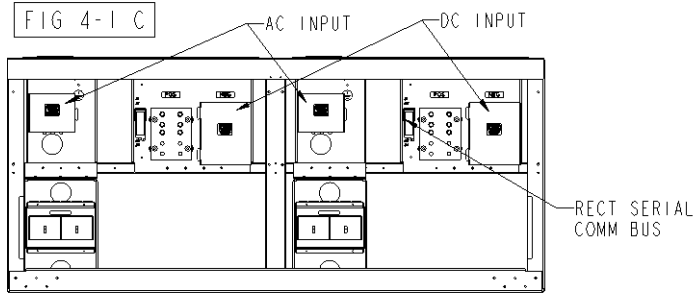
**BACK TO BACK  
AC LEFT / DC RIGHT**



**BACK TO BACK  
AC RIGHT/ DC LEFT**



**SIDE BY SIDE  
AC LEFT / DC RIGHT**



**SIDE BY SIDE  
AC RIGHT / DC LEFT**

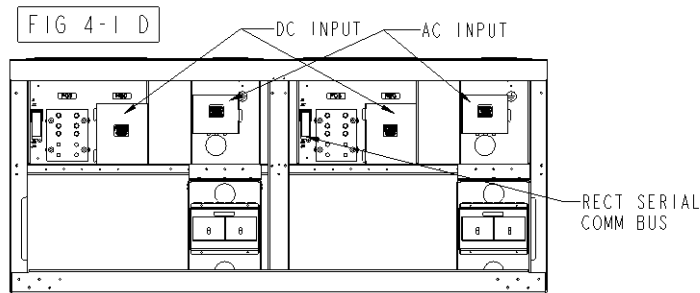


Figure 4-1 FRPS-400 Front view, Typical Connections, front cover removed

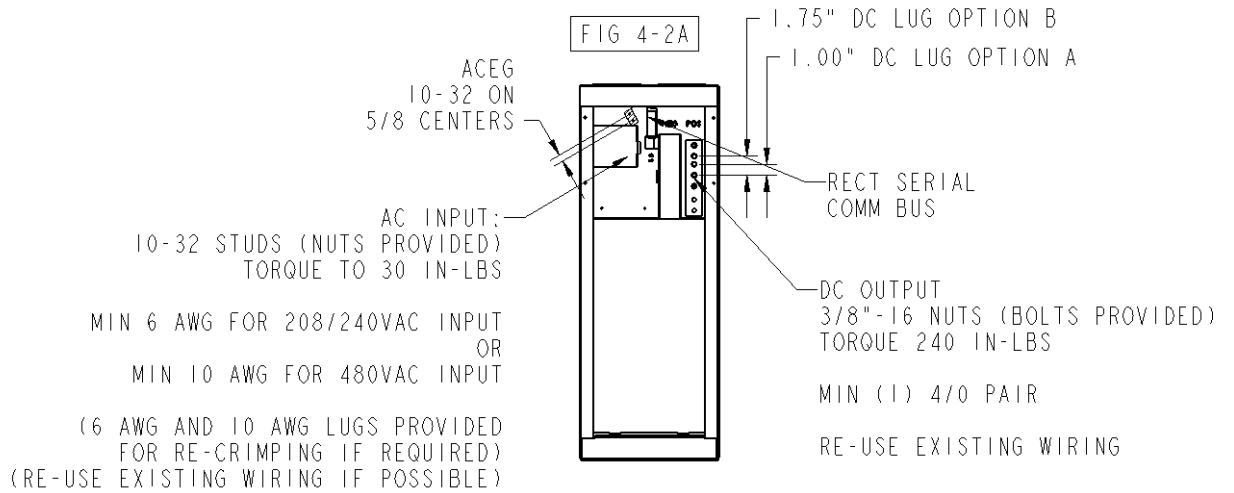


Figure 4-2 FRPS-200 Front view, Typical Connections, front cover removed

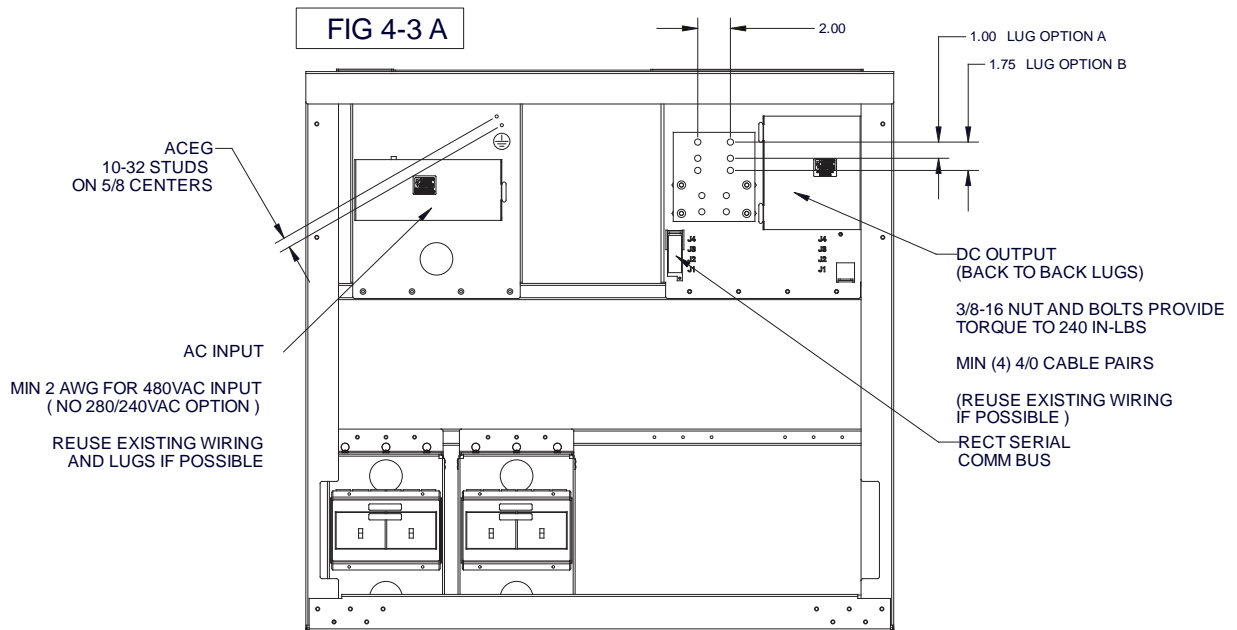


Figure 4-3A FRPS-RHM 800 L283 Front view, Typical Connections, front cover removed

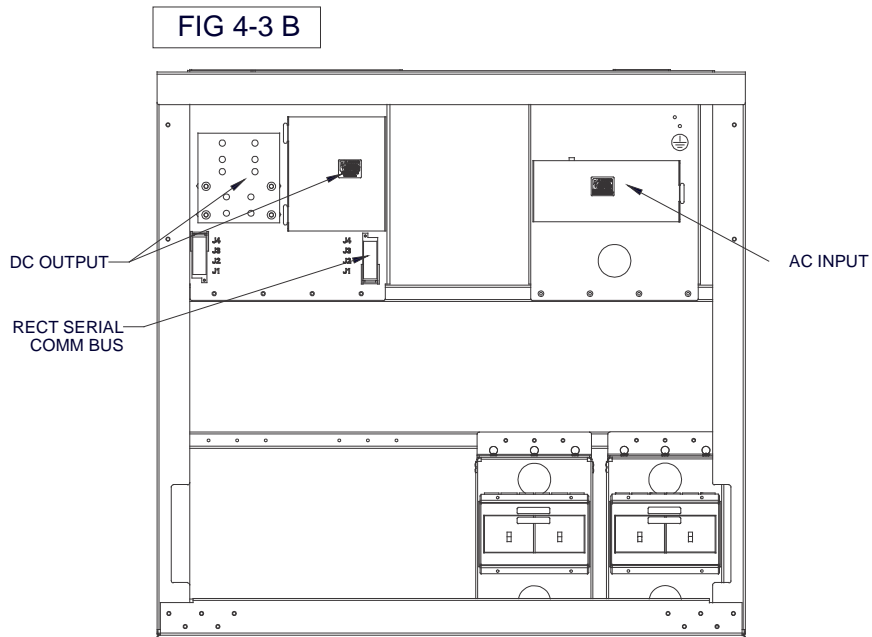


Figure 4-3B FRPS-Peco- 800 L483 Front view, Typical Connections, front cover removed

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## Serial Bus Connection

### For Galaxy SC Controllers (see Fig 5-1, 5-2)

Step	Action	
1.	Open the front door of the Galaxy SC controller. Is a BJC3 circuit board installed in BJCA, B, or C slots, located on the right side of the card cage? .See Figure 5-1, . 5-2	
	Yes – Which slot; A, B or C? On the back of the controller locate the corresponding backplane position; A, B or C and verify the RIM is installed in the correct position. See Figure 5-2.	No. Power down the basic side (right side) of the controller by partially sliding out the BJA basic controller power board. Install a BJC3 board in one of the open BJC* slots and install the RIM in the corresponding backplane position. Insert the BJA power board and continue. See Figure 5-2.
2.	Plug the serial cable (Not included. See table below for ordering information) into J3 or J4 of the RIM on the back of the Galaxy SC controller.	
3.	Route the serial cable from the Galaxy SC controller to the FRPS cabinet #1 and plug it into J1 connector located next to the DC output cables. See Figure 4-1., 4-2 or 4-3	
4.	Close the front door of the controller	

### For Galaxy Millennium Controllers (see Fig 5-3 or 5-4)

Step	Action
1.	Remove the front cover of the Millennium controller
2.	Plug the serial cable (Not included. See table below for ordering information) into Serial Rectifier Bus J8 connector of the Millennium (Fig 5-3 ) or the P9 connector of the Millennium II (Fig 5-4)
3.	Route the serial cable from the Millennium controller to the FRPS cabinet #1 and plug it into J1 connector located next to the DC output cables. See Figure 4-1, 4-2 or 4-3
4.	Replace the cover

Optional Serial Cables	
Comcode	Description
847090799	10' serial cable
847865425	25' serial cable, includes coupler to extend the cable as required.

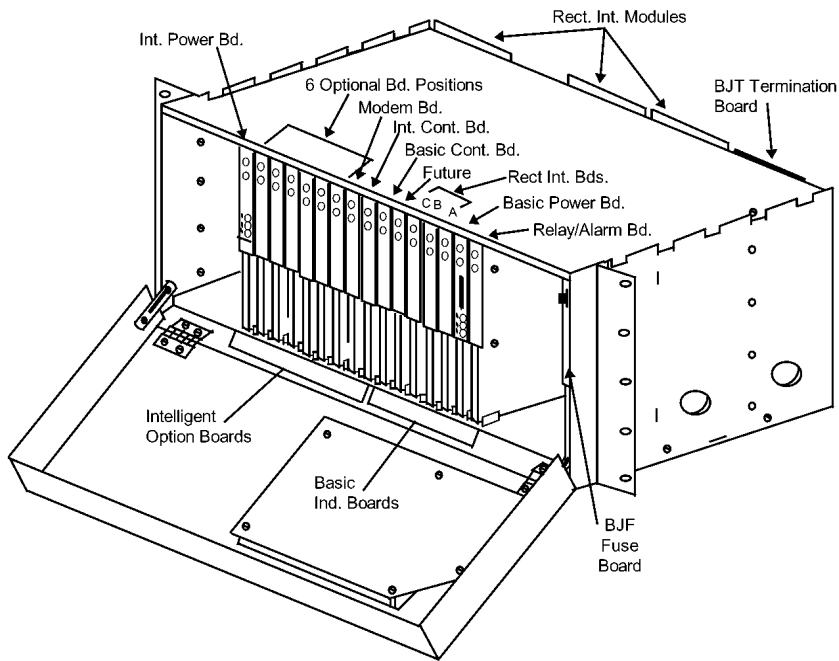


Figure 5-1 Galaxy SC Controller circuit board locations

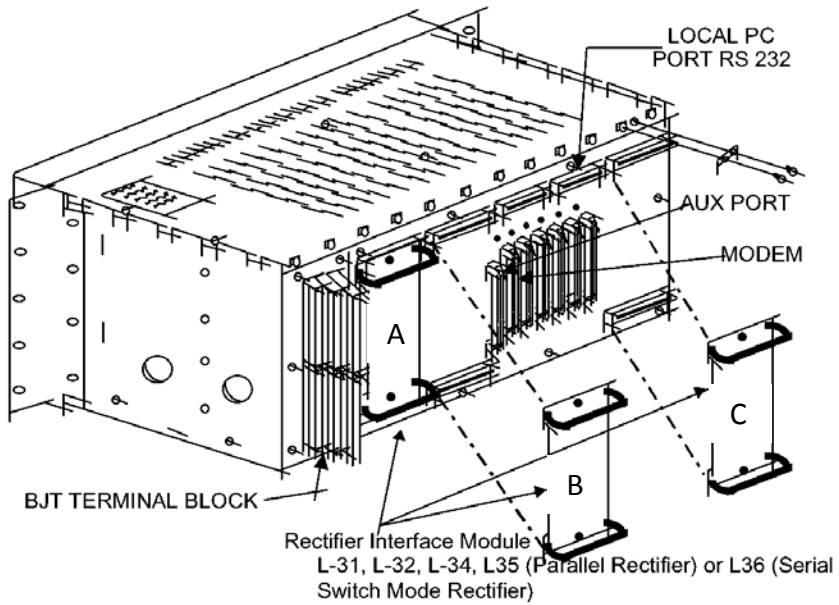


Figure 5-2 Galaxy SC controller backplane and Rectifier Interface Modules



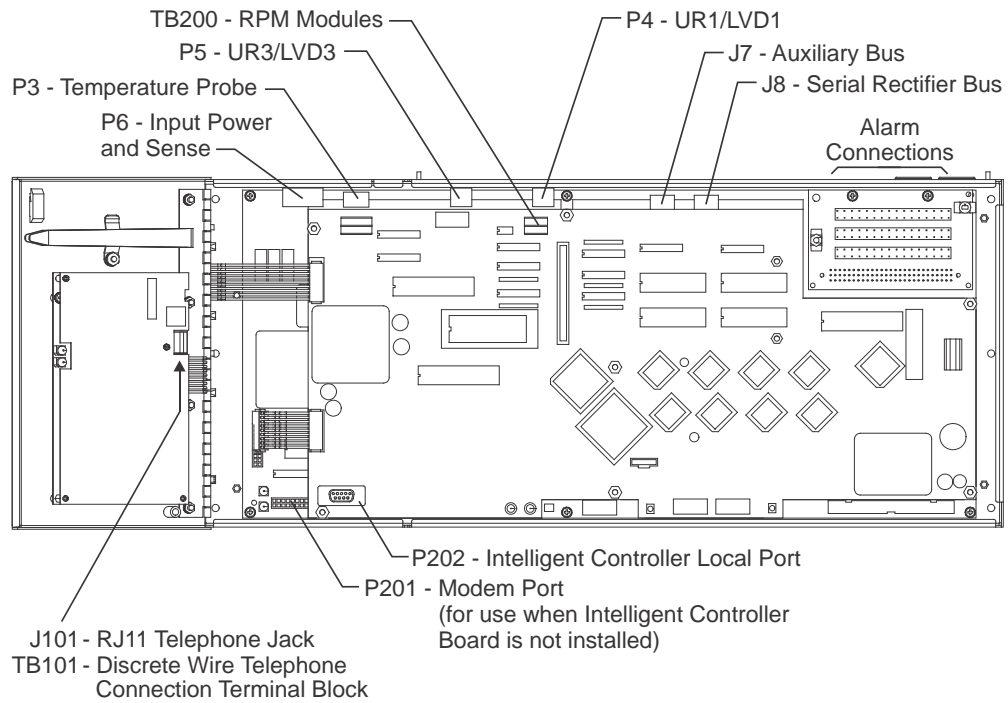


Figure 5-3 Millennium Controller Connector Locations

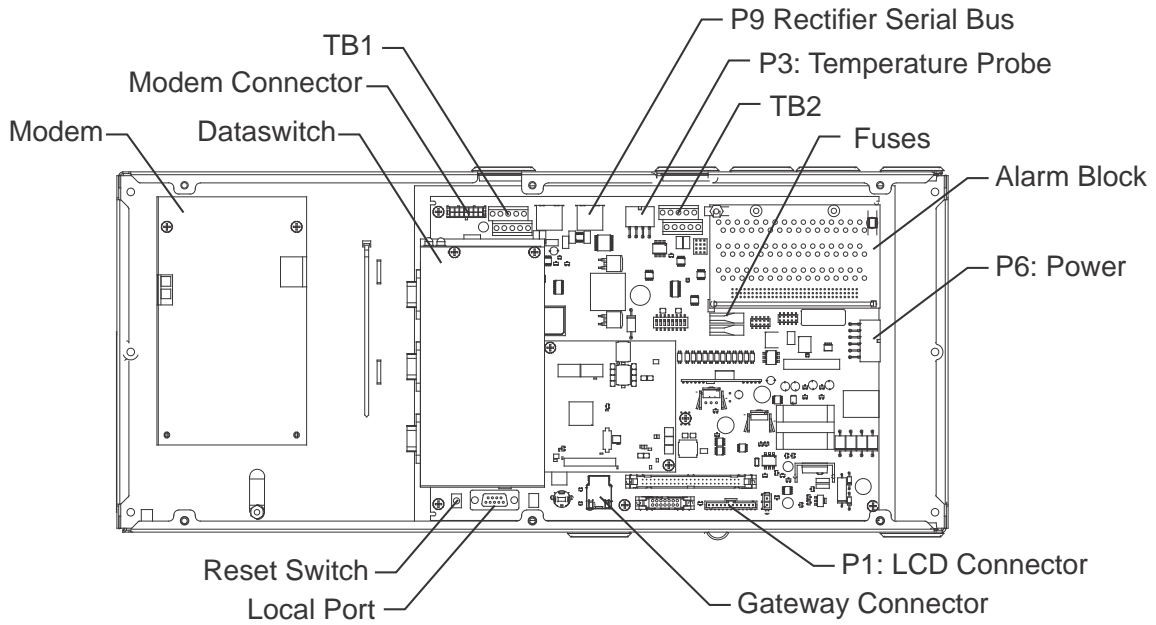


Figure 5-4 Millennium II Controller Connector Locations

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## Power up and Installation

### Initial System Checkout and Preparation for Power Up

**Before Installing Rectifiers** Prior to installing rectifiers verify that AC voltage is not present to the FRPS.

**Safety Reminder** Some procedures are performed while AC voltage is present at the cabinet; **exercise extreme caution** and observe all precautions described in the safety section of this product manual.

**NOTE:** The retrofit cabinets without circuit breakers are shipped from the factory setup for a 380/400/480 Vac installation. The keying plate on each shelf will need to be removed, turned over and reinstalled to the 208/240 Vac side for applications using the 595LTB rectifier.



*Caution DO NOT INSTALL A 595LTB RECTIFIER INTO 380/400/480 Vac system; they will be damaged.*

Step	Action
1.	Determine the AC input voltage.
	If 480 VAC proceed to step 3.      If 208/240 VAC proceed
Danger: Verify AC power is OFF and use appropriate lock-out tag-out procedures before continuing.	
2.	Use a ¼" nut driver to remove the input VAC keying plate located at the back of each rectifier shelf. Turn the plate over so "208 VAC" is showing and reinstall the plate. See Figure 5-6.
3.	Verify all AC circuits are off
4.	Locate the label on the top of the rectifier. Verify that the actual AC voltage and the label AC voltage markings match.
5.	Verify the rectifier On/Standby switch is in the standby position.
6.	Carefully slide the rectifier toward the rear of the shelf until the guide pins on the rectifier contact the connector on the rear of the shelf.
7.	Using the Allen-head wrench (T-handle) secure the rectifier to the shelf. Note: It is extremely important to fully seat the rectifier. See Fig 6-2
8.	Turn on the AC source circuit breaker for the installed rectifier.
9.	Turn on the rectifier's On/Standby switch and close the output breaker.
10.	As the rectifier powers up the green ON LED will illuminate and the red ALM LED will blink until the rectifier establishes communication to the controller. Once controller communication is established the ALM LED will turn off.

11.	Set rectifier ID number (choose appropriate number); a. Press and hold the rectifier power switch in the up position until the number in the display begins to blink, release the switch. b. Depress and release the switch until the desired rectifier ID is reached. c. Release the switch and the ID will be saved.
12.	Follow steps 6 thru 11 until all rectifiers are on and ID'd.

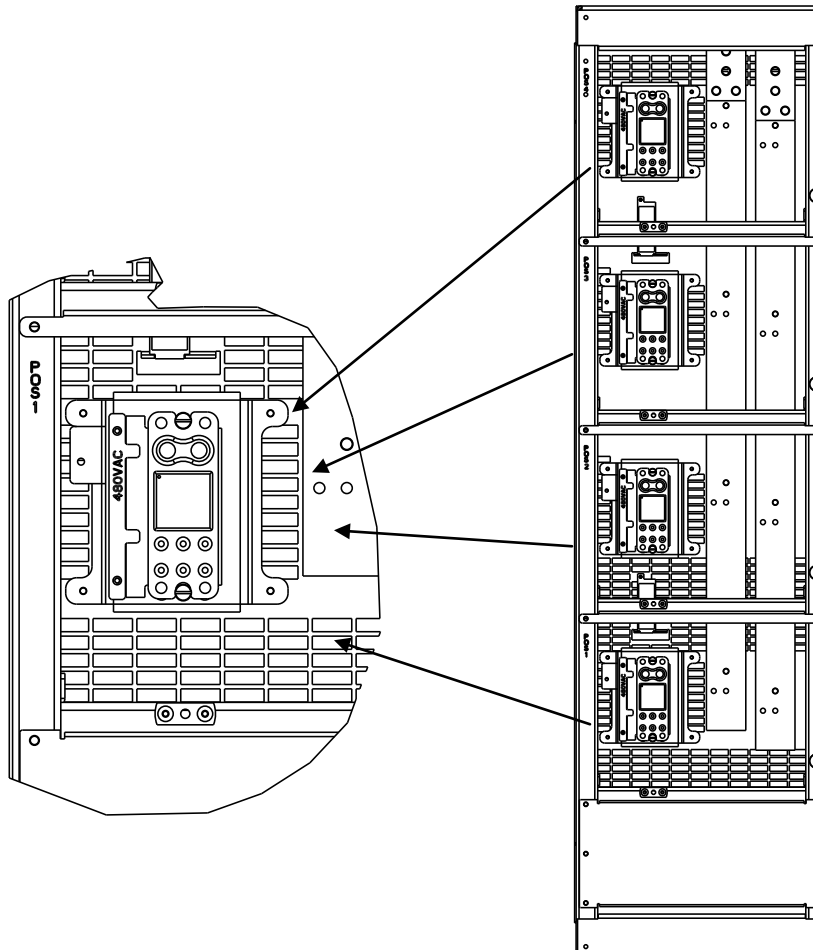


Figure 6-1 Connectors on rear of each rectifier shelf

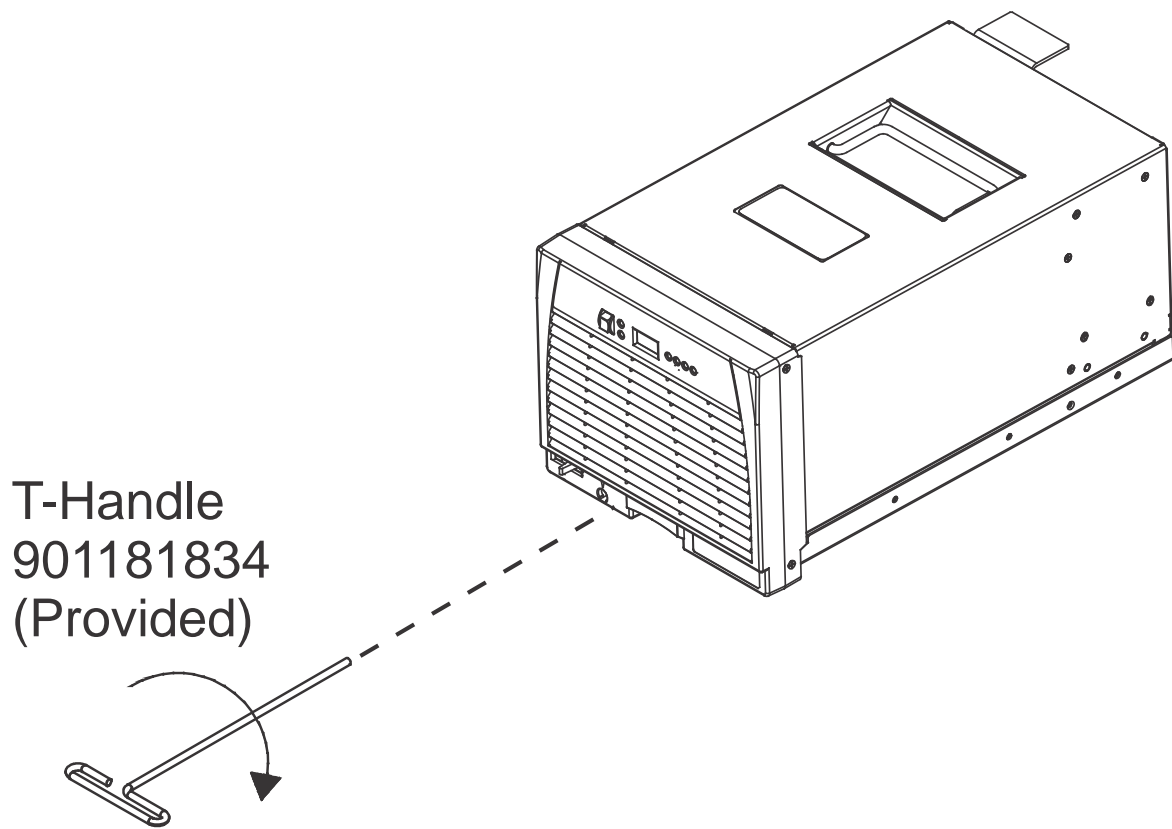


Figure 6-2 Securing the rectifier in the rectifier slot

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## Specifications

Weight with earthquake zone 4 bracing installed		
	No Rectifiers Installed	Four Rectifiers Installed
FRPS-400	255 lbs.	483 lbs.
FRPS-200	205lbs	316 lbs
FRPS-800	285 lbs	513 lbs
<b>Safety Compliance</b>		
System:	National Recognized Test Laboratory Listed per the requirement of Underwriters Subject Letter 1801, DC Power Distribution Centers for Telecommunications Equipment.	
Rectifiers:	Individually UL Recognized and/or CSA Certified to UL60950-1 and CAN/CSA C22.2 No. 60950-1. Individually approved to IEC-60950-1/EN60950-1 by an EC Notified Body and have outputs classified as SELV.	
<b>Installation Area Limitations</b>		
Install only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) in accordance with articles 110-26, 110-27, and 110-18 of the U.S. National Electric Code (NEC-2011), ANSI/NFPA No. 70, and pursuant to applicable local codes.		
<b>Environmental Limitations</b>		
Use this equipment in a controlled environment (an area where the humidity is maintained at levels that cannot cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified). The FRPS has been evaluated for use in a continuous ambient temperature not to exceed 45°C. Short-term excursions to 50°C are acceptable.		
<b>Grounding/Bonding Network</b>		
This product operates equally well if installed as part of the Isolated Ground Plane (Isolated Bonding Network) or the Integrated Ground Plane (Mesh-Bonding Network, aka, Common Bonding Network). Lineage recognizes there are different grounding techniques that are equally successful. Adhere to a commonly accepted and consistent grounding approach to ensure personnel safety, network protection, and proper equipment operation. Multiple low impedance paths to Earth ground are essential.		
<b>Intra-Building Wiring</b>		
The equipment and subassembly ports are suitable for connection to intra-building or unexposed wiring or cabling. The equipment and subassembly ports can be connected to shielded intra-building cabling grounded at both ends.		

595 Rectifier Specifications	
Nominal Input voltage	(595LTA) 380-480Vac, 3 wire = PE
	(595LTB ) 200-240Vac, 3 wire + PE
Input frequency range	47Hz – 63Hz
AC ripple	<100mVrms
Power Factor	0.98 from 50% to 100% load
Total Harmonic Distortion (THD)	<5% from 50% to 100% load
Operating voltage range	-44Vdc to -58Vdc
Regulation	+/- 0.5%
Output Noise	<2mV psophometric
Electromagnetic Immunity	10V/meter over 20Mhz -2000MHz
Output current	220A ( 0 to 37C ) , 200A ( 0 to 50C)
Heat release 595LTA	(595LTA) 450W (1550 BTU/hr)
	(595LTB) 510W (1750 BTU/hr)

**AC Surge Protection:** It is important that AC surges reaching rectifiers do not exceed the capacity of the rectifier internal surge protection. Protection must be provided external to the FRPS system to limit surge energy reaching the rectifiers. Site surge protection must be coordinated with rectifier internal surge protection and must clamp at a lower voltage than the rectifier internal protection. The internal protection voltage and current characteristics of the rectifiers are as follows:

595LTA		595LTB	
Phase to Phase Voltage	MOV Conduction Current	Phase to Phase Voltage	MOV Conduction Current
625 Vac (RMS)	0A	320Vac(RMS)	0A
940Vpeak	1mA	462Vpeak	1mA
1650 Vpeak	100A	810Vpeak	100A