



Galaxy Power System 4848/100
with 595 Series Rectifiers S1:3 and later
(GPS 4848/100)
H569-434

Note: Refer to User's Guide Issue 8 for
595 Series Rectifiers prior to S1:3.

User's Guide
Select Code 167-792-155
Comcode 107933384
Issue 10
February 2008

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Notice:

The information, specifications, and procedures in this manual are subject to change without notice. Lineage Power assumes no responsibility for any errors that may appear in this document.

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1 Introduction

GPS 4848/100

Overview

The Galaxy Power System (GPS) 4848/100 was developed to support -48 volt telecommunications powering solutions in worldwide markets. The GPS 4848/100 combines 200-ampere, fan-cooled, switchmode rectifiers, microprocessor control technologies, battery and load disconnect/reconnect options, and a comprehensive line of fuse and circuit breaker dc distribution options in a modular front-access design. This modularity ensures easy access, simplified installation and maintenance, and allows the system to expand in capacity and features as power needs grow.

With 10,000-ampere maximum capacity, distribution flexibility, and universal ac input capability, the GPS 4848/100 supports switching, transmission, and wireless applications in central office locations and environmentally controlled remote sites (huts or vaults). For centralized architecture, bus bars are available to 10,000A.

Notes The Galaxy SCF Controller is no longer available in the GPS 4848/100. For information about systems with SCF controllers, see Issue 5 of this manual.

GPS 4848/100 supports 595LT series rectifiers, one per shelf. See GPS 4848/100 with Dual Rectifier Shelf User's Guide for Specifications of 595LT series rectifiers.

This document includes 595 series rectifiers S1:3 and later. For information about systems with 595 Series Rectifiers prior to S1:3, see Issue 8 of this manual.

GPS 4848/100, continued

Illustration

Figure 1-1 is an isometric view of the GPS 4848/100 with a Millennium Controller.

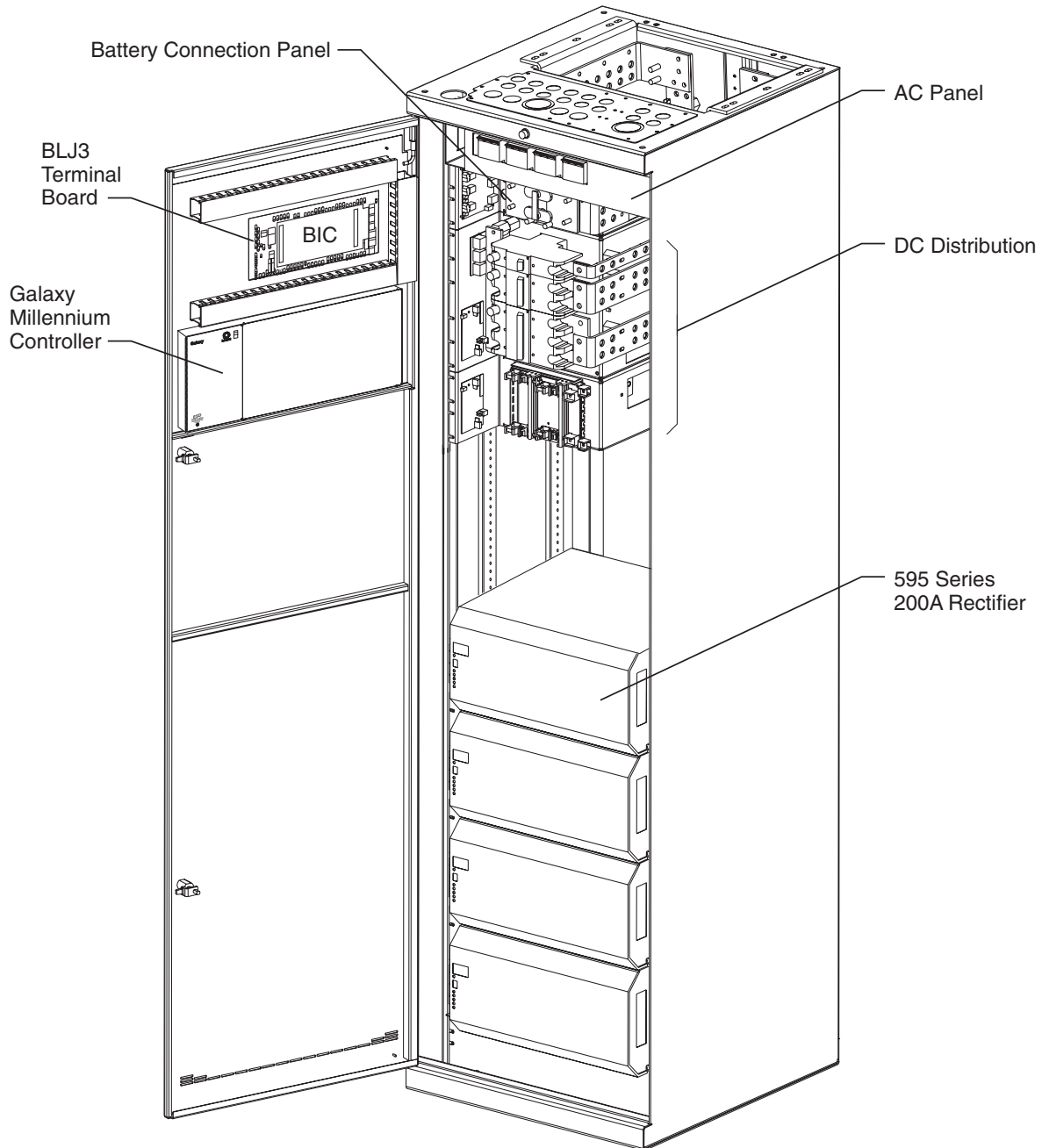


Figure 1-1: GPS 4848/100 With Millennium Controller

GPS 4848/100, continued

Safety

- UL¹ Listed (US and Canada): UL Subject 1801 with applicable sections of UL1950/CSA² 950)
- VDE Licensed to VDE 0805/IEC950/EN60950

Electromagnetic Compliance

- Emission:
 - FCC Part 15 Class B
 - EN55022 (CISPR 22) Radiated/Conducted Emission, Class B
- Immunity
 - IEC/EN 61000-4-2 ESD level 3 and 4
 - IEC/EN 61000-4-3 Radiated Immunity, 10V/m
 - IEC/EN 61000-4-4 Electrical Fast transients/Burst, level 4
 - IEC/EN 61000-4-5 Lightning Surge, level 4

CE Marking

- CE marked per European Union Council Directives:
 - Low-Voltage Directive (73/23/EEC) and
 - EMC Directive (89/336/EEC) as amended by CE Marking Directive (93/68/EEC)

Telcordia

- GR-63 and GR-1089 NEBS (including Level 3 testing)
- Report by an independent test house

1. UL is a registered trademark of Underwriters Laboratories, Inc.
2. CSA is a registered trademark of Canadian Standards Association.

Customer Service Contacts

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

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 is still available, but for emergencies only. Services provided through this contact include initiating the spare parts procurement process, ordering documents, product warranty administration, and providing other product and service information.

For other customers worldwide the 800 number may be accessed after first dialing the AT&T Direct country code for the country where the call is originating, or you may contact your local field support center or your sales representative to discuss your specific needs.

Customer Training

Lineage Power offers customer training on many Power Systems products. For information call 1-972-284-2163. 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, product software and software upgrades, visit our web site at <http://www.lineagepower.com>

2 System Description

Overview

Block Diagram

Figure 2-1 shows a basic block diagram of the Galaxy Power System 4848/100. It illustrates the arrangement and interconnections of the system components from the ac input to the dc output.

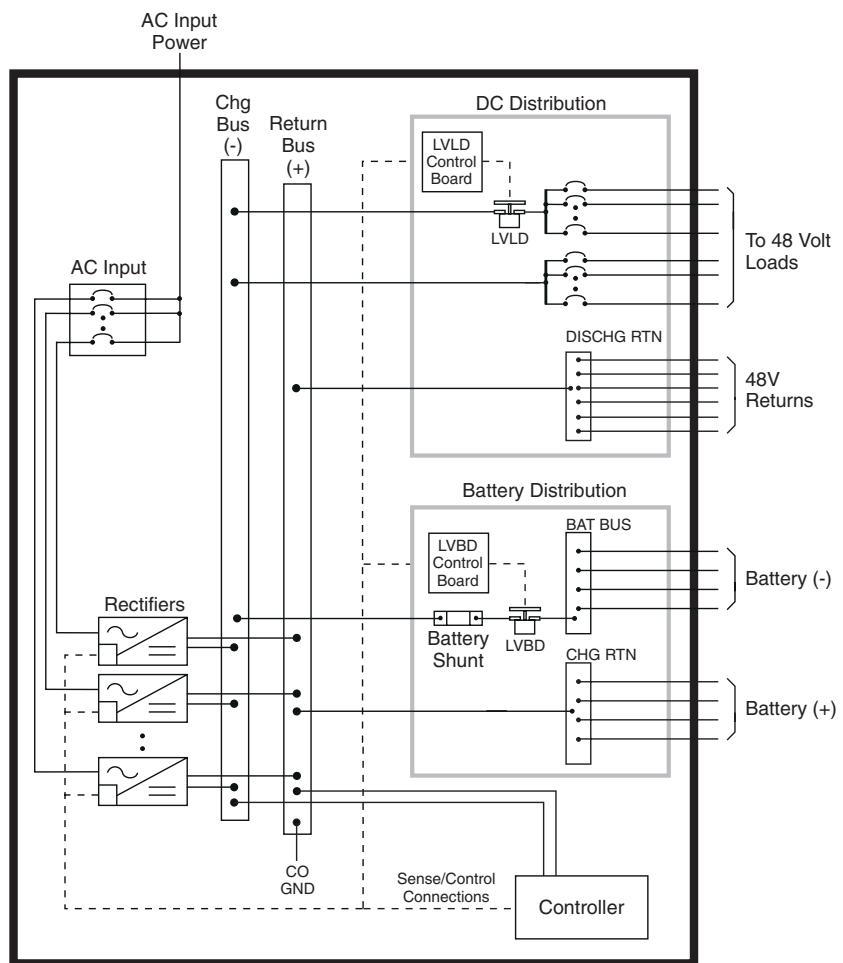


Figure 2-1: Block Diagram of the GPS 4848/100

Overview, continued

System Components

The power system accepts alternating current from the commercial utility or a standby ac power source and rectifies it to produce dc power for the using equipment. The system's control and alarm functions interact with the rectifiers and the office. In addition, the system provides overcurrent protection and charge, discharge, and distribution facilities. Battery reserve automatically provides a source of dc power if the commercial or standby ac fails. Battery reserve can be engineered to supply dc power for a specific period of time. In normal practice, battery capacity is sized to provide 3 to 8 hours of reserve time.

AC Input connects the commercial and/or standby ac power sources to the rectifiers within the system and provides overcurrent protection. In some applications the ac service is wired directly to the rectifiers and overcurrent protection is provided at the service panel.

Rectifiers convert an ac source voltage into the dc voltage level required to charge and float the batteries and to power the using equipment.

Controller provides the local and remote control, monitoring, and diagnostic functions required to administer the power system.

Batteries provide energy storage for an uninterrupted power feed to the using equipment during loss of ac input or rectifier failure.

DC Distribution Panel provides overcurrent protection, connection points for the using equipment, and bus bars used to interconnect the rectifiers, batteries, and dc distribution.

Battery Connection Panel provides connection points for the battery strings through battery disconnect fuse, contactors, current monitoring shunts, and equalize converters.

Architecture

Introduction

For the GPS 4848/100 system, the basic system components, i.e., ac input panels, battery connection panels, dc distribution panels, rectifiers, and controller, can be configured to form two distinct system architectures: a distributed architecture or a centralized architecture.

3 ***Galaxy Millennium Controller***

Overview

Mounting Location The Galaxy Millennium Controller mounts inside the front door with the display viewed from the outside.

Circuit Boards The Galaxy Millennium Controller is equipped with a Basic control board for basic operations and an optional Intelligent control board that provides advanced local and remote monitoring and data acquisition features. These control boards monitor each other's status and issue appropriate alarms in the event a failure occurs. Circuit packs are accessed by opening the hinged cover from the left side.

Reference Material

Controller Product Manual A Galaxy Millennium Controller, Select Code 167-792-180, is furnished with every GPS 4848/100. Refer to the manual for information regarding configuration and operation.

RPM System Product Manual Refer to the Galaxy Remote Peripheral Monitoring System product manual (Select Code 167-790-063) for additional information regarding module operation.

User Interface and Display, continued

LEDs

Two rows of LEDs show the source and severity of various alarms. An alarm may light two LEDs: one alarm LED and one status LED. More than one alarm LED may be on at the same time. In this case, the status LED will be that of the most severe active alarm.

The first row of seven LEDs indicates the source of the alarm: BD, battery on discharge; BATT, battery; DIST, distribution; RECT, rectifier; AC, ac power supply; RM, remote monitoring; and CTRL, controller.

The second row includes five LEDs. The first four LEDs indicate the severity of the reported alarms: CRIT, critical; MAJ, major; MIN, minor; and NORM, normal. Another LED, labeled COM, will be illuminated when the internal modem is in use.

A pushbutton labeled LAMP TEST tests the controller's circuit pack LEDs and front panel LEDs. It will also test the indicators of serially connected rectifiers.

Pushbutton Controls

A group of pushbutton keys beneath the backlit LCD display provides the primary user interface with the controller. These keys are used singly or in combination to navigate through the controller's menus. The following is the general description of these keys.

- Up arrow key: Use to navigate the menu; press the key to move the cursor up one line.
- Down arrow key: Use to navigate the menu; press the key to move the cursor down one line.
- Left arrow key: Use to navigate the menu; press the key to move the cursor left one field.
- Right arrow key: Use to navigate the menu; press the key to move the cursor right one field.
- MENU key: Press this key any time to view the MAIN menu.
- HELP key: Press this key to display limited on-line help information.
- ENTER key: Use this key to select a menu item.
- ESCAPE key: Use this key to return to the immediately higher level menu.

Test Jacks

A pair of test jacks allows direct measurement of the dc bus sense voltage being monitored.

4 ***Rectifiers***

595 Series

Overview

Two 200-ampere rectifiers are available for the GPS 4848/100 system: 595A Series and 595B Series. The 595A Series operates from 3-phase ac service with a phase-to-phase voltage within the range of 320-530Vac. The 595B Series operates from 3-phase ac service with a phase-to-phase voltage within the range of 170-260Vac.

The rectifiers are shipped separately from the cabinets for quick and straightforward installation into rectifier shelves at the site. Interconnections to ac input, dc output, and control signals occur automatically during insertion. The rectifiers are keyed to prevent installation of a rectifier with incompatible ac input. No operational settings or adjustments to potentiometers are necessary. The installer must set the rectifier's ID using the ON/STBY switch to allow the controller to learn the rectifier's physical location for alarm reporting.

Features

Output Voltage Adjustment

This feature allows the rectifier output voltage to be set through the controller.

Output Current “Walk-in”

This feature controls the time (up to eight seconds) required for the rectifier to reach normal operating conditions after it is turned on. This feature minimizes the starting surge on the customer's power source.

Electronic Current Limit

When the output current tends to increase above the current limit set point (30% to 110% of rated output), the current limit circuit overrides the voltage regulating signal and safely limits the output current of the rectifier, thus preventing damage to itself, the battery, or the load.

Selective High Voltage Shutdown (SHVSD)

This feature allows the rectifier to respond and shut down at the output high voltage threshold set through the Galaxy controller.

Backup High Voltage Shutdown (BHVSD)

This is a hardwired feature independent of the rectifier's microcontroller. This feature is always active and will operate whether communicating with the controller or not and whether the rectifier's microcontroller is active or failed.

Restart

Upon shutdown, the rectifier will attempt to restart. The rectifier will try to restart three times before issuing a rectifier fail alarm to the controller. The rectifier will also accept a restart command from the controller for a remote restart.

Output Circuit Breaker

The output circuit breaker located on the front panel protects the power system from rectifier malfunction and may be used to disconnect the rectifier from the system output bus.

Fan Alarm and Control

The rectifier contains three cooling fans whose speed is based on ambient temperature and output power level. The fan's speed is lowered during low-load and low-temperature conditions to minimize audible noise and maximize fan life.

Features, continued

- Thermal Alarm*** The rectifier senses the internal operating temperature and will issue a thermal alarm if the internal temperature exceeds a safe operating level. Ambient temperatures above the maximum rating will result in a rectifier shutdown and the issuing of a thermal alarm (TA).
- Controller Communications Alarm*** When communications between the rectifier and controller are interrupted, the rectifier continues to operate and the red **ALM** LED on the rectifier blinks.
- Autonomous Operation of the Rectifier*** If communication with the Galaxy controller is lost, the rectifier will continue to operate and deliver regulated power to the system load.
- Connectorized*** The rectifiers provide the controller with a full complement of status and alarm messages. The rectifier status and alarm signals, ac input, and dc output are all connectorized for easy installation and maintenance. All connections automatically occur as the rectifier is physically mated to its shelf.
- “Forced” Load Sharing*** The controller forces rectifiers to load share by sending messages to them. In the event communication to the controller is lost or the controller malfunctions, load share balance is maintained while ac or dc power is applied to the rectifiers.

6 ***Battery Connection Panels***

Overview

Introduction

Batteries are connected to the GPS 4848/100 cabinets based on the system architecture.

Distributed Architecture

For distributed power architecture, the batteries are terminated on battery connection panels with shunts that monitor the battery charge / discharge current through circuits on the cabinet BIC (Bay Interface Card). These battery connection panels are located either in the very top of the cabinet (shunt-only panels) or directly below the ac input panel.

As options, these panels may also include fuses or low battery voltage disconnect/reconnect (LVBD/R) contactors. When equipped with contactor(s), contactor control card(s) provide local/manual control of the contactor(s) and communications with the controller for configured/remote control.

Off Line Equalize (OLE) battery connection panels additionally provide means to manually equalize single battery sections. A plug-in dc to dc converter provides up to 65V to fully charge battery section cells, equalizing cell float voltages. This restores fully charged cell capacity to each cell in the section. A timer terminates the manually initiated equalize operation.

Centralized Architecture

For systems with centralized architecture, the batteries are connected between the system charge and charge return buses. In turn, these buses are connected to rectifier termination buses located behind the ac input panel.

Illustrations

The battery connection panels are illustrated in Figures 6-1 through 6-8.

8 ***Circuit Boards***

Overview

Function

Circuit boards (sometimes referred to as “cards” or “circuit packs”) are included in bays, battery connection panels, and dc distribution panels to provide data required by the controller and to control devices such as contactors and lamps.

Terminal Boards

Terminal boards are used to provide shunt voltage data to the controller, where it is used to calculate current. Data from the terminal boards located on the battery connection panels are used to calculate battery current; data from terminal boards located on the dc distribution panels are used to calculate load currents.

Alarm Boards

Alarm boards perform two functions:

- monitor panel functions and activate local indicators when faults occur on the panel;
- provide alarm data to the controller.

Alarm/Terminal Boards

Alarm/terminal boards combine the functions of alarm boards and terminal boards.

BLJ Terminal Board

The BLJ terminal board is located inside the cabinet door. The BLJ is the termination point for all signal cables in each cabinet and between cabinets.

Overview, continued

Bay Interface Card Each cabinet has a Bay Interface Card (BIC) that attaches to the cabinet's terminal board (BLJ). The BIC provides controller access to alarm monitoring, battery voltages, battery currents, and temperature probes in the cabinet through the serial rectifier bus. The BIC also provides connection of the system serial rectifier bus to the bay rectifiers. See Figure 1-1.

Contactor Control Board Contactor control boards provide four functions:

- Monitor and report shunt voltage to the controller
- Monitor and report contactor status to the controller
- Operate the contactor based on controller commands
- Operate or block the contactor based on maintenance switch settings

9 Specifications

GPS 4848/100

Table 9-A: Galaxy Power System 4848/100 Specifications

Electrical	
Nominal output voltage	-48Vdc
Operating Voltage Range (Float or Boost)	-44Vdc to -58Vdc
Output Current (System Maximum)	10,000A ¹ ¹ Centralized bus bars available to 5,200A
Nominal Input Voltage (595A3 Rectifier)	380-480Vac, 3-wire plus ground
Nominal Input Voltage (595B3 Rectifier)	200-240Vac, 3-wire plus ground
Input Voltage Range per phase (595A3 Rectifier)	320Vac - 530Vac
Input Voltage Range per phase (595B3 Rectifier)	176Vac - 254Vac
Input Frequency Range	47 Hz - 63 Hz
System Efficiency (including ac and dc cables)	>88%
Regulation (line and load range with controller)	± 0.5%
AC Ripple	<100mVrms
Output Noise	<2mV psophometric
Electromagnetic Immunity	10V/meter over 20 MHz - 2000 MHz

Table 9-A: Galaxy Power System 4848/100 Specifications (Continued)

Physical		
Width, Depth	600 mm, 600 mm (23.6 in. x 23.6 in.)	
Weight (approximate, per cabinet)	250 kg (551 lbs.)	
Height (cabinet only)	2134 mm (84.0 in.)	
Height (cabinet with link bus bar)	2274 mm (89.5 in.)	
Environmental		
Maximum Input Current, per cabinet	120 amperes per phase, 3-wire	
Heat Release, per cabinet (54Vdc 24A dc)	595A/LTA	595B/LTB
Per Rectifier	1,030W (3,520 BTU/hr)	1,180W (4,050 BTU/hr)
4 Rectifiers	4,120W (14,100 BTU/hr)	4,720W (16,120 BTU/hr)
6 Rectifiers	6,180W (21,100 BTU/hr)	7,080W (24,170 BTU/hr)
7 Rectifiers	7,210W (24,600 BTU/hr)	8,260W (28,200 BTU/hr)
8 Rectifiers	8,240W (28,100 BTU/hr)	9,440W (32,200 BTU/hr)
Operating Temperature	0°C to 40°C	
Operating Relative Humidity	5% - 95%	
Units Per Initial Cabinet		
Rectifiers	0 - 6	
Controller	1	
Battery Disconnect Modules	1 - 3	
DC Distribution	1 - 6 (maximum of 5 with battery disconnect)	
Units Per Growth Cabinet		
Rectifiers	0 - 6	
Battery Disconnect Modules	0 - 1	
DC Distribution	1 - 6 (maximum of 5 with battery disconnect)	

Table 9-A: Galaxy Power System 4848/100 Specifications (Continued)

Standards Compliance	
Safety	<ul style="list-style-type: none"> • UL³ Listed (US and Canada): UL Subject 1801 with applicable sections of UL1950/CSA⁴950) • VDE Licensed to VDE 0805/IEC950/EN60950 <p>³UL is a registered trademark of Underwriters Laboratories, Inc.</p> <p>⁴CSA is a registered trademark of Canadian Standards Association.</p>
Electromagnetic Compliance	<ul style="list-style-type: none"> • Emission: <ul style="list-style-type: none"> – FCC Part 15 Class B – EN55022 (CISPR 22) Radiated/Conducted Emission, Class B • Immunity <ul style="list-style-type: none"> – IEC/EN 61000-4-2 ESD levels 3 and 4 – IEC/EN 61000-4-3 Radiated Immunity, 10V/m – IEC/EN 61000-4-4 Electrical Fast Transients/Burst, level 4 – IEC/EN 61000-4-5 Lightning Surge, level 4
CE Marking	<ul style="list-style-type: none"> • CE marked per European Union Council Directives: <ul style="list-style-type: none"> – Low-Voltage Directive (73/23/EEC) – EMC Directive (89/336/EEC) as amended by CE Marking Directive (93/68/EEC)
Telcordia	<ul style="list-style-type: none"> • GR-63 and GR-1089 NEBS (including Level 3 testing) • Report by an independent test house

Rectifiers

Table 9-B: 595 Series Rectifier Specifications - S1:3 and later
See Issue 8 for pre S1:3 specifications.

Electrical		
Output Voltage	52Vdc typical	
Equalize Voltage	65Vdc typical	
Output Voltage Adjustment	44-58Vdc float/boost 58-65Vdc equalize mode	
Regulation (with controller)	±0.5%	
High Voltage Shutdown (selected by controller)	Float/boost 44-60Vdc (56Vdc default) Equalize 44-67Vdc (65Vdc default)	
Backup High Voltage Shutdown	Float/boost 59-60Vdc (59.5Vdc nominal) Equalize 65.5-66.5Vdc (66Vdc nominal)	
Thermal Alarm	595A3 105°C ^I 595B3 103°C ^I ^I Internal rectifier component temperature	
Ripple	100mVrms	
Noise	<2mV psophometric	
Permanent Overload	220A _{dc}	
Current Limit Set Point	60A _{dc} - 220A _{dc} (60A _{dc} - 100A _{dc} in equalize)	
Nominal Input Voltage 595A3 Rectifier	380-480Vac, 3-wire plus ground	
Nominal Input Voltage 595B3 Rectifier	200-240Vac, 3-wire plus ground	
Input Voltage Range	595A3 Rectifier 320Vac - 530Vac	595B3 Rectifier 176Vac - 254Vac
Input Current	595A3 Rectifier 20A at 480Vac 25A at 380Vac	595B3 Rectifier 40A at 208Vac 35A at 240Vac
Specified	30A	50A
Rated Maximum	23.7A at 320Vac 16.2A at 480Vac 20.4A at 380Vac	44.1A at 176Vac 38.8A at 200Vac 37.3A at 208Vac 32.3A at 240Vac
Typical Maximum	24.9A at 320Vac 16.6A at 480Vac 21.0A at 380Vac	45.3A at 176Vac 39.9A at 200Vac 38.3A at 208Vac 33.2A at 240Vac
Typical Maximum Rectifiers A3 / B3 S1:2 and prior		
Frequency Range	47 - 63 Hz	
Power Factor	>0.98 @ 50% to 100% load	
Total Harmonic Distortion	<5% @ 50% to 100% load	

Table 9-B: 595 Series Rectifier Specifications - S1:3 and later
See Issue 8 for pre S1:3 specifications. (Continued)

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 GPS system, if necessary, 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:

595A3

Phase to Phase <u>Voltage</u>	MOV Conduction <u>Current</u>
625 Vac (RMS)	0 A
940 Vpeak	1 mA
1650 Vpeak	100 A

595B3

Phase to Phase <u>Voltage</u>	MOV Conduction <u>Current</u>
320 Vac (RMS)	0 A
462 Vpeak	1 mA
810 Vpeak	100 A

Physical

Width	445 mm (17.5 in) rear of unit
Height	210 mm (8.25 in) rear of unit
Depth	470 mm (18.2 in) overall, less connector
Weight	27 kg (<59 lbs)

Environmental

Efficiency	> 92% @ 100A _{dc} - 220A _{dc} output current
Storage Temperature	-40°C - +85°C
Storage Relative Humidity	5% - 90%
Altitude	-50 to 4000 meters (Note: For altitudes above 1500 meters, derate the temperature by 0.656° Celsius per 100 meters.)
Audible Noise	< 60dBA at room temperature, mounted in cabinet
Heat Release:	Per Rectifier
54V _{dc} , 160A	854W [2915 BTU/hr]
54V _{dc} , 200A	1068W [3645.7 BTU/hr]

10 ***Safety***

Please read and follow all safety instructions and warnings before servicing the GPS 4848/100. Reference the Safety section of the GPS Installation Guide and individual module product manuals for safety statements specific to the modules.

11 Maintenance and Replacement

Requirements

System

With the exception of the battery, periodic maintenance specific to the power system is not required. The ac service for the building must be maintained with ANSI specified limits. The temperature and humidity within the power room must be maintained within the limits specified in Section 9 of this product manual.

Refer to Table 11-A for system replacement parts.

Batteries

The batteries must be maintained as directed by the battery manufacturer's requirements.

Controller

For replacement circuit packs for the Galaxy Millennium Controller, refer to Table 11-B.

Requirements, continued

Rectifier

With the exception of a fan failure, rectifiers are repaired by replacement.

Refer to “Installing or Replacing a Rectifier” and “Removing a Rectifier” in this section.

Vacant Rectifier Positions

Vacant rectifier positions in a cabinet below the top installed rectifier may cause excessive temperature in the remaining rectifiers. If a rectifier below the top rectifier is removed, it must be replaced immediately or the vacated position must be occupied by a Rectifier Shelf Cover (848680211).

If a spare rectifier or Rectifier Shelf Cover is not available, a rectifier from the top position must be relocated to occupy the vacant position.

Rectifier Fan Assembly

The expected life of the rectifier fans at 25°C (77°F) is approximately seven years. The fans in the rectifiers may be replaced in the field.

Two approaches can be taken to fan maintenance:

- The first approach is to replace the fans on a routine basis every six to seven years; this ensures that the fans do not fail in the field under normal operating conditions. This approach is appropriate when there are no remote alarm facilities at the site.
- The second approach, assuming one has remote alarm capability, is to wait until the fans fail. The rectifier will safely shut down and issue both a fail alarm and a thermal alarm. The fans can then be replaced. Since it is likely that all the rectifiers in that installation are of roughly the same age, all rectifier fans at that site should be replaced at that time.

The approach used depends on the location and manning of the site as well as the monitoring of alarms used at the site.

Refer to “Replacing the Rectifier Fan Assemblies” in this section.

13 ***Troubleshooting Millennium Systems***

Introduction

In This Section This section provides information for locating and interpreting visual indicators to help identify problems.

Preparation Read Section 12, *Troubleshooting Preparations*, thoroughly before proceeding.

Technical Assistance When visual indicators do not identify a defective part, notify Lineage Power Technical Support.

CTRL Alarm LED

Table 13-C: Controller Alarms
(See Figures 12-2 and 12-3)

Controller LED	Controller Alarm Status	Millennium Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
CTRL	MAJ	Controller Fail	--	<ul style="list-style-type: none"> •BSH failure→ •BSJ failure •Option board failure •Display failure •BIC failure 	<p>Check the BSH board to see if the green LED is extinguished and the yellow LED is lit. If so, perform the following steps:</p> <ol style="list-style-type: none"> 1. Press the SW200 reset switch on the top of the BSH board. If all diagnostics pass, it is possible that some type of “one time” abnormality occurred to cause the failure. 2. If the diagnostics did not pass, or if the problem recurs, unplug all the optional circuit board cables, then press the reset switch on the top of the BSH board again. If all the diagnostics pass, install optional circuit board cables one at a time, verifying operation after each. 3. If the diagnostics did not pass, replace the BSH board and verify the failure is resolved. If so, reinstall the optional circuit boards and cables one at a time. 4. If the problem is not corrected, call technical support.

Table 13-C: Controller Alarms (Continued)
 (See Figures 12-2 and 12-3)

Controller LED	Controller Alarm Status	Millennium Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
CTRL	MAJ	Controller Fail	--	<ul style="list-style-type: none"> •BSH failure •BSJ failure→ •Option board failure •Display failure •BIC failure 	<p>Check the BSJ board to see if the green LED is extinguished and the yellow LED is lit. If so, perform the following steps:</p> <ol style="list-style-type: none"> 1. Press the SW201 reset switch on the top of the BSJ board. (This circuit has an automatic restart, which will try three times to restart the microprocessor.) 2. If the diagnostics did not pass, or if the problem recurs, remove all the optional circuit board cables, then press the reset switch on the top of the BSJ board again. If all the diagnostics pass, install optional circuit board cables one at a time, verifying operation after each. 3. If the diagnostics did not pass, replace the BSJ board and verify the failure is resolved. If so, reinstall the optional circuit boards and cables one at a time. 4. If the problem is not corrected, call technical support.

Table 13-C: Controller Alarms (Continued)
(See Figures 12-2 and 12-3)

Controller LED	Controller Alarm Status	Millennium Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
CTRL	MAJ	Controller Fail	--	<ul style="list-style-type: none"> •BSH failure •BSJ failure •Option board failure→ •Display failure •BIC failure 	<p>Check the option boards (modem and data switch) to see if the green LED is extinguished and the yellow LED is lit. If so, perform the following steps:</p> <ol style="list-style-type: none"> 1. Press the SW201 reset switch on the top of the BSJ board. (This circuit has an automatic restart, which will try three times to restart the microprocessor.) If the BSJ is not present, press the reset switch on the top of the BSH board. 2. If the diagnostics did not pass, or if the problem recurs, replace the failed option board.
CTRL	MAJ	Controller Fail	--	<ul style="list-style-type: none"> •BSH failure •BSJ failure •Option board failure •Display failure→ •BIC failure 	<p>If the front panel LCD module, LEDs, or switches fail, perform the following steps:</p> <ol style="list-style-type: none"> 1. Verify that the ribbon cable from the BSH board to the display is not cut, abraded, or otherwise mangled. Replace the cable if damaged. 2. Press SW200 to reset the BSH board. 3. If the LCD module is still not operating, replace the LCD module; if the switches and LEDs are still not operating, replace the BSH board.

Table 13-C: Controller Alarms (Continued)
(See Figures 12-2 and 12-3)

Controller LED	Controller Alarm Status	Millennium Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
CTRL	MAJ	Controller Fail	--	<ul style="list-style-type: none"> •BSH failure •BSJ failure •Option board failure •Display failure •BIC failure→ 	<ol style="list-style-type: none"> 1. Strap K1, K2, K3 on BLJ from “C” to “R” prior to replacing BIC. See Figure 8-2. 2. Replace BIC.
CTRL	MAJ	Circuit Pack Fail	--	See “Controller Fail”.	See “Controller Fail”.
CTRL	MAJ	Controller Fuse	--	Fuse has operated.	Replace the controller fuse labeled F2 (intelligent power).
CTRL	MAJ	Alarm Battery Supply Fuse	--	Fuse has operated.	Replace the controller fuse labeled F5 (alarm battery supply).
CTRL	MAJ	Remote Peripheral Fuse	--	Fuse has operated.	Replace the controller fuse labeled F1 (option power).
CTRL	MAJ	Sense/Control Fuse	--	Fuse has operated.	Replace the controller fuse labeled F4 (voltage sense).
CTRL	MAJ	Bay Interface ID Conflict	--	Two or more bay interface cards (BICs) have the same ID number.	Following instructions printed on the label over the BIC, adjust the DIP switches to change the ID number.
CTRL	MAJ	Major Communication Fail Alarm	Blinking ALM LED on rectifiers or red LED on BIC	Loss of communication with controller: <ul style="list-style-type: none"> •Defective interface from BIC or multiple rectifiers to controller •Internal failure of controller, BIC, or multiple rectifiers 	<ol style="list-style-type: none"> 1. Verify that the controller is powered and operating correctly. 2. If there are no controller alarms, replace the equipment that has lost communication. 3. If the problem is not corrected, call technical support.

RECT Alarm LED

Table 13-E: Rectifier Related Alarms
(See Figures 12-4 and 12-6)

Controller LED	Controller Alarm Status	Millennium Controller Display	Rectifier LED	Rectifier Display	Possible Problem(s)	Possible Solution(s)
RECT	MAJ	ID Not Configured	None	None	Rectifier ID number has not been set.	Set rectifier ID using procedure in Section 11, "Installing or Replacing a Rectifier."
RECT	MAJ	ID Conflict	None	None	Two or more rectifiers have the same ID number.	See above.
RECT	MAJ	Multiple Rectifier Fail	ALM	None	More than one rectifier has an ALM LED lit.	See alarms listed below.
RECT	MAJ	High Voltage Alarm	ALM	HO	<ul style="list-style-type: none"> •Lightning has struck system. •Internal rectifier failure 	<ol style="list-style-type: none"> 1. Toggle the ON/STBY switch into the STBY position and then back into the ON position. 2. If the problem is not corrected, replace the rectifier.
RECT	MIN	Rectifier Fail	ALM	HO	High output voltage: <ul style="list-style-type: none"> •Rectifier high voltage shutdown •Internal rectifier failure 	<ol style="list-style-type: none"> 1. Verify the configurable HV thresholds in the controller. 2. Toggle the ON/STBY switch into the STBY position and then back into the ON position. 3. If the problem is not corrected, replace the rectifier.

Table 13-E: Rectifier Related Alarms (Continued)
(See Figures 12-4 and 12-6)

Controller LED	Controller Alarm Status	Millennium Controller Display	Rectifier LED	Rectifier Display	Possible Problem(s)	Possible Solution(s)
RECT	MIN	Rectifier Fail	ALM	TA	Thermal alarm: •Excessive ambient temperature •Internal rectifier failure	<ol style="list-style-type: none"> 1. Verify that there is no obstruction of the fan inlet. 2. Toggle the ON/STBY switch into the STBY position and then back into the ON position. 3. If the problem is not corrected, replace the rectifier.
RECT	MIN	Rectifier Fail	ALM	CB	Circuit breaker alarm: •DC output circuit breaker open •Internal rectifier failure	<ol style="list-style-type: none"> 1. Toggle the ON/STBY switch into the STBY position; toggle the DC output circuit breaker into the OFF position and then into the ON position. Return the ON/STBY switch to the ON position. 2. If the problem is not corrected, replace the rectifier.

Table 13-E: Rectifier Related Alarms (Continued)
 (See Figures 12-4 and 12-6)

Controller LED	Controller Alarm Status	Millennium Controller Display	Rectifier LED	Rectifier Display	Possible Problem(s)	Possible Solution(s)
RECT	MIN	Rectifier Fail	ALM	ICS IP5 IP6 IP7 InF FSE LS	Internal rectifier failure	<ol style="list-style-type: none"> 1. Place the ac circuit breaker for the rectifier in the OFF position. 2. Remove the rectifier from the shelf. 3. Wait for 30 seconds or until all front panel display LEDs have extinguished. 4. Replace the rectifier. 5. Return the ac breaker to the ON position. 6. Place the rectifier ON/STBY switch into the ON position. 7. If the problem is not corrected, replace the rectifier.
RECT	MIN	Rectifier Fail	ALM	LO	Low output voltage: <ul style="list-style-type: none"> •Excessive output current •Internal rectifier failure 	<ol style="list-style-type: none"> 1. Toggle the ON/STBY switch into the STBY position and then back into the ON position. 2. If the problem is not corrected, replace the rectifier.

Table 13-E: Rectifier Related Alarms (Continued)
(See Figures 12-4 and 12-6)

Controller LED	Controller Alarm Status	Millennium Controller Display	Rectifier LED	Rectifier Display	Possible Problem(s)	Possible Solution(s)
RECT	MIN	Rectifier Fail	ALM	SEN	Thermal sensor failure: •Internal rectifier failure	<ol style="list-style-type: none"> 1. Place the ac circuit breaker for the rectifier in the OFF position. 2. Remove the rectifier from the shelf. 3. Wait for 30 seconds or until all front panel display LEDs have extinguished. 4. Replace the rectifier. 5. Return the ac breaker to the ON position. 6. Place the rectifier ON/STBY switch into the ON position. 7. If the problem is not corrected, replace the rectifier with a new one.
RECT	MIN	Rectifier Fail	FAN ALM	None	Fan failure	Replace the fan in the rectifier.
RECT	MIN	Manual Off	STBY	Blank	Rectifier has been manually turned off.	Turn rectifier on.
RECT	MIN	External Transfer Shutdown	STBY	TR	System is operating on external engine.	No action required.
RECT	MIN	High Float Voltage	None	None	Configuration problem	Call technical support.
RECT	MIN	Excess Rectifier Drain	None	None	Internal rectifier fault	Replace rectifier.

Table 13-E: Rectifier Related Alarms (Continued)
 (See Figures 12-4 and 12-6)

Controller LED	Controller Alarm Status	Millennium Controller Display	Rectifier LED	Rectifier Display	Possible Problem(s)	Possible Solution(s)
RECT	MIN	Excess System Drain	None	None	System load exceeds shunt rating.	Call technical support.
RECT	MIN	Limited Recharge	None	None	Rectifier capacity has been exceeded.	Install more rectifiers.
RECT	MIN	Rectifier Fail	ALM	ILC	Rectifier not fully seated.	<ol style="list-style-type: none"> 1. Place the ac circuit breaker for the rectifier in the OFF position. 2. Remove the rectifier from the shelf. 3. Wait for 30 seconds or until all front panel display LEDs have extinguished. 4. Replace the rectifier. 5. Return the ac breaker to the ON position. 6. Place the rectifier ON/STBY switch into the ON position. 7. If the problem is not corrected, replace the rectifier with a new one.

With respect to Cable and Wire Products manufactured by Seller which Seller elects to repair but which are not readily returnable for repair, whether or not installed by Seller, Seller at its option, may repair the cable and Wire Products at Customer's site.

- D. If Seller has elected to repair or replace a defective Product, Customer shall have the option of removing and reinstalling or having Seller remove and reinstall the defective or nonconforming Product. The cost of the removal and the reinstallation shall be borne by Customer. With respect to Cable and Wire Products, Customer has the further responsibility, at its expense, to make the Cable and Wire Products accessible for repair or replacement and to restore the site. Products returned for repair or replacement will be accepted by Seller only in accordance with its instructions and procedures for such returns. The transportation expense associated with returning such Product to Seller shall be borne by Customer. Seller shall pay the cost of transportation of the repaired or replacing Product to the destination designated by Customer.
- E. Except for batteries, the defective or nonconforming Products or parts which are replaced shall become Seller's property. Customer shall be solely responsible for the disposition of any batteries.
- F. If Seller determines that a Product for which warranty service is claimed is not defective or nonconforming, Customer shall pay Seller all costs of handling, inspecting, testing, and transportation and, if applicable, traveling and related expenses.
- G. Seller makes no warranty with respect to defective conditions or nonconformities resulting from actions of anyone other than Seller or its subcontractors, caused by any of the following: modifications, misuse, neglect, accident, or abuse; improper wiring, repairing, splicing, alteration, installation, storage, or maintenance; use in a manner not in accordance with Seller's or Vendor's specifications or operating instructions, or failure of Customer to apply previously applicable Seller modifications and corrections. In addition, Seller makes no warranty with respect to Products which have had their serial numbers or month and year of manufacture removed, altered, or experimental products or prototypes or with respect to expendable items, including, without limitation, fuses, light bulbs, motor brushes, and the like. Seller's warranty does not extend to any system into which the Product is incorporated. This warranty applies to Customer only and may not be assigned or extended by Customer to any of its customers or other users of the Product.

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