



***CPS6000-M2***  
***Frame-Mounted Battery Plant***  
***Model H5694720***



Product Manual  
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**Notice:**

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# 1 Introduction

## Document Objectives

This manual provides installation and maintenance information for the Lineage Power CPS6000-M2 power system:

- Product Description
- Safety Information
- Installation Procedures
- Test and Acceptance
- Troubleshooting
- Controller and Rectifier Operations
- Product Warranty

## Audience

Equipment Installers – Instructions for installation, test, and acceptance.

Equipment Users – Plant basics and troubleshooting.

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**CAUTION:** This unit must be installed, serviced, and operated only by 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.

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## Applications

The 48V CPS6000-M2 is ideally suited for small central office (CO) applications and high end huts and vaults.

## Additional Product Documentation

For additional specification, engineering and installation information, refer to the following drawings as needed. These drawings may be accessed on our web site at <http://lineagepower.com/>. Click on Energy Systems Products/CPS6000 Plants.

Drawing	Description
H5694720	Ordering Guide
167-790-063	Remote Peripheral Monitoring (RPM)
157-010-202	210E Thermal Probe Multiplexer Module
167-792-182	Advanced Features User Guide For The Millennium II

## 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, 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.

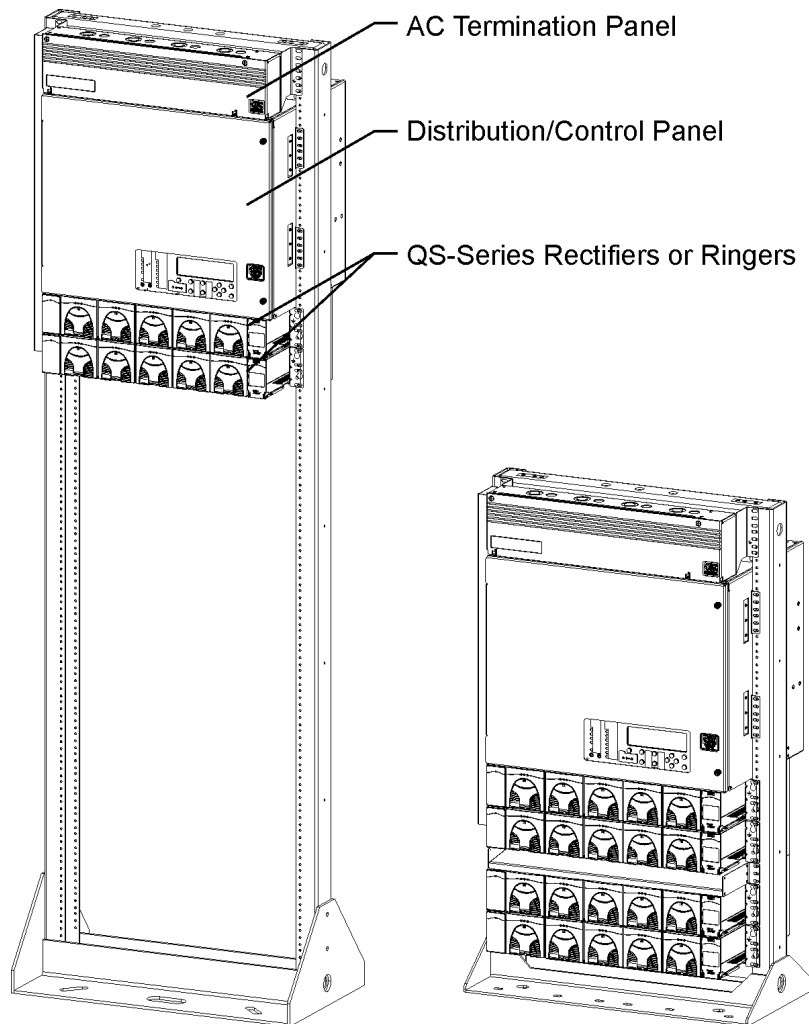
### Downloads and Software

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

## 2 Product Description

The 48V CPS6000-M2 Power Plant is a 23 inch wide, front access, frame mounted battery plant. The system integrates QS series vertical airflow rectifiers and ringers, dc distribution options, battery connections and the Galaxy Millennium II controller in 500A and 1000A capacity systems. System dimensions are 25.5 inches wide, 15 inches deep and 29.8 inches tall (500A system) or 38.5 inches tall (1000A system). This allows the system to be mounted in either a 42 inch (1/2 height) frame for mounting on a battery stand or Unigy battery stack or in a 7 foot (full height) framework with battery trays.

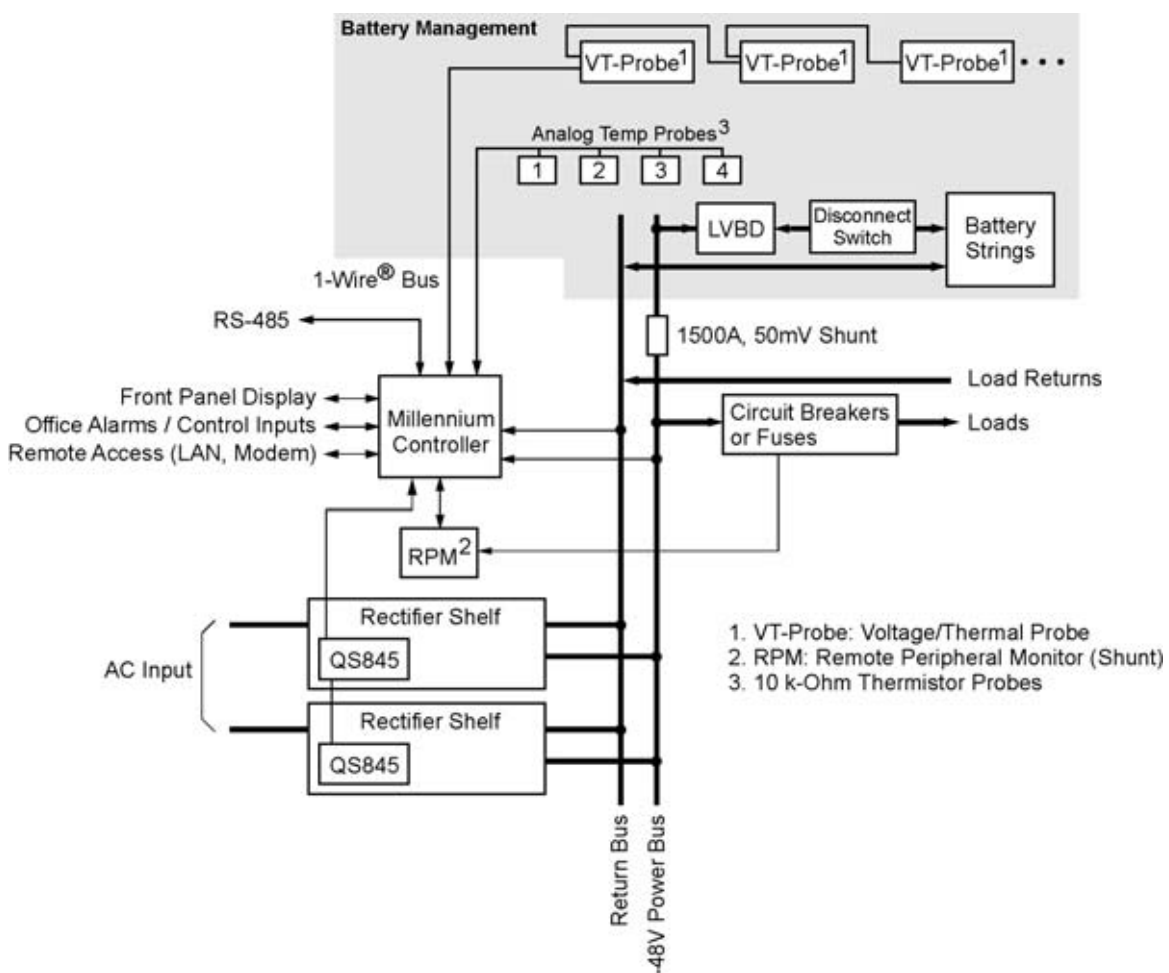
The system operates directly from commercial power in 208/220/240Vac single phase @ 50/60Hz. 110Vac operation is also available with some rectifiers. AC connects to a terminal block panel at the top of the system.



**48V CPS6000-M2 DC Power System Configuration**

## Architecture

The plant architecture is shown in the diagram below. The CPS6000-M2 System rectifiers accept alternating current (ac) power and produce a regulated dc -48V nominal voltage distributed to float the batteries, power the controller and power the loads through distribution circuit breakers or fuses. Batteries are used to provide backup dc power when the ac is lost. They are connected in parallel with the rectifiers through either optional battery breakers or a low voltage disconnect (LVD). AC power is distributed to each rectifier through ac terminal blocks located in the ac termination panel at the top of the frame. The Millennium II system controller monitors and controls system operation.



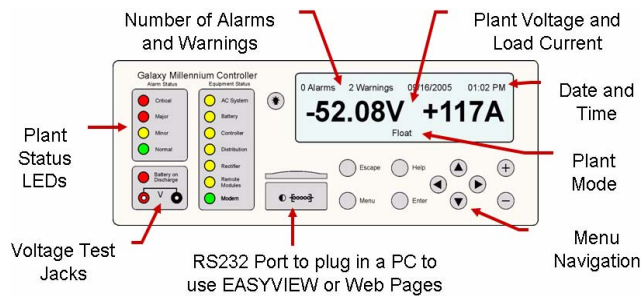
**CPS6000-M2 Block Diagram**



## Millennium II Controller

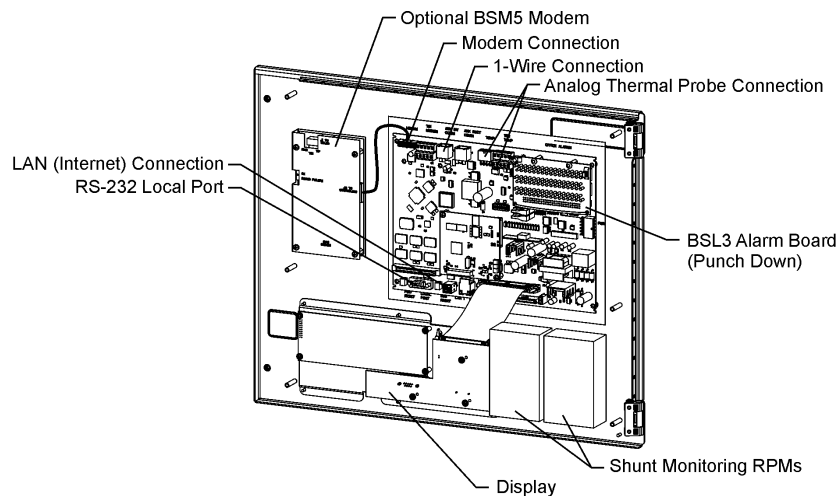
The Millennium II controller is located on the door of the dc distribution. It uses an RS485 bus to serially monitor and control rectifiers, ringers and peripheral modules called RPM's. It can also monitor and control external power equipment, including standby generators, converter plants, and inverters.

Local viewing and setting of system parameters and various alarm thresholds, user-definable alarm inputs and relays can be accessed either by a LCD graphics display with intuitive navigation mounted on the front door of the system or by the local RS-232 port connected to a notebook computer.



Remote access is available through a 10/100 Base-T network connection to the world wide web (internet) or your enterprise network (intranet) using standard browsers such as Microsoft Internet Explorer® or Netscape® Navigator. There is also an optional BSM5 56k bps modem available.

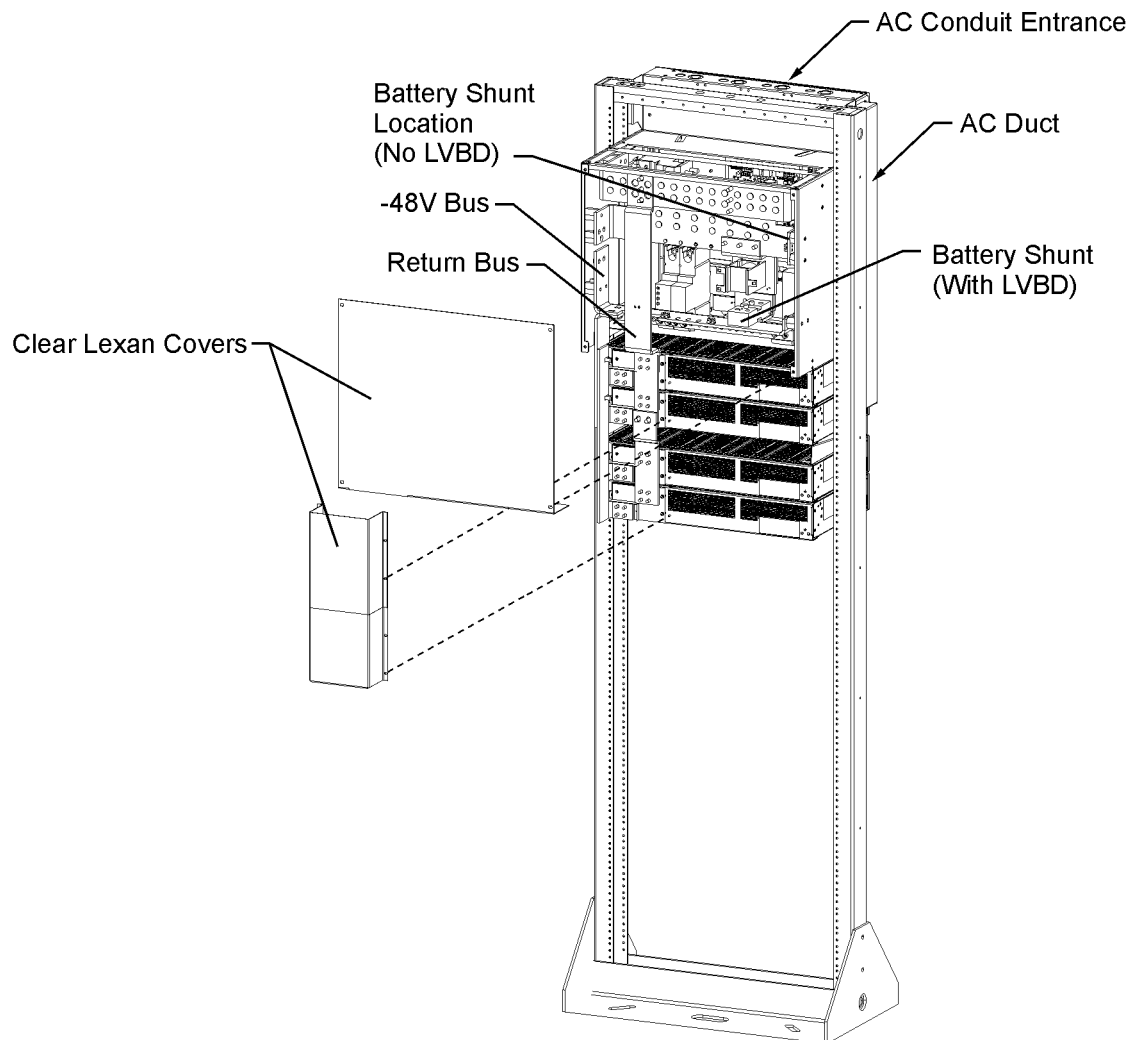
The controller performs various battery management functions to ensure peak performance and protection from thermal issues. In addition to monitoring for open battery breakers, measuring current from the battery shunt and monitoring and control of a optional low voltage battery disconnect contactor, the controller also measures battery string temperature and voltage with either traditional analog thermistor based temperature probes or digital QS873 Voltage/Thermal Probes (VT Probes) for slope thermal compensation. The VT probes connect in a daisy-chain fashion with one probe mounted to the negative post of each mid-string battery using the serial 1-Wire® bus.



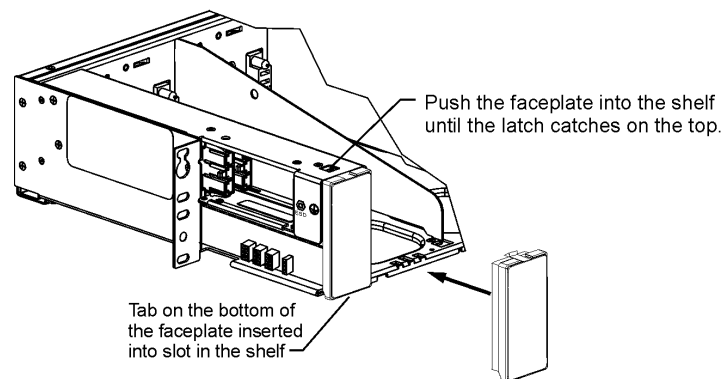
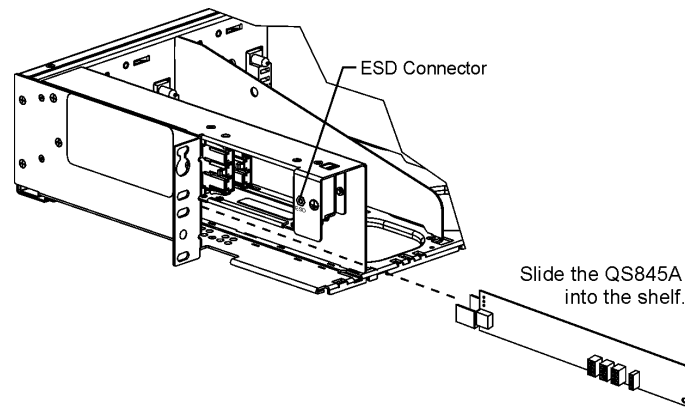
## Rectifier Shelves

Rectifier shelves are equipped in either two shelf (500A system) or four shelf (1000A system) arrangements. DC output from each rectifier is bused up the back to the distribution and protected by clear lexan covers. Individual AC feeds from terminal blocks in the ac box route down the ac duct to a connector on each shelf. Serial communication cables daisy-chain from QS845A interface boards on the left side of each shelf and up to the controller.

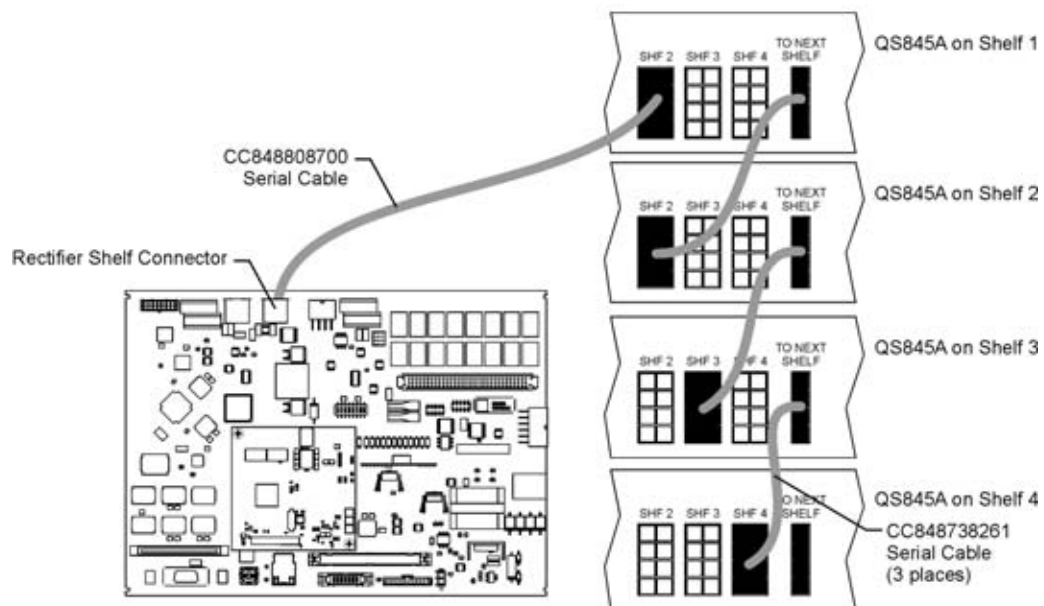
The system is designed to allow field upgrades from two shelf to four shelf systems. This can be safely accomplished on working systems because the new shelves are first installed and then bus and cable links added.



**DC Bussing to Rectifier Shelves (Rear View)**



### QS845A Rectifier Interface Board Access



### Rectifier Communication Connections

# QS-Series Rectifiers

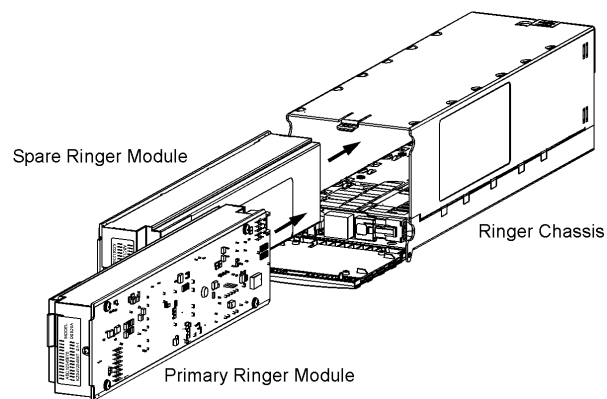
These constant power rectifiers are hot pluggable for quick installation. All interconnections (AC input, DC output, and control) are made automatically during insertion. The rectifiers communicate with the controller via a digital RS-485 serial cable allowing all rectifier settings to be made automatically by the controller. Load-share circuits allow all rectifiers to apportion the plant load equally, reducing the stress on individual units. The rectifier uses temperature dependent variable speed fans to provide vertical flow cooling. QS-series of rectifiers are available in 15A and 25A operating from 85VAC to 275VA and 20A, 30A, 40A, and 50A operating from 150VAC to 275VAC.



## QS-Series Rectifier

## QS-Series Ringers

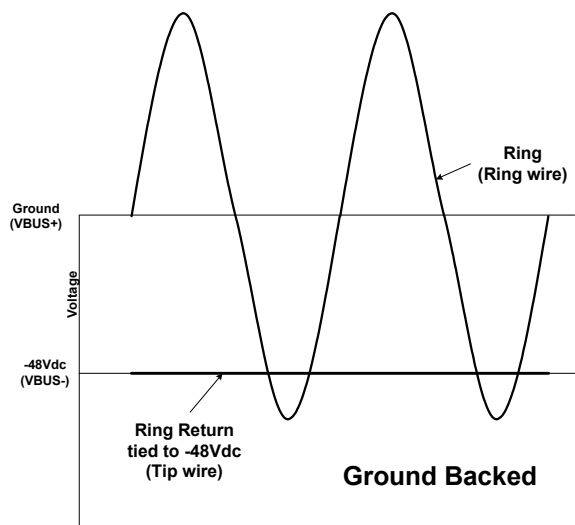
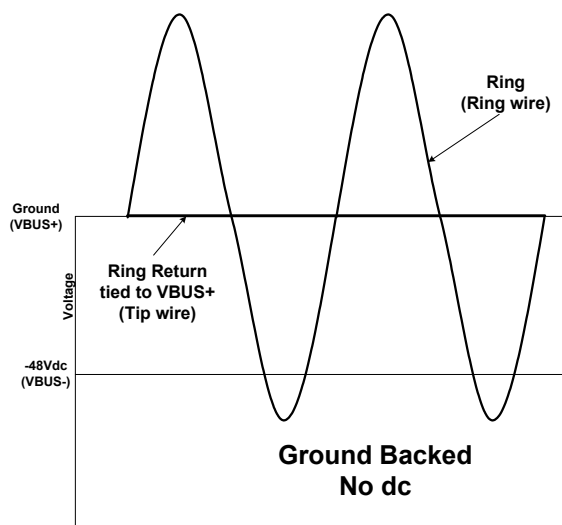
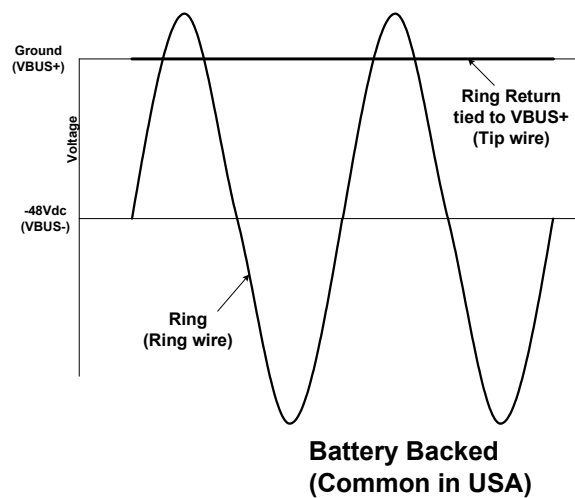
QS820A Ringers convert -48Vdc to a 100VA ringing power output with configurable ac voltage, ac frequency, and dc offset. A ringer chassis may be installed in the two rightmost positions of any rectifier shelf. Each ringer chassis includes two vertical airflow fans, accepts up to two QS820A ringers, a primary and a spare, and provides a single ringing output. Install one ringer for non-redundant (simplex) operation and two ringers for redundant (duplex) operation. Should the primary ringer fail or be removed, the ringer output is provided by the spare ringer. The controller provides ringer output voltage and frequency settings, status and alarm communication. If communication is lost, the ringers continue to operate with the last received configuration.



## QS820A Ringers and QS820M Chassis

## Types of Ringing

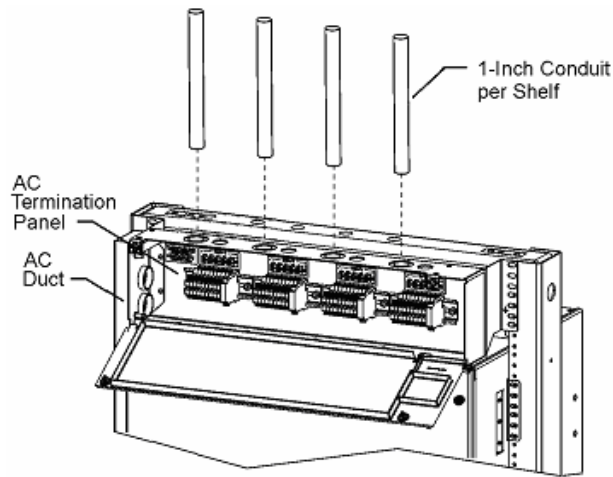
QS820 Ringers can be configured to provide one of three types of ringing: Battery Backed, Ground Backed, and Ground Backed-no dc. Ringing type is selected with jumper J12 on the chassis and by enabling or disabling dc Offset in the controller



## Ring Signaling Types

## AC Input

- Connects to AC termination panel at the top of the system.
- One 1-inch conduit per shelf.
- Each rectifier fed individually by 10 gage wire protected with a 20A circuit breaker or fuse.



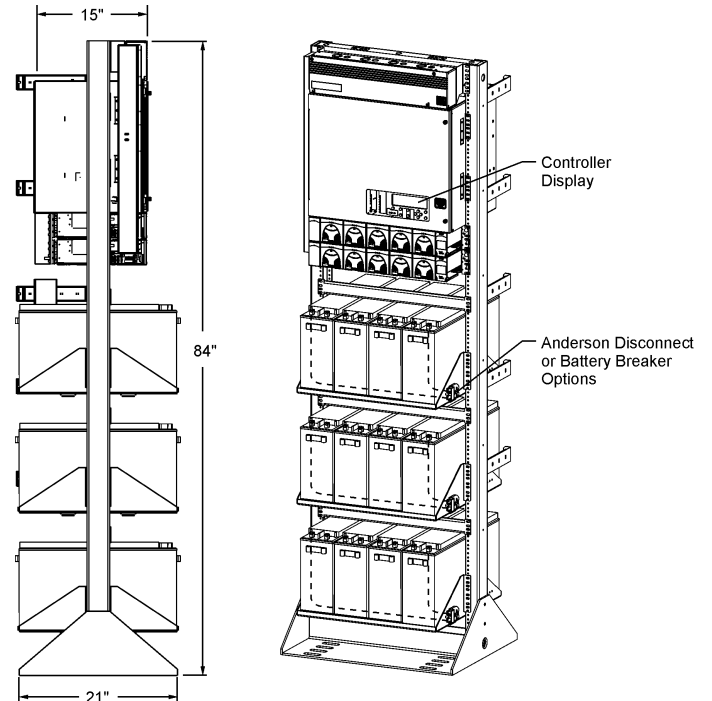
## Battery Options and Monitoring Features

### Battery Options

- Designed for operation with Flooded, VRLA, NiCad, and Lithium batteries (Nickel metal Hydride in the future).
- Half-height systems mount on Unigy II batteries, Full Height systems may be equipped with battery trays.
- Battery trays available for up to 170Ahr batteries with Anderson PowerPole® connectors or circuit breaker disconnects.

### Battery Monitoring Features

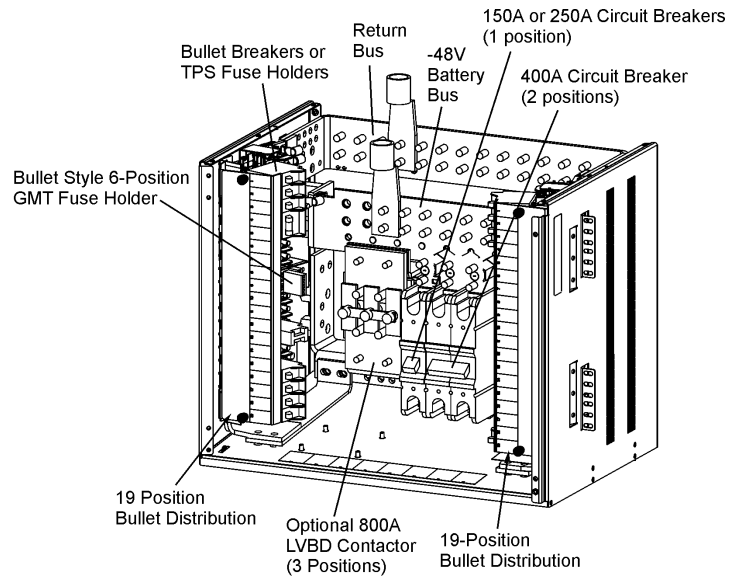
- Open String (OS) Alarms
- Emergency Power Off (EPO) for disconnecting batteries from the system
- Temperature/voltage probes (up to 16) used in Battery Management options
  - Slope Thermal Compensation
  - Battery High Temp Disconnect
- Battery Discharge Test
- Battery Shunt
  - Low Voltage Battery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



## DC Distribution and Battery Termination

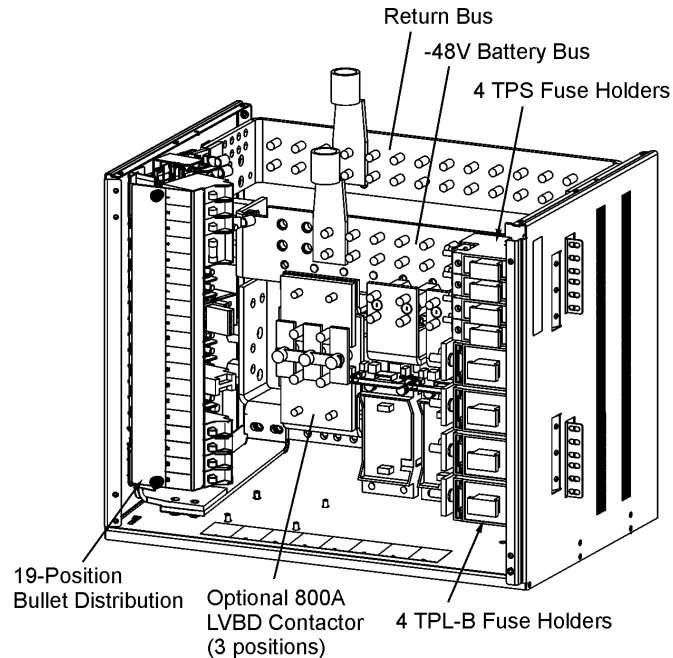
### Group 660 Option

- Two 19 position bullet distribution panels each rated at 400A.
- 12 pair of battery landings for battery cables up to 350Kcmil. (6 pair with 750Kcmil cable) 3/8" studs on 1" centers
- 8 position center section for optional 800A Low Voltage Battery Disconnect (LVBD), GJ type circuit breakers with 25mV shunts or TPL-C fuse blocks with 1500A, 50mV shunts.



### Group 661 Option

- One 19 position bullet distribution panel rated at 400A.
- One fuse panel rated at 600A equipped with 4 TPS fuses with 100A, 50mV shunt monitoring and 4 TPL-B fuses with 600A, 50mV shunt monitoring
- RPM shunt monitoring for fuse panel and up to 4 center TPL-C fuse blocks with 1500A, 50mV shunt monitoring
- 12 pair of battery landings for battery cables up to 350Kcmil. (6 pair with 750Kcmil cable) 3/8" studs on 1" centers
- 8 position center section for optional 800A Low Voltage Battery Disconnect (LVBD), GJ type circuit breakers with 25mV shunt or TPL-C fuse blocks with 1500A, 50mV shunt.



## Specifications

AC Input	
Input Distribution	Terminal Blocks per rectifier fed from 20A breaker or fuse at the AC service panel.
Wire Size	10 AWG minimum for individual feeds.
System Output	
System Voltage	-48V
Maximum Output Current:	
Two Rectifier Shelves (G255)	450A charge, 500A discharge
Four Rectifier Shelves (G256)	800A charge, 1000A discharge
Maximum Recharge Current	Installed rectifier capacity minus plant -48V load
Low-Voltage Disconnect	39 to 50 Vdc
Low-Voltage Reconnect	39 to 55 Vdc
Safety / Standards Compliance	
Safety Agency Approvals	Underwriters Laboratories (UL) Listed per Subject Letter 1801: Power Distribution Center for Communications Equipment, and cUL Certified (CSA 22.2 950): Safety of Information Technology Equipment
	VDE licensed to VDE0805/EN60950
	Rectifiers are individually UL Recognized (UL1950), cUL Certified (CSA 22.2 234) or evaluated to EN60950 by an EC Notified Body, as appropriate.
European Economic Community (EEC) Directives	EMC Directive 89/336/EEC, Low Voltage Directive 73/23/EEC as amended by Marking Directive 93/68/EEC
Radiated and Conducted Emissions	FCC Part 15, Class A EN55022 (CISPR22), Class A
Harmonics	EN61000-3-2 (IEC61000-3-2)
Voltage Fluctuations	EN61000-3-3 (IEC61000-3-3)
Electromagnetic Immunity	Meets Telcordia GR-1089-CORE
Electrostatic Discharge	EN61000-4-2 Level 3
RF Immunity	IEC61000-4-3 Level 3, 10 V/m
EFT	IEC61000-4-4 Level 3, No Error; Level 4, No Damage
Surge	IEC 61000-4-5 Level 3, No Error; Level 4, No Damage
Conducted Immunity	IEC 61000-4-6 Level 3, 10V
Voltage Dips, Interruptions, and Variations	IEC 61000-4-11
Environmental	
Operating Ambient Temperature	-20 to 45 °C
Altitude	-200 to 13,000 feet (-61 to 3962 meters) See Note 1
Humidity	10% to 95% non-condensing
Audible Noise	< 60 dBA
Earthquake Rating	Zone 2 or Zone 4, upper floors, depending on battery configuration
Note 1: For altitudes above 5000 feet, derate the temperature by 3.6 °F per 1000 feet. For altitudes above 1524 meters, derate the temperature by 0.656 degrees Celsius per 100 meters.	



## **Installation Category**

CPS6000-M2 is suitable for connection to ac utility systems where the expected level of lightning surges complies with ANSI C62.41 Category B or IEC 60664-1 Overvoltage Category II.

A service entrance surge protector is required in applications where the installation categories can not be classified as being compliant to either ANSI C62.41 Category B or IEC 60664-1 Overvoltage Category II.

CPS6000-M2 rectifiers have been tested for repeated lightning surges typically found in an Overvoltage Category III installation; however, a service entrance surge protector is recommended in cabinet applications to bring the power feeds in compliance to the installation categories above. The service entrance protection should be coordinated with the protection provided in the power modules.

The power module provides common-mode protection via a 320V MOV in series with a 2500V gas-discharge device and differential-mode protection via a 320V MOV in series with a 3.5A fuse

**Millennium II Controller**

<b>General</b>		<b>Specifications</b>	
Input Voltage Range		-48 Vdc (Range: 18-60V)	
Maximum Input Power		36W depending upon options	
Display		Graphic displayed arranged to 8-line by 40-character backlit LCD	
Configuration Method		Through front panel LCD display and menu keys Through IBM compatible PC with RS-232 port Through LAN internet connection	
Mounting Requirements		Door mounted	
<b>Input/Outputs</b>		<b>Specifications</b>	
Form C Alarm Output Contact Ratings		60VDC at 0.5A	
Plant Voltage Measurement			
Accuracy			
0 to 50 °C ( $\pm 0.05\%$ of full scale + 1 count)		48V Systems: $\pm 40$ mV	
-40 to 85 °C ( $\pm 0.1\%$ of full scale + 1 count)		48V Systems: $\pm 70$ mV	
Resolution		0.01V	
Plant Current Measurement			
Accuracy		0 to +50 °C : $\pm 0.5\%$ of full scale	
Resolution		-40 to +85 °C: $\pm 1.25\%$ of full scale	
1A			
Temperature Measurement			
Accuracy			
Thermistor temperature		-5 to +55 °C: $\pm 2^\circ\text{C}$	
One-Wire Serial probes		-40 to +85 °C: $\pm 3^\circ\text{C}$	
Resolution		-5 to +55 °C: $\pm 1^\circ\text{C}$	
0.1°C		-40 to +85 °C: $\pm 3^\circ\text{C}$	
4-20mA Input Monitor			
Accuracy		$\pm 100\mu\text{A}$	
Resolution		$\pm 10.0\mu\text{A}$	
General (0-5V) Input			
Accuracy		0 to +50 °C: $\pm 0.5\%$ of full scale	
Resolution		-40 to +85 °C: $\pm 1.0\%$ of full scale	
0.01VDC			

## Rectifiers

Item	Specification	
Nominal Output Voltage	48/52/54.5 Vdc	
Operating Output Voltage Ranges	42 to 58 Vdc	
Boost Voltage	48 to 58 Vdc	
Output Current	<b>QS861A:</b> 0 to 15A at 54.5V <b>QS862A:</b> 0 to 30A at 54.5V	<b>QS852A:</b> 0 to 20A at 54.5V <b>QS853A:</b> 0 to 25A at 54.5V <b>QS864A:</b> 0 to 40A at 54.5V <b>QS865A:</b> 0 to 50A at 54.5V
Nominal Input Voltage	<b>QS861A:</b> 100/120/208/240 Vac <b>QS862A:</b> 100/120/208/240 Vac	<b>QS852A:</b> 208/240 Vac <b>QS853A:</b> 208/240 Vac <b>QS864A:</b> 208/240 Vac <b>QS865A:</b> 208/240 Vac
Input Voltage Ranges	<b>QS861A:</b> 85 to 275 Vac (Shutdown from 135 to 150V) <b>QS862A:</b> 85 to 275 Vac (Shutdown from 135 to 150V)	<b>QS852A:</b> 150 to 275 Vac <b>QS853A:</b> 150 to 275 Vac <b>QS864A:</b> 150 to 275 Vac <b>QS865A:</b> 150 to 275 Vac
Input Current	<b>QS861A:</b> 8A at 120 Vac 4.4A at 208 Vac <b>QS862A:</b> 13A at 120 Vac 8.8A at 208 Vac	<b>QS852A:</b> 7.4A at 208 Vac <b>QS853A:</b> 7.4A at 208 Vac <b>QS864A:</b> 11.8A at 208 Vac <b>QS865A:</b> 14.5A at 208 Vac
Operating Frequency Range	45 to 66 Hz	
Operating Temperature	-40 to +65 °C	
Output Voltage Regulation	±0.5%	
Output Noise, Ripple	250 millivolts peak to peak maximum, over the range dc to 100 MHz	
Load Share Accuracy	1.5A maximum deviation between rectifiers	
Heat Dissipation at Full Load	<b>QS861A:</b> 141W (480 BTU) per rectifier at 120 Vac operation 160W (546 BTU) per rectifier at 240 Vac operation <b>QS862A:</b> 177W (604 BTU) at 100 to 120 Vac operation 212W (724 BTU) at 200 to 240 Vac operation <b>QS852A:</b> 133W (454 BTU) per rectifier at 240 Vac operation <b>QS853A:</b> 151W (515 BTU) per rectifier at 240 Vac operation <b>QS864A:</b> 240W (819 BTU) per rectifier at 240 Vac operation <b>QS865A:</b> 267W (911 BTU) per rectifier at 240 Vac operation	
Selective High-Voltage Shutdown	Above 58 Vdc	
Backup High-Voltage Shutdown	Above 60 Vdc for 1 millisecond	

## Ringers

Item		Specification
Input Voltage		-40 to -57 Vdc See Output VA Thermal Limiting.
Nominal Input Voltage		-48 Vdc
Input Current		5 A max.
Output Voltage	ac Component	65 to 100 Vac Factory Default: 100Vac
	ac tolerance	$\pm 5$ Vac
	Regulation	$\pm 5\%$ ac component only
	dc Offset	<ul style="list-style-type: none"> <li>-40 to +57 Vdc Battery Backed</li> <li>+40 to +57 Vdc Ground Backed</li> <li>0 Vdc Offset Disabled</li> </ul>
	Type of ringing Battery Backed Ground Backed Ground Backed no-dc	<ul style="list-style-type: none"> <li>dc Offset tracks dc Input Voltage</li> <li>Factory Default: Enabled</li> <li>Battery or Ground Backed is selected by Ringer Chassis jumper J12 or by external connection of Ring Rtn to Battery or to Ground. Factory Default: Battery Backed by Jumper</li> </ul>
	dc Offset Tracking Error	$\pm 3$ Vdc
	Harmonic Distortion	5% THD
	Crest Factor	1.21 to 1.51
Output Frequency		15 to 50 Hz Factory Default: 20 Hz
Frequency tolerance		$\pm 1$ Hz
Output VA		100 VA
	Thermal Limiting	Output VA may be reduced by reducing Vac when operating simultaneously above 50°C and less than -50Vdc input. Vac is reduced only sufficiently to prevent damage to the ringer.
Load Power Factor		Operating: 0.5 Leading to 0.9 Lagging No Damage: 0 Leading to 0.7 Lagging
Operating Temperature		-40 to +75 °C See Output VA Thermal Limiting.
Heat Dissipation		50 W (170 BTU / hr)
Under Voltage Shutdown		50% of Output Vac Set Point While shutdown due to external fault, restart will be performed at approximately 2 minute intervals.

# 3 Safety

## Safety Statements









Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the CPS6000-M2 System:

- The CE Mark demonstrates compliance with the European Union Council Directives for Low Voltage and EMC.
- The CPS6000-M2 platform is Underwriters Laboratories (UL) Listed per Subject Letter 1801, DC Power Distribution Centers for Telecommunications Equipment.
- CPS6000-M2 shelves equipped with QS820A ringers have hazardous secondary voltages on the secondary bus output connectors.
- Install only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) in accordance with articles 110-16, 110-17, and 110-18 of the U.S. National Electric Code (NEC), ANSI/NFPA No. 70, and pursuant to applicable local codes.
- This equipment is to be used in controlled environments (an area where the humidity is maintained at levels that cannot cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified).
- This equipment has been evaluated for continuous use in ambient temperature from -40°C to 65°C.
- This equipment must not be installed over combustible surfaces.
- For installations in the United States, Listed compression connectors are to be used to terminate Listed field-wired conductors where required. For all installations, the appropriate connector is to be applied only to the correct size conductor as specified by the connector manufacturer, using only the connector manufacturer's recommended tooling or tooling approved for that connector.
- If the proper connector for the country of installation is not provided, obtain appropriate connectors and follow manufacturer's and all local requirements for proper connections. All national and local rules and regulations should be followed when making field connections.
- The main output voltage (48V) meets SELV requirements.
- Insulation on field-wired conductors should be rated no less than 90° Celsius. Wire conductor size should be sized per electrical codes for 75° Celsius wire, and based on the ampacity of the associated protection device. Wiring internal to enclosed equipment cabinets should be rated at 105° Celsius (minimum).

- Torque electrical connections to the values specified on labels or in the product documentation.
- Battery input 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.
- Alarm contacts on the office alarm board are not fused; therefore, current limiting protection for these contacts must be provided by external circuits. Maximum ratings for alarm connections are 60Vdc and 0.5 amperes. Exceeding these maximum ratings could result in fire or damage to the unit.
- Fuse and/or circuit breaker loads must **not** exceed 80% of the fuse and/or circuit breaker current rating. Distribute loads across the panel.
- The short circuit current capability of the battery input to the distribution panel must not exceed 10,000A.
- AC branch circuits to this equipment must be protected with either fuses or circuit breakers sized as required by the National Electric Code (NEC) and/or local codes. The maximum size of the over-current protector is based on the type of shelf. Refer to the equipment ratings to assure rating of equipment will not exceed 80% of the value of the protector chosen.
- High leakage currents are possible due to contribution from simultaneous multiple AC input connections. Earth ground connection is essential before connecting the ac source to the shelf. This connection must be achieved by ensuring that the C.O. grounding stud is connected as shown in the Installation Section, or quality service personnel shall ensure that the rack system is bonded per the provision below.
- An accessible ac disconnect/protection device to remove power from the equipment in the event of an emergency must be provided. Disconnect all AC branch circuits prior to making AC connections.
- Installing fuses or circuit breakers not specified for use in these distribution modules may result in injury to service personnel or equipment damage. Use only replacement parts listed in this manual and on the equipment drawings.
- The telecom-type (e.g., GMT type) fuses can produce sparks during interruption or clearing of a fault on a high energy circuit. Use only fuses provided with safety caps for this type of circuit. Installing telecom-type fuses not equipped with safety caps may result in injury to service personnel.
- While installing batteries, follow all safety precautions outlined in the appropriate battery product manuals.

## Warning Statements 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.

<b>DANGER</b>	Indicates the presence of a hazard that will cause death or severe personal injury if the hazard is not avoided.
<b>WARNING</b>	Indicates the presence of a hazard that can cause death or severe personal injury if the hazard is not avoided.
<b>CAUTION</b>	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 non-insulated 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

When working on or using this type of equipment, the following precautions should be noted:

- This unit must be installed, serviced, and operated only by 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 could 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.
- High leakage currents may be possible on this type of equipment. Make sure the equipment is properly safety earth grounded before connecting power.
- 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.
- Hazardous energy and voltages are present in the unit and on the interface cables that can shock or cause serious injury. Follow all safety warnings and practices when servicing this equipment. When equipped with ringer modules, hazardous voltages will be present on the ringer output connectors.

In addition to proper job training and safety procedures, the following are some basic precautions that should always be used:

- 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.



## Handling Batteries

- To direct attention to the possible source of danger from battery gases, post one or more warning signs, lettered in large characters, in a conspicuous location near the battery. For example:



- Fully brief anyone who is permitted access to battery areas on the hazards of handling lead-acid batteries. Make it clear to anyone handling, unpacking, or installing lead-acid batteries that they contain electrolyte (sulfuric acid and water). Everyone must wear protective equipment such as rubber gloves, rubber aprons, full face mask, and splash-proof goggles when performing any activity involving handling of batteries or cells containing electrolyte.
- A storage battery gives no indication by its appearance of the potential energy stored in it. All lead-acid storage cells/batteries have enormous short circuit capability which can result in serious burns. Use extreme care to avoid shorting out cell and/or battery terminals. Shorting a cell or battery with a non insulated tool can vaporize or throw the tool.
- All lead-acid batteries generate hydrogen gas, even under open circuit conditions. If not permitted to escape, this gas can build up to explosive concentrations. NEVER tamper with or block the vent caps of the 12IR125 battery modules. A damaged gas vent cap could become clogged, resulting in an explosion due to internal pressure. Such an explosion could short circuit other battery modules and result in a fire. ALWAYS place batteries in a well-ventilated area. NEVER place battery modules in a sealed environment.
- In case of electrolyte contact with the skin, remove the electrolyte **immediately** by flushing the affected area with large amounts of plain tap water. In case of electrolyte in the eye, pour water into the inner corner of the eye and allow at least one quart of water to run over the eye and under the eyelid. Eye injuries should be treated by a physician **immediately**.

# Special Installation Notes

## Deutsch

- **Installationsanleitung**
- Eingangsspannung ( Voltage ) : 120/200-240VAC , DC 54VDC  
Eingangsstrom ( Current ) : <15A per rectifier, DC 15A-1000A  
Eingangsleistung ( Watts ) :  
Nennfrequenz ( Frequency ) : 50 / 60 Hz
- Seriennummer ( Assembly No. ) : J5694720
- Modellnummer (Modell No. ) : H5694720
- Abmessungen sind nur zur Referenz : 978mm x 648mm x 381mm  
( Dimensions are for reference only )
- Max. Umgebungstemperatur : max. 45 deg. C  
( Max. Operation temperatur )
- **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 / overvoltage category II )
- Ausgangsspannungen und -ströme: DC 58 V / SELV  
( Output Voltage and Current )
- **--Das Gerät darf nur in Räumen mit beschränktem Zutritt aufgestellt werden.  
( 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 darauf zu achten das alle Anforderungen gemäß EN60950 eingehalten werden.

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

## **Espanol**

### **Notas especiales para instalaciones en países de habla hispana**

- Instrucciones de instalación (Installation Instructions)
- Voltaje (Voltage): 120/200-240VAC
- Corriente (Current): <15A per rectifier  
Frecuencia (Frequency): 50/60Hz
- Voltaje y corriente de salida (Output Voltage and Current): 54VDC, 15A-1000A  
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)

# 4 Installation

This section describes the following installation sequence for the CPS6000-M2 power system.

1. Preparations
2. Anchoring frame
3. Connecting frame ground
4. Connecting CO ground
5. Connecting ac utility
6. Installing batteries
7. Wiring dc loads and installing fuses/circuit breakers
8. Installing rectifiers and converters
9. Controller Connections
10. Starting Up System

## Preparation

### Safety

Please review all safety warnings in Section 3 before beginning the installation process. Observe all warnings and labels on the equipment.

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**WARNING:** Due to the possibility of working on energized circuits during these procedures, all tools and test equipment must be insulated in an approved manner. Proper ESD protection is required in order to prevent ESD damage to the equipment.

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**WARNING:** Only qualified personnel should install and service the power system and plug-in modules. Hazardous energy and voltages are present in the unit and on the interface cables and will shock or cause serious injury or death if safety precautions are ignored. Follow all safety warnings and practices when servicing this equipment.

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### Wiring Guidelines

- All electrical connections should be made using the proper crimping tools and dies and should be torqued to values specified.
- All building wiring should comply with the NEC and other applicable local codes.
- The temperature rating of the wire must be 90°C minimum.. Wire gauge must be sized based on 75°C wire and the ampacity of the associated branch-circuit protection.
- Wiring internal to enclosed equipment cabinets must be rated no less than 105° Celsius.

### Packaging

- All packages should be opened with a box cutter with the blade minimally exposed so that only the sealing tape is cut.
- Save all packaging material until the system has been powered up and all parts are operating within specifications.

### Installation Tools

You will need the following tools to install and test the CPS6000-M2 System.

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Wire cutters and strippers</li> <li>• Heat shrink gun</li> <li>• 5/16-inch (8 mm) hex driver</li> <li>• Digital meter with an accuracy of <math>\pm 0.02\%</math></li> <li>• Screw drivers (flat-blade and Phillips)</li> <li>• ESD wrist strap</li> <li>• 48V test load</li> <li>• Calibrated clamp-on dc current meter (0.1 ADC sensitivity)</li> <li>• Torque wrench</li> <li>• Socket wrenches:               <ul style="list-style-type: none"> <li>– 7/16" and 9/16" for load and battery connections;</li> <li>– 19 mm for anchor bolts;</li> <li>– 12" extension for socket</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Masonry drill kit as required</li> <li>• Compression for installation of various compression lugs</li> <li>• Protective canvas</li> <li>• Insulating rubber mat</li> <li>• Standard insulated installation tools, screwdrivers, etc.</li> <li>• 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.</li> </ul> |
|---|--|

**Accounting for Ship Loose Materials**

QTY	H5694720 Group	COMCODE	DESCRIPTION
60	660, 661	802841635	Flat Washer, 3/8
60	660, 661	801829607	Lock Washer, 3/8
60	660, 661	841064777	Nut Hex, 3/8
40	660, 661	230707-1	Amp Barrel Terminal
144	660, 661	901352617	Nut 1/4 - 20
3	441, 451, 471	406954222	Cable ties for securing battery cables
1	441, 451, 471	CC848809104	2 gauge battery cable
2	440-471	901281444	Phillips flat head screws 10-32 x 3/8
3	440-471	848466884	Battery separators
1	440, 441, 451, 471	CC848768201	Front battery bracket
1	441, 451, 471	CC848770248	Clear cover for battery breaker
2	441, 451, 471	845143858	Screw 6-32 x 1/4
2	101-104	CC408575947	1/4-20 x 3/4-inch HH bolt
2	101-104	801829557	1/4-inch lockwasher
2	101-104	CC408576012	1/4-inch flat washer
1	104	CC848795385	Drill template

**Torque Requirements**

Torque (in-lb)	Connection
10	AC terminal block screws
35	10-32 screw for dc rear covers and ac duct
35	12-24 frame-mounting screws
65	1/4-20 nuts for bullet panel loads
135	M8 bolts for large breaker and fuse kits and LVBD connections
240	3/8-16 nuts for large breaker and fuse load leads and all battery leads

# Anchoring Frame

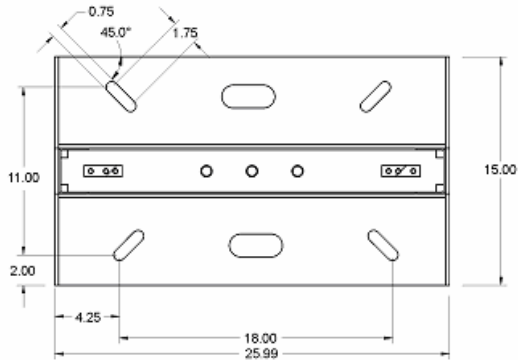
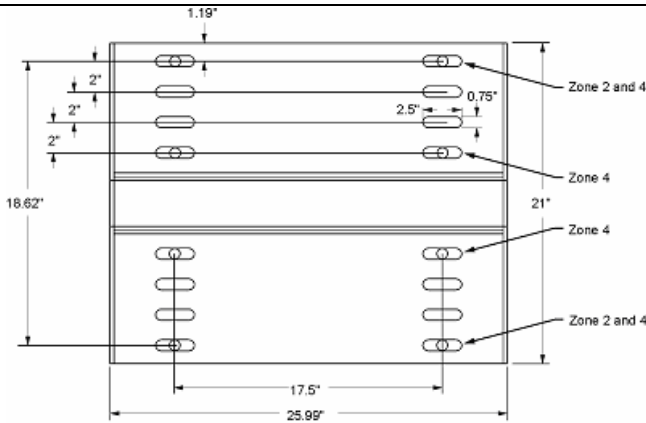
## Floor Mounted Frames

Using the 847135688 Floor Anchor Kit (recommended):

Anchor Type (Hilti)	Wrench	Hole Size	Torque
(4) 12 mm Cap Bolts	19 mm	18mm 100mm deep	720 in·lbs 60 ft·lbs 81.6 N·m

**Note:** For systems with tray mounted batteries at sites requiring Seismic Zone 4 rating, (2) 847135688 kits are required to provide (8) floor anchors.

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

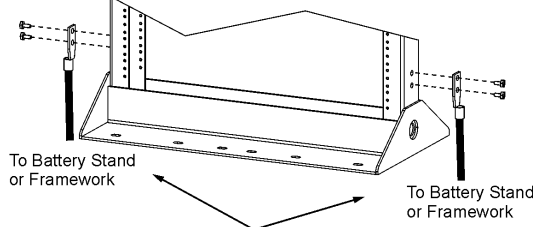
Step	Action
1	<p>Mark floor anchor locations, using the provided Floor Template.</p>  <p><b>G103 7ft Standard Frames</b></p>
	 <p><b>G104 7ft Heavy Duty Frames</b></p>
2	<p>Drill anchor holes.</p> <p><b>Caution:</b> Follow safe floor drilling procedures to prevent possible asbestos exposure.</p>
3	<p>Place frame and install floor anchors according to manufacturer requirements.</p>



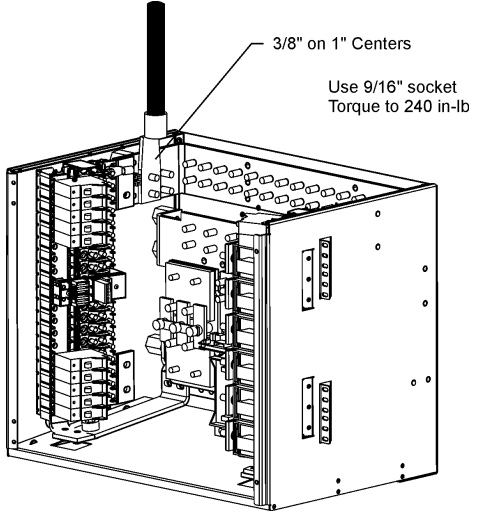


**Battery or Battery Stand Mounted Frames:**

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.

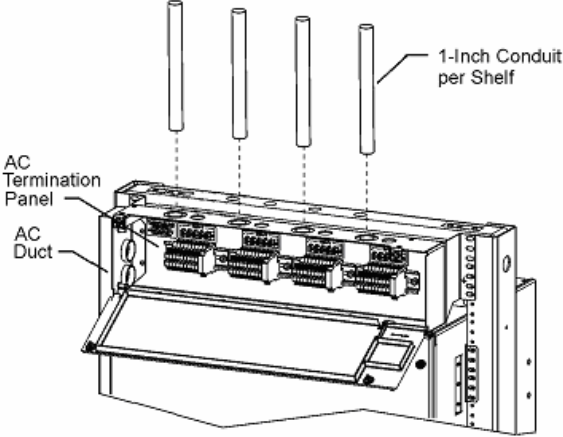
Step	Action
1	<p>Secure Frame Ground connection with provided hardware:</p> <ul style="list-style-type: none"> <li>(2) 801256165 1/4-20 x 3/4" HH bolt</li> <li>(2) 801829557 1/4-inch lockwasher</li> <li>(2) 802841577 1/4-inch flat washer</li> </ul> <p>If required by local code or practice, treat with an oxidation inhibitor such as NO-OX.</p> <p>Use 7/16" socket. Torque to 65 in-lbs.</p> <div data-bbox="841 436 1372 730">  <p>Use either of two locations provided for frame ground connection to supporting framework.</p> <p><b>Note:</b> Landings are compatible with lugs with 5/8" hole spacing for 1/4" or 6mm hardware.</p> </div>

**Connecting Central Office Ground (COG)**

	Action
	<ul style="list-style-type: none"> <li>• COG lead landing is as shown.</li> <li>• If required by local code or practice, treat with an oxidation inhibitor such as NO-OX.</li> <li>• Secure COG connection with provided hardware: <ul style="list-style-type: none"> <li>(2) 841064777 3/8-16 nut</li> <li>(2) 801829607 3/8-inch lockwasher</li> <li>(2) 814251898 3/8-inch flat washer</li> </ul> </li> <li>• Use 9/16" socket. Torque to 240 in-lbs.</li> </ul> <div data-bbox="863 1150 1339 1663">  </div> <p><b>Note:</b> Landings are compatible with lugs with 1" hole spacing for 3/8" hardware.</p>

## Connecting AC Utility

**WARNING:** Disconnect all AC branch circuits prior to making AC connections to the CPS6000 Plant System. When connecting to utility source, ensure compliance to all local and national wiring rules.

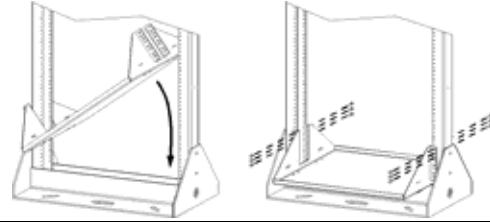
Step	Action
1	<ul style="list-style-type: none"> <li>AC is connected to terminal blocks located at the top of the equipment frame.</li> <li>Route and attach conduit or other commercial fitting. A 1-inch conduit is required per rectifier shelf.</li> </ul> 
2	<ul style="list-style-type: none"> <li>Pull and terminate AC wire.</li> <li>Terminal blocks are provided for up to twenty rectifiers (four shelves).</li> <li>Each rectifier must be fed by 10 gauge wire protected by a 20A circuit breaker or fuse.</li> <li>Terminate ground connection on terminal blocks or optional lugs.</li> </ul>

# Installing Batteries

## Installing Battery Trays

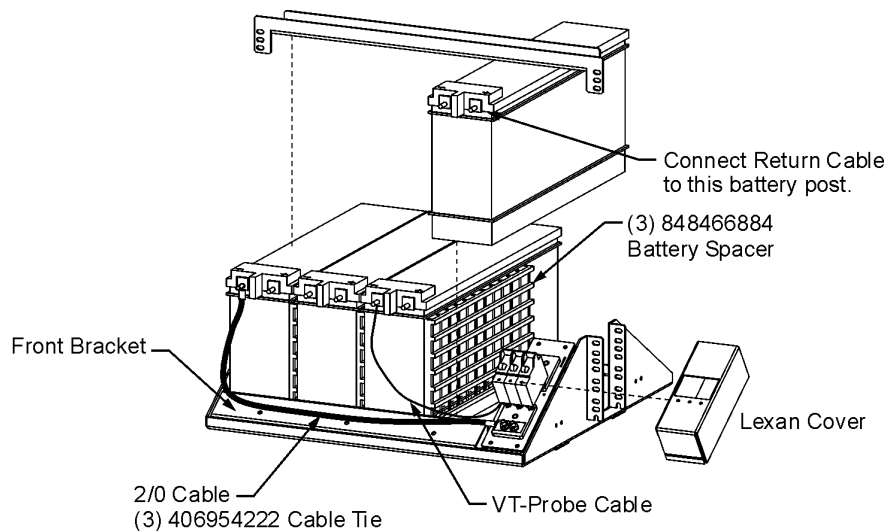
Optional battery trays are suitable for use with general trade VRLA batteries. VRLA batteries come in two jar widths; approximately 4.25" width, typically used in 19" frame applications and approximately 5" width, typically used in 23" frame applications. These battery trays accommodate both types.

Step	Action
1	Position the battery tray in the frame as shown. Secure with provided (Comcode 901078717) rack screws.



## Installing 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.




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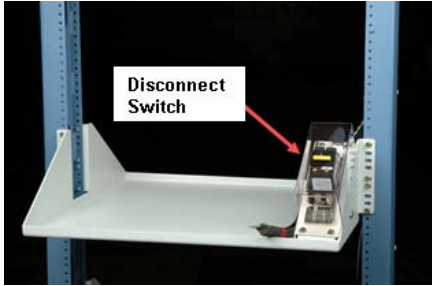

**WARNING:** All batteries contain hazardous electrical energy. Lead-acid batteries contain sulfuric acid and explosive hydrogen gas. Follow all precautions noted in the literature accompanying the batteries. Use only insulated tools.

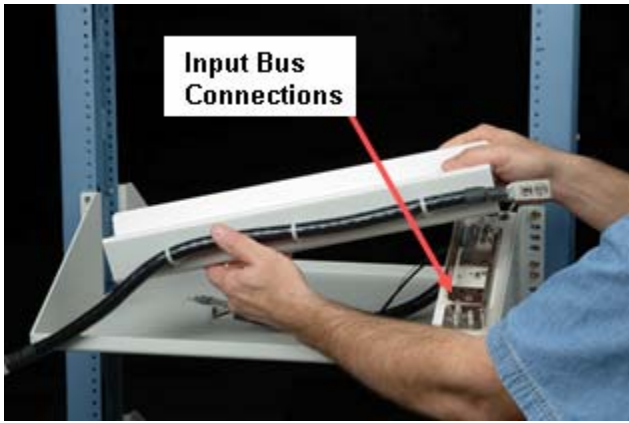



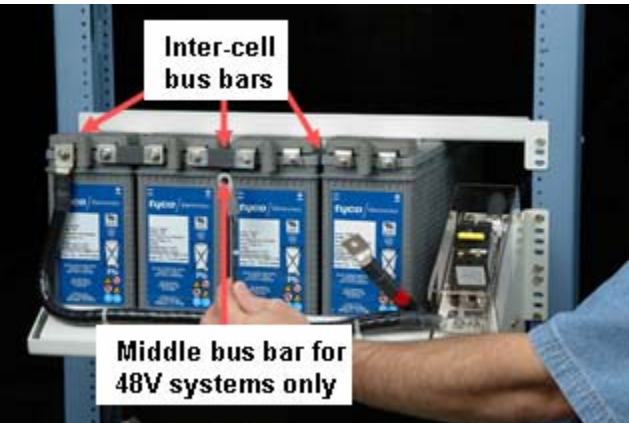
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**CAUTION:** Equipment frame anchoring, load rating, and seismic zone rating should be verified before field installing trays and batteries.

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## Typical Battery Installation on Trays with Battery Disconnect

Step	Action	
1	<p>Ensure disconnect switch is in the OFF position (downward) prior to making any connections.</p> <p>Remove the two 6/32 screws to remove the plastic cover.</p>	
Does system have larger batteries?		
	Yes – Proceed to Step 2.	No – Go to Step 3.
2	<p>Reposition the battery disconnect switch to the outside of the battery tray as shown using (2) provided 901281444 Flathead 10-32 x 3/8" Phillip screws.</p>	

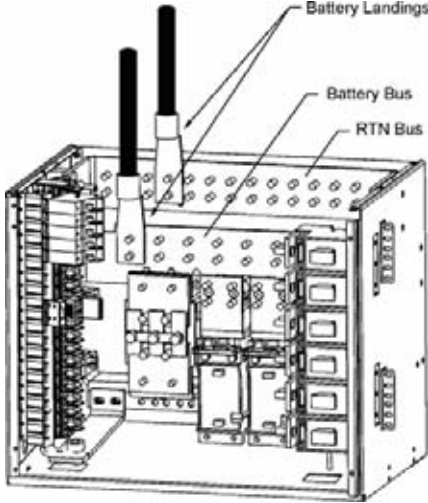
Step	Action
<p><b>3</b></p>	<p>Place front bracket on battery tray. Batteries sit on flange of bracket holding it in place.</p> <p><b>Note:</b> For systems with larger batteries the front bracket is mounted to extend beyond the front of the tray.</p> <div data-bbox="743 243 1369 663">  </div> <div data-bbox="857 699 1256 827">  </div>
<p><b>4</b></p>	<p>Connect one end of the 2 gage cable to the input bus of the disconnect switch. Secure with 1/4-20 hex nuts (901352617) provided. Torque to 65 in-lb.</p> <div data-bbox="743 909 1369 1329">  </div>
<p><b>5</b></p>	<p>Re-attach clear plastic cover to disconnect switch and secure with 6-32 screws.</p>
<p><b>6</b></p>	<p>Place four batteries on each battery tray.</p> <p>Position three Battery Spacers between the batteries.</p> <div data-bbox="743 1329 1369 1398">  </div>
<p><b>7</b></p>	<p>Interconnect three inter-cell bus bars to configure one 48V battery string per the battery manufacturer's instructions.</p> <div data-bbox="743 1413 1369 1833">  </div>

Step	Action	
8	Attach the battery securing top rail. Secure with provided (Comcode 901078717) rack screws	
9	Connect the 2 gage cable between the V- post of the leftmost battery and the input bus of the disconnect switch. Torque to battery manufacturer's specification.	
	<b>Is the system equipped with a factory installed QS873 VT thermal probe?</b> Note: The Millennium II can support up to 16 QS873VT 1-Wire probes. It also has the capability of directly monitoring up to (4) analog temperature probes. Temperature measurements are also available through the use of Remote Peripheral Modules (RPM's).	
	No – Proceed to Step 11.	Yes – Proceed to Step 10.
10	Connect the QS873 VT thermal probe to the inter-cell busbar at the V- post in the middle of the battery string.  Cable-tie to front bracket along with the battery cable.  See “Installing Thermal Probes” later in this chapter if field installing Thermal Probes	



Step	Action	
11	Connect the factory-wired battery cable to the V+ post of the right-most battery. Torque to battery manufacturer's specification.	
	Battery installation is complete.	

### Attaching Battery Cables to CPS6000-M2 Busses

	Action	
	<ul style="list-style-type: none"> <li>Battery Cable landings are as shown. If required by local code or practice, treat with an oxidation inhibitor such as NO-OX.</li> <li>Secure Battery Cable connections with provided hardware (per cable): <ul style="list-style-type: none"> <li>(2) 841064777 3/8-16 nut</li> <li>(2) 801829607 3/8-inch lockwasher</li> <li>(2) 814251898 3/8-inch flat washer</li> </ul> </li> <li>Use 9/16" socket. Torque to 240 in-lbs.</li> </ul>	 <p><b>Note:</b> Landings are compatible with lugs with 1" hole spacing for 3/8" hardware.</p>

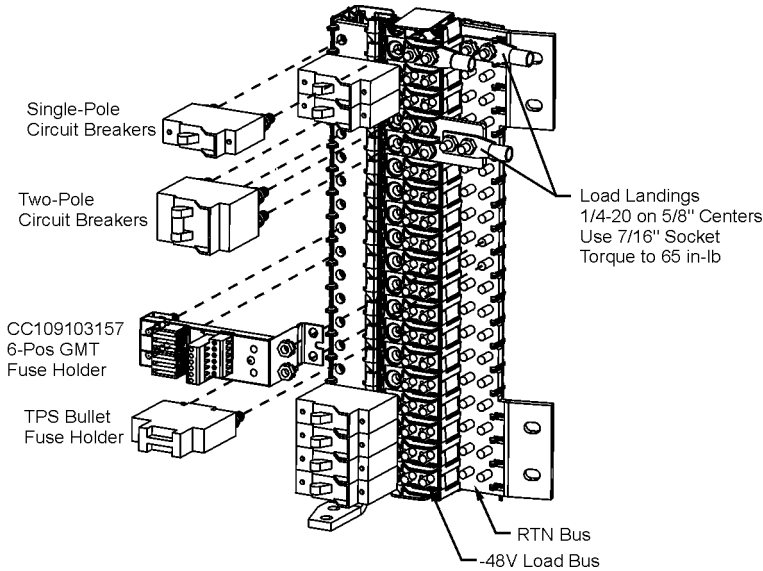
# Installing and Wiring DC Loads

## Installing DC Bullet Style Distribution


Bullet Terminal distribution panels accept Bullet Terminal Circuit Breakers, TPS Fuse Holders, and GMT Fuse Modules.

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

- **CAUTION:** In order to meet UL Listing temperature limits, GMT Fuses on the bullet fuse module must meet these layout restrictions:
- All 12A rated fuses must have an unused position to at least one side.
- All 15A rated fuses must not be installed next to another fuse. Leave empty position.
- **CAUTION:** In order to meet UL Listing temperature limits, bullet distribution panels must meet the following layout restrictions
- Panel is rated 400A but derates to 350A if Large Breakers or Fuses are installed in the Center Section of distribution.
- bullet circuit breakers rated 80A, 90A and 100A require one adjacent position be left unoccupied.

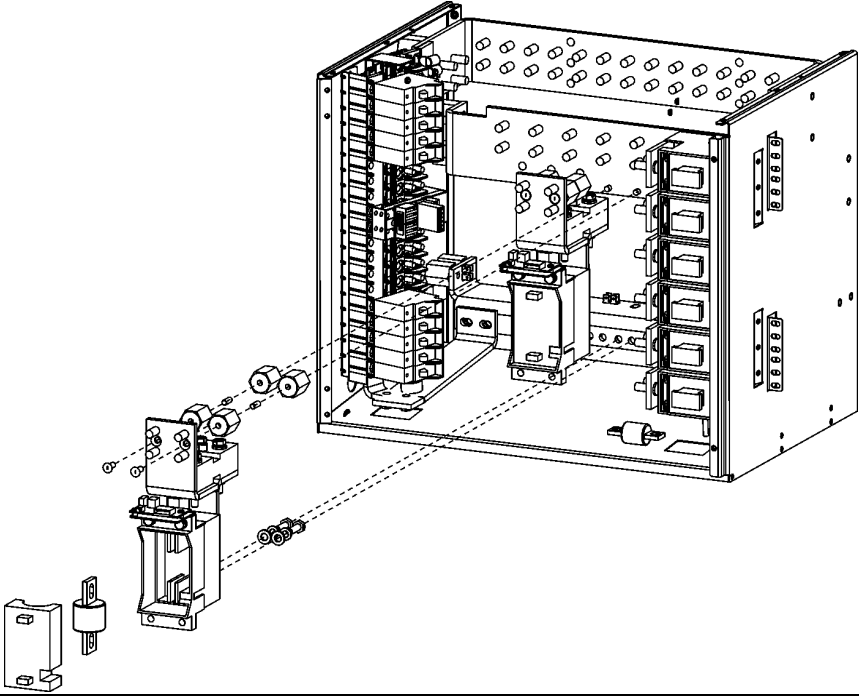
Step	Action
1	<p>Loosen screws and swing hinged retainer cover clear of the distribution devices (if present).</p>  <p style="text-align: center;"><b>Vertical distribution panel</b></p>
2	Insert distribution devices into the panel load busses as shown in the figure above.
3	<p>Connect loads.</p> <p><b>Note:</b> To allow for future growth start from the top most position and work down the panel. This will allow orderly and managed cable dressing as loads are added.</p>



Step	Action
4	Secure GMT Module Return bus bars to the distribution panel Return bus bar with provided (901352617) 1/4-20 nuts.
5	Secure the hinged retainer cover if removed in step 1 above.
<b>Single- and Two-Pole, Breakers and TPS Fuses:</b>	
6	Secure Two-Pole adapter busses to the distribution Load and Return busses with provided (901352617) 1/4-20 nuts.
7	Secure Load and Return Cable connections with provided (901352617) 1/4-20 nuts. Use 7/16" socket. Torque to 65 in-lbs.
8	Verify (using a voltmeter) polarity 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 and do not install load fuses until the load equipment is ready to be energized.
<ul style="list-style-type: none"> <li><b>WARNING:</b> Do not install load fuses until the load equipment is ready to be energized.</li> </ul>	
<b>Three-Pole Breakers:</b>	
10	Secure Three-Pole adapter busses to the distribution Load and Return busses with provided (901352617) 1/4-20 nuts. Use 7/16" socket. Torque to 65 in-lbs.
11	Secure Load Cable connections with provided hardware (per cable): (2) 841064777 3/8-16 nut (2) 801829607 3/8-inch lockwasher (2) 814251898 3/8-inch flat washer Use 9/16" socket. Torque to 240 in-lbs.
12	Using a voltmeter, verify polarity of the voltage between the Return bus and the distribution input bus.
13	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.
<ul style="list-style-type: none"> <li><b>WARNING:</b> Do not install circuit breakers until the load equipment is ready to be energized.</li> </ul>	
<b>GMT Bullet Fuse Modules:</b>	
	
14	Strip load wire 3/8" and secure in the GMT module terminal block. Use #1 slot screwdriver. Torque to 13 in-lbs.
15	Dress and wire tie with service loop to provide strain relief.
16	Using a voltmeter, verify polarity of the voltage between the RTN and distribution input bus.
17	Verify wiring polarity at the input of the load equipment.
<ul style="list-style-type: none"> <li><b>WARNING:</b> Do not install load fuses until the load equipment is ready to be energized.</li> </ul>	

## Installing TPL-C Fuse Holders and Panels

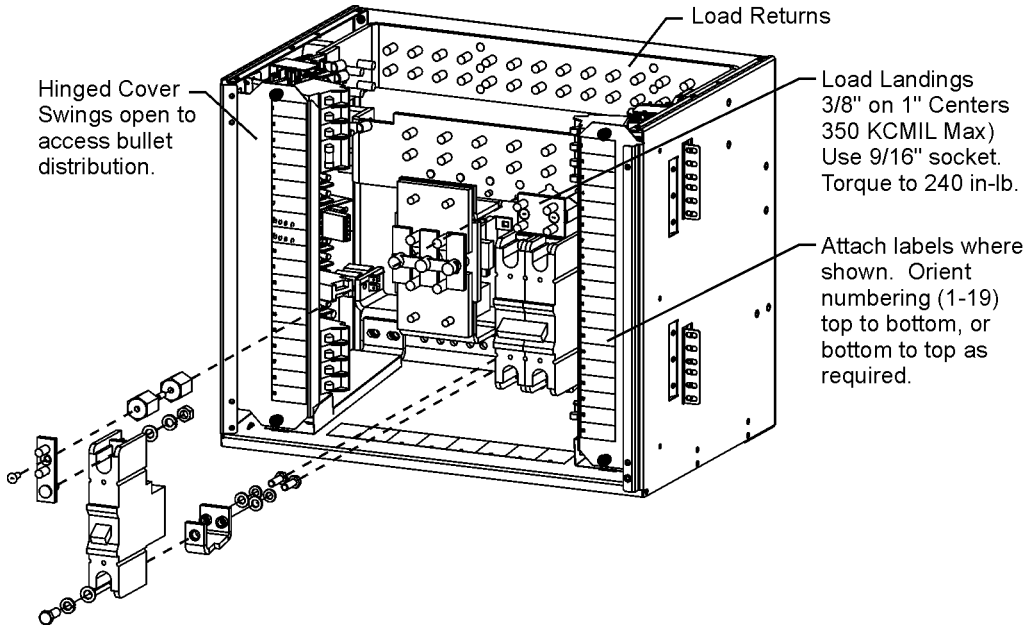
TPL-C Fuse holders can either be factory or field installed per kit CC109129129128. The following figure shows the installation of this kit and corresponding fuse installation. Note that the fuse snaps into the fuse handle which is then pushed into the holder.

Step	Action
1	<p>Ensure Fuse Holders are empty prior to making any connections.</p> 
2	<p>Secure Load Cable connections with provided hardware (per cable):</p> <ul style="list-style-type: none"> <li>(2) 841064777 3/8-16 nut</li> <li>(2) 801829607 3/8-inch lockwasher</li> <li>(2) 814251898 3/8-inch flat washer</li> </ul> <p>Use 9/16" socket. Torque to 240 in-lbs.</p>
<p><b>WARNING:</b> Do not install load fuses until the load equipment is ready to be energized.</p>	

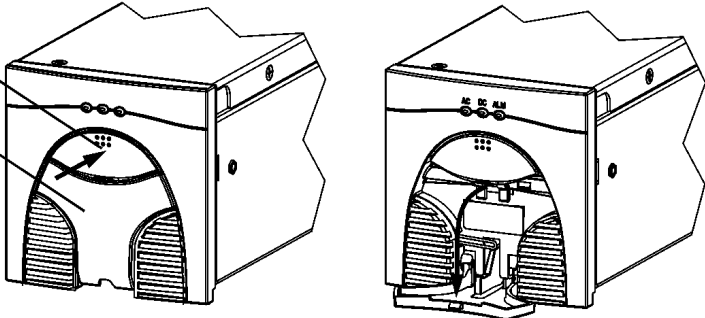
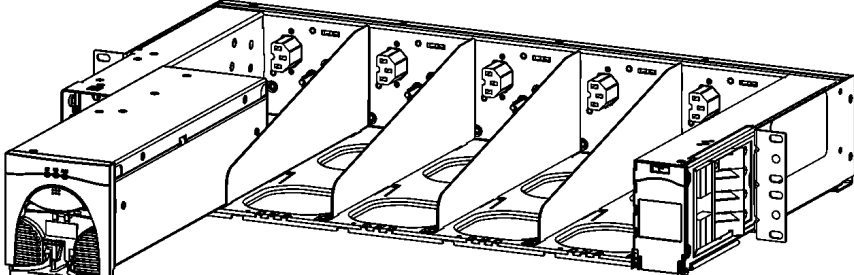
## Installing Large Circuit Breakers

KS22012 Circuit Breakers can either be factory installed or field installed per the following kits:

- CC109127635 150A Single Pole Breaker
- CC109127627 250A Single Pole Breaker
- CC109127486 Two Pole Breaker

Step	Action
1	<p>Ensure Circuit Breakers are in the OFF (down) position prior to making any connections.</p>  <p>Hinged Cover Swings open to access bullet distribution.</p> <p>Load Returns</p> <p>Load Landings 3/8" on 1" Centers 350 KCMIL Max) Use 9/16" socket. Torque to 240 in-lb.</p> <p>Attach labels where shown. Orient numbering (1-19) top to bottom, or bottom to top as required.</p>

## Installing QS-Series Rectifiers

	Action
	<p>Rectifiers are installed or removed with the rectifier handle in the open position as shown.</p> <p><b>Releasing the Latch Handle</b></p> <p>Press Latch/Handle Release Button In</p> <p>Latch/Handle in Latched Position</p>  <p>Latch/Handle Springs Out</p> <p><b>Installing / Removing the Rectifier</b></p>  <p>To Install: Release the latch/handle. Push the rectifier in firmly until seated. The latch/handle will pop most of the way up. Push the latch/handle back into the latched position</p> <p>To Remove: Release the latch/handle. Push the latch/handle all the way down (shown). Pull the rectifier out by the latch/handle.</p>

Use the above rectifier installation procedure as needed in the following steps:

Step	Action
1	Turn on ac service circuit breakers 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 green Norm LED is lit.

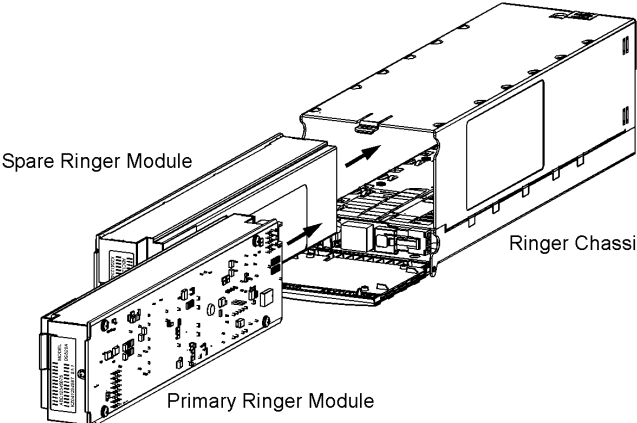
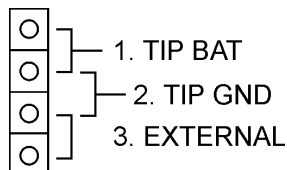
Step	Action
5	Apply 10 amperes of load to the system.
6	If equipped, verify the contactor closes and connects the battery strings.
7	If an audible alarm is present, press the ENTER key to MUTE the audible alarm.
8	Verify all LEDs are green on the controller and the display is visible with the proper voltage shown.
9	Increase the plant 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 Norm LED is lit.
13	Verify the two rectifiers are present and verify the rectifier output currents by using the front panel: <b>MENU &gt; STATUS &gt; RECTIFIERS &gt; RECTIFIER CURRENTS.</b>
14	Increase the plant load current to 50 amperes.
15	Continue to add rectifiers until the system is fully equipped or has a maximum of 20 rectifiers.
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 Set-point.
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.

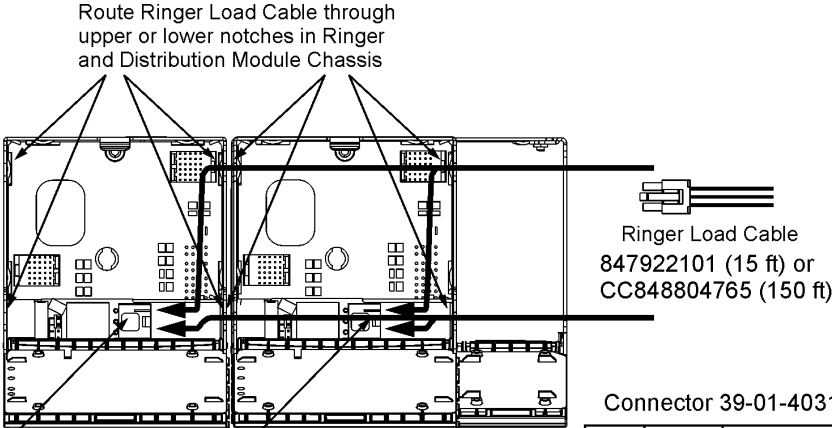
For more information on QS Rectifiers, see the **Troubleshooting** section.

## Installing QS-Series Ringers

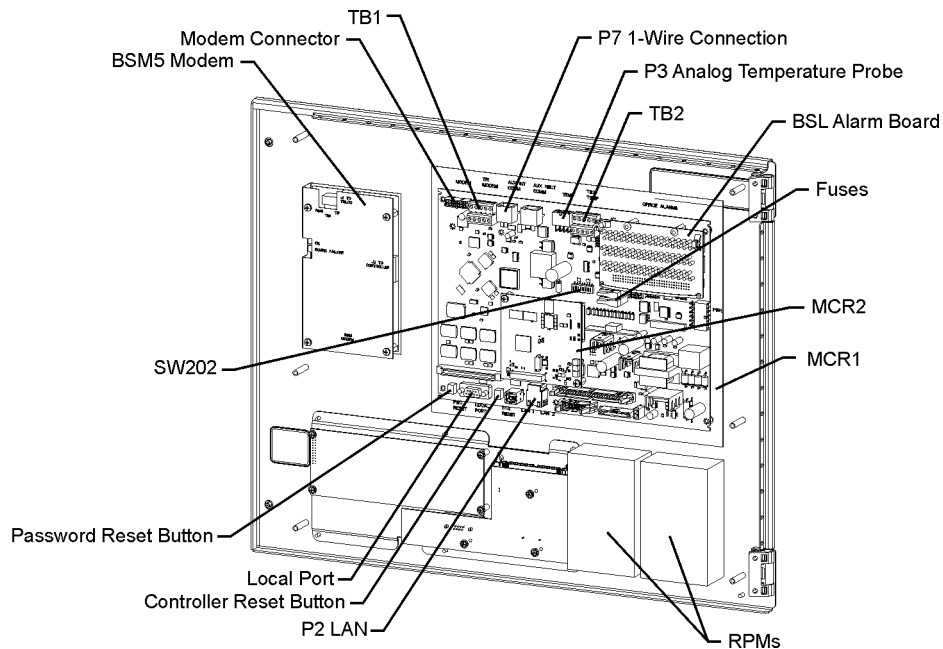


Step	Action
1	<ul style="list-style-type: none"> <li>Up to two Ringer Chassis's may be installed per rectifier shelf, one in each of the two right-most power slots. Each Ringer chassis accepts up to two ringer modules, a primary and a spare.</li> <li>For redundant ringing, install both Primary and Spare Ringers in each Ringer Chassis.</li> </ul> <p><b>WARNING:</b> Consider the Ring signal as hazardous voltage. When rectifiers and/or battery power is present, all installed QS820M ringer chassis and QS820A ringer modules will be powered.</p> <ul style="list-style-type: none"> <li>Note: Ringer output connections are made after ringers are seated in the Ringer chassis.</li> <li>Note: The primary and spare Ringer modules install facing opposite directions. No rectifiers may be installed to the right of a Ringer Chassis. Slots dedicated to Ringers do not require an ac input circuit in the AC Termination Panel</li> </ul>
2	<ul style="list-style-type: none"> <li>Slide the ringer chassis into the power slot.</li> <li>Press firmly until the connector on the rear of the ringer chassis engages with the connector at the back of the power slot on the shelf.</li> <li>Verify the hook under the front left of the ringer chassis hooks under the shelf.</li> <li>Press down on the faceplate latch and open the faceplate.</li> <li>Secure the ringer chassis to the shelf using one #4 screw, hand tight to approximately 5 in-lbs.</li> <li>Repeat if a second ringer chassis is required.</li> </ul> <div data-bbox="841 1245 1318 1747"> <p>Press Down on the Faceplate Latch to Release the Faceplate</p> <p>#4 Screw Hand Tight (Approximately 5 in-lb)</p> </div>

Step	Action																
3	<ul style="list-style-type: none"> <li>Locate connector on rear of ringer module and the mating connector on the inside rear of the ringer chassis.</li> <li>Align the ringer module connector with the ringer chassis connector. Place the ringer module in the guides and slide the ringer in until it fully engages with the connector at the back of the ringer chassis.</li> <li>Note: The Ringer modules install facing opposite directions</li> <li>Repeat until all Ringer modules are installed.</li> </ul>																
4	<ul style="list-style-type: none"> <li>Use Tip Jumper J12 to set the Ringer output type.</li> <li>Note: Ringer output type is determined by connecting Ring Return (Tip) to Battery or Ground. External connection of Ring Return (TIP) to Battery or Ground may be used with J12 in EXTERNAL position. Ringer output is disabled if Ring Return is not connected to Battery or to ground.</li> </ul> <table border="1"> <thead> <tr> <th>Ringing Type</th><th>Tip Jumper J12 Position</th><th>Comments</th></tr> </thead> <tbody> <tr> <td>Ground Backed</td><td>1. TIP BAT</td><td></td></tr> <tr> <td>Battery Backed</td><td>2. TIP GND</td><td></td></tr> <tr> <td>Ground Backed – no-dc</td><td>2. TIP GND</td><td>Also requires Controller configuration of dc Offset: Disabled</td></tr> <tr> <td>Externally Selected</td><td>3. EXTERNAL</td><td>Requires external connection of Tip to Battery or Ground.</td></tr> </tbody> </table> <div style="text-align: center;">  </div> <p>Repeat until all Ringer modules are installed</p>		Ringing Type	Tip Jumper J12 Position	Comments	Ground Backed	1. TIP BAT		Battery Backed	2. TIP GND		Ground Backed – no-dc	2. TIP GND	Also requires Controller configuration of dc Offset: Disabled	Externally Selected	3. EXTERNAL	Requires external connection of Tip to Battery or Ground.
Ringing Type	Tip Jumper J12 Position	Comments															
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Externally Selected	3. EXTERNAL	Requires external connection of Tip to Battery or Ground.															

Step	Action											
5	<ul style="list-style-type: none"><li>Connect Ringer loads using Molex 39-01-4031 connector, Socket Terminal to the HDR13 plug located inside the Ringer Chassis at the bottom-front</li></ul>											
	<p><b>WARNING:</b> Consider the Ring signal as hazardous voltage.</p>											
	<div><p>Route Ringer Load Cable through upper or lower notches in Ringer and Distribution Module Chassis</p><p>Ringer Load Cable 847922101 (15 ft) or CC848804765 (150 ft)</p><p>Connector 39-01-4031</p><table><tr><th>Pos</th><th>Color</th><th>Description</th></tr><tr><td>1</td><td>BK</td><td>Ring</td></tr><tr><td>2</td><td>BR</td><td>Tip</td></tr><tr><td>3</td><td>Bare</td><td>Equipment Ground</td></tr></table></div>	Pos	Color	Description	1	BK	Ring	2	BR	Tip	3	Bare
Pos	Color	Description										
1	BK	Ring										
2	BR	Tip										
3	Bare	Equipment Ground										

## Controller Connections





The MCR1/MCR1B control board contains the connections for all the input and outputs. The following table provides a list of the connections with their respective reference designators and brief description of the particular connection.

Interface Reference	Description
<b>P1</b>	Connectorized interface for large parallel format 8x40 LCD assembly
<b>P2</b>	10/100 Base-T LAN/Ethernet interface
<b>P3</b>	Connectorized interface for 10K/30K thermistor probe options or 210E
<b>P6</b>	Connectorized input for input power, monitoring of two shunts, plant sense voltage, and Major Fuse alarm (Same connection as on the Millennium)
<b>P7</b>	RJ45 receptacle for ground referenced Auxiliary RS485 circuit and One-Wire monitoring devices
<b>P8</b>	BSL1-4 circuit pack Interface connector for Input/Output to controller
<b>P9</b>	RJ45 receptacle for isolated RS485 system component monitoring and control of rectifiers, converters, low voltage disconnect contactors, and bay level alarm inputs (Serial Rectifier bus)
<b>P13</b>	Factory test connector (not used in the field)
<b>P14</b>	Connectorized interface for future smaller serial format LCD
<b>P15</b>	Connectorized interface for future smaller serial format LCD
<b>P201</b>	Connectorized interface for optional Modem
<b>P202</b>	Ground referenced DB-9 for local RS232 serial port
<b>P205</b>	Option board connector
<b>TB1</b>	Terminal block interface for RS232/RS485 Auxiliary port and Remote Peripheral Module (RPM) connections
<b>TB2</b>	Terminal block interface for three additional 10K thermistor probe or 210E connection options
<b>J10</b>	USB interface (reserved for future use)

## Fuses

Two Fuses, located on the MCR1/MCR1B board, provide protection for the controller input power and Alarm Battery Supply (ABS). ABS is used to power alarm panels or other devices requiring the power system voltage at no more than 1.3A.

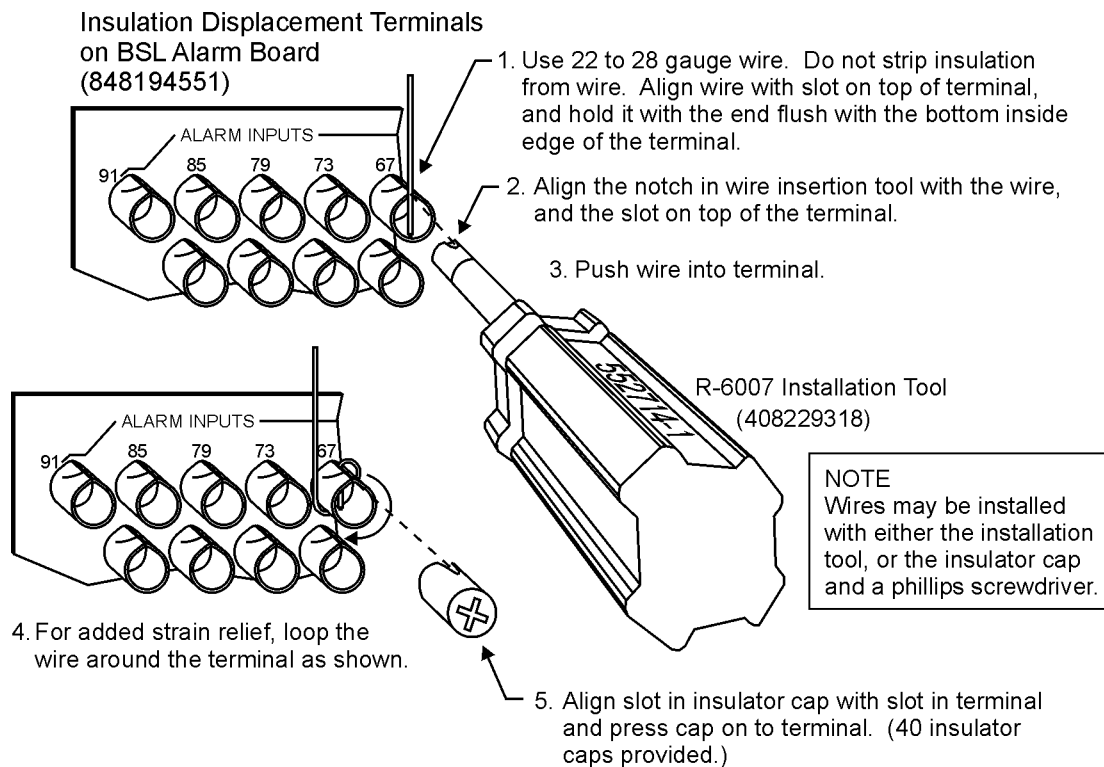
Fuse	Description	Fuse Size
F1	Controller Input Power	3A
F2	Alarm Battery Supply (ABS)	1.3A

## Network (LAN) Connections

Step	Action
<b>Note</b>	The LAN port P2 is an IEEE 802.3 compliant 10/100Base-T Ethernet interface. This port can be used for remote monitoring or configured as local Craft port. Factory default is to be a DHCP client where the network will serve the controller and IP address.  Since the cable length required to connect to the network is variable, this cable must be supplied by the user.
<b>1</b>	At the controller, <b>connect</b> one end of the network interface cable to P2. This connector is located at the bottom center of the MCR1 board, and immediately below the MCR2 board.
<b>2</b>	<b>Connect</b> the other end to an IEEE 802.3 compatible network.
<b>3</b>	<b>Configure</b> the network parameters by contacting the customer's network administrator.

## BSL Alarm Outputs and Control Inputs

The following tables provide the input/output signal assignments for the BSL alarm interface board. Use 18-26 gage wire for alarm board terminations. Form-C Alarm contact ratings are 60VDC, 0.3A



## BSL Alarm Outputs

Signal Name	Pin Number	Signal Reference	Signal Name	Pin Number	Signal Reference
Power Critical Alarm -Audio	1	PCRAO	Minor Fuse Alarm	34	MNFR
	2	PCRAC		35	MNFC
	3	PCRAR		36	MNFO
Power Critical Alarm -Visual	4	PCRVR	Battery On Discharge Alarm	37	BDO
	5	PCRVC		38	BDC
	6	PCRVO		39	BDR
Power Critical Alarm-External	7	PCREO	AC Fail Alarm	40	ACFR
	8	PCREC		41	ACFC
	9	PCRER		42	ACFO
Power Major Alarm-Audio	10	PMJAR	Rectifier Fail Alarm	43	RFAO
	11	PMJAC		44	RFAC
	12	PMJAO		45	RFAR
Power Major Alarm –External	13	PMJEO	High Voltage Alarm	46	HVR
	14	PMJEC		47	HVC
	15	PMJER		48	HVO
Power Major Alarm–Visual	16	PMJVR	User Relay 1	49	UR1O
	17	PMJVC		50	UR1C
	18	PMJVO		51	UR1R
Power Minor Alarm-Audio	19	PMNAO	Controller Fail Alarm	52	CTLRR
	20	PMNAC		53	CTLRC
	21	PMNAR		54	CTLRO
Power Minor Alarm –Visual	22	PMNVR	User Relay 2	55	UR2O
	23	PMNVC		56	UR2C
	24	PMNVO		57	UR2R
Power Minor Alarm –External	28	PMNER	Very Low Voltage	58	VLVR
	29	PMNEC		59	VLVC
	30	PMNEO		60	VLVO
Major Fuse Alarm	31	MJFO			
	32	MJFC			
	33	MJFR			

### BSL Alarm and Control Inputs

Alarm	Pin Number	Signal Name
Low Voltage 2 Disconnect State Detect	61	LVD2
	62	LVD2R
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
Timer Control Return	69	TRTN
Plant Battery Test	70	PBTR
	71	PBT
Open String Detect	72	OS
Transfer Rectifier 1	73	TR1
General Purpose Input 4	74	IN-4 (previously TEQ)
General Purpose Input -5 (Previously Engine Transfer)	75	IN-5 (Previously ETR)
Reserve Operation	77	RO
	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
General Purpose 0-5Vdc Measuring Circuit	91	0-5V
General Purpose 0-5Vdc Measuring Circuit-RTN	92	0-5VR

Following are additional details concerning the alarm and control input signals.

**BSL-63 FAJ: Fuse Alarm Major**

An optional “battery” or non-grounded potential input, must use an external 1K ohm 2W current limiting resistor at the source. A Fuse Alarm Major is generated when battery potential is received.

**BSL-65 FAN: Fuse Alarm Minor**

An optional “battery” or non-grounded potential input, must use an external 1K ohm 2W current limiting resistor at the source. A Fuse Alarm Minor is generated when battery potential is received.

**BSL-72 OS: Open String Alarm**

An optional “battery” or non-grounded potential input, 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.

**BSL-64 AMJ: Aux Major**

An optional “battery” or non-grounded potential input, 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.

**BSL-66 AMN: Aux Minor**

An optional “battery” or non-grounded potential input, 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.

**LVD1: BSL-84 Low Voltage Disconnect Active**

An optional “battery” or non-grounded potential input, must use an external 1K ohm 2W current limiting resistor at the source if not using standard Lineage Power LVD circuit boards or controller. This circuit is used to inform the controller that the monitoring circuit of a Low Voltage Disconnect device has failed.

**LVD2/LVD2R: BSL-61/62 Low Voltage Disconnect Active**

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.

**External Boost Option**

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 board 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.

**Rectifier Sequence Option**

The controller is capable of sequencing rectifiers on line after detecting AC is being provided by emergency generator. Internal Rectifier Sequencing requires external wiring to ETR/ETRR on BSL pin numbers 75/76, and optionally RO/ROR on BSL pin numbers 77/78, in order to

function. The controller can also accept ground signals onto TR1 to TR4 on BSL 73/79/ 85/80 from an external device to control the sequencing of plant rectifiers in groups as follows:

### TR leads and Associated Rectifiers

TR Signal	Rectifiers Affected
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

### Alarm Battery Supply Outputs on BSL Board

#### ABS Pin Numbers

Signal Name	Pin No.
ABS	93
ABS	94
DG	95
DG	96

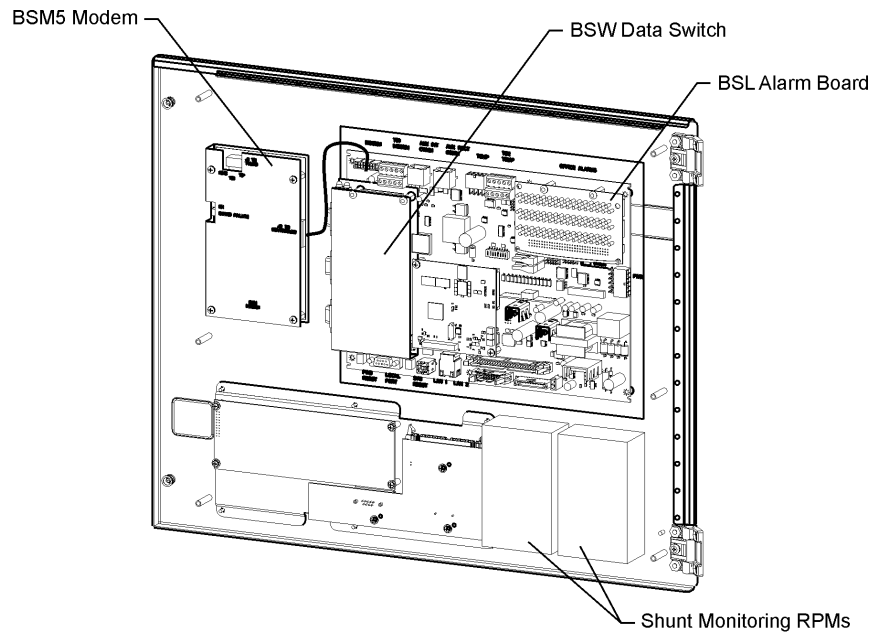
#### BSL-93, 94 ABS: Alarm Battery Supply

This is an alternate plant voltage source for user alarm systems. This power is fused with a 1-1/3 ampere ABS fuse labeled F2 on the controller.

#### BSL-95, 96 DG: Discharge Ground

Plant ground/return source for user alarm systems.

## Installing Optional Circuit Packs



### Field-Installable Circuit Packs

#### BSM5 Modem Card

Step	Action
<b>Note</b>	Installation or replacement of this pack can be done “hot”; power removal is not necessary.
<b>1</b>	Remove the controller plastic front cover.
<b>2</b>	Place insulator under BSM5 modem and install to the door using four 407882141 standoffs. Wrap insulator around modem and secure with four 845143866 screws.
<b>3</b>	Connect 848091798 cable assembly between the BSM5 J100 plug and P201 on the MCR1 board.
<b>4</b>	<p><b>Note:</b> This step may be performed at a later time</p> <p>Connect a telephone cable to the RJ11 connector at the top of the BSM5 board</p> <p><b>OR</b></p> <p>Connect Tip/Ring conductors to TB1 at the top of the board.</p> <p><b>NOTE:</b> Tip is TB1 pin 1 (Pin closest to the RJ11 connector) and Ring is Pin 3. Pin 2 is not used.</p>
<b>5</b>	Operate the controller reset switch on the MCR1 board in the lower left corner of the MCR1 board.
<b>Note</b>	The Password Reset button is to the LEFT of the serial port connector (Not present on the MCR1B must use the front panel), and the <b>Controller Reset</b> is to the right of the serial connector.

## BSW Data Switch Card

Step	Action
<b>Note</b>	Installation or replacement of this pack can be done “hot”; power removal is not necessary.
<b>1</b>	Install two 407882133 standoffs on the MCR1 located just below TB1 connector in the upper left hand corner.
<b>2</b>	Place BSW pack inside the 847950938 insulator.
<b>3</b>	Plug BSW pack into the P205 connector on the MCR1 board
<b>4</b>	Secure the BSW board to the standoffs with two 900562208 screws.
<b>Note</b>	To install the Data Switch Extension board, please see the Basic Installation And User’s Guide For The Millennium II Controller (167-792-181).

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



## Remote Peripheral Monitoring (RPM)

Monitoring modules available consist of:

- 221F -50-150mV Shunt monitors (6 channels + 1 temperature channel)
- 221J 0-100mV DC Voltage transducer monitors (6 channels + 1 temperature channel)
- 221A 0-3V DC Voltage monitors (6 channels + 1 temperature channel)
- 221B 0-16V DC Voltage monitors (6 channels + 1 temperature channel)
- 221C 0-70V DC Voltage monitors (6 channels + 1 temperature channel)
- 221D 0-200V DC Voltage monitors (6 channels + 1 temperature channel)
- 222A Binary Input monitor (6 channels + 1 temperature channel)
- 223T Temperature monitor (7 Channels)
- 214A Control Relay module (3 sets of programmable form C relay outputs)

The user may connect a maximum of 95 of any combination of these modules serially.

Step	Action																
NOTE:	This section only describes a <b>single module</b> connection to the controller. Modules <b>MUST BE PROGRAMMED</b> after they have been installed or they may not function properly. Detailed connection and configuration information may be found in the RPM Product Manual 167-790-063.																
1	<p>Using RPM bus cable (comcode 407377704), wrap the cable through the EMI inductor bead twice. Place the bead approximately 3 inches from the controller. Connect the bus cable to TB-1 on Millennium and TB101 on the RPM</p> <table><tr><th>TB-1 Pin Assignments</th><th>TB-1 Pin Descriptions</th><th>RPM Conductor Color</th><th>RPM Conductor Description</th></tr><tr><td>6</td><td>*6</td><td>Blue or White</td><td>Power/Communications</td></tr><tr><td>8</td><td>*8</td><td>Blue or White</td><td>Power/Communications</td></tr><tr><td>9 or 10</td><td>FGND</td><td>Bare wire</td><td>Shield</td></tr></table> <p>*connections of the bus wire are NOT polarity sensitive.</p>	TB-1 Pin Assignments	TB-1 Pin Descriptions	RPM Conductor Color	RPM Conductor Description	6	*6	Blue or White	Power/Communications	8	*8	Blue or White	Power/Communications	9 or 10	FGND	Bare wire	Shield
TB-1 Pin Assignments	TB-1 Pin Descriptions	RPM Conductor Color	RPM Conductor Description														
6	*6	Blue or White	Power/Communications														
8	*8	Blue or White	Power/Communications														
9 or 10	FGND	Bare wire	Shield														

Step	Action												
2	<div><p>560 Ohm Resistor (405298308) Should be installed:</p><ul style="list-style-type: none"><li>• When using a single RPM module</li><li>or</li><li>• When daisy-chaining RPM modules (as shown), the resistor should only be installed in the last module in the chain.</li></ul></div> <div><p>RPM Cable Assembly - (2 wire, shielded)</p><p>RPM Cable Assembly - (2 wire, shielded)</p><p>Inductor Bead</p><p>To Galaxy Controller RPM Bus Input</p><ul style="list-style-type: none"><li>• Up to 95 RPM modules can be daisy-chained on a single bus as shown.</li><li>• Maximum bus length, from the controller to the last RPM module in the chain, is 300 meters.</li></ul></div>												
3	Secure the module connection unit and route the wires through the open-faced bottom of the connection unit.												
4	<div>Make the connections to TB2 on the connection unit:</div> <table><thead><tr><th>TB-2 Pin</th><th>RPM Conductor Color</th><th>RPM Conductor Description</th></tr></thead><tbody><tr><td>IN</td><td>Blue or White</td><td>Power/Communications</td></tr><tr><td>OUT</td><td>Blue or White</td><td>Power/Communications</td></tr><tr><td>SHIELD</td><td>Bare wire</td><td>Shield</td></tr></tbody></table> <div><p>*connections of the bus wire are NOT polarity sensitive.</p><p>* there are 2 IN, and 2 OUT connections. Either one may be used.</p></div>	TB-2 Pin	RPM Conductor Color	RPM Conductor Description	IN	Blue or White	Power/Communications	OUT	Blue or White	Power/Communications	SHIELD	Bare wire	Shield
TB-2 Pin	RPM Conductor Color	RPM Conductor Description											
IN	Blue or White	Power/Communications											
OUT	Blue or White	Power/Communications											
SHIELD	Bare wire	Shield											
5	Locate the control unit. This is the half with circuitry on it.												
6	Each RPM must have a unique switch address to be recognized by the controller. In the lower right hand side of the control unit (inside), are two rotary switches. Set SW-1 (LO) to 1. The module will be recognized as 01 by the controller. Other modules added cannot have the same address or 00 for the address.												
7	Carefully attach the control unit to the connection unit using the ribbon connector.												
Note	This connector/cable is not keyed, so be careful to line up the pins properly.												
8	After approximately 1 minute, the green LED on the front of the module will blink once approximately every 5 seconds.												

## Thermal Probes

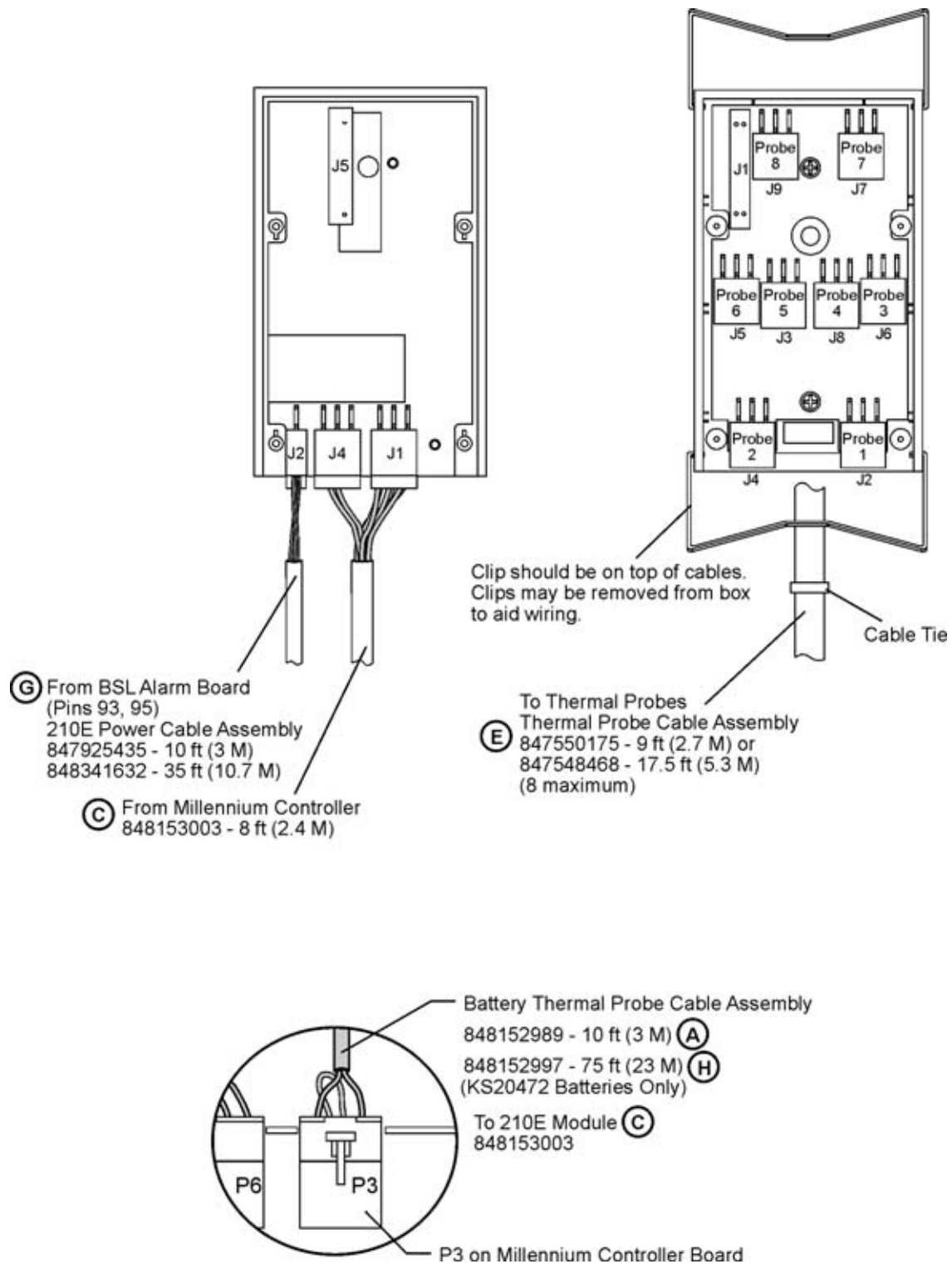
Without thermal probes, many of the controller's battery management features will not function, or will produce erroneous results. Some features requiring thermal inputs are:

- Slope Thermal Compensation
- Reserve Time Prediction
- High Temperature Alarm
- High Temperature Disconnect

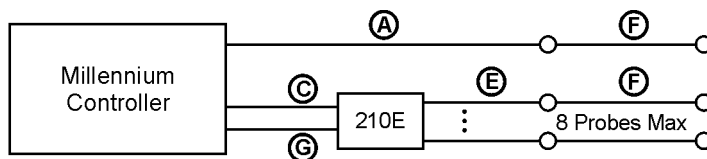
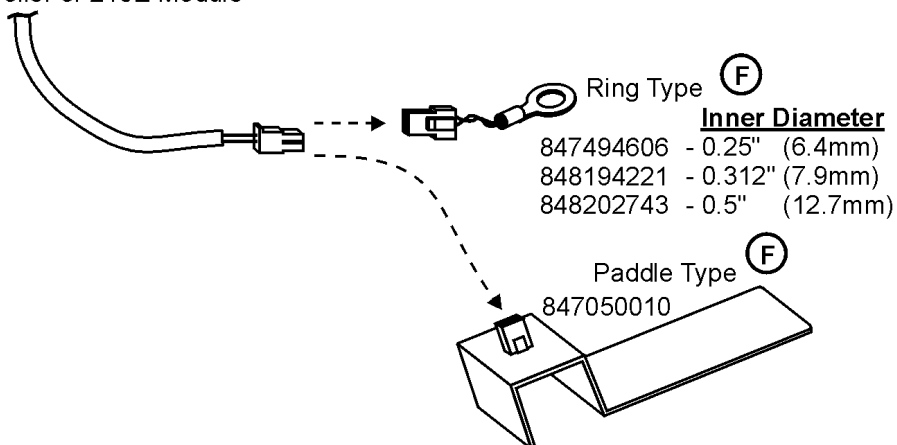
The controller supports both analog and digital thermal probe inputs. Analog signal probes connect to the controller at the P3 temperature probe connector or TB2 terminal block. The first thermal probe connects to P3 and three more probes may be connected to TB2 by cutting of the connector. If more than four thermal probes are required, a 210E Thermal Probe Multiplexer can be connected to the P3 connector for an additional 8 probes. The 210E monitors the probe temperatures and reports the highest temperature to the controller. See Section 8 for thermal probes and cable options. See Product Manual 157-010-202 (Thermal Probe Multiplexer) for ordering and installation of a 210E and associated cables.

TB2 Pin	Description
1	Probe 2
2	Probe 2 RTN
3	Probe 3
4	Probe 3 RTN
5	Probe 4
6	Probe 4 RTN

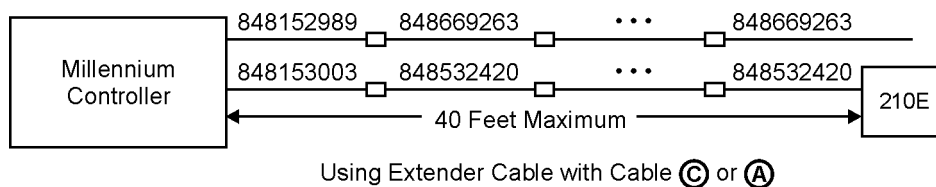
There are also QS873 VT 1-Wire thermal probes that use the P7 1-Wire connector on the controller.



Thermal Probe Cable  
Assembly (various lengths)  
to Controller or 210E Module

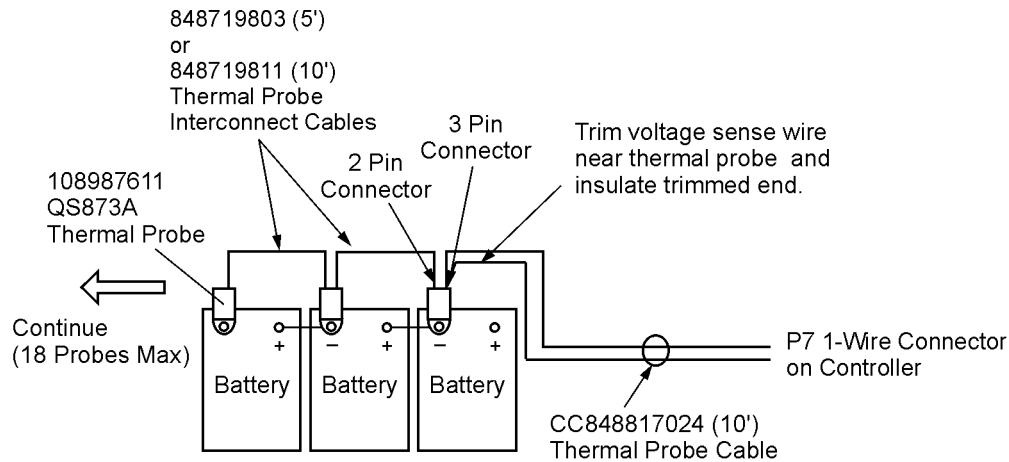


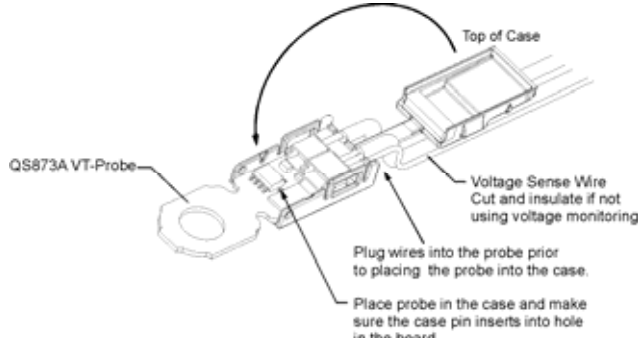
Probes and 210E modules can be combined for a maximum total of four connections to the Controller.



### Analog Thermal Probe Cables

## Installing QS873 VT Battery Probes



Step	Action
1	Insert the RJ-45 end of the CC848817024 wireset into the P7 1-wire connector on the controller.
2	Cut the brown voltage sense wire on the CC848817024 at the 3-pin connector.
3	<p>QS873 probe provides 2-pin and 3-pin receptacles and a 1/4-inch ring terminal.</p> <p>Insert the 3-pin connector end into the receptacle on the closest VT-Probe.</p> 
4	Snap the cover closed on the VT-probe.
5	Place the first probe to the battery post (as in the battery string picture above).
6	Verify the number of probes (1) registered with the controller with command: <b>MENU → STATUS → BATTERIES → NUM TEMP PROBES.</b>
7	Connect either the 848719803 (5-ft) or the 848719811 (10-ft) cable to the 2-position receptacle of the first probe and to the 3-position receptacle of another probe.
8	Verify the number of probes (2) registered with the controller with command: <b>MENU → STATUS → BATTERIES → NUM TEMP PROBES.</b>
9	Repeat Steps 7-8 for each probe until all probes are installed.
10	When all probes are installed, verify they are connected and operating with command: <b>MENU → STATUS → BATTERIES → NUM TEMP PROBES.</b>

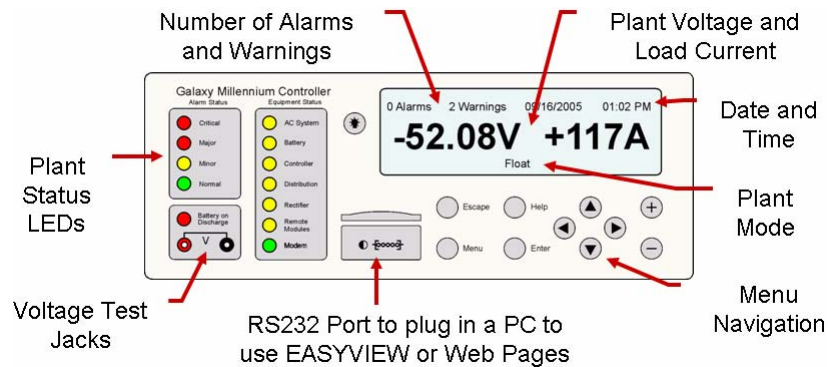
The controller is now set to make thermal measurements in performing slope thermal compensation. Additional parameters may be set on the controller to customize this feature.

## 5 Controller User Interface

The Millennium II controller monitors and controls system components rectifiers, converters, distribution modules, and Remote Peripheral Modules (RPMs) via a digital communications bus. It can also monitor and control external power equipment, including standby generators, converter plants, and inverters.









System parameters, various alarm thresholds, user-definable alarm inputs and relays can be viewed and configured from the controller display, or from a laptop computer connected to a local RS-232 or Ethernet port, or by remote access is through a network connection to the world wide web (internet) or your enterprise network (intranet). An optional 56k modem is also available.

**NOTE:** A complete list of Controller Alarm Descriptions and Troubleshooting instructions can be found in Section 7.



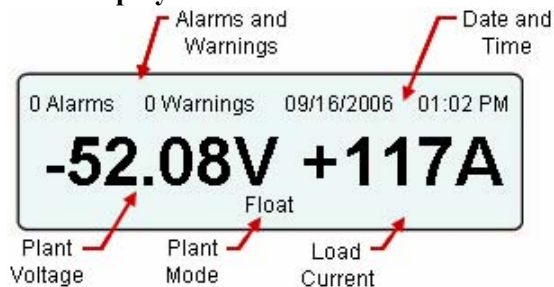
**Millennium II Front Panel Main Display**

### Menu Navigation Buttons

	<b>Display Contrast</b>	In the Main Display, the ▲ ▼ buttons increase or decrease the display contrast.
	<b>Parameter Change</b>	When changing a system parameter, the ▲ ▼ buttons increase or decrease the value of the parameter.
	<b>Direction Buttons</b>	In the Menus, the ◀ ▲ ▼ ▶ direction buttons navigate to make a selection
 Enter	<b>Enter Button</b>	Enters a sub-menu or confirms a parameter change. From the Home Page only, goes to the top level Main menu.
 Menu	<b>Menu Button</b>	Goes to the top level Main menu.
 Escape	<b>ESC Button</b>	Goes up one menu level or exits a parameter change without saving.
 Help	<b>Help Button</b>	Shows a Help screen.
	<b>Lamp Test</b>	Initiates a Lamp Test operation.

## Millennium II Main Display and Menus

### Main Display



The Main Display is the normal controller display. The display will return to the Main Display after a period of inactivity.

### Top Level Menu

MENU	
Alarms	Diagnostics
Warnings	History
Status	Configuration
Control / Operations	Statistics

The Main menu allows you to view your equipment status in detail, history, and to view and edit a variety of parameters.

### Information Menus

MENU	
Alarms	Diagnostics
Warnings	History
Status	Configuration
Control / Operations	Statistics

These Information menus give detailed information regarding the status and history of your plant.

### Control / Operations Menu

CONTROL / OPERATIONS	
Start Lamp Test	Clear History
Restart Devices	Clear Statistics
Clear Events	Alarm Test
Uninstall Equipment	Start Battery Test

The Control / Operations menu allows you to perform common operations on your plant. Operations that are required to turn up and verify your plant are detailed in the Installation and Test and Verification sections of this manual.



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**Configuration Menu**

CONFIGURATION	
Shunt	Batteries
Float Settings	Contactor Interfaces
Plant	Disconnects
Rectifier	Ringers

The Configuration menu allows you to access and modify all user accessible plant parameters. Configuration tasks that are required to turn up and verify your plant are detailed in the Installation and Test and Verification sections of this manual.

**NOTE:** An Hourglass may appear in the lower left hand corner of the screen. This indicates that a configuration change is being saved to non-volatile memory.




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**CAUTION:** Incorrect plant settings can result in hazardous conditions and equipment damage or injury. Make sure all plant settings are suitable for your application, batteries, and other equipment.

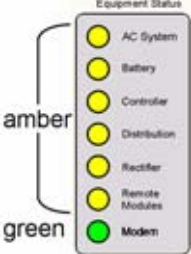
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## Millennium II Controller Status and Alarms

### Alarm Status LEDs

Status	Function	Condition
	<b>Normal</b>	Normal operation, no alarms, inputs and outputs are in their normal range.
	<b>Critical Alarm</b>	Power to load equipment is at immediate and high risk.
	<b>Major Alarm</b>	Power to load equipment is at immediate risk.
	<b>Minor Alarm</b>	A problem requiring attention exists, but power to load equipment is not at immediate risk.
	<b>Battery on Discharge</b>	Batteries are discharging and delivering current to the load.
	<b>Remote Access [LAN/Modem]</b>	Blinks to indicate traffic on an attached LAN or Modem.
<b>Note:</b> Which conditions are indicated as Critical, Major, and Minor Alarms may be configured by the user.		

### Equipment Status LEDs

Status	Function	Condition
	<b>AC System</b>	AC input to one or more rectifiers is out of range.
	<b>Battery</b>	The batteries are not in a normal operating state.
	<b>Controller</b>	The system controller has detected an internal problem.
	<b>Rectifier/Converter</b>	A rectifier or converter power unit in the system has failed
	<b>Distribution</b>	The output distribution is not in a normal operating state.
	<b>Remote Modules</b>	There is a problem with a Remote Peripheral Module (RPM)
	<b>Remote Access [LAN/Modem]</b>	Blinks to indicate traffic on an attached LAN or Modem.

### Audible Alarm



The controller assembly is equipped with a user configurable alarm buzzer.

### Voltage Test Jacks



Voltage Test Jacks allow you to measure the main plant output voltage with a hand-held meter.

## Local and Remote Access Ports

### Local Access



Connect a laptop PC to a RS-232 port or Ethernet port and access the controller with EasyView or Web Pages.

### Remote Access








An RJ-45 Ethernet connector is provided for 10/100 Base-T network connection to the world wide web (internet) or your enterprise network (intranet) using Microsoft Internet Explorer®, Mozilla Firefox®, or other web browser. An optional 56k modem is also available.

## Examples of Frequently Used Menu Features:

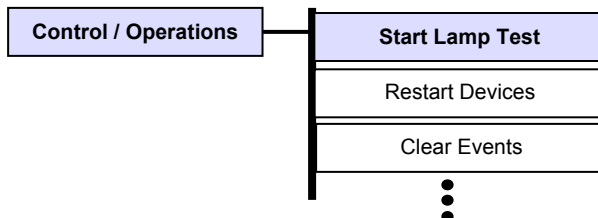
This section contains a small number of menu navigation examples to help you get familiar with the menu.

The examples below use shorthand to describe the navigation process. For example, “**MENU → CONTROL / OPERATIONS → START LAMP TEST**” means:

Step	Action
1	Press  to go to the top level <b>Menu</b> .
2	Press  navigation buttons to select <b>Control / Operations</b> .
3	Press  to select and enter <b>Control / Operations</b> .
4	Press  navigation buttons to select <b>Start Lamp Test</b> .
5	Press  to execute the <b>Start Lamp Test</b> command.

### Lamp Test: **MENU > CONTROL / OPERATIONS > START LAMP TEST**

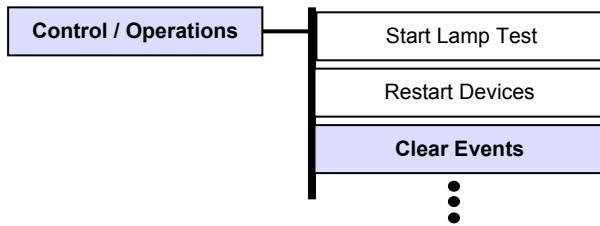
Lamp Test allows you to make sure all LEDs and displays in your system are working. This test lights up all of the LEDs and displays in the system for about ten seconds. Multicolor LEDs light up multiple colors in sequence, and should be lit for the entire length of the test.



Using the Lamp Test feature is a quick and easy way to see if a system component is communicating with the system controller. If it responds to Lamp Test, then it is receiving commands from the controller.

**Clear Events: MENU > CONTROL / OPERATIONS > CLEAR EVENTS**

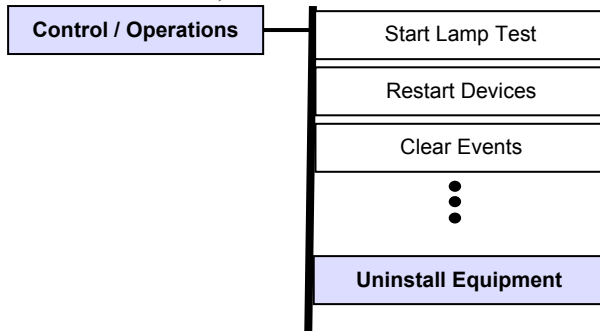
Latched events may be cleared using this feature. Latched events remain active after their cause is removed (retired) until manually cleared.



If the Alarm is a Latched Event and does not retire after performing this operation, the alarm condition most likely still exists.

**Uninstall Devices: MENU > CONTROL / OPERATIONS > UNINSTALL EQUIPMENT**

This command can be used to clear a COMMUNICATION Fail alarm that has been caused by removing installed equipment (rectifiers, converters, distribution monitors, thermal probes, batteries monitors).

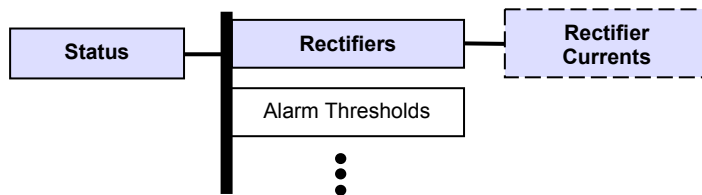
**Alarm Cutoff**

This feature is used to silence local audible alarms. Any subsequent Power Critical, Power Major, or Power Minor alarm will again sound the audible alarm.

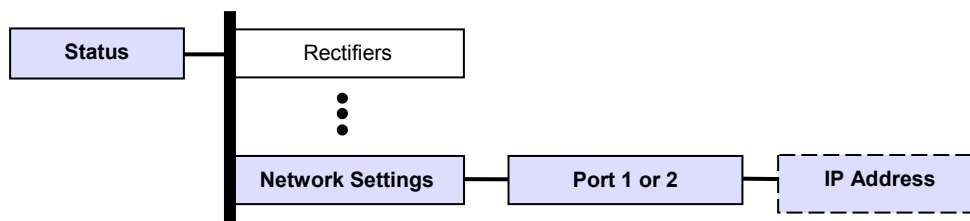
When the alarm occurs, the “**CUT OFF AUDIBLE ALARM**” appears. Press **ENTER** to turn off alarms. Then “**TURN ON AUDIBLE ALARM**” message appears to turn audible alarms back on.

**View Rectifier Current: Menu → Status → Rectifiers → Rectifier Currents**

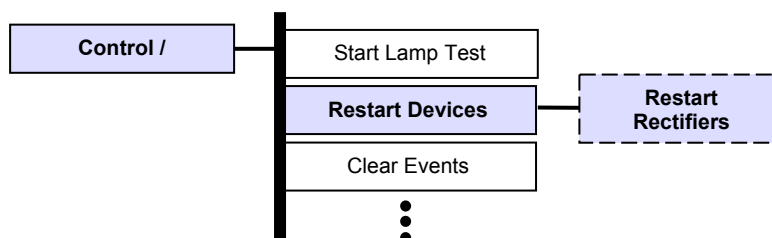
This command is used to view rectifier currents.

**View IP Address: Menu → Status → Network Settings → (Port #) → IP Address**

This command is used to view the controller's network IP address.

**Restart Rectifiers: Menu → Control / Operations → Restart Rectifiers**

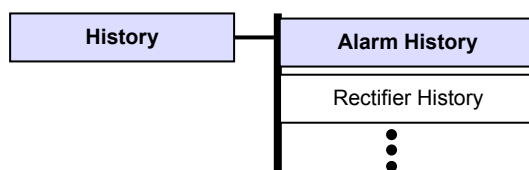
This command is used to restart rectifiers.



This is a non-invasive procedure: rectifiers and converters that are operating normally ignore this command.

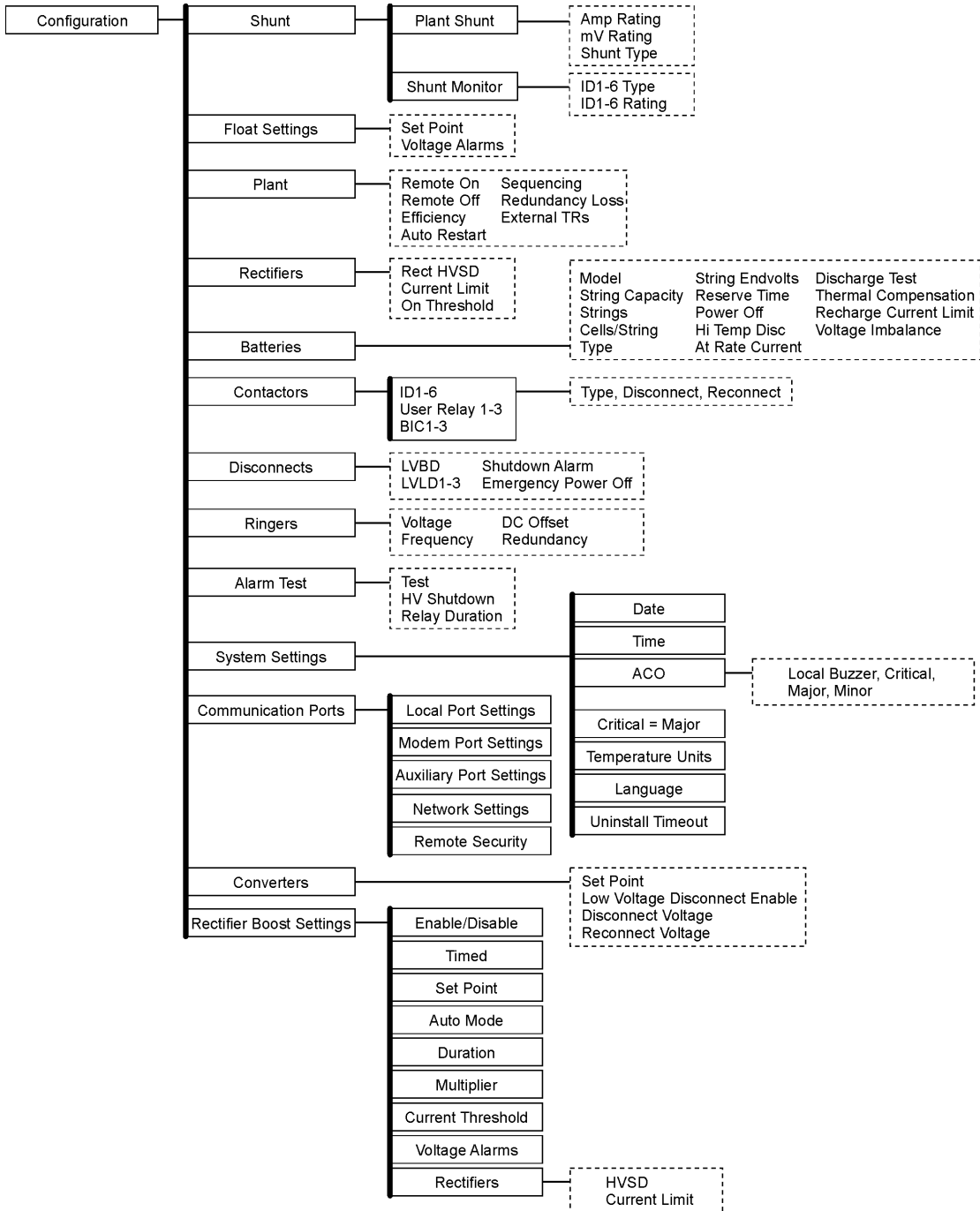
**Alarm History: Menu → History → Alarm History**

This command is used to view alarm history.



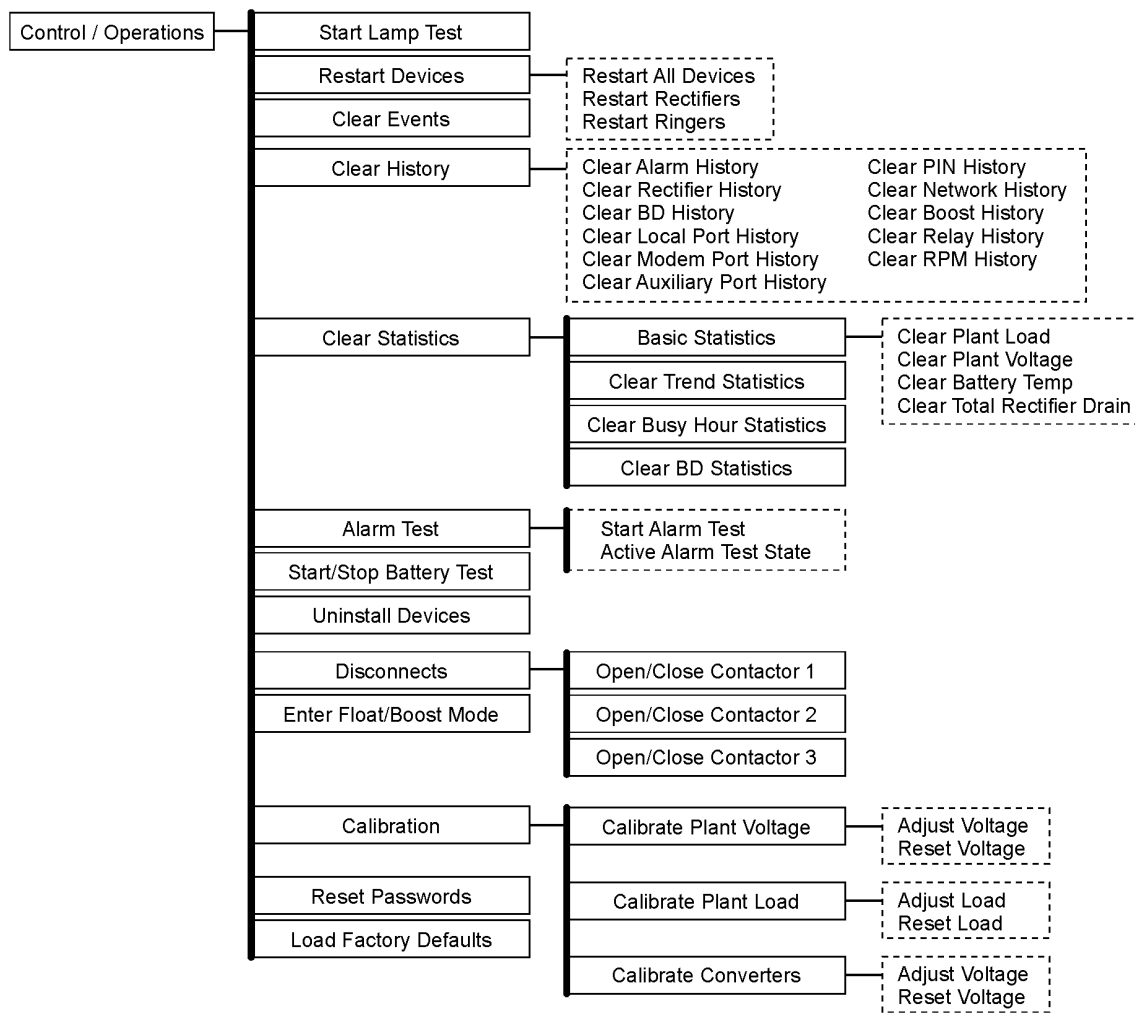
# Controller Display Menu Maps

## Configuration Menu Map

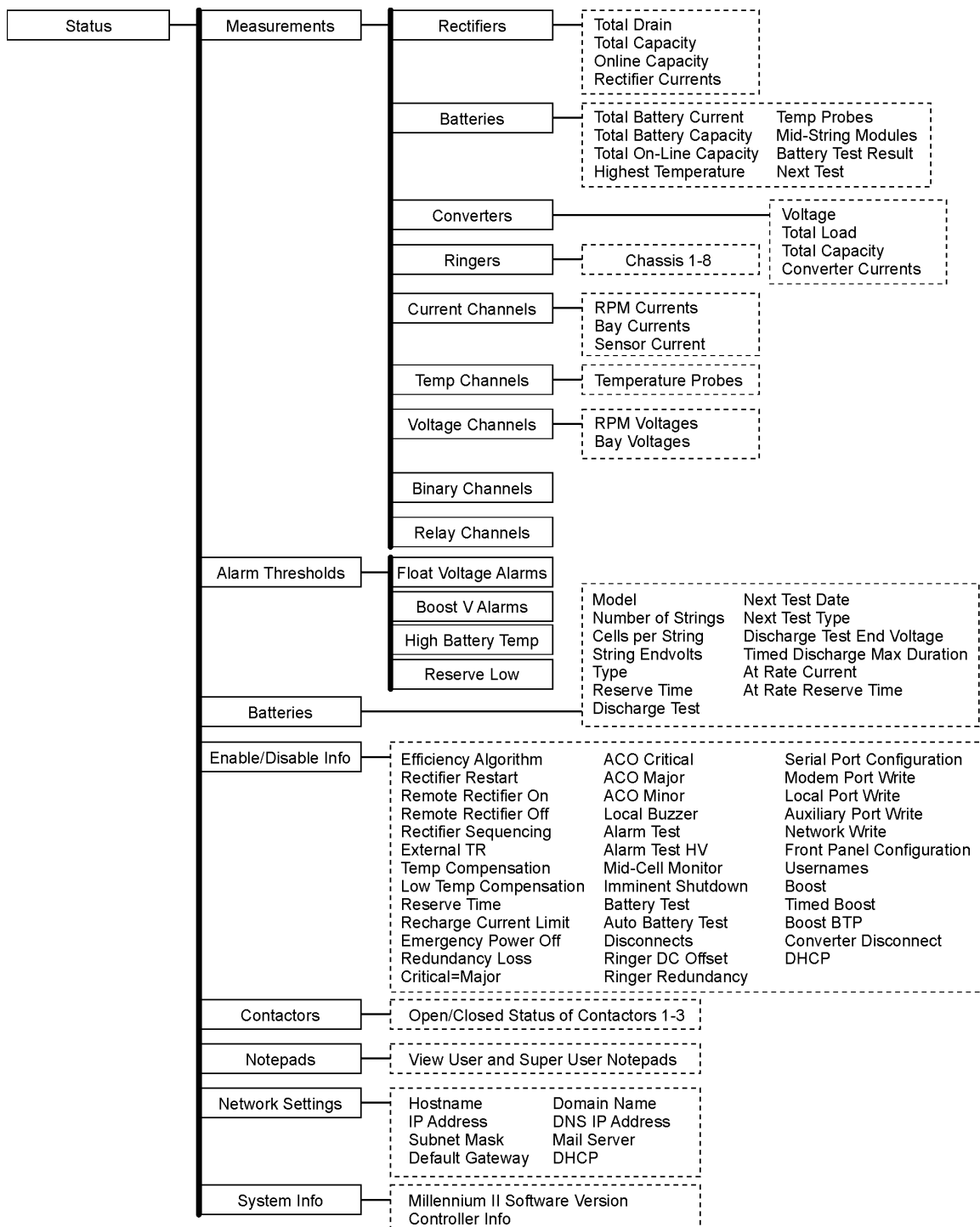


\*Note: The QS series of constant power rectifiers do not utilize the current limit threshold setting (30-110%) under Rectifier configuration. QS series rectifiers are designed to provide 100% their nameplate power rating at any given normal output condition and will ignore this configuration.

## Control and Operations Menu Map

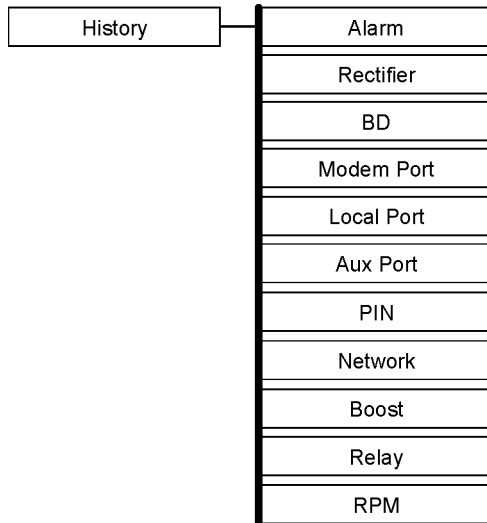


## Status Menu Map

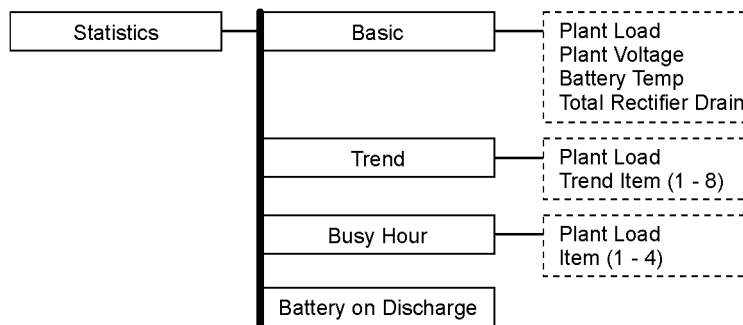




## History Menu Map

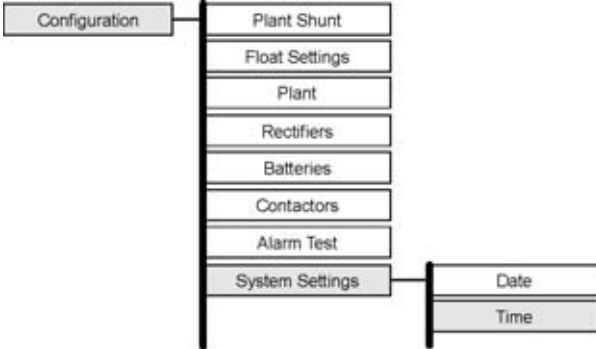
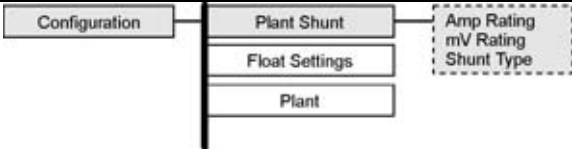


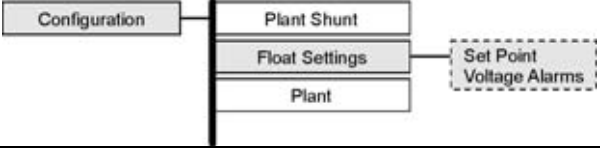
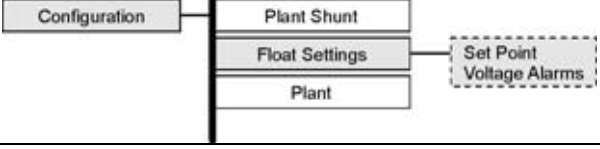
## Statistics Menu Map

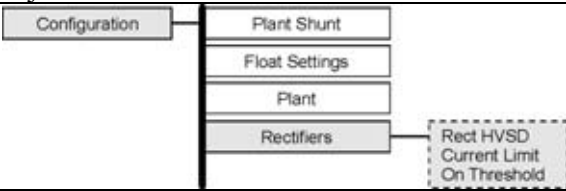
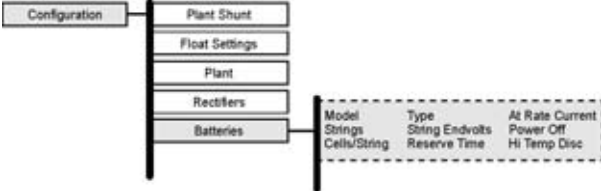
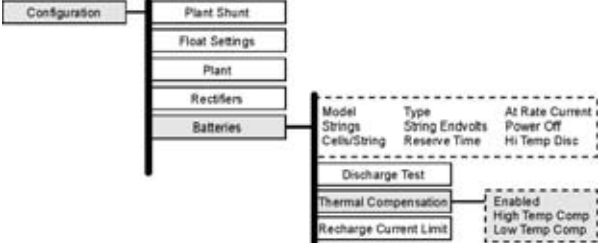


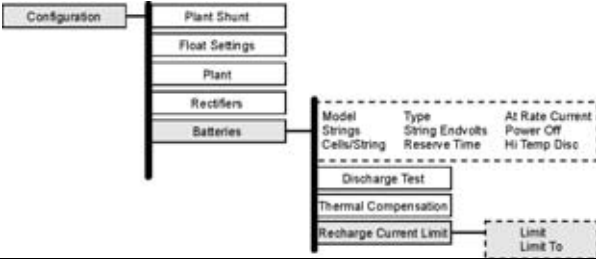
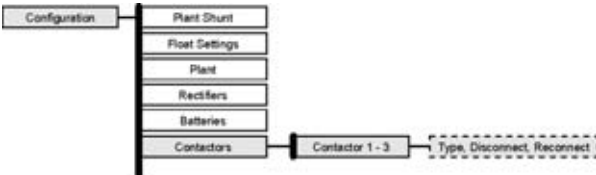
## Minimum Controller Configuration

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
1	DATE/TIME	
	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 <i>Energy Policy Act of 2005</i> . Starts in 2007.
3	SYSTEM SHUNT	
	Type	CPS6000-M2 is factory configured with a battery shunt. The battery shunt is a 1500A, 50mV device located in the V- (hot)

Step	Configuration Attribute to Change	Menu Path/Action
4		bus.
	mV	Factory configured to 50
	I	Factory configured to 1500A
	<b>ALARM THRESHOLDS</b>	
	High Voltage	When the plant voltage exceeds this threshold, the plant High Voltage Alarm (HVA) is turned ON, and the controller will send a signal to the rectifiers to shut down in an orderly and timely fashion. This will also light the Major (MJ) LED, and activate the PMJ relay (assuming there is no alarm with CRITICAL severity level active). Move the cursor to the fields and use the <+> or <-> key to adjust the High Voltage shut down alarm for FLOAT mode to the desired level. Press <ENTER> to save the change.
	High Voltage Float	When the plant voltage exceeds this threshold, the plant High Float Voltage Alarm (HFV) is turned ON, and this will also light the Minor LED, activate the PMN contact closure (assuming there is no alarm with CRITICAL or MAJOR severity level active). The purpose of this alarm is to indicate that the plant voltage is high probably due to an adjustment in the plant rather than due to a failure. This alarm allows the High Voltage (HV) shutdown threshold to be raised slightly, thus reducing the number of nuisance shutdowns without decreasing the plant reliability. Move the cursor to the fields and use the <+> or <-> key to adjust the High Voltage shut down alarm for FLOAT mode to the desired level (normally less than the HV threshold). Press <ENTER> to save the change.
5	Battery on Discharge	If the plant voltage is less than the threshold value, the Battery Discharge alarm is turned ON, this in turn activates the PMJ and BD relays, and lights the MAJ and BD LEDs. Move the cursor to the fields, and use the <+> or <-> key to adjust the threshold to the desired level. Press <ENTER> to save the change.
	Very Low Voltage	This alarm threshold is used to indicate that the system voltage is very low, and that the batteries have discharged to a dangerously low depth. When the plant voltage falls below this level, the Very Low Voltage (VLV) and Power Critical alarm will be generated. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.
5	<b>Rectifiers</b>	

Step	Configuration Attribute to Change	Menu Path/Action
	Set-point	This value sets the system voltage for all serial rectifiers. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.
		
	HVSD	The configuration of this field sets the internal high voltage shutdown value of all serial rectifiers. Move the cursor to the field and use the <+> or <-> key to adjust the threshold value. Press <ENTER> to save the change.
6	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.
7	Thermal Comp	 <p>This feature allows dynamic control of sealed cell battery voltage as a function of temperature.</p>
	Enabled	Enables or Disables the Thermal Compensation Feature. Move

Step	Configuration Attribute to Change	Menu Path/Action
		the cursor to the field and use the <+> or <-> key to Enable or Disable. Press <ENTER> to save the change.
	High Temp Comp	This feature allows the system to compensate for high temperatures.
	<i>Volt Step Down</i>	Battery step temperature can be set from 113-185F. At this temperature, the system voltage is reduced by 0.17 X # of cells/string.
	<i>High Comp Limit</i>	This sets the maximum temperature for which thermal compensation is active.
	<i>Decrease</i>	This sets the slope (mV/degC) for high temperature compensation.
	<i>Nominal Temp</i>	This field set the temperature at which no compensation is required. The system voltage is at the set-point float mode.
	Low Temp Comp	This feature allows the system to compensate for low temperatures.
	<i>Low T Comp</i>	This enables or disables the low temperature compensation feature.
	<i>Low Comp Limit</i>	This sets the minimum temperature for which thermal compensation is active.
	<i>Increase</i>	This sets the slope (mV/degC) for low temperature compensation.
8	<b>Recharge Current Limit</b>	<p>This feature sets the total amount of current that will be allowed to recharge the batteries.</p> 
	<i>Limit</i>	The configuration of this field enables or disables the feature.
	<i>Limit to</i>	This programmable value sets the maximum amount of recharge current (in Amps) that will be allowed for recharging the batteries. The range is from 10 – 1000A.
9	<b>Contactors</b>	<p>Up to three optional LVD devices can be connected to a Millennium and configured from this screen.</p> 
	Contactor 1-3	
	<i>Type</i>	This setting identifies the type of contactor, BATTERY, LOAD or NONE that has been installed in the plant. Be sure that the wiring for the contactor being configured matches the

Step	Configuration Attribute to Change	Menu Path/Action
		type chosen here. To toggle between the various contactor types, move the cursor to one of the fields and use the <+> or <-> key to select the desired type. Press <ENTER> to save the change.
	<i>Disconnect</i>	This setting configures the plant voltage at which the contactor will disconnect from the bus. Use the <+> or <-> key to adjust the voltage to the desired level. Press <ENTER> to save the change.
	<i>Reconnect</i>	This setting configures the plant voltage at which the contactor will reconnect to the bus. To prevent the contactor from re-operating when battery voltage increases due to load removal, a voltage several volts higher than the disconnect voltage is recommended. Use the <+> or <-> key to adjust the voltage to the desired level. Press <ENTER> to save the change.

## Controller Defaults

### Dip Switch Settings

The Millennium II has 8 dip switch (SW202) positions that may be configured. SW202 is located on the MCR1 board, above the MCR2 board.

#### Millennium II Controller Dip Switch Settings

Switch Position	Default	Description	Closed (1)	Open (0)
SW202-8	1	Front Panel Configuration	ENABLED	DISABLED
SW202-7	1	Modem/Aux/Local/Network/ Port Setting Configuration (Remote Access)	ENABLED	DISABLED
SW202-6	0	Enhanced Security Mode (See Table 5-I, for features affected)	ENABLED	DISABLED
SW202-5	1	Auxiliary Port Configuration	RS-232	RS-485
SW202-4	0	Remote Rectifier in Standby	ENABLED	DISABLED
SW202-3	0	Boost Mode	ENABLED	DISABLED
SW202-2	1	Reserved for Future Use	ENABLED	DISABLED
SW202-1	1	Reserved for Future Use	ENABLED	DISABLED

#### Modem/Aux/Local/Network/ Port Setting Configuration (Remote Access)

The modem and auxiliary ports can be configured for full access or read-only access by properly configuring DIP switch 202-7. Full access with Read/Write capability is achieved by closing SW202-7 (Set to a “1”).

#### Enhanced Security Mode

Restricted access is also available. When Enabled, the controller prevents remote configuration changes via the modem, network, and auxiliary ports that will affect the state of the plant, even when logged in as a Super-User or Administrator. This enhanced remote security is enabled and disabled with DIP switch SW202-6. The functions and parameters restricted with the enhanced remote security feature are listed below.

## Enhanced Remote Security Features

Restricted Configuration Items
Enable or disable Rectifier Restart feature
Change All Rectifier On Threshold
Change Timed Manual Boost Duration
Change Boost Current Threshold
Change Rectifier Status to “Standby”/ “Vacant” status is prohibited. The change to “On”status is allowed.
Change Rectifier Shunt Voltage configuration
Change Rectifier Float High Voltage Shutdown Threshold
Change Rectifier Boost High Voltage Shutdown Threshold
Change Rectifier Float Set Point
Change Rectifier Boost Set Point
Change Rectifier Boost Current Limit (Setting has no affect on QS Series rectifiers)
Change Converter Voltage Set-Point
Change Converter Low Voltage Disconnect Threshold
Change Converter Low Voltage Reconnect Threshold
Enable or disable Converter Low Voltage Disconnect feature
Change Converter Status to “Standby”/ “Vacant” status is prohibited. The change to “On”status is allowed.
Change Battery High Temperature Threshold
Enable or disable Battery Current Limit
Change Battery Limit Threshold
Change Battery Contactor Status to “Open” status is prohibited. The change to “Close” status is allowed.
Change Battery Disconnect Threshold
Change Battery Reconnect Threshold
Change Very Low Voltage Alarm Threshold and Severity
Change Multiple Rectifier Fail Alarm Threshold and Severity
Change Limited Recharge Current Alarm Threshold and Severity
Change Excess Rectifier Drain Alarm Threshold and Severity
Change Engine Transfer Timeout Alarm Threshold and Severity
Change Reserve Time Low Alarm Threshold and Severity
Change Multiple Converter Fail Alarm Threshold and Severity
Change Battery On Discharge Alarm Threshold and Severity



## Voltage Threshold Ranges and Default Values

The following table provides the ranges and factory default settings of key configurable voltage thresholds in the Millennium II.

**Voltage Threshold Ranges and Default Values**

	Low	High	Default
<b>Very Low Voltage (VLV)</b>			
24V	20.00	25.50	23.00
48V	40.00	51.00	46.00
<b>Battery on Discharge (BD)</b>			
24V Float	23.00	28.00	25.00
24V Boost	23.00	28.00	25.00
48V Float	46.00	55.00	51.00
48V Boost	46.00	55.00	51.00
<b>High Float Voltage (HFV)</b>			
24V Float	24.75	29.75	26.50
24V Boost	25.75	31.75	26.50
48V Float	50.00	60.00	53.00
48V Boost	52.00	60.00	53.00
<b>High Voltage Shutdown Alarm (HV)</b>			
24V Float	24.75	29.75	26.8
24V Boost	25.75	31.75	26.8
48V Float	50.00	60.00	53.6
48V Boost	52.00	60.00	53.6
<b>Rectifier On Threshold (ROT)</b>			
24V	20.00	25.00	22.00
48V	40.00	51.00	44.00

## Controller Alarm Severity, LED and Relay Default Values

The following tables provide the various controller alarms and their associated default severity and LED assignments as well as rectifier specific alarms. These items may be reconfigured through remote means.

**Controller Alarm Severity, LED and Relay Default Values**

Symbol	Default Designation	Default Severity	Default LED	Default Relay
<b>AAC</b>	ACO Active	RO	None	None
<b>ABS</b>	Alarm Battery Supply Fuse	Major	CTLR	CTLR
<b>AMJ</b>	Auxiliary Major	Major	None	None
<b>AMN</b>	Auxiliary Minor	Minor	None	None
<b>ATA</b>	Alarm Test Active	RO	None	None

Symbol	Default Designation	Default Severity	Default LED	Default Relay
<b>ATB</b>	Alarm Test Aborted	RO	None	None
<b>ATF</b>	Alarm Test Failed	Warning	None	None
<b>BBL</b>	Memory Backup Battery Low	Warning	None	None
<b>BCA</b>	Battery Type Conflict	Warning	None	None
<b>BDA</b>	Battery on Discharge	Major	BD	BD
<b>BFA</b>	Battery Test Failed	Minor	BAT	None
<b>BID</b>	Bay Interface ID Conflict	Major	CTLR	CTLR
<b>BTA</b>	Battery Test Active	RO	BD	BD
<b>BTJ</b>	Battery Thermal Major	Major	BAT	None
<b>BTN</b>	Battery Thermal Minor	Minor	BAT	None
<b>CCH</b>	Configuration Changed	RO	None	None
<b>CDFA</b>	Converter Distribution Fuse	Major	RECT	MJF
<b>CDID</b>	Converter ID Conflict	Major	RECT	None
<b>CFA</b>	Converter Fail	Minor	RECT	None
<b>CLC</b>	Clock Changed	RO	None	None
<b>CMA</b>	Minor Communications Failure	Minor	CTLR	None
<b>CMFA</b>	Multiple Converter Fail	Major	RECT	None
<b>CNF1</b>	Contactor 1 Failed	Major	BAT	None
<b>CNF2</b>	Contactor 2 Failed	Major	BAT	None
<b>CNF3</b>	Contactor 3 Failed	Major	BAT	None
<b>CNO1</b>	Contactor 1 Open	Major	BAT	None
<b>CNO2</b>	Contactor 2 Open	Major	BAT	None
<b>CNO3</b>	Contactor 3 Open	Major	BAT	None
<b>COF</b>	Queue Overflow	Warning	None	None
<b>COR</b>	Number Did Not Respond	Warning	None	None
<b>CPA</b>	Circuit Pack Fail	Major	CTLR	CTLR
<b>CRA</b>	Controller Fail	Major	CTLR	CTLR
<b>DID</b>	Rectifier ID Conflict	Major	RECT	None
<b>EMD</b>	Energy Management Disabled	Warning	None	None
<b>EPD</b>	Excess Plant Drain	Minor	RECT	None
<b>EPO</b>	Emergency Power Off	Critical	BATT	None
<b>EPR</b>	External Password Reset	Warning	None	None
<b>ETO</b>	Engine Transfer Timeout	Minor	AC	None
<b>EXL</b>	Excessive Login Attempts	Warning	None	None
<b>FAJ</b>	External Fuse Major	Major	DIST	MJF
<b>FAN</b>	External Fuse Minor	Minor	DIST	MNF
<b>HCL</b>	History Cleared	RO	None	None
<b>HFV</b>	High Float Voltage	Minor	RECT	None
<b>HVA</b>	High Voltage	Major	RECT	HV
<b>LMR</b>	Limited Recharge	Minor	RECT	None

Symbol	Default Designation	Default Severity	Default LED	Default Relay
<b>LVD</b>	Low Voltage Disconnect	Minor	BAT	None
<b>LVDA</b>	Low Voltage Disconnect Fail	Minor	BAT	None
<b>MCM</b>	Major Communication Fail	Minor	CTLR	None
<b>MDF</b>	Module Failure	Minor	RM	None
<b>MOR</b>	Measurement Out Of Range	Minor	RM	None
<b>MTC</b>	Module Type Conflict	Warning	None	None
<b>NNC</b>	Number Not Configured	Warning	None	None
<b>OSA</b>	Open String	Minor	BAT	None
<b>PFD</b>	Password At Default	Warning	None	None
<b>PGI</b>	Program Line Invalid	Major	None	None
<b>PHT</b>	Processor Halt	RO	None	None
<b>POR</b>	Number Did Not Respond	Warning	None	None
<b>RLS1</b>	Redundancy Loss	Minor	RECT	None
<b>RPI</b>	Rectifier/Plant Inconsistency	Warning	None	None
<b>RTL</b>	Reserve Time Low	Minor	BAT	None
<b>SNC</b>	Shunt Not Configured	Warning	None	None
<b>STF</b>	Self Test Failed	Minor	CTLR	CTLR
<b>TPA</b>	Thermal Probe Failure	Minor	CTLR	CTLR
<b>URC</b>	User Relay Conflict	Warning	None	None
<b>VLA</b>	Very Low Voltage	Critical	BAT	UR3
<b>VSF</b>	Sense/Control Fuse	Major	CTLR	CTLR
<b>ZID</b>	ID Not Configured	Major	RECT	None

### Rectifier Alarm Defaults

Symbol	Default Designation	Default Severity	Default LED	Default Relay
<b>ACF</b>	AC Fail	Minor	AC	ACF
<b>CLM</b>	Rectifier Current Limit	RO	None	None
<b>ERD</b>	Excess Rectifier Drain	Minor	RECT	None
<b>ETS</b>	External Transfer Shutdown	Minor	RECT	None
<b>HPA</b>	Half Power	Minor	RECT	None
<b>LCA</b>	Low Current Alarm	Minor	RECT	None
<b>LSF</b>	Load Share Fuse	Minor	RECT	None
<b>MACF</b>	Multiple AC Fail	Major	AC	ACF
<b>MAN</b>	Manual Off	Minor	RECT	None
<b>MFA</b>	Multiple Rectifier Fail	Major	RECT	RFA
<b>MMAN</b>	Multiple MAN Alarm	Major	RECT	None
<b>PHA</b>	Phase Or Low Output	Minor	AC	None

Symbol	Default Designation	Default Severity	Default LED	Default Relay
<b>RIC</b>	Rectifier Incomplete Config	Warning	None	None
<b>RFA</b>	Rectifier Fail	Minor	RECT	RFA

## Web Interface

The Millennium II with its 10/100Base-T port supports standard protocols like SNMP, TCP/IP, FTP and Telnet. It also has an integrated web server that serves up web pages to remote PCs using standard web browsers. Simply typing the IP address assigned to the controller in the browser will serve up the log-in screen. The web pages support the majority of the functionality supported by EasyView and the T1.317 interface. The best way to learn the operation and content of the screens is through use. Following are few sample screens. Note: web pages are updated for functionally and aesthetics. Thus, some of the screens shown may be slightly different than those served up by your Millennium II.

## Craft Port

The web interface can be accessed remotely over the LAN or with a direct connection from a local PC. Once logged in the interface is the same. The following describes configuring the port as a local Craft port. . This mode of operation allows a user to connect an external craft PC directly to the port and use the PC's standard Web browser to locally access the system. This Craft port is supported by the Millennium II operating in DHCP (Dynamic Host Configuration Protocol) server mode. While the Craft port is operating as a DHCP server, it should **never** be plugged into the building or surrounding LAN.

To access the system using the Craft Port follow the following basic procedure:

Step	Action
<b>1</b>	<p>Find and take note of the controller's Working IP (WIP) on the front panel display by going to <b>Menu→Status→Network Settings→Port 1</b></p> <p><b>Note: If the Port is not configured as a Server it will not have the correct IP address.</b> To use the Ethernet port locally as a Craft port it needs to be configured as a DHCP Server. DHCP Server operation can be validated at <b>Menu→Status→Network Settings</b>. Scroll down to view the port's present configuration.</p> <p>If it is not in DHCP Server mode, make sure the Craft port is not plugged into a LAN connection and re-configure the DHCP setting from the front panel to be Server. This parameter is found in <b>Menu→Configuration→Communication Ports→Network Settings→DHCP</b>.</p> <p>Note: the controller should automatically reboot to accept the new Ethernet port configuration. This process takes approximately two minutes. Validate the change to server mode at <b>Menu→Status→Network Settings</b></p>
<b>2</b>	<p>Attach the LAN cable between the RJ45 (P2) on the main board to the appropriate Ethernet port on the Craft PC.</p>

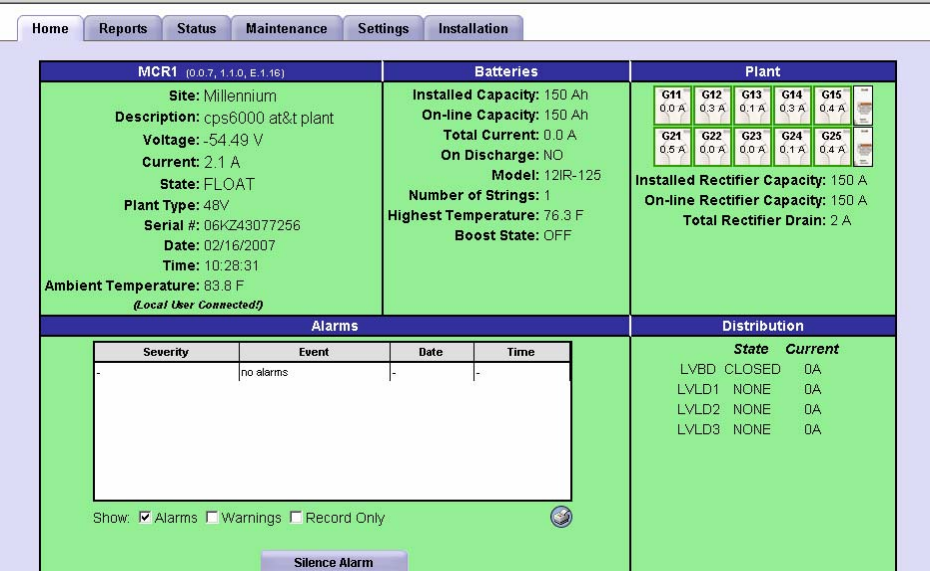

3	Open the PC's browser and enter the controller's WIP as the destination address. This address should be <a href="http://192.168.2.1">http://192.168.2.1</a> . The Millennium II has HTTP capabilities and should begin to return appropriate system representative web pages.								
4	<p>Using a standard browser, a login page similar to that depicted below should be served up by the Millennium II controller. There are three levels of access through the port; Read-Only, Read/Write, and Read/Write with password management privileges. Passwords defaults for the Craft port as well as other remote access means default as follows:</p> <table> <thead> <tr> <th data-bbox="358 506 444 531">Access</th><th data-bbox="1057 506 1276 531">Default Password</th></tr> </thead> <tbody> <tr> <td data-bbox="358 537 570 562">User (Read-Only)</td><td data-bbox="1057 537 1154 562">lineage</td></tr> <tr> <td data-bbox="358 569 656 594">Super-User (Read/Write)</td><td data-bbox="1057 569 1192 594">super-user</td></tr> <tr> <td data-bbox="358 600 987 625">Administrator (Read/Write/Password Administration)</td><td data-bbox="1057 600 1281 625">administrator</td></tr> </tbody> </table>	Access	Default Password	User (Read-Only)	lineage	Super-User (Read/Write)	super-user	Administrator (Read/Write/Password Administration)	administrator
Access	Default Password								
User (Read-Only)	lineage								
Super-User (Read/Write)	super-user								
Administrator (Read/Write/Password Administration)	administrator								

These password defaults can be changed by a user of administrator privileges.



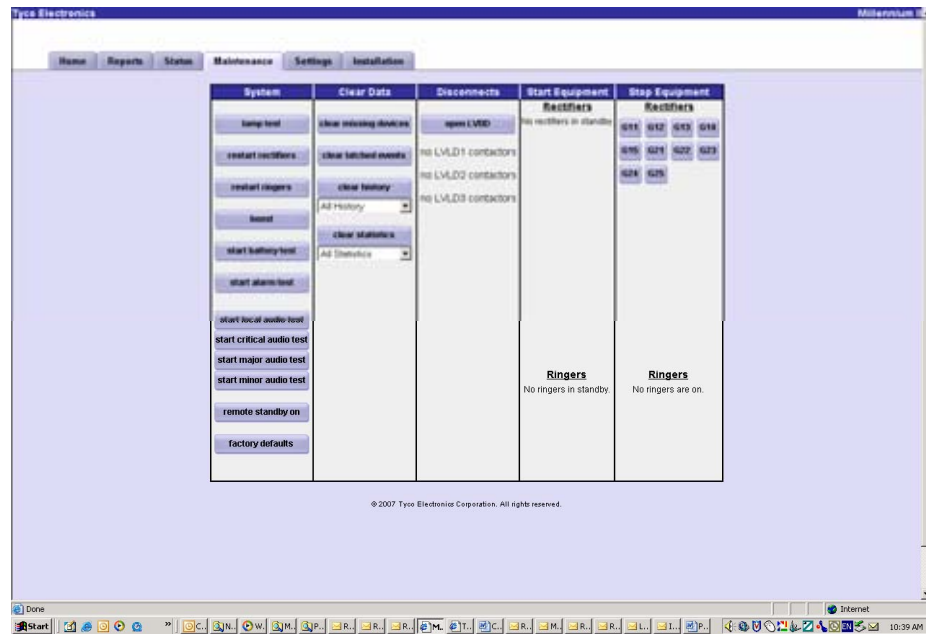
### Login Web Page

After the controller has granted access through the port, the controller serves up a Home page similar to that shown below. Front panel access and capabilities are a super-set of the functions and features available through the Craft port. Configuration of individual parameters and features can be performed by using the items located in the Settings tab or a general quick configuration of the system can be performed through the Installation tab. The Home Page has tabs that are partitioned as the following:

<p><b>Home</b></p>	<p>Main login page that shows representative graphic of the plant. The graphic will depict the number of shelves, rectifiers in place with their appropriate outputs, empty slots, and indicate which rectifiers are in alarm.</p> <p>High-level summary for the Batteries, Distribution, Alarms present, and controller summary are shown. There are also quick link tabs that take you to specific features. These tabs are the Home, Reports, Maintenance, Settings, and Installation.</p>  <p>The screenshot shows the Home page with a navigation bar at the top containing tabs: Home, Reports, Status, Maintenance, Settings, and Installation. The main content area is divided into several sections:</p> <ul style="list-style-type: none"> <li><b>MCR1 (0.0.7, 1.1.0, E.1.16)</b>: Site: Millennium, Description: cps6000 at&amp;t plant, Voltage: -54.49 V, Current: 2.1 A, State: FLOAT, Plant Type: 48V, Serial #: 06KZ43077256, Date: 02/16/2007, Time: 10:28:31, Ambient Temperature: 83.8 F (Local User Connected).</li> <li><b>Batteries</b>: Installed Capacity: 150 Ah, On-line Capacity: 150 Ah, Total Current: 0.0 A, On Discharge: NO, Model: 12IR-125, Number of Strings: 1, Highest Temperature: 76.3 F, Boost State: OFF.</li> <li><b>Plant</b>: A grid of 10 rectifier outputs (G11-G25) showing current values (e.g., G11: 0.0 A, G12: 0.3 A, G13: 0.1 A, G14: 0.3 A, G15: 0.4 A, G21: 0.5 A, G22: 0.0 A, G23: 0.0 A, G24: 0.1 A, G25: 0.4 A). Summary: Installed Rectifier Capacity: 150 A, On-line Rectifier Capacity: 150 A, Total Rectifier Drain: 2 A.</li> <li><b>Alarms</b>: A table with columns: Severity, Event, Date, Time. It shows "no alarms". Below the table are checkboxes for "Show: [x] Alarms [ ] Warnings [ ] Record Only" and a "Silence Alarm" button.</li> <li><b>Distribution</b>: A table with columns: State, Current. It shows LVBD: CLOSED 0A, LVL1: NONE 0A, LVL2: NONE 0A, LVL3: NONE 0A.</li> </ul>
<p><b>Reports</b></p>	<p>The reports tab displays reports that the system controller can display through web pages. These reports include Event History, Inventory, Statistics, Trends, and Battery on Discharge. Individual history groups like Alarm History, Boost History, Login History, and Rectifier history are also available.</p>  <p>The screenshot shows the Reports page with the same navigation bar. The main content area contains a box with the text "Please select which report you would like to view:" and a list of links:</p> <ul style="list-style-type: none"> <li>Inventory</li> <li>Battery Discharge</li> <li>Statistics</li> <li>Trends</li> <li>Alarm History</li> <li>Boost History</li> <li>Login History</li> <li>Rectifier History</li> </ul> <p>At the bottom of the page, there is a copyright notice: "© 2007 Tyco Electronics Corporation. All rights reserved."</p>

**Maintenance**

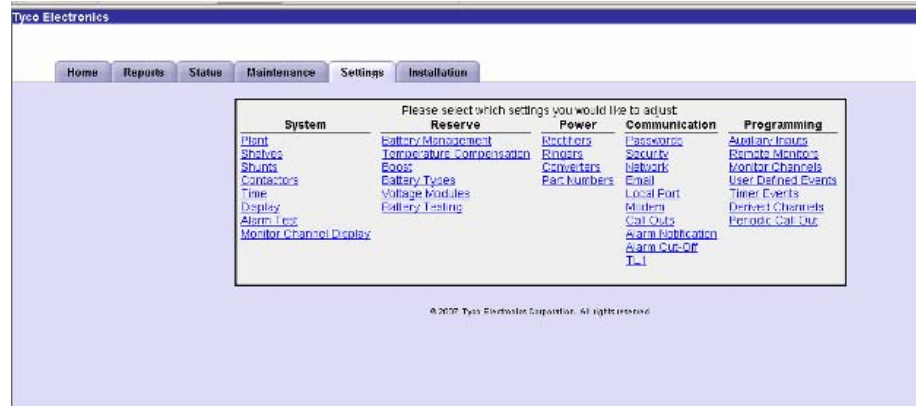
Allows remote access to Control/Operation commands assessable through the front panel. These include restarting rectifiers/ringers, starting alarm or battery tests, asserting boost, clearing history and statistics, clearing latched events and missing equipment, placing rectifiers/ringers in and out of Standby.



Note: The “Factory Defaults” button under system loads the default settings assigned to a specific battery type as defined in the defaults configuration file. Presently this function is unavailable since hard coded defaults are utilized and there is no default configuration file.

**Settings**

Items in this menu are used to configure all the individual system parameters, features, and thresholds. These fields are arranged by System, Reserve, Communication and Programming.

**Installation**

This tab allows a quick configuration of the primary items that need to be set for a site. These items include selecting the battery type, date, time, and the site ID mentioned during the front panel configuration start-up section.

The screenshot shows the Tyco Electronics web interface for configuring the Millennium II system. The interface includes tabs for Home, Reports, Status, Maintenance, Settings, and Installation. The 'Installation' tab is active, showing sections for 'Confirm Equipment Installed', 'Set Basic System Information', 'Set/Reset Default Battery Type Values', and 'Dip Switch Settings - SW202'.

**Confirm Equipment Installed**

- 10 Rectifiers
- 0 Ringer Chassis
- 0 Ringers
- 0 Distribution Modules
- 0 Thermal Probes
- 0 Mid-String Probes

**Set Basic System Information**

Enter the Site ID:

Enter the Site Description:

Set the date for this system:

Set the time for this system:

**Set/Reset Default Battery Type Values**

**Dip Switch Settings - SW202**

Switch	Description	Enable
8	Front Panel Configuration	<input checked="" type="checkbox"/>
7	Remote Configuration	<input checked="" type="checkbox"/>
6	Enhanced Remote Security	<input type="checkbox"/>
5	Reserved for Future Use	
4	Remote Rectifier in Standby	<input checked="" type="checkbox"/>
3	Boost Operation Mode	<input checked="" type="checkbox"/>
2	Reserved for Future Use	
1	Reserved for Future Use	

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This page is provides the minimum configuration for configuring the Millennium II for Basic plant operation.

Web pages will be improved for usability as well as for features. The best method of understanding the functions and features available through the Craft port is by clicking on the individual items and exploring to become more familiar with the items. More details on the front panel capabilities and Craft port web pages are found in the controller section.

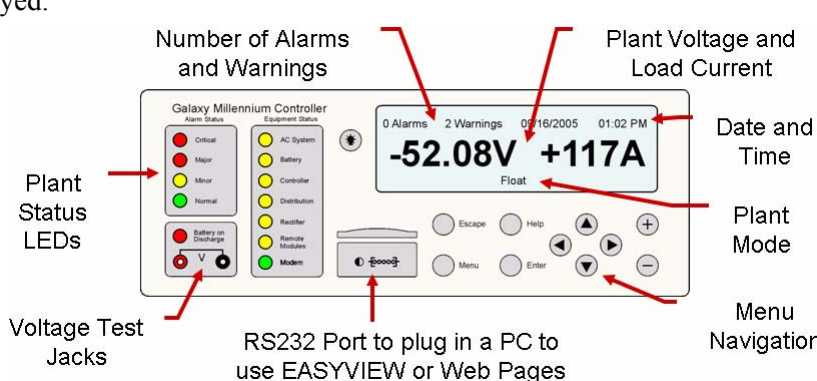


## 6 Acceptance Testing

**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 ac circuit breakers supplying rectifiers.
3	Adjust the contrast (if needed) for the site's ambient condition by using the up and down arrow keys at the Main Menu. Contrast adjust is also available at : <b>MENU &gt; CONFIGURATION &gt; SYSTEM SETTINGS &gt; DISPLAY CONTRAST.</b>
	<b>After approximately 30 seconds, are all lit LEDs on all components including rectifiers, the controller, LVD control boards, and Aux Displays green?</b>
	<b>Yes</b> – Go to Step 7. <b>No</b> – Proceed to Step 4.
4	Initiate the “Clear Events” and “Uninstall Equipment” operations found under <b>MENU &gt; CONTROL / OPERATIONS</b> menu. Reference to Appendix A: Pulsar Controller User Interface as needed.
5	If the controller appears not to be powered or not responsive, remove and reseal the controller.
6	<p>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 “0 ALARMS”. The system float voltage, total load current, and system operating mode should be observable as indicated for no alarms and the system rectifier voltage should be displayed.</p>  <p>The diagram shows the Galaxy Millennium Controller interface with the following components labeled:</p> <ul style="list-style-type: none"> <li><b>Number of Alarms and Warnings:</b> Points to the top status bar showing "0 Alarms - 2 Warnings".</li> <li><b>Plant Voltage and Load Current:</b> Points to the large display showing "-52.08V" and "+117A".</li> <li><b>Date and Time:</b> Points to the top right corner showing "09/16/2005 01:02 PM".</li> <li><b>Plant Status LEDs:</b> Points to the left side of the interface showing "Critical", "Major", "Minor", and "Normal" status indicators.</li> <li><b>Voltage Test Jacks:</b> Points to the "V" and "A" test points at the bottom left.</li> <li><b>RS232 Port to plug in a PC to use EASYVIEW or Web Pages:</b> Points to the port at the bottom center.</li> <li><b>Plant Mode:</b> Points to the "Float" label below the voltage display.</li> <li><b>Menu Navigation:</b> Points to the right side of the interface showing "Escape", "Help", "Menu", "Enter", and arrow keys.</li> </ul>
7	If Slope Thermal Compensation (STC) is active, turn off STC by disconnecting and reconnecting the probes. An alarm may occur, and will retire when the probes are reconnected.

Step	Action
8	<p>Check the voltage readings on the controller display.</p> <p>The Millennium II is factory configured with a rectifier Float voltage set-point of - 54.50V</p> <p>Note that if STC is active or if the connected batteries are not fully charged, the voltages may be lower.</p> <p>(If possible, open the external battery disconnect prior to making measurements to eliminate these effects. If QS873 temperature probes have all ready been installed in the system, then STC may be active. This will be indicated by the Plant Mode “FLOAT – TEMP COMP”.)</p>
<b>Remove and Replace Rectifier and Verify Results:</b>	
9	Remove a rectifier from its slot.
10	Verify the controller LED and display light amber and indicate a missing rectifier condition.
11	When the controller prompts to remove equipment press enter ■.
12	Verify the controller LED and display light green.
13	Replace the removed rectifier in its original slot.
14	Verify the controller LED and displays remain lit green.

### 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.
4	Repeat test for each distribution panel or sub-system.

#### ac Fail Alarms

Step	Action
1	Turn off ac circuit breaker feeding a single rectifier.
2	Verify ACF – ac Fail Minor is reported for the correct rectifier ID.
3	Restore ac and verify alarms clear and the controller returns to Normal.
4	Remove ac from two or more rectifiers.
5	Verify ACF2 – Multiple ac Fail Major is reported for the correct rectifier IDs.
6	Turn on ac circuit breaker turned off in Step 1 and verify alarms clear and the controller returns to Normal.

## Battery On Discharge Alarms

Step	Action
1	Change BD alarm to 2 volts below float voltage ( <b>MENU &gt; CONFIGURATION &gt; FLOAT SETTINGS &gt; VOLTAGE ALARMS &gt; BD</b> ).
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 ( <b>MENU &gt; CONFIGURATION &gt; VOLTAGE ALARMS &gt; FLOAT VOLTAGE ALARMS</b> ).
2	Adjust the float voltage to a value greater than this threshold ( <b>MENU &gt; CONFIGURATION &gt; FLOAT SETTINGS &gt; SET POINT</b> ).
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.

## Manual Contactor Control and Alarms












Step	Action
1	Open the contactor by controller command ( <b>MENU &gt; CONTROL / OPERATIONS &gt; DISCONNECTS</b> ).
2	Verify the controller reports a Contactor Open alarm.
3	Close the contactor by controller command.
4	Verify the alarms clear and the controller returns to Normal.












## Automatic Contactor Control and Alarms









**WARNING:** If this is an operating plant with loads, skip this test.

Step	Action
1	Check the disconnect thresholds ( <b>MENU &gt; CONTROL / OPERATIONS &gt; DISCONNECTS</b> ).
2	Adjust the float voltage to a value less than this threshold ( <b>MENU &gt; CONFIGURATION &gt; FLOAT SETTINGS &gt; SET POINT</b> ).
3	Disconnect the batteries in the plant.
4	Verify the battery disconnect opens and the controller reports a Contactor Open alarm.
5	Restore the plant voltage back to its original setting.
6	Verify the contactor closes.
5	Verify the alarms clear and the controller returns to Normal.

















## 7 Troubleshooting














Controller Status Display	Power Unit LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
<b>No Alarms</b>  Normal green	 AC OK green  DC OK green	 green	<b>Normal Operation</b>	
<b>MIN AC Fail</b>  Minor amber  AC System amber	 AC OK off (one rectifier)	 green	<ul style="list-style-type: none"> <li>• Single rectifier not receiving ac power.</li> <li>• AC input circuit breaker has opened.</li> <li>• AC input voltage is out of range.</li> </ul>	<ol style="list-style-type: none"> <li>1. Verify rectifier input circuit breaker is closed.</li> <li>2. Verify ac power to rectifier is available and in range.</li> <li>3. If problem not corrected, replace rectifier.</li> </ol>
	 AC OK green  DC OK green	 green	<ul style="list-style-type: none"> <li>• A rectifier has been removed from the system while it is unpowered.</li> </ul>	<ol style="list-style-type: none"> <li>1. Issue the “uninstall equipment” under the operations menu for any rectifier that was removed while unpowered.</li> </ol>

Controller Status Display	Power Unit LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
<b>MIN AC Fail, MAJ Multiple AC Fail</b>  Major red  AC System amber	 AC OK off (multiple rectifiers)	 green	<ul style="list-style-type: none"> <li>Multiple rectifiers not receiving ac power.</li> <li>AC input circuit breakers have opened.</li> <li>AC input voltage is out of range.</li> </ul>	<ol style="list-style-type: none"> <li>1. Verify rectifier input circuit breakers are closed.</li> <li>2. Verify ac power to rectifiers is available and in range.</li> <li>3. If problem not corrected, replace rectifiers.</li> </ol>
	 AC OK green  DC OK green	 green	<ul style="list-style-type: none"> <li>One or more rectifiers have been removed from the system while it is unpowered.</li> </ul>	<ol style="list-style-type: none"> <li>1. Issue the “uninstall equipment” under the operations menu for any rectifier that was removed while unpowered.</li> </ol>
<b>MAJ Battery on Discharge</b>  Major red  Battery on Discharge red	 Norm amber	 green	<ul style="list-style-type: none"> <li>Rectifier output voltage has fallen below the battery on discharge threshold set by the user.</li> </ul>	<ol style="list-style-type: none"> <li>1. Investigate other alarms that may be present such as rectifier related problems.</li> <li>2. If ac power is present but the system voltage remains low, call your local field representative</li> </ol>
















Controller Status Display	Power Unit LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
<b>MIN Rectifier Fail</b>  Minor amber  Rectifier/ Converter amber	 Fail red (one rectifier)	 green	<ul style="list-style-type: none"> <li>Rectifier output has dropped below 18V (36V), rectifier has shut down*.</li> <li>Excessive ambient temperature, rectifier has shut down.</li> <li>Clogged air filter</li> <li>A rectifier has failed.</li> </ul>	<ol style="list-style-type: none"> <li>Verify that there is no obstruction of the airflow path.</li> <li>If equipped, replace or clean air filter</li> <li>Reset the rectifier by removing the rectifier, waiting approximately 30 seconds, and replacing the rectifier.</li> <li>If problem persists, replace the rectifier.</li> <li>If problem still persists, call your local field representative.</li> </ol>
<b>MIN Rectifier Fail, MAJ Multiple Rectifier Fail, MAJ Battery on Discharge</b>  Major red  Rectifier/ Converter amber	 Fail red (multiple rectifiers)	 green	<ul style="list-style-type: none"> <li>Multiple rectifier outputs have dropped below 18V (36V), rectifiers have shut down*.</li> <li>Excessive ambient temperature, multiple rectifiers have shut down</li> <li>Multiple rectifiers have failed</li> </ul>	<ol style="list-style-type: none"> <li>Reset the rectifiers by removing the rectifiers, waiting approximately 30 seconds, and replacing the rectifiers.</li> <li>If problem not corrected, replace rectifiers.</li> <li>Verify that there is no obstruction of the airflow path.</li> <li>Reset rectifies by removing them, waiting approximately 30s and replacing them.</li> <li>If problem persists, replace the rectifiers.</li> <li>If problem still persists, call your local field representative.</li> </ol>





\* 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.

Controller Status Display	Power Unit LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
	 Fail red (all rectifiers)	 green	<ul style="list-style-type: none"> <li>All rectifier outputs have dropped below 18V (36V), all rectifiers have shut down*.</li> <li>Defective controller.</li> </ul>	<ol style="list-style-type: none"> <li>Remove controller and reset the rectifiers by removing the rectifiers, waiting approximately 30 seconds, and replacing the rectifiers.</li> <li>If output voltage does not go to set-point previously set by user, call your local field representative.</li> </ol>
<b>MAJ High Voltage</b>  Major red  Rectifier amber	 Fail red (one or multiple rectifiers)	 green	<ul style="list-style-type: none"> <li>High output voltage from rectifier(s)</li> <li>Rectifier(s) high voltage shut down*.</li> <li>Internal rectifier(s) failure</li> </ul>	<ol style="list-style-type: none"> <li>Reset the rectifier(s) by removing the rectifier(s), waiting approximately 30s and replacing the rectifier(s).</li> <li>If problem persists, replace rectifier(s).</li> <li>If problem still persists, call your local field representative.</li> </ol>
<b>MAJ Fuse Major</b>  Major red  Distribution amber	 AC OK green  DC OK green	 red	<ul style="list-style-type: none"> <li>One or more output circuit breakers or fuses have opened.</li> </ul>	<ol style="list-style-type: none"> <li>Clear circuit fault(s).</li> <li>Reset circuit breaker(s) or replace fuse(s).</li> </ol>
<b>MAJ Contactor Open</b>  Major red  Battery amber	 AC OK green  DC OK green	 amber blink	<ul style="list-style-type: none"> <li>One or more LVD contactors is manually forced open.</li> </ul>	<ol style="list-style-type: none"> <li>Place disconnect switch(s) in ON position.</li> </ol>

Controller Status Display	Power Unit LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
<b>MIN Battery High Temperature</b>  Minor amber  Battery amber	 AC OK green  DC OK green	 green	<ul style="list-style-type: none"> <li>Batteries have exceeded temperature threshold set by user.</li> </ul>	<ol style="list-style-type: none"> <li>1. Call your local field representative.</li> </ol>
<b>MIN Thermal Probe Fail</b>  Minor amber  Battery amber	 AC OK green  DC OK green	 green	<ul style="list-style-type: none"> <li>Battery thermal probe failed.</li> </ul>	<ol style="list-style-type: none"> <li>1. Ensure thermal probe is properly connected to thermal probe cable.</li> <li>2. Ensure cable is properly connected to the rear of the Distribution Module.</li> <li>3. If problem persists, replace thermal probe.</li> <li>4. If problem still persists, call your local field representative.</li> </ol>
<b>No response</b>  display blank	 Fail red blink	 red blink	<ul style="list-style-type: none"> <li>Controller failure, all devices on the communication bus reporting loss of communication with controller.</li> </ul>	<ol style="list-style-type: none"> <li>1. Check controller to ensure it is properly inserted into its slot. If so, perform the following steps:</li> <li>2. Remove the controller board for 1 minute and then reset.</li> <li>3. If problem persists, replace controller with new controller board.</li> <li>4. If problem still persists, call your local field representative.</li> </ol>



Controller Status Display	Power Unit LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
<b>MIN Minor Communication Fail</b>  Minor amber	 Fail red blink (one rectifier)	 green	<ul style="list-style-type: none"> <li>Rectifier lost communication with controller.</li> </ul>	<ol style="list-style-type: none"> <li>Reset the rectifier by removing the rectifier, waiting approximately 30 seconds, and replacing.</li> <li>If problem persists, replace the rectifier.</li> <li>If problem still persists, call your local field representative.</li> </ol>
	 AC OK green  DC OK green	 green	<ul style="list-style-type: none"> <li>Rectifier removed from a running system, but not uninstalled.</li> </ul>	<ol style="list-style-type: none"> <li>Issue the “uninstall equipment” under the operations menu for any rectifier that was removed.</li> </ol>
<b>MAJ Major Communication Fail</b>  Major red	 AC OK green  DC OK green	 red blink	<ul style="list-style-type: none"> <li>LVD Board lost communication with the controller.</li> </ul>	<ol style="list-style-type: none"> <li>Replace Distribution Module Board.</li> <li>If problem persists, call your local field representative.</li> </ol>
<b>MIN Clock Battery Low</b>  Minor amber  Controller amber	 AC OK green  DC OK green	 green	<ul style="list-style-type: none"> <li>Internal Lithium Battery Is Low</li> </ul>	<ol style="list-style-type: none"> <li>The battery is not field replaceable. The controller unit must be replaced.</li> <li>Off-load all desired information such as alarm history, statistics, and any field configuration that is different than the standard.</li> <li>Replace controller, and upload any non-standard configuration.</li> </ol>

Controller Status Display	Power Unit LEDs	Dist. Module LED	Possible Problem(s)	Possible Solution(s)
<p><b>No Alarm, but individual Shunt Currents are displayed at or above their maximum display values (<math>\geq 600\text{A}</math> for loads, <math>\geq 800\text{A}</math> for battery)</b></p>  <p>Normal green</p>	 <p>AC OK green</p>  <p>DC OK green</p>	 <p>green</p>	<ul style="list-style-type: none"> <li>One or both of the QS871A shunt inputs is open-circuit.</li> </ul>	<ol style="list-style-type: none"> <li>Verify that the respective shunt has its green and yellow wire connections attached used for the current measurements.</li> <li>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.</li> </ol>

## Troubleshooting Controller Circuit Pack

After power up, or after a reset, the multicolor LED (Located to the right of the MCR2 board) will be RED while self diagnostics are in progress (which will take about 10 seconds). If all diagnostics pass, the red LED will change to green. If failures are detected during diagnostics the LED will change to Amber. If a terminal is attached to the local port during diagnostics, the diagnostic messages will show which test failed. During normal operation if a failure occurs, the green LED will change to amber. When a failure occurs, perform the following steps.

Step	Action
1	Press the reset switch (System Reset, located to the right of the serial port connector at the bottom of the MCR1 board). If all diagnostics pass, it is possible that some type of “one time” abnormality occurred to cause the failure, such as hot-insertion of option boards, shorting connector pins when installing optional equipment, etc. If the diagnostics did not pass, or if the problem reoccurs, go to the next step.
2	Remove all optional circuit packs then again press the reset switch on the MCR1 board. If the problem is not resolved, proceed to the next step. If all diagnostics pass, install optional packs one at a time, verifying operation after each.
3	Replace the MCR1/MCR2 boards and verify the failure is resolved before installing and connecting any optional circuit packs.

## Modem and Data Switch Cards

The intelligent option boards (Modem and Data switch) are diagnosed by the microprocessor. If problems are detected the option board's amber LED is lit, otherwise the green LED is lit. If the amber LED is lit, first reset the MCR1 board and see if the problem clears. If the problem reoccurs, replace the option board.

# Controller Alarm Descriptions

## Controller Alarm Descriptions

Alarm Description	Explanation
<b>ACO Active</b>	Alarm Cut-Off has been initiated to silence local audible alarms. Any subsequent Power Critical, Power Major, or Power Minor alarm disables ACO. A programmable ACO time-out period for each alarm severity resets silenced alarms.
<b>Alarm Battery Supply</b>	Operated ABS fuse (F2) on Millennium II's MCR1 card.
<b>AC Fail</b>	A rectifier is reporting an ACF to the controller.
<b>Auxiliary Major</b>	A resistive battery potential is present on the AMJ alarm input BSL-64, indicating a major alarm is active in the external equipment connected to this point.
<b>Auxiliary Minor</b>	A resistive battery potential is present on the AMN alarm input BSL-66, indicating a minor alarm is active in the external equipment connected to this point.
<b>Alarm Test Active</b>	Alarm Test is currently active. Any real alarm with a severity of Critical, Major or Minor, other than RFA or HV, aborts an active Alarm Test.
<b>Alarm Test Aborted</b>	Alarm Test has been aborted by an alarm. This is a latched event, remaining active until cleared by a user.
<b>Memory Backup Battery Low</b>	The controller memory battery requires replacement.
<b>Battery Type Conflict</b>	The DC Plant – Battery Type and Battery Management – Battery Test Class attributes (sealed vs. flooded) do not match.
<b>Battery On Discharge</b>	The plant voltage is below the threshold set for BD in the present plant mode, FLOAT or BOOST/BTP. This alarm will not retire immediately upon rectifier restoration after an extended discharge. Plant voltage will not fully recover until depleted battery energy has been replaced. Do NOT adjust the rectifier voltage adjustments if they are at or near rated output currents.
<b>Battery Test Failed</b>	A Battery Test was aborted before a reserve time could be established. This is a latched event, remaining active until cleared by a user.
<b>Bay Interface ID Conflict</b>	The ID for a BIC (Bay Interface Card) connected to the controller's serial bus is the same as that of a previously installed BIC.
<b>Battery Test Active</b>	A Battery Test session has been initiated. (Available only in plants with all serial rectifiers. Rectifier voltage has been lowered and the batteries are discharging.) The BD LED and BD relays are active and both the BD and VLV alarm thresholds along with STC (Slope Thermal Compensation) are inhibited while the Battery Test is active.
<b>Configuration Changed</b>	A change has been made to a configuration setting. This is a latched event, remaining active until cleared by a user.
<b>Converter Distribution Fuse</b>	A converter distribution module connected to the controller's serial bus is reporting an operated fuse in its output distribution.
<b>Converter ID Conflict</b>	The ID for a converter connected to the controller's serial bus is the same

Alarm Description	Explanation
	as that of a previously installed converter.
<b>Connected Equip Alarm 1</b>	Equipment monitored by Galaxy through Data Switch Port-1 is reporting an alarm.
<b>Connected Equip Alarm 2</b>	Equipment monitored thru Data Switch Port-2 is reporting an alarm.
<b>Connected Equip Alarm 3</b>	Equipment monitored thru Data Switch Port-3 is reporting an alarm.
<b>Connected Equip Alarm 4</b>	Equipment monitored thru Data Switch Port-4 is reporting an alarm.
<b>Connected Equip Alarm 5</b>	Equipment monitored thru Data Switch Port-5 is reporting an alarm.
<b>Connected Equip Alarm 6</b>	Equipment monitored thru Data Switch Port-6 is reporting an alarm.
<b>Converter Fail</b>	A converter connected to the serial bus has failed.
<b>Converter Fan Major</b>	More than 1 converter fan has failed.
<b>Converter Fan Minor</b>	A single converter fan has failed.
<b>Clock Changed</b>	A change has been made to the Time or Date setting. This is a latched event, remaining active until cleared by a user.
<b>Rectifier Current Limit</b>	The rectifiers connected to the controller's serial bus have reached their current limit setting. Plant voltage may, therefore, be lower than that requested in Rectifier Manager.
<b>Minor Comm Fail Alarm</b>	The controller has lost communication with a device that it had previously recognized on its rectifier/converter serial bus. If one of these devices is to be permanently removed, it is necessary to issue a UNINSTALL DEVICES command to clear the alarm.
<b>Multiple Converter Fail</b>	Multiple converters connected to the controller's serial bus have failed. This threshold is programmable.
<b>Contactor 1 Failed</b>	A contactor controlled by the controller's LVD settings (usually used with all LVBD contactors of a plant) is in the opposite state of that it has been instructed to be in (open if instructed to be closed, closed if instructed to be open).
<b>Contactor 2 Failed</b>	A contactor controlled by the controller's LVD settings (usually used with all LVBD contactors of a plant) is in the opposite state of that it has been instructed to be in (open if instructed to be closed, closed if instructed to be open).
<b>Contactor 3 Failed</b>	A contactor controlled by the controller's LVD settings (sometimes used with some of the LVLD contactors of a plant) is in the opposite state of that it has been instructed to be in (open if instructed to be closed, closed if instructed to be open).
<b>Contactor 1 Open</b>	The contactors controlled by the controller's LVD settings (usually used with all LVBD contactors of a plant) are open (disconnected).
<b>Contactor 2 Open</b>	The contactors controlled by the controller's LVD settings (usually used with some or all LVLD contactors of a plant) are open (disconnected).
<b>Contactor 3 Open</b>	The contactors controlled by the controller's LVD settings (sometimes used with some of the LVLD contactors of a plant) are open (disconnected).
<b>Queue Overflow</b>	The 256 event call-out on alarm memory queue filled, causing events occurring while full to be dropped from the call-out queue. This is a latched event, remaining active until cleared by a user. Usually indicates that programmed phone numbers are not responding.

Alarm Description	Explanation
<b>Number Did Not Respond</b>	Active when both a primary and alternate call-out phone number failed to connect at least 3 times in a row. This is a latched event, remaining active until cleared by a user.
<b>ID Conflict</b>	The ID for a rectifier connected to the controller's serial bus is the same as that of a previously installed rectifier.
<b>Energy Management Disabled</b>	The Energy Management feature has been disabled in software, or due to an active BD alarm, Boost mode, or attached rectifiers that are not configured or have an invalid load reading.
<b>Excess Plant Drain</b>	Plant load has been reported at greater than the plant shunt size. This is a latched event, remaining active until cleared by a user.
<b>External Password Reset</b>	The administrator password has been reset to its default (ADMINISTRATOR) by use of the password reset switch on the front of the MCR1 board. This is a latched event, remaining active until cleared by a user. This event is logged into history each time it occurs, regardless of whether it has been cleared previously or not.
<b>Excess Rectifier Drain</b>	A connected rectifier load has been reported at greater than the programmable threshold for this event. This is a latched event, remaining active until cleared by a user.
<b>External Transfer Shutdown</b>	A rectifier shutdown is active through external signals into TR1 to TR4 on Millennium BSL-73, 79, 85, 80.
<b>Excessive Login Attempts</b>	A user has failed 6 times at entering a correct password at login or 3 times when changing security levels. This is a latched event, remaining active until cleared by a user. This event is logged into history each time it occurs, regardless of whether it has been cleared previously.
<b>External Fuse Major</b>	A resistive battery potential is present on the FAJ alarm input at Millennium BSL-63, indicating a major fuse or CB alarm is active in the plant distribution circuit connected to this point.
<b>External Fuse Minor</b>	A resistive battery potential is present on the FAN alarm input at Millennium BSL-65, indicating a minor fuse alarm is active in the plant circuit connected to this point. Typically only the capacitor charge circuit fuse alarm is wired here as a minor fuse alarm
<b>History Cleared</b>	A user has cleared the event history record of one of Millennium II's history reports. This is a latched event, remaining active until cleared by a user.
<b>High Float Voltage</b>	Plant voltage is above the programmed threshold for this alarm. The HFV threshold should be set lower than the HV threshold which causes a HVSD signal to be issued to plant rectifiers.
<b>High Voltage</b>	Plant voltage is above the programmed threshold for this alarm. The HV alarm causes a HVSD signal to be issued to plant rectifiers.
<b>Low Current</b>	A connected rectifier has load share enabled, but its present output load is less than a predefined threshold for that rectifier type. (Usually 3% or less of capacity.)
<b>Limited Recharge</b>	The plant load has exceeded the programmed percentage of the total rectifier capacity set for this alarm. Rectifier capacity may be inadequate for recharging batteries in an acceptable period of time following an extended battery discharge. This is a latched event, remaining active until cleared by a user.

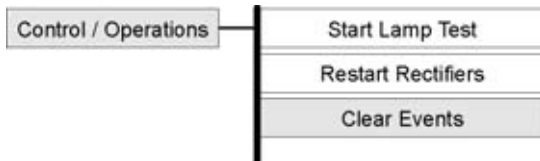
Alarm Description	Explanation
<b>Low Voltage Disconnect</b>	An externally controlled LVD is open, providing a closure signal to Millennium BSL-61/-62 for alarm purposes.
<b>Low Voltage Disconnect Fail</b>	The monitoring circuit of an external LVD has failed, providing a resistive battery potential signal into Millennium BSL-84.
<b>Manual Off</b>	A connected rectifier has been manually turned off or has lost AC input power.
<b>Major Comm Fail Alarm</b>	The controller has lost communication with two or more devices that it had previously recognized on its rectifier/converter/BIC serial bus. Typically indicates that the serial bus is physically interrupted. If any of these devices is being permanently removed from service, it is necessary to issue UNINSTALL DEVICES command to clear this alarm.
<b>Module Failure</b>	RPM system alarm. A module connected to the RPM serial buss has failed or has been disconnected.
<b>Multiple AC Fail</b>	The controller has detected more than one AC failure from connected rectifiers. This is a programmable threshold.
<b>Multiple MAN Alarm</b>	The controller has detected that more than one rectifier has manually been placed in standby. This is a programmable threshold.
<b>Multiple Rectifier Fail</b>	The number of rectifiers currently processing a RFA alarm has exceeded the programmable threshold for this alarm.
<b>Measurement Out of Range</b>	RPM system alarm. A channel measurement on a RPM is outside the DC voltage range designed for that RPM type. Often indicates reversed polarity for measurement leads on a unipolar module type.
<b>Module Type Conflict</b>	RPM system alarm. A module has been connected and given the address used previously by a module of a different type, without unlocking the previous module's configuration.
<b>Number Not Configured</b>	A call-out number has been assigned as the notification destination for an alarm, which does not have the phone number field defined.
<b>Open String</b>	A battery disconnect circuit is providing a resistive battery potential signal into Millennium BSL-72, indicating that a battery string is presently off line.
<b>Password At Default</b>	One or more of the log-in passwords is at its default value. All passwords must be set to something other than their default before this event will clear.
<b>Program Line Invalid</b>	The program line for a derived channel, user defined event channel, or RPM control relay channel contains an invalid operand. Typically occurs when a RPM channel value or state is used in a program line and that RPM is disconnected or otherwise goes into a failure mode.
<b>Processor Halt</b>	The controller stopped processing, usually due to a reset or reboot.
<b>Number Did Not Respond</b>	Active when the periodic status call-out phone number failed to connect 4 times in a row. This is a latched event, remaining active until cleared by a user.
<b>Rectifier Fail</b>	A connected rectifier is reporting a failure condition to the controller.
<b>Rect/Plant Inconsistency</b>	The plant load has exceeded the total rectifier drain by more than the factor programmed for this alarm, without causing plant voltage to fall. This is a latched event, remaining active until cleared by a user. Either the plant load reading or the total rectifier drain value is in error.



Alarm Description	Explanation
<b>Redundancy Loss</b>	The programmed number of redundant rectifiers in the system is not sufficient. System load has exceeded the redundancy limit.
<b>Emergency Power Off</b>	Emergency Power off input closure to ground.
<b>Reserve Time Low</b>	The predicted battery reserve time has fallen below the programmed threshold.
<b>Shunt Not Configured</b>	The shunt has been configured for either battery or load type and the value programmed for shunt Amps is invalid.
<b>Self Test Failed</b>	During initial boot, one or more of the tests performed on the controller failed. This is a latched event, remaining active until cleared by a user.
<b>Thermal Probe Failure</b>	A temperature probe used for the Reserve Time Prediction or Slope Thermal Compensation features is returning a temperature outside of an acceptable range.
<b>User Relay Conflict</b>	Battery management contactor LVD CN1, CN2, or CN3 has been configured for a type other than NONE and associated user relay UR1, UR2, or UR3 has also been assigned to report an alarm condition.
<b>Very Low Voltage</b>	The plant voltage is below the threshold set for VLV. This is a critical alarm, indicating that load failures are imminent.
<b>ID Not Configured</b>	A device on the rectifier/converter serial bus has been recognized without an assigned ID.

## Clear Events

Events that have generated an Alarm and retired, but the Alarm remains active, may be cleared using this feature. Alarms that remain, even though the condition has gone away, are referred to as Latched Events.

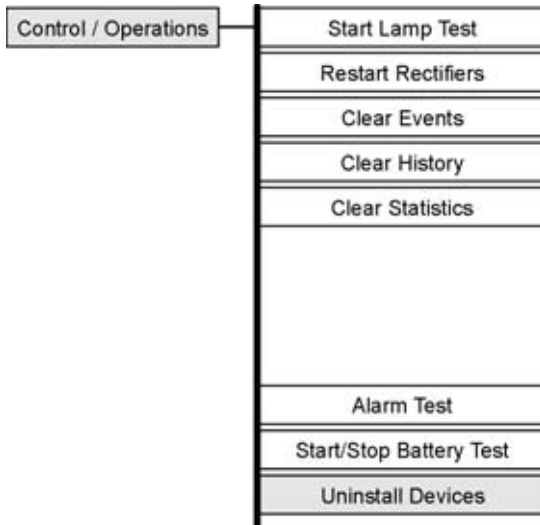


Step	Action
<b>1</b>	From the Default Screen, press the <b>Menu</b> button for the Main Menu.
<b>2</b>	Using the Up/Down Arrows, Scroll to <b>Control/Operations</b> and press <b>Enter</b> .
<b>3</b>	Select <b>Clear Events</b> , and press <b>Enter</b> .
<b>4</b>	Press <b>Enter</b> again to clear the latched events, or <b>Escape</b> to return to the menus.
<b>Note</b>	If the Alarm is a Latched Event and does not retire after performing this operation, the alarm condition most likely still exists.



## Uninstall Devices

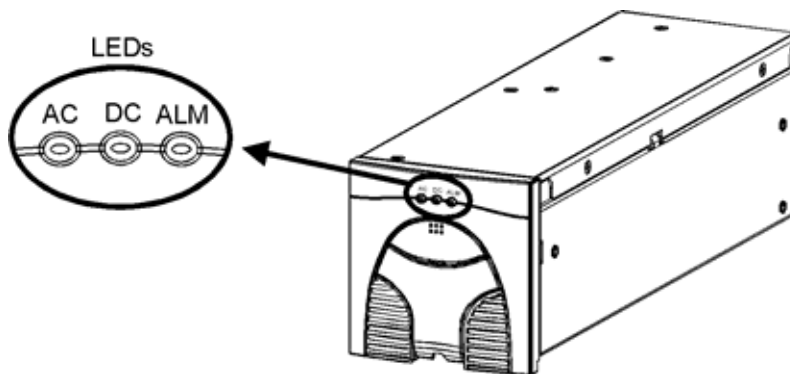
This feature is used to logically remove serial bus devices that have been physically removed and an alarm generated to indicate this removal. Rectifiers and converters are the most common devices that require this feature. 1-Wire devices are also considered serial bus devices.
























Step	Action
<b>Note</b>	This feature uninstalls ALL devices that have been physically removed.
<b>1</b>	From the Default Screen, press the <b>Menu</b> button for the Main Menu.
<b>2</b>	Using the Up/Down Arrows, Scroll to <b>Control/Operations</b> and press <b>Enter</b> .
<b>3</b>	Select <b>Uninstall Devices</b> , and press <b>Enter</b> .
<b>4</b>	Press <b>Enter</b> again to Uninstall Devices, or <b>Escape</b> to return to the menus.

## Troubleshooting QS-Series Rectifiers

The status of a QS-Series rectifier is provided by LEDs on the rectifier face, and by extensive real time data, alarm and event history accessible through the system controller.



## Rectifier Status LEDs

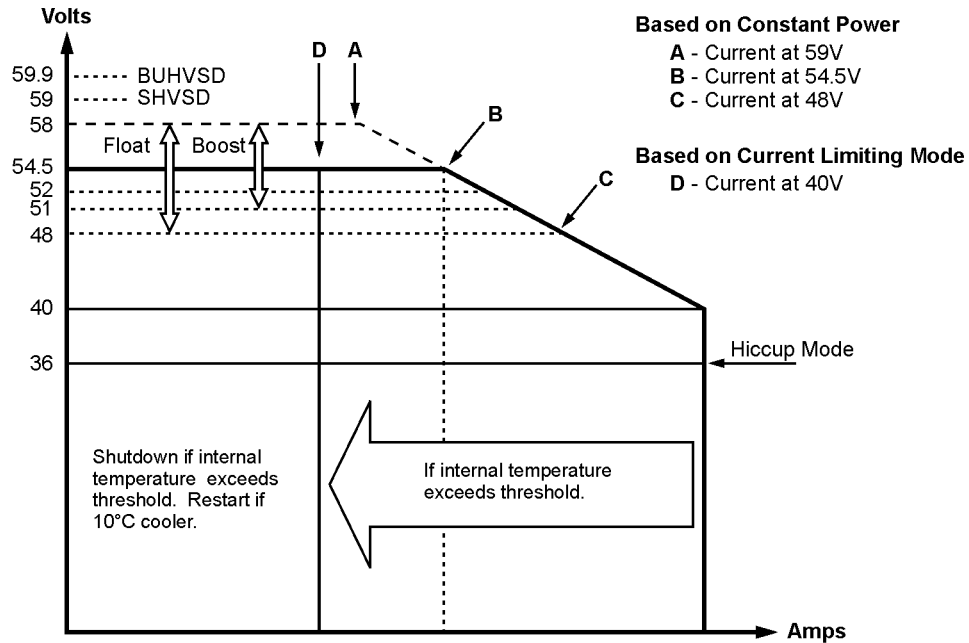
LEDs	Condition
AC  green DC  green ALM  off	<b>Normal operation:</b> No alarms, inputs and outputs are in their normal range, communicating with the system controller.
AC  off DC  off ALM  off	<b>Unpowered:</b> No input or output voltage present. <input checked="" type="checkbox"/> Remove and reinsert rectifier. <input checked="" type="checkbox"/> Check input voltage with a voltmeter, if input voltage is present, replace rectifier. <input checked="" type="checkbox"/> Check output bus voltage with a voltmeter, if output bus voltage is present, replace rectifier. <b>AC Fail:</b> Rectifier input is missing or out of range. <input checked="" type="checkbox"/> Correct AC fault.
AC  green DC  off ALM  off or red blink	<b>Startup:</b> The rectifier initializing, but has not started delivering power. <input checked="" type="checkbox"/> Wait for initialization to complete.
AC  green DC  off ALM  off	<b>Standby:</b> The rectifier is okay and has input ac, but has been placed in Standby by the controller and is not delivering power. Note: If a rectifier in standby loses communication s with the controller it will exit Standby mode and deliver power
AC  green DC  green ALM  off or red blink	<b>Output Limit:</b> The rectifier is okay and delivering full output <ul style="list-style-type: none"> <li>• At max rated output</li> <li>• At thermal limit</li> </ul> <input checked="" type="checkbox"/> View rectifier currents. If the rectifier output for one rectifier differs from the output of other units in the system by more than 2A, replace rectifier.
AC  green DC  off ALM  red	<b>Shutdown*:</b> The rectifier cannot deliver output. <ul style="list-style-type: none"> <li>• High Voltage Shutdown</li> <li>• Thermal Shutdown</li> <li>• Under Voltage Protect</li> </ul> Component failure, replace rectifier. <input checked="" type="checkbox"/> Correct system output short, high temp, etc. <input checked="" type="checkbox"/> Remove and reinsert rectifier. If fault remains and other units are functioning correctly, replace rectifier.
AC  any DC  any ALM  red blink	<b>Communication Fail:</b> Blinks to indicate the rectifier is not communicating with a system controller. <input checked="" type="checkbox"/> Remove and reinsert rectifier. If fault remains and other units are communicating correctly, replace rectifier.

\* When a rectifier 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 rectifier will lock out, and user intervention is required to restart.

## Output Power Curve

This curve is valid for both low-line and high-line operation. Use the table following the curve for the current levels at key voltage levels. The rectifier can deliver constant power to approximately 48Vdc. Further loading of the rectifier will result in the rectifier operating in the constant-current mode. If the rectifier is loaded below approximately 36V, the rectifier enters the hiccup mode.

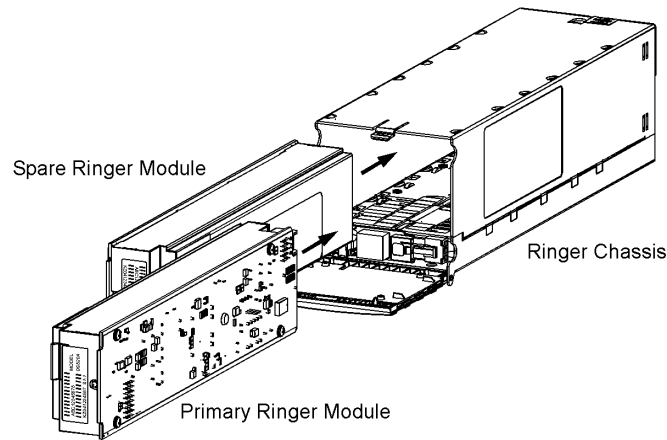
During start-up, the rectifier can deliver an increased amount of current as specified at point C. Point B is the nominal operating point. Point D is the internal thermal threshold beyond which the rectifier shuts down to protect itself. Point D is not based on constant power.










Rectifier	Power	A	B	C	D
15A	818W	14.1A	15A	17.0A	12A
20A	1090W	18.8A	20A	34.1A	24A
25A	1363W	23.5A	25A	28.4A	20A
30A	1635W	28.2A	30A	34.1A	24A
40A	2180W	37.6A	40A	45.4A	32A
50A	2725W	47.0A	50A	56.8A	40A

## Troubleshooting QS-Series Ringers

The status of a QS-Series ringer is provided by a tri-color on the face, and by alarm and event history accessible through the system controller.



### Ringer Status LEDs

LED	Condition
 green	<b>Normal operation:</b> No alarms, inputs and outputs are in their normal range, communicating with the system controller. Note: In a redundant system, one ringer is in “Normal Operation” and the second unit is in “Standby (on-line spare)”, see below.
 off	<b>Unpowered:</b> No input or output voltage present. <input checked="" type="checkbox"/> Remove and reinsert ringer. <input checked="" type="checkbox"/> Check input voltage with a voltmeter, if input voltage is present, replace ringer. <input checked="" type="checkbox"/> Check output bus voltage with a voltmeter, if output bus voltage is present, replace ringer.
 amber	<b>Startup:</b> The power unit initializing, but has not started delivering power. <input checked="" type="checkbox"/> Wait for initialization to complete. <b>Lamp Test:</b> The controller has initiated a Lamp Test operation
 green blink	<b>Standby (on-line spare):</b> The ringer is okay and has input, but is an on-line spare and is not delivering power. The unit will switch to “normal operation” if the other ringer fails. <b>Standby (remote):</b> The ringer is okay and has input, but has been placed in Standby by the controller and is not delivering power.
 amber	<b>External Fault:</b> <ul style="list-style-type: none"> <li>• Ring Return not terminated</li> <li>• Output limited – excessive output load</li> <li>• Output limited – excessive temperature</li> </ul>
 red	<b>Internal Fault:</b> <ul style="list-style-type: none"> <li>• Thermal shutdown</li> <li>• Ringer failure</li> </ul>
 red blink	<b>Communication Fail:</b> Blinks to indicate the ringer is not communicating with a system controller. <input checked="" type="checkbox"/> Remove and reinsert ringer. If fault remains and other units are communicating correctly, replace ringer.

## Troubleshooting VT-Probes

### Checking for Defective VT-Probes

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

Step	Action
1	Disconnect all probes by disconnecting 1-wire cable at P7 on the controller.
2	Run the command: <b>MENU &gt; CONTROL / OPERATIONS &gt; UNINSTALL EQUIPMENT</b> . The controller green normal LED should light
3	Reconnect 1-wire cable at P7 on the controller with only one thermal probe connected.
4	Run the command: <b>MENU &gt; STATUS / MEASUREMENTS &gt; BATTERIES</b> and scroll down to <b>TEMP PROBES PRESENT</b> It should read one
5	Add the next probe and repeat step 4 to make sure the proper number of probes appears. (wait at least 1 minute for it to recognize)
6	If a probe is not recognized or an alarm is generated then this probe may be defective.
7	Remove defective probe and repeat step 2 to uninstall that probe.
8	Repeat step 5 until all probes are installed and recognized.

## 8 Ordering Information and Spare Parts

To configure and order a frame, identify the required group numbers from the system configuration table and Lineage Power will assign an ordering code for that configuration. The pre-configured systems table lists some comcodes already assigned.

Pre-Configured Systems		
Comcode	H5694720 Group Numbers	Description
CC109126744	103, 256, 660, (2) 600M, 600R	7 ft frame, 4 rectifier shelves, Millennium II Controller, Two TPL-C fuse blocks with shunt monitoring and 38 bullet positions.
CC109126752	103, 256, 661, (2) 600M	7 ft frame, 4 rectifier shelves, Millennium II Controller, Two TPL-C fuse blocks, four TPL-B fuse blocks, four TPS fuse blocks all with shunt monitoring and 19 bullet positions.
CC109126728	103, 255, 660, (2) 600M, 600R	7 ft frame, 2 rectifier shelves, Millennium II Controller, Two TPL-C fuse blocks with shunt monitoring and 38 bullet positions.
CC109126736	103, 255, 661, (2) 600M	7 ft frame, 2 rectifier shelves, Millennium II Controller, Two TPL-C fuse blocks, four TPL-B fuse blocks, four TPS fuse blocks all with shunt monitoring and 19 bullet positions.

<b>System Configuration Table</b>		
<b>H5694720 Group</b>	<b>Description</b>	<b>Rack Spaces</b>
<b>Frameworks</b>		
102	42 inch tall framework	22U
103	7 foot tall light-duty framework (600 lb zone 4, 1200 lb zone 2)	46U
104	7 foot tall heavy-duty framework (1200 lb zone 4, 1800 lb zone 2)	46U
<b>Battery Tray e/w Anderson Disconnects and 2 Gauge Cable</b>		
440	Battery Tray on 7U (12.25") spacing for 100AH Batteries	7U
450	Battery Tray on 8U (14.00") spacing for 110-150AH Batteries	8U
470	Battery Tray on 9U (15.75") spacing for 170AH Batteries	9U
<b>Battery Tray e/w Disconnect Breaker Panel and 2 Gauge Cable</b>		
441	Battery Tray on 7U (12.25") spacing for 100AH Batteries	7U
451	Battery Tray on 8U (14.00") spacing for 110-150AH Batteries	8U
471	Battery Tray on 9U (15.75") spacing for 170AH Batteries	9U
<b>Rectifier Shelves with AC Termination Panel</b>		
255	Two 5-position Rectifier Shelves, AC Termination Panel and space for one Group 660 or 661 Distribution Panel	17U
256	Four 5-position Rectifier Shelves, AC Termination Panel and space for one Group 660 or 661 Distribution Panel	22U
<b>Distribution</b>		
660	Distribution Panel e/w Millennium II controller. Distribution includes 38 positions for bullet style Fuse Holders or Breakers, and 8 positions for equipping Group 600_ Breakers, Fuses or Contactors.	--
661	Distribution Panel e/w Millennium II controller. Distribution includes 19 positions for bullet-style Fuse Holders or Breakers, 4 TPL-B 0-250A Fuse Holders with Load Shunts, 4 TPS 0-70A Fuse Holders with Load Shunts, and 8 positions for Group 600_ Breakers, Fuses or Contactors. (Includes shunt module RPM for monitoring up to 12 shunts on TPS, TPL-B and TPL-C Fuse Holders)	--
<b>The Following Groups ordered for Group 660 or 661 (8 positions Available)</b>		
600B	150A KS22012 Circuit Breaker Kit. (Breaker e/w 25mV shunt and wiring to connect to RPM)	1-pos
600E	250A KS22012 Circuit Breaker Kit. (Breaker e/w 25mV shunt and wiring to connect to RPM)	1-pos
600G	400A KS22012 Circuit Breaker Kit. (Breaker e/w 25mV shunt and wiring to connect to RPM)	2-pos
600M	TPL-C Fuse Holder and 1500A, 50mV load shunt Kit includes wireset for connecting to shunt RPM	2-pos
600R	6 channel shunt module (RPM) for monitoring shunts on Groups 600B, 600E, 600G and 600M in a Group 660 Panel. (661 already provides two RPMs). (Mounts on distribution door)	no-pos
600T	800A Low Voltage Battery Disconnect (LVBD) Contactor.	3-pos

Field Installed Equipment Ordered Separately		
Item	Description	Comcode
<b>Rectifier</b>		
QS861A	85-275Vac input, 15A output	108993531
QS862A	85-150Vac input, 25A output 165-275Vac input, 30A output	108986704
QS852A	165-275Vac input, 20A output	CC109106440
QS853A	165-275Vac input, 25A output	CC109121290
QS864A	165-275Vac input, 40A output	CC109129747
QS865A	165-275Vac input, 50A output	CC109129755
QS850	Rectifier Slot Filler	108994273
<b>Ringer</b>		
QS820A	Ringer (1 or 2 Ringers plug into a Ringer Chassis).	108990082
QS820M	Ringer Chassis occupies a single slot in the rectifier shelf (no ringers included)	108991262
Ringer Output Cable (connects to Ringer Chassis)	15-foot cable 150-foot cable	847922101 CC848804765
<b>Distribution</b>		
150A Single Pole Breaker	KS22012 breaker mounts in center section.	CC109127635
250A Single Pole Breaker		CC109127627
400A Two Pole Breaker		CC109127486
TPL-C Fuse Holder	Fuse Holder requires two positions in center section	CC109129128
TPL-B Fuse Block Head	Converts TPL-C Fuse Holder to use TPL-B 0-250A fuse	408472322
GMT Bullet Fuse Holder	Provides 6 GMT fuse positions in two bullet positions	CC109103157
TPS Bullet Fuse Holder	TPS Bullet Fuse Holder (Alarms on Blown fuse or Fuse Head Removal)	408548944
TPS Bullet Fuse Holder	TPS Bullet Fuse Holder (Alarms on Blown fuse only)	CC408617410
<b>Modem Kit</b>		
Modem Kit	BSM5 Modem Kit	108284639



## Battery Monitoring Equipment

Part #	Description
108987611	QS873A Thermal Probe
CC848817024	10 ft wireset (thermal probe to controller)
848719803	5 ft wireset (thermal probe to thermal probe)
848719811	10 ft wireset (thermal probe to thermal probe)
848652947	10 ft wireset (extend cc848817024 thermal probe cable)
555052-1	In-line coupler (extending thermal probe cable)

## Anchors & Frame Ground

Part #	Description
847135688	(4) 12mm Cap Bolt Floor Anchor
848398566	32 ft long green 2 gage cable for H-tap or C-tap to aisle ground ring
848722203	4 ft long green 1/0 gage cable for H-tap or C-tap to aisle ground ring

## Bullet Style Battery Circuit Breakers

### Yellow Handle (Alarms on Mid-Trip and in Off position)

Part #	Amperage	CB Positions	Min Wire Ga
CC408574370	50	1	8
408560123	60	1	6
CC408574387	70	1	6
CC408574395	100	1	2
CC408574404	125	2	2
CC408574412	150	2	1/0
CC408574420	200	2	2/0

**Bullet Style Load Circuit Breakers**

Part #	Amperage	CB Positions	Min Wire Ga
407998137	3	1	10
407998145	5	1	10
407998152	10	1	10
407998160	15	1	10
407998178	16	1	10
407998186	20	1	10
407998194	25	1	10
407998202	30	1	10
408213486	40	1	8
407998210	45	1	8
407998228	50	1	6
407998236	60	1	6
407998244	70	1	2
407998251	80*	1*	2
407998269	90*	1*	2
407998277	100*	1*	2
408185353	125	2	2
408185346	150	2	1/0

Note: \* 80, 90 and 100A Breakers require one adjoining space be left unoccupied

**TPL-B and TPL-C Fuses**

Part #	Amperage	Min Wire Ga
405673161	0.5A Alarm Fuse	
TPL-B Fuses		
406794776	70	6
408239648	80	4
406794784	100	2
406925685	125	1/0
406794792	150	2/0
406794818	200	4/0
406794982	225	4/0
406794842	250	4/0
TPL-C Fuses		
406794867	300	(2) 4/0
406794875	400	(2) 4/0
406794883	500	(2) 4/0
406794891	600	(2) 350

**KS22012 Breaker Kits**

Part #	Amperage
CC109127635	150A Single Pole Breaker
CC109127627	250A Single Pole Breaker
CC109127486	400A Two Pole Breaker

**Bullet Style Fuse Holder and TPS Fuses**

Part #	Amperage	WP-92461 List	Min Wire Ga
406700567	3	100	10
406700583	5	101	10
406700591	6	102	10
406700609	10	103	10
406700617	15	104	10
406700625	20	105	10
406700633	25	106	10
406700641	30	107	10
406700658	40	108	10
406700674	50	109	8
406700682	60	110	6
406700690	70	111	6
402328926	0.18 Alarm Fuse		

**GMT Fuse Holder and Fuses**

Part #	Description
CC109103157	6-pos GMT Bullet Fuse Holder
408515823	Fuse Puller
405006222	0.25A
406976894	0.5A
405673146	1.33A
405181983	2A
406976985	3A
406159061	5A
405725433	7.5A
406159236	10A
406473959	12A
406700690	15A

**Terminal Lugs for Bullet Style Breakers and TPS Fuses (1/4" on 5/8" centers)**

<b>Lug Part #</b>	<b>STR Wire GA (Class B)</b>	<b>Flex Wire GA (Class I)</b>	<b>WP-91412 List</b>
406021626	8	8	75
405347519	6	6	3
405347576	4	4	5
405348202	2	--	54
405347683	--	2	8
<b>Lugs for 2-pole Adapter Bus</b>			
407817568	1/0	--	179
407817550	2/0	1/0	180
407817576	--	2/0	181
CC848756916	2-pole adapter bus kit		

**Terminal Lugs for CO Ground, Battery, Large Breakers and Fuses  
(3/8" on 1" centers)**

<b>Lug Part #</b>	<b>STR Wire GA (Class B)</b>	<b>FlexWire GA (Class I)</b>	<b>WP-91412 List</b>
406332841	6	6	111
406338665	2	--	121
407726041	--	2	176
405348228	1/0	--	56
405348236	2/0	1/0	57
406021725	--	2/0	77
405348251	4/0	--	59
405347923	--	4/0	27
407890763	350	--	186
407890748	--	350	183
406335141*	750	--	135
407890730*	--	750	184

\*Battery Landings Only

**Miscellaneous Spares for Millennium II Controller**

<b>Part #</b>	<b>Part Description</b>
848742858	Millennium II Controller Board (MCR1/MCR2)
848741711	BSL3 Alarm Board (punch down)
848749507	BSL4 Alarm Board (wire wrap)
108851338	BSM5 Modem Board (not complete kit)
108163601	BSW1 Data Switch Board
847473774	Easy View Software Package
406530725	1-1/3 A fuse (GMT)
406204230	3 A fuse (GMT)
405298308	Terminating Resistor for RPM
406712968	406712968 Inductor Bead for RPM
407377704	RPM Cable (ordered by the foot)

## 9 Product Warranty

A. Seller warrants to Customer only, that:

- 1 As of the date title to Products passes, Seller will have the right to sell, transfer, and assign such Products and the title conveyed by Seller shall be good;
- 2 During the warranty period stated in Sub-Article B below, Seller's Manufactured Products (products manufactured by Seller), which have been paid for by Customer, will conform to industry standards and Seller's specifications and shall be free from material defects;
- 3 With respect to Vendor items (items not manufactured by Seller), Seller warrants that such Vendor items, which have been paid for by Customer, will be free from material defects for a period of sixty (60) days commencing from the date of shipment from Seller's facility.

B. The Warranty Period listed below is applicable to Seller's Manufactured Products furnished pursuant to this Agreement, commencing from date of shipment from Seller's facility, unless otherwise agreed to in writing:

**Warranty Period**

<b>Product Type</b>	<b>New Product</b>	<b>Repaired Product*</b>
Central Office Power Equipment**	24 Months	6 Months

\* *The Warranty Period for a repaired Product or part thereof is six (6) months or, the remainder of the unexpired term of the new Product Warranty Period, whichever is longer.*

C. If, under normal and proper use during the applicable Warranty Period, a defect or nonconformity is identified in a Product and Customer notifies Seller in writing of such defect or nonconformity promptly after Customer discovers such defect or nonconformity, and follows Seller's instructions regarding return of defective or nonconforming Products, Seller shall, at its option attempt first to repair or replace such Product without charge at its facility or, if not feasible, provide a refund or credit based on the original purchase price and installation charges if installed by Seller. Where Seller has elected to repair a Seller's Manufactured Product (other than Cable and Wire Products) which has been installed by Seller and Seller ascertains that the Product is not readily returnable for repair, Seller will repair the Product at Customer's site.

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.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER'S SOLE AND EXCLUSIVE REMEDY SHALL BE SELLER'S OBLIGATION TO REPAIR, REPLACE, CREDIT, OR REFUND AS SET FORTH ABOVE IN THIS WARRANTY.

# Appendix A: Battery Functions

## Float Mode

Float mode is the default mode of operation of the battery plant. The plant voltage, while in float mode, is determined by the configuration parameter Rectifier Float Set point and may be adjusted by the Battery Thermal Compensation circuit, if active. No individual adjustment of plant rectifiers is necessary. Load sharing among plant rectifiers is automatic in all plant modes and will take effect within several seconds of a new rectifier being added to the system.

The Float Set point should be set per the battery manufacturer's recommendations. Note that the actual Float Set point measured on the plant may differ from the value set by the user if thermal compensation is enabled. See Slope Thermal Compensation (next topic) for more details.

## Slope Thermal Compensation

The following is a list of slope thermal compensation parameters that can be configured in the controller.

### Battery High Temperature Alarm

Alarm threshold can be set from 30°C to 85°C. The alarm retires when the temperature drops to 10°C below the set threshold. The factory default setting is 55°C.

### High Temperature Compensation

The system controller has the ability to disable or enable the high temperature compensation feature independent of detection of a thermal probe. The feature is defaulted to be enabled however it can be disabled by going to the appropriate configuration menu. Settings for this feature are as follows.

**V Step Down:** Battery step temperature can be set from 45°C to 85°C. The factory default setting is 75°C.

**High Comp Limit:** The upper temperature thermal limit can be set from 30°C to 55°C. The factory default setting is 45°C.

**Decrease:** The upper temperature slope setting (rate of decrease) can be set from -1mV to -10mV in -2mV steps. The factory default is -3mV.

**Nominal Temperature:** Temperature above or below which Slope Thermal Compensation is enabled. The stable range is 15 to 30°C. The factory default setting is 25°C.



## Low Temperature Compensation

This feature is disabled by default, and can be enabled only if Temperature Slope Thermal Compensation is enabled. The following are the associated parameters.

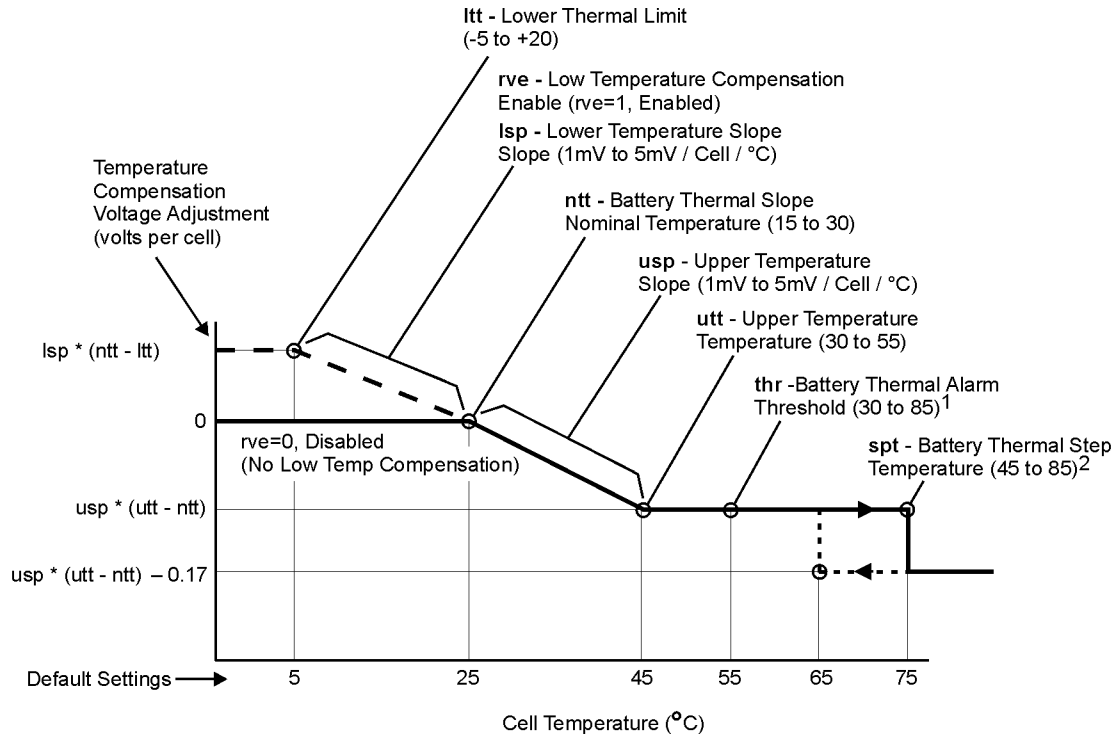
**Low Comp Limit:** Low temperature thermal compensation can be set from -5°C to 20°C. The factory default setting is 0°C.

**Increase:** The low temperature slope (rate of increase) can be set from 1mV to 10mV in 1mV increments. The factory default setting is 3mV.

The Millennium II has a flexible Thermal Compensation feature which provides voltage compensation from that level established by the Plant Float Set-Point (fsp) or Boost Set-Point (bsp), dependent on the highest temperature monitored by the temperature probes located at the plant batteries. Thermal Compensation should be used in a plant containing “sealed” or valve regulated “maintenance free” batteries. Refer to the Installation Instructions for more details on wiring and configuring this feature.

Thermal Compensation lowers plant voltage from the fsp for monitored battery temperatures which are above the ideal temperature established during configuration as the Battery Thermal Slope Nominal Temperature (ntt). The items in parenthesis are the user configurable points referred to in the graph shown below. Lowering the plant voltage helps to keep the batteries at their optimum state of charge while protecting them from thermal runaway. Thermal runaway is a complex sealed battery phenomenon where, for one or more of a number of reasons, one or more cells in a string are unable to dissipate the internal heat generated by their charging current and experience an increase in internal temperature. By lowering the float voltage as cell temperature increases, the float current is lowered to a point where this destructive behavior can be avoided. If a cell failure is imminent and the cell temperature continues to rise above the threshold configured for Battery Thermal Step Temperature (stp), plant voltage drops in a single step to a level which keeps the remaining cells in the string from overcharging and being damaged. Refer to the following figure for a graphical view of Battery Thermal Compensation and the relationship of its various set points.

The Millennium II can also increase plant voltage above that set by the fsp or bsp for colder environments, again seeking to keep batteries at their optimum charge state. Batteries will lose capacity as the battery temperature drops below their optimal operating temperature. Increasing the plant voltage for decreases in temperature will cause more current to flow into the batteries. This results in electrolysis of the water in the batteries. Since this reaction is exothermic, it also serves to keep batteries warm. This feature results in an increase in plant voltage, and is required to be enabled during controller configuration.



1. The Battery Thermal Alarm occurs when the temperature rises above the thr set point. It retires when the temperature decreases to 10°C below the thr set point (45°C default).
2. Plant voltage decreases an additional 0.17 volts per cell when the temperature increases above the spt set point. It is increased 0.17 volts per cell when the temperature decreases to 10°C below the spt set point, as indicated by the dashed line (65°C default).

### Slope Thermal Compensation

The following describes the configuration parameters which may be activated or altered by the user. Refer to Appendix B for the ranges of values the parameters may take and their factory default settings.

**Lower Thermal Limit (ltt):** The lower temperature where, if Low Temperature Compensation is enabled, the controller will increase plant voltage to a level corresponding to  $(lsp * (ntt - ltt) * 24)V$  above the fsp. Plant voltage will be increased proportionally at any temperature between this point and the Battery Thermal Slope Nominal Temperature (ntt).

**Low Temperature Compensation Enable (rve):** A 0 disables and 1 enables the Low Temperature Thermal Compensation feature. Since rve increases plant voltage rather than decreasing it based on temperature, the option is provided to disable it separately from the entire feature so that equipment loads sensitive to high voltages can be protected.

**Lower Temperature Slope (lsp):** The slope rate for the voltage increase per cell when the battery temperature is below the ntt (Battery Thermal Slope Nominal Temperature).

**Battery Thermal Slope Nominal Temperature (ntt):** The zero compensation temperature point. Temperatures monitored between this point and the Upper Temperature Limit (utt) will result in a proportional decrease of plant voltage to a level corresponding to  $(usp * (utt - ntt) * 24)V$  below the fsp at the utt. If Low Temperature Compensation is enabled, temperatures monitored between this

point and the Lower Thermal Limit (l<sub>tt</sub>) will result in a proportional increase of plant voltage to a level corresponding to  $(l_{sp} * (n_{tt} - l_{tt}) * 24)V$  above the f<sub>sp</sub> at the l<sub>tt</sub>.

**Upper Temperature Slope (usp):** The slope rate for the voltage decrease per cell when the battery temperature is above the n<sub>tt</sub> (Battery Thermal Slope Nominal Temperature).

**Upper Temperature Limit (utt):** The upper temperature where Battery Thermal Compensation will have reduced plant voltage to a level corresponding to  $(usp * (utt - n_{tt}) * 24)V$  below the f<sub>sp</sub>. Plant voltage will be reduced proportionally at any temperature between this point and the Battery Thermal Slope Nominal Temperature (n<sub>tt</sub>).

**Battery Thermal Alarm Threshold (thr):** A monitored battery temperature above this threshold results in a Battery Thermal alarm with a PMN severity.

**Battery Thermal Step Temperature (spt):** A monitored battery temperature above this threshold results in an additional 4.08V “step” decrease in plant voltage.

## Plant Battery Test

The following is a list of plant battery test parameters that can be configured in the controller. The result of the Plant Battery Test is available in the “Batteries” sub-menu of the “Status” menu.

**Manual Test:** Permits manually starting a battery discharge test. The test can be set to end on either of the following two parameters.

**Duration:** The duration of the test can be set from 0.1 hours to 99.9 hours.

**Cutoff Cell V:** The test can be set to end when battery cell voltage reaches this cutoff voltage. Cutoff voltage can be set from 1.5V to 2.0V.

**Automatic Test:** This utility offers the flexibility of running pre-programmed battery tests at specific times and days, and for specific durations.

**Automatic Test:** Enable or disable automatic periodic running of the battery test. The factory default setting is disabled.

**Interval:** The test interval (time between tests) can be set from 1 to 18 months in 1 month increments. The factory default setting is 12 months.

**Next Test:** Enter a particular day in dd-mm-yy format to automatically run the battery test on that day.

**Start Time:** Enter a particular time in hh-mm format to automatically run the battery test at that time. The setting can be configured from 0 to 23 hours. 00:00 is midnight.

**Hours from BD:** Time interval needed to elapse since the last Battery on Discharge alarm before a battery test can be performed. This can be set from 0 to 240 hours in 1 hour increments. The factory default setting is 72 hours.

**Recharge Amp Limit:** This section contains the settings for battery recharge current limit.

**Limit:** Enable or disable battery discharge current limiting.

**Limit To:** Current limit setting, from 5A to 100A. The factory default setting is 50A.

During this test, the controller lowers the rectifier voltage to 44V. (This value was chosen to be higher than 1.2V plus the highest possible LVD contactor disconnect threshold so as not to accidentally open the LVD contactor.) Lowering the rectifier output voltage to 44V creates a battery on discharge condition. If the batteries are present and healthy, the plant voltage will remain above 48V and the batteries will support the load. If the batteries are not present or are not able to support the load, the plant voltage will immediately drop to approximately 44V without any consequence to the load. The Battery on Discharge alarm is masked during this test.

The test is terminated by the occurrence of any of the following conditions:

- Initiating another Plant Battery Test. That is, once the test has been initiated, the test may be stopped by initiating another test either through the controller or by shorting pins 19 and 20 of the host interface connector.
- An alarm condition occurring. Any alarm condition that occurs during this test will result in the test being aborted regardless of whether the contact-closure exists between pins 19 and 20 of the host interface connector.
- The test has continued for over 100 minutes.
- The plant voltage has dropped below 44V. In this case, the system will abort the test and resume rectifier operation.

After the test has stopped, the plant will revert to the float mode. It may go to boost mode if the auto-boost feature has been enabled.

## Boost Mode

Boost charging is a feature of the Millennium II controller, which allows the user to temporarily raise the plant voltage to a higher, predetermined level in expediting the time needed to charge batteries. The system may manually be placed in the boost-mode through the front panel.

The measured boost voltage may not exactly match the value chosen by the user if the thermal compensation feature is enabled. This is because the Millennium II performs thermal compensated boost charging and will adjust the boost value based on the battery temperature per the slope chosen by the user.

The plant will exit the boost mode and enter the float mode if any of the following occurs:

- The current flowing into the battery string(s) is less than 5A
- The duration of boost mode charging has reached 8 hours
- The controller receives either a High-Voltage, Rectifier Fail alarm, or High-Battery Temperature alarms

- User sets the plant state to Float via the user interfaces.

Once initiated, the boost mode may be exited by placing the Plant State to Float.

## Auto-Boost Charge

This feature may be enabled from the front panel or other remote access means. When enabled, the plant enters the boost-charging mode of operation following a battery discharge once the BD alarm has been retired, provided the duration of the discharge was greater than 4 minutes. The controller will not enter the auto-boost-charging mode if the discharge duration was less than 4 minutes.

When in auto-boost mode, the controller raises the plant voltage to the value selected by the user. The controller keeps the plant in this mode of operation for a minimum of 5 minutes.

The exit conditions for the Auto-Boost Charge are the same as those for Boost Charge.

## Redundancy Loss Function

This feature must be enabled from the front panel. The controller determines the number of rectifiers present and compares the actual currents being drawn by the load to that produced by the total number of rectifiers less one. If the measured load current exceeds the N rectifier's capacity for over 1 min, the alarm condition is activated. The alarm condition is latched on until the Clear Events command is activated from the front panel.

This feature may be used by customers to determine if the load being served is greater than N rectifiers worth, in an N+1 system. That is, the load requirements have changed such that the power system is no longer operating as a redundant power system. An additional rectifier may be required to ensure continuous redundant operation.

If enabled, this feature will be disabled during battery discharge and recharge conditions. It will be enabled when the battery charging current falls below 5A.

## Battery Voltage Imbalance Detection

Millennium II controllers utilizing the MCR1 (848704268) main circuit pack hardware does not support the Battery Voltage Imbalance Detection feature. The Battery Mid-String Voltage Imbalance detection feature is available only with Millennium II controllers that utilize the MCR1B (CC109126307) version of the main circuit pack. This feature requires the use of the 1-Wire ES771A Remote Voltage Monitoring Module.

Millennium II controllers with the MCR1B will automatically enable this feature when it detects the presence of an ES771A module. The ES771A module should be placed in the electronics cabinet. It will utilize the QS873A VT-Probes to obtain the voltage of the mid-string battery voltage for monitoring. The VT-Probe is to be placed on the negative battery terminal located in the middle of the battery string. The Millennium II has data on the plant voltage and its mid-string value. This mid-string voltage measured from each monitored battery string is compared to the plant voltage minus the measured half-string voltage. If the comparison results in a difference of greater than the programmed voltage difference, 1.7V by default, for longer than 24 hours, the alarm is asserted. The alarm may be retired by initiating the Clear Events command from the front panel.

After this feature has been enabled, the system waits for 12 hours to ensure the battery strings are stable. A battery string is considered to be stable if the charging current is less than 3A. If a stable battery string yields a difference measurement greater than 1.7V for over 12 continuous hours, a Battery Voltage Imbalance alarm is generated.

When the alarm is issued, the Float Set-Point (fsp) and the Battery on Discharge (BoD) threshold values are reduced by fsp/number of cells per string. Once the alarm has been cleared by the CLE command, the plant reverts to its normal fsp; however, the BoD threshold is maintained at the new threshold for up to four minutes before reverting back to the old threshold. This is done to ensure the batteries have had enough time to charge up to the nominal fsp and to prevent any spurious BoD alarm conditions.

This feature may be used by customers as part of their overall battery maintenance program in determining the health of battery strings. A voltage imbalance of 1.7V between half-string voltages may mean a shorted-cell somewhere in the string. A service person should be sent out to the site and determine if the string should be replaced.

### **Battery Recharge Current Limit**

The Battery Recharge Current Limit feature must be enabled from the front panel or other remote access means. The battery recharge current limit feature enables the Millennium II controller to limit the recharge current flowing into the batteries or battery section during the charge cycle. The recharge current flowing into the battery section can be limited to any value between 10A and 1000A.

Note that this feature will not have any impact on the current being delivered to the load. Further, there will be no effect on the discharge current flowing from the battery strings to the load during an ac fail condition. The controller will maintain the recharge current within 10% of the set level.

# Appendix B: EasyView for Windows®

## Overview

EasyView® for Windows OS (EasyView) is a program that runs on an IBM®-compatible PC with an RS-232 port or laptop computer and provides access to a Millennium II Controller. (Hereafter the term PC is used to refer to a PC with an RS-232 port or laptop computer.) The program provides access to controller alarms, system status, control and configuration. To use EasyView you will have to load the EasyView application onto your PC, connect your PC to the controller, and run the EasyView application.

## Loading the EasyView Application

The EasyView software may be freely downloaded from the Lineage Power web site from

<http://www.lineagepower.com>

Click on the Download link and scroll down the page to the EasyView Monitoring Software section in order to download the EasyView. Once downloaded, install the software.

## Making the Connection

To use EasyView to access a Millennium II controller you will need a PC, and a controller programming cable (comcode 848658100). Connect the cable to the serial port of your PC and to the controller programming connector of the Millennium II.

*Windows is a registered trademark of Microsoft Corporation  
IBM is a registered trademark of IBM Corporation*

## Configuring a Site

Start the EasyView program by selecting its icon. Once started, you will enter the Default screen. This is where the system alarms, warnings, and site descriptions are displayed. To configure a site, press the F11 key from this screen, or select Setup Sites from the Options menu. The Site List popup screen is displayed.

On this screen, hit the Add button and then the Modify button.

On the Description field, type in an identifier, e.g., Millennium II Controller Connection. Then select Set Default Passwords button. To view controller status information without being able to change any settings, select User in the Connect Password field. If you will be changing parameters, select Super User. Super-users have configuration privileges.

## Serial Port Setup

This selection defines the entire connection method except for password. If a suitable Serial Port Setup choice is not listed, you must define one by:

- Clicking on “Show Serial Port Setups”

- Clicking on “Add”

- Clicking on “Modify”

You will be making a direct connection to the controller. Look for the “Set Default Values for” field and hit either Com 1 direct, Com 2 direct, Com 3 direct, or Com 4 direct depending on which communications port you will be using to connect to the controller. Hitting the button will automatically set all other parameters for you. Hit the OK button to exit this field. Hit OK again to exit the Site field. Then hit the Close button.

## Connect to Site

To connect to the Millennium II controller, hit F12 or from the Connect menu, select the Connect to Site option. You may now select one of the listed sites. EasyView will start the connect process and display the commands it is sending to the controller and responses it is getting back. When the connection process is completed, EasyView will obtain the alarms and warnings of the controller and display them on the default screen.



## Navigating Once Connected

Once you've connected to the controller, you should see the following screen. Note that any alarms currently on the plant will be visible.



There are three pull-down menus you may choose to gain access to plant features and functions. They are Configure, Control, and Status.

### Configure

This pull-down menu allows one to access all Millennium II controller parameters that may be uniquely configured. It allows access to set alarm thresholds and alarm relays, set battery connect and disconnect thresholds, enable auto-boost mode and set boost charge thresholds, change passwords, enable imminent shutdown feature, set rectifier parameters, configure serial ports, and configure slope thermal compensation.

### Control

This pull-down menu allows one to access all controller parameters that may be activated to perform a function. It allows one to perform a plant battery test, clear all clearable alarms, perform a lamp test, change the plant state from float to boost mode, and inhibit or restart rectifiers.

### Status

This pull-down menu allows one to obtain the status of the battery management system, i.e., battery current, battery temperature, number of VT-Probes and ES771A Voltage Imbalance Detection modules are present. It also allows rectifier management, i.e., provides information as to the number of rectifiers present and their output current.

### Exiting

To exit the program, either hit the Disconnect icon or hit File and Exit.

# Appendix C: Upgrading Software Through Network Connection Or Craft Port

Software can be upgraded through the 10/100Base-T connection either over the network or when configured as the Ethernet Craft Port. There are four program files that can be upgraded on the Millennium II: The boot block, the factory defaults, application, and web pages. The present application does not have a factory defaults file. Hard coded defaults are utilized. In any case, each of these items has a specific file name. FTP is used for upgrading controller software. Each file goes in a certain directory on the controller:

Item	File	Directory
Boot Block	m2-boot.bin	/
Defaults <sup>1</sup>	m2-dflts.bin	dflts
Application	m2-app.bin	code
Web pages	M2-pages.web	web
Backup Configuration	config.gal	config

These files must be uploaded to the NE843 using FTP either through the web page interface or through a direct Telnet session. To use FTP, the user must first initiate a Telnet session through the Craft port or network connection. To use the Ethernet port locally as a Craft port it needs to be configured as a DHCP Server. DHCP Server operation can be validated at **Menu→Status→Network Settings**. Scroll down to view the port's present configuration.

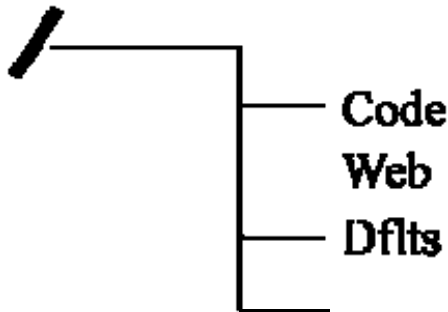
If it is not in DHCP Server mode, make sure the Craft port is not plugged into a LAN connection and re-configure the DHCP setting from the front panel to be Server. This is parameter is found in **Menu→Configuration→Communication Ports→Network Settings→DHCP**. Note: the controller should automatically reboot to accept the new Ethernet port configuration. This process takes approximately two minutes.

Common FTP commands used when performing file operations are:

- **ftp** – Initiate the ftp session.
- **cd** – Change directories in the controller.
- **put** – Copy files from the PC running FTP to the controller (The present working directory of the PC will be the source directory for the file being copied.)
- **get** – Copy files from the controller to the PC running FTP (The present working directory of the PC will be the destination directory for the file being copied.)
- **bye** – Exit the FTP session
- **pwd** – Display the path of the current directory

- **rm** – Remove a file from a directory
- **ls** – List all files in a directory

Note: The Millennium II has a file/directory structure as shown below: Where “/” is the root directory. Each subdirectory contains files that are necessary for the Application Software and web pages. Thus, using an FTP client, shown previously, files may be transferred to/from these controller directories. The exact path to the upgrade file may be used in the “put” command to update the software. Note: software upgrades require administrator level privilege. Thus, the password required is **administrator**. Similar responses are seen when opening a Telnet session remotely over the LAN connection. Note: you have to give the path of to the file in conjunction with the put commands.



### Factory Defaults

Using any FTP client, perform the following steps to load default web pages:

1. Type: *FTP x.x.x.x* (The controller should have a Working IP Address of 192.168.2.1 in server mode).

```

ftp 192.168.2.1
Connected to 192.168.2.1
220 MILLENNIUM FTP Ready
  
```

2. Login as “guest” using the using the network administrator password (administrator).

```

User (192.168.2.1:(none)): guest
331 User name okay, need password
Password: administrator
230 Logged in
  
```

3. Change directory (cd) to the **dflts** directory by typing: *cd dflts*.

```

ftp> cd dflts
250 CWD command successful
  
```

4. Use the “put” command to copy the web pages to the controller.

```

ftp> put m2-dflts.bin
200 Port command okay
150 Opening data connection for STOR (192.168.2.1,1576)
  
```

5. Verify the transfer by a message displayed indicating a successful file transfer.

```

226 File sent OK
ftp: 917504 bytes sent in 2.31Seconds 396.50Kbytes/sec.
  
```

6. Type “bye” to exit the FTP session.

```
ftp> bye  
221 Goodbye!
```

The controller should automatically reboot

### Application Software

Using any FTP client, perform the following steps to load Application Software:

1. Change your directory to the PC directory where the Application code is stored.
2. Type: *FTP x.x.x.x ( The controller should have a Working IP Address of 192.168.2.1).*

```
ftp 192.168.2.1  
Connected to 192.168.2.1  
220 MILLENNIUM FTP Ready
```

3. Login as “guest” using the network administrator password (administrator).

```
User (192.168.2.1:(none)): guest  
331 User name okay, need password  
Password: administrator  
230 Logged in
```

4. Change directory (cd) to the **code** directory by typing: *cd code*.

```
ftp> cd code  
250 CWD command successful
```

5. Use the “put” command to copy the application software to the controller.

```
ftp> put m2-app.bin  
200 Port command okay  
150 Opening data connection for STOR (192.168.2.1,1576)
```

6. Wait until the message indicating a successful file transfer is displayed.

```
226 File sent OK  
ftp: 917504 bytes sent in 2.31Seconds 396.50Kbytes/sec.
```

7. Type “bye” to exit/logout of the FTP session.

```
ftp> bye  
221 Goodbye!  
The controller should automatically reboot
```

### Web Pages

Using any FTP client, perform the following steps to load default web pages:

1. Type: *FTP x.x.x.x ( The controller should have a Working IP Address of 192.168.2.1).*

```
ftp 192.168.2.1  
Connected to 192.168.2.1  
220 MILLENNIUM FTP Ready
```

2. Login as “guest” using the using the network administrator password (administrator).

```
User (192.168.2.1:(none)): guest  
331 User name okay, need password  
Password: administrator  
230 Logged in
```

3. Change directory (cd) to the **web** directory by typing: *cd web*.  

```
ftp> cd web
```

250 CWD command successful
  4. Use the “put” command to copy the web pages to the controller.  

```
ftp> put m2-pages.web
```

200 Port command okay  
150 Opening data connection for STOR (192.168.2.1,1576)
  5. Verify the transfer by a message displayed indicating a successful file transfer.  
226 File sent OK  

```
ftp> 917504 bytes sent in 2.31Seconds 396.50Kbytes/sec.
```
  6. Type “bye” to exit the FTP session.  

```
ftp> bye
```

221 Goodbye!
- The controller should automatically reboot

The software can also be uploaded through the web pages. Login into through the web pages as “administrator” and go to the “Installation” tab and use the easy to use “Upgrade Code” feature button located at the bottom of the page. The sample screen is shown below.

Clicking the “Upgrade Code” button provides an interface to select which file is to be upgraded as well as a tool to help select the location of the file to FTP. Following is a sample screen.

# Revision History

**Issue 8**

January 2008 – Rebranding.

**Issue 7**

October 2007 – Added shunt information to Groups 600B, E and G.

**Issue 6**

September 2007 – Removed optional voltage monitoring information.

**Issue 5**

July 2007 – Update ordering information.

**Issue 4**

April 2007 – Added Test and Acceptance section. Major rewrite and reformat. 0. Added SW upgrade section. Added notes about MCR1B and ES771A operation. Added note about rectifier current limit section. Added web section.

**Issue 3**

September 2006 – Added right-side distribution panel information.

**Issue 2**

Updated ordering information.

**Issue 1**

Initial release