ES24/60-JBA01
Power System

Installation, Operations & Maintenance Manual

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1 General

1.1 Using This Manual

This manual contains specifications and instructions to properly install and maintain the power supply system. Component specifications and drawings are also included.

This manual contains information related to the operation and maintenance of the Alarm Control Unit (ALU), the +24V Power Supply Unit (PSU), and the Distribution Module. Additional information is provided on system status and alarms, troubleshooting, and system maintenance. Appendix A of this manual contains drawings, which are used for these purposes. Appendix contains a simple block diagram for different functional blocks and systems schematic.

Step-by-step procedures required for the installation and turn-up are detailed. All equipment parameter setting, adjustments, and confirmation, as well as system monitoring, operations, and maintenance procedures, are included.

Warnings are printed in bold, italic lettering. They alert the installation or maintenance craftsperson of a potential hazard to either the equipment or the craftsperson if the warning is not followed.

1.2 Safety Notice

The system is not liable for any hazards incurred by not following proper safety procedures. Installation, operation, and maintenance personnel should always follow these safety rules:

1. Before installing the system, verify the AC input voltage and frequency, the AC breaker rating and type, and other environmental conditions as noted in the specifications.
2. The system has passed stringent system testing prior to shipment. **To avoid electrical shock. The rectifier system requires a single ground point permanently connected to earth ground.**
3. An AC breaker must provide adequate isolation between the system input and commercial AC main.
4. The environment should be dust free and controlled by an AC system. The area must be free of any flammable vapors or fluids.
5. To avoid electrical hazard, the covers must not be removed on any component, including the ALU and the rectifier.
6. Circuit breakers or fuses must be replaced with approved replacement circuit breakers meeting the original design specification.
7. All connections must be made per the latest issue of the applicable national and local codes

2 Product Description

2.1 Product Description

This power Shelf consists of modular rectifiers, an Alarm Control Unit (ALU), and a DC distribution module. Up to five rectifiers and an alarm unit can be equipped on a shelf containing an integrated distribution module. The rectifiers can operate from a universal range of AC line voltages.
The system is controlled and monitored by the ALU. System level rectifier voltage settings, system status, and alarms are displayed on the ALU. The system float voltage, equalize voltage, and alarm thresholds are set from RMS or Web browser. The ALU also provides automatic de-rating of the output power over the whole operating line voltages.

2.2 Product Main Features

The Power Shelf has the following main features:

- +24 VDC/60 Amps, N+1 redundancy
- Modular design for scalable, cost effective expansion
- Front access for simple installation and maintenance
- High power density
- Active Power Factor Correction (>.99PFC)
- High efficiency
- Temperature compensated float voltage control
- Alarm Control Unit
- Low Voltage Battery Disconnect (LVBD)
- Remote Monitoring and control

2.3 System Specifications

2.3.1 System Configuration

(1) AC Input: 175VAC ~ 275VAC, with 40Amps AC Breaker
(2) System Capacity: 60Amps. Max.
(3) Rectifier: +24V/20A×1~3
(4) Control and Supervisory Unit
(5) Low Voltage Disconnect Switch: 80A @ Single Pole at Battery Side
(6) Battery Breaker: 100A×1
(7) DC output Breaker: 30Ax5

Figure 1 shows the outlook of the power shelf.

2.3.2 Electrical Data

The system electrical data is provided in the following tables.

2.3.3.1 Input

Table 1 displays the system input specifications.

Specification	Value
Nominal range	90-275 VAC
Operational range	90-275 VAC
Frequency	45-65 Hz
Power Factor	>0.99

THD	<5%
Efficiency	>90%

2.3.3.2 Output

Table 2 displays the system output specifications.

Specification	Value
DC Volts	21-29.5 VDC
Power Each module System	 600W 1800W
Load regulation	<0.5%
Line regulation	<0.1%
Current Limit	110%
Current share	<5%
Battery breakers	1 pcs, 100 Amps CB

2.3.3.3 Status/Alarm Indicators

The Power Shelf has the following status/alarm indicators:

- AC ON @ Rectifier
- Rectifier Fail Alarm (RFA) @ Rectifier
- Current Limit (CL) @ Rectifier
- Float Charge (FL)
- Equalize Charge (EQU)
- High Voltage Alarm (HV)
- Low Voltage Alarm (LV)
- Minor Alarm (MIN)
- Major Alarm (MAJ)
- High Voltage Shutdown (HVSD)
- AC Fail (ACF)
- FUSE ALM (Breaker Trip Alarm)
- LVDS OPEN

2.3.3.4 Mechanical Data

Table 3 displays the system mechanical data.

Dimension	Value
Height	132.0mm
Depth	381.5mm
Width	482.6mm

2.3.3.5 Environmental Data

Table 4 displays the system environmental data.

Specification	Value
Operating temperature	0℃ to +50℃
Storage temperature	-40℃ to +70℃
Humidity	0% to 95% RH
Altitude	-500 ft. to 10,000 ft.

3 Power Supply Unit (PSU)

3.1 Description

This rectifier units are rated at 20Amps at +24 VDC when operated from high line.

Warning: In the absence of the ALU, the automatic derating of the rectifiers at Low Line(90~175Vac) is not effective. Exceeding the 50% load limit at Low Line may damage the rectifiers.

The modular design provides the flexibility to configure and expand the system as the load demand increases. Each rectifier unit is swappable with front access for ease of maintenance without system shutdown, providing uninterrupted service.

The rectifier unit has an active power factor correction of greater than 0.99 for maximum AC utilization. Each module is equipped with an AC switch located at the front of the module.

3.2 Specifications

Detailed rectifier specifications are provided in the following sections.

3.2.1 Electrical

Detailed electrical specifications for the rectifier are provided in this section.

3.2.1.1 Input

Table 5 displays the rectifier input specifications.

Specification	Value
Input Voltage	90 VAC to 275 VAC, Single Phase, (during 90 to 175 VAC de-rated to 50% Load)
Input Current	6 Amps at 176 VAC, Full Load
Line Frequency	45 to 65 Hz
Power Factor	>0.99, at 220 VAC Input, Full Load
THD	<7%, at 220 VAC Input, Full Load
Efficiency	>87%, Full Load
Inrush Current	<12 Amps (peak), 220 VAC, Full Load, Cold Start
Start Time Delay (Walk-In)	3 to 10 seconds
Protection	Fuse

3.2.1.2 Output

Table 6 displays the rectifier output specifications.

Specification	Value
DC Output Voltage	20 to 30 VDC [factory preset at 27 VDC]
Output Power	600 W Maximum
Regulation: Load Line	 <0.5% (Load 0 to 100%) <0.1%
Current Limit	110% Max. of Rated Output Current
Noise: Audio Band Wide Band Acoustic	 <2mV <10 mVrms (10 KHz to 100 MHz) <55 dBA @ 1M
Current Sharing	<5% of Rated Output Current
Dynamic Response	10% to 90% Load Change Overshoot ≤5% Rated Output Voltage Recovery Time <1 ms to ≤1% Rated Output Voltage
Protection	Fuse

3.2.1.3 Protection

Table 7 displays the protection specifications.

Condition	Response	Specification
High Output Voltage	Automatic Shutdown and Latch	29.5Vdc ± 0.5Vdc
Over Current/Output Short	Automatic Shutdown and Recovery	
Over Temperature	Automatic Shutdown and Recovery	85 °C ± 5 °C
Brownout	No Damage	
AC Input Voltage High	Automatic Shutdown and Recovery	310Vac ± 10Vac
AC Input Voltage Low	Automatic Shutdown and Recovery	70Vac ~ 85Vac

3.2.1.4 Adjustments

Table 8 displays the adjustments.

Adjustment	Description
Test Points (I+,I-)	Current (10A ⇔ 2V)
Float Voltage (FLO)	Variable Resistor or Setting on ALU
Current Limit (CL)	Variable Resistor or Setting on ALU

3.2.2 Environmental

Table 9 displays the environmental specifications.

Specification	Value

Operating temperature	32°F to +122°F (0°C to +50°C)
Storage temperature	-40 to +185°F (-40°C to +85°C)
Humidity	0% to 95% Relative Humidity Noncondensing
Altitude	-500 ft. to 10,000 ft.
Weight	2 Kg (4.4 lbs.)
EMI/FRI suppression	Conforms to EN 55022, BS 6527 FCC Part 15 Subpart J, and CISPR 22 Class B
Current harmonic	Conforms to EN 61000-3-2/A12, EN 60555-2, IEC 555-2 Class A
Voltage fluctuation	Conforms to EN 61000-3-3, EN 60555-3
Electrostatic discharge	Conforms to EN 61000-4-2, IEC 1000-4-2, IEC 801-2 Level 4
Radiated susceptibility	Conforms to IEC 1000-4-3, IEC 801-3 Level 3
Electrical fast transients	Conforms to EN 61000-4-4, IEC 1000-4-4, IEC 801-4 Level 4
Conducted susceptibility	Conforms to IEC 1000-4-6 Level 3
Lightning/surge	Conforms to ANS/IEEE C62.41.-1, 1991 B3, IEC 1000-4-5 Level Special (6KV)
Safety	Meets IEC 950, EN60950, UL/C^{UL} and UL Listed and CE Marked
MTBF	>150 K hours
Cooling	Fan cooling

3.2.3 Status/Alarm Indicators

Table 10 displays the status alarm indicators

Indicator	Color	Function	Description
LED	Amber	CL	Current Limit
LED	Green	AC	AC ON
LED	Red	RFA	Rectifier Failure Alarm

3.2.4 Mechanical Data

Table 11 displays the rectifier mechanical data.

Dimension	Value
Height	5.2 in. (132mm)
Depth	10.35 in. (263mm)
Width	3.3 in. (83.6mm)

3.3 Operation and Adjustment

All operating adjustments are made at the front panel of each rectifier. The following components are located on each rectifier panel:

1. Float voltage adjustment
2. Current limit adjustment
3. Current test points
4. Alarm indicators

Figure 3 shows the indicators and adjustment points on this unit.

Rectifier adjustments must be done sequentially from the first through the fourth rectifier with AC applied. All adjustments must be made with no load, and the batteries disconnected to ensure adjustment accuracy.

3.3.1 Start-Up

To start up the system, approximately 3 to 8 seconds after the AC applied, the RFA LED extinguishes.

3.3.2 Float Voltage Adjustment

Verify the required float voltage setting per battery manufacturer specification. If the factory setting differs from the battery manufacturer recommended setting, the ALU float voltage parameter and each rectifier's float voltage must be adjusted to the new setting. A digital multimeter and a small screwdriver are required to perform this procedure. Located the float voltage access point (FL) at the front of the rectifier.

To adjust the float voltage, perform the following steps:

1. Remove the ALU.
2. Place the digital multi-meter probe in the V+ and V- output voltage connecter.
3. Adjust the float voltage by using a screwdriver to turn the FL point to the voltage value as shown on the meter. The tolerance error should not exceed 0.02V.

Notes:

1. ***Turning the variable resistor adjustment point clockwise increases the value, and counterclockwise***
2. ***Refer to Figure 3 (rectifier front view) for the location of V+, V- and FL point.***
3. ***When the setting is completed, temperature and voltage compensation must be reset to the default value.***

3.3.3 Current Limit Setting

Warning: Current limit setting is not intended to be adjusted in the field. Users should only use it for their reference.

Current limit adjustment is made by turning the CL variable resistor with the digital multimeter probes in the I+, I- test points. This current limit is set at the factory. The factory setting is always the maximum value of 110%. For a 24V/20Amp rectifier, the computation for the current limit is 1.1×20=22Amps.

The following adjustment procedure is for reference only:

1. At the rectifier, place the digital multimeter probes in the I+, I- test points.
2. Place a small screwdriver in the CL adjustment point.
3. Turn the variable resistor counterclockwise to increase the value. Turn the variable resistor clockwise to decrease the current limit value.

3.4 System Alarm

During an alarm condition, the faulty rectifier illuminates its RFA light on the front panel. The rectifier fail alarm signal is sent to the ALU, which processes the alarm, closes the RFA alarm contacts, and lights the

alarm LEDs.

3.5 PSU Block Diagram

Refer to Figure 5.

3.6 PSU Operating Principle

After applying the incoming line voltage to the rectifier, current is applied to the EMI filter and circulates through protection components such as the AC circuit breaker and the fuse. The major functions of the protection devices are to prevent the rectifier from being damaged by surge voltage, to efficiently reduce the noise of differential mode and common mode, to eliminate the high frequency noise from input current, and to prevent noise reverse to the source circuit.

The AC input voltage is rectified and converted to a 400 VDC bus through a PFC boost stage. This PFC stage maintains the Power Factor at >.99 and the Total Harmonic Distortion (THD) at <7%.

The 400 VDC bus voltages is modulated at a frequency higher than 100 KHz and stepped down through a transformer. Output of this transformer is rectified and filtered to provide the output DC voltage.

4 Alarm Control Unit

4.1 Description

The Alarm Control Unit (ALU) with RS232 & LAN interface and remote monitoring function provides output alarms, alarm threshold adjustments, float and equalize voltage adjustments, temperature compensation voltage settings, low voltage disconnect voltage threshold settings, an equalize charge timer, and system alarm LEDs. The module is hot-swappable.

Input Voltage Range	Output
90-275 VAC	100%

4.2 Specifications

4.2.1 Input Characteristics

Table 13 displays the input characteristics.

Characteristic	Value
Input Voltage Range	20V to 29.5V
Input Current	<0.5 Amps

4.2.2 Push Buttons

This alarm unit has 4 push buttons on the front panel. These push buttons are used to control the alarm unit. Following are possible functions these buttons will act:

Settings	*Description*
FL/EQU	This button is used to manually select SMR into float or equalize state.
HVSD RST	This button is used to reset alarm state when SMR HVSD .
SMR RST	This button is used to ignore the RFA alarm caused by empty slot.
V/A	This button is used to change the display mode of LED display, "V" is system output voltage and "A" is current.

4.2.3 Indicators

Table 15 displays the ALU indicators.

Indicator	Color	Function	Description
LED1	Green	FL	System Float State
LED2	Yellow	EQU	System Equalize State
LED3	Red	HV	DC High Voltage Alarm
LED4	Red	LV	DC Low Voltage Alarm-Minor
LED5	Yellow	MIN	System Minor Alarm
LED6	Red	MAJ	System Major Alarm
LED7	Red	HVSD	High Voltage Shutdown Alarm
LED8	Red	AC FAIL	AC Voltage Alarm

LED9	Red	FUSE ALM	Fuse Blown Alarm
LED10	Red	LVDS OPEN	Low Voltage Disconnect Open

4.2.4 Relay Output

Table 16 displays the relay output (Please refer to Figure 6)

Relay	Function	Description
Relay1	ACF	AC Failure
Relay2	MAJ	Major Alarm
Relay3	FA	Fuse Alarm
Relay4	HVSD	High Voltage Shutdown
Relay5	HV	DC High Voltage Alarm-Minor
Relay6	LV	DC Low Voltage Alarm-Minor
Relay7	LVDS	Low Voltage Disconnect Open
Relay8	Min	Minor Alarm

4.2.5 ALU Alarm Signal Descriptions

MAJ: Major Alarm

(1) 2 or above rectifiers fail.
(2) Temperature sensor disconnect.
(3) AC Low Voltage Alarm.
(4) AC High Voltage Alarm.
(5) LVDS Trip Alarm.
(6) Over temperature.
(7) HVSD Alarm.
(8) Fuse Alarm.

MIN: Minor Alarm

(1) One rectifier fail.
(2) Current Limit Alarm.
(3) DC High Voltage Alarm.
(4) DC Low Voltage Alarm.

HV: The alarm condition exists when the DC output voltage is higher than the parameter setting.

LV: The alarm condition exists when the DC output voltage is lower than the parameter setting.

AC Fail: The alarm condition exists when the AC voltage is absent.

LVDS: The alarm condition exists when the DC output voltage is lower than the threshold voltage.

Fuse Fail: The alarm condition exists when the DC Load output fuse is blown.

4.2.6 Physical

Table 18 displays the ALU mechanical data.

Dimension	Value
Height	5.2 in. (132mm)
Depth	9.54 in. (242.4mm)
Width	1.85 in. (47mm)

4.2.7 Environmental

Table 19 displays the environmental specifications.

Specification	Value
Operating temperature	32°F to +122°F (0°C to +50°C)
Storage temperature	-40°F to +185°F (-40°C to +85°C)
Humidity	0% to 95% Relative Humidity Non-condensing
Altitude	-500 to 10,000 ft.
Weight	4.4 lbs. (2Kg)
ESD	IEC 1000-4-2 (Contact 4KV Air 8KV)

4.2.8 Remote Monitoring and Control

The ALU provide the flowing remote monitoring methods.

- Use RS232 Interface.

4.3 Parameter Setting and Control

4.3.1 Parameter setting

Items	DESCRIPTIONS	Default Setting	Recovery	Setting Range	Window	Tolerance
ACH	AC high voltage alarm threshold	264V	261 V	221~330V	3V	±3V
ACL	AC Low voltage alarm threshold	176V	179 V	110~219V	3V	±3V
DCH	DC voltage High Alarm	29V	28 V	28-30v	1V	±0.5V
DCL	DC voltage Low Alarm	23V	24 V	22-26v	1V	±0.5V
TBH	TB Temp High Alarm	40°C/104°F	37°C/95°F	20~65°C /68~149°F	3°C/9°F	±3°C/±5°F
Temp Comp	Temperature Compensation	ON		ON/OFF		
		Above 1.3V		0~1.8		±0.2V
		Below 1.3V		0~1.8		±0.2V
FL Voltage	FL Voltage Setting	27V		26~28V		±0.5V
EQU Voltage	EQU Voltage Setting	28V		26.2~28.3V		±0.5V
HTSD SW	TB Temp High SD Switch	ON		ON/OFF		
HTSD Point	TB Temp High SD Point	67°C/153°F	53°C/128°F	Default Setting	15°C /25°F	±3°C/±5°F
HVSD	DC Voltage SD Alarm	30v	29v	29-30	1V	±0.5V

Auto Equ Charge Tm	Auto Equ Charge Time	1		0~23hr		
Bat Cap	Batter Total	74AH		0~600AH		
LVDS Trip	LVDS1 Trip Voltage	22	Least One SMR Work	19-23v		±0.5V
BATT Div	BATT Div	4		1~20		
M-D-Y-H-M-S	Current Time	Current time				

4.3.2 Control

Settings	Description	Comment
Remote SMR On/Off Function Description	 Remote SMR on/off capability exists through the CSU control. CSU automatically shuts down SMR in case of DC high voltage. Users can manually shut down SMR from Remote Management System.	
Floating/Equalize control Function Description	 SMR floating/equalize status can be set through the CSU control. CSU automatically transfer SMR to floating mode in case of mains recover after deep discharge resulted from blackout/battery test Users can manually set SMR to floating or equalize from CSU.	
HVSD Recovery - Function	- When system HVSD alarm recovery and system voltage reduce to normal, this function is used to reset the HVSD alarm	

4.3.3 Parameter Modify

Enter the Remote monitoring software or use the internet Brower to modify the parameter.

5 DC Distribution

5.1 DC Cabling

The DC output terminal which marked “FAA” (Load-) and “BATTERY & FAA DC 0V” (Load+) are at the rear of the shelf. Refer to Figure 4.

5.2 Low Voltage Battery Disconnect

The low voltage disconnect contactor is installed in front of the battery connection bus. Battery and system bus are connected in parallel. When LVDS opens, it disconnects the batteries from the system bus.

5.3 Battery Connections

The battery connections are behind the distribution module should be made through the breaker. “BATTERY & FAA DC 0V” (Load+) for battery positive and “BAT. Load” (Load-) for battery negative.

5.4 Battery Breaker

100A * 1

5.5 DC Output Breaker

30A * 5

5.6 LVDS

80A * 1, Single Pole at Battery Side.

6 Installation

6.1 Preliminary Inspection

Prior to removing the system from the crate, note any damage to the carton. Remove the system from the packaging and inspect the shelf and components for any dents or damage. If any damage is noted, contact the carrier immediately.

6.2 System Mounting

The power system is typically shipped with the shelf in one carton and rectifiers in individual cartons. The shelf typically is shipped with the ALU and the distribution module. The module can be mounted in a 19”relay rack provided by the customer.

This system allows the relay rack to be installed as close to a rear wall as is necessary for the installation. The front of the system should be clear of all obstruction and allow room for proper ventilation, installation, and maintenance.

6.3 Module Installation

In order to reduce the weight of the system, all power modules can be removed from the shelf when mounting the shelf onto a rack.

1) Ensure that the AC power is isolation.
2) Loosen the fixed thumbscrew on the rectifier and pull the rectifier out.
3) Loosen the fixed thumbscrew on the ALU panel and pull the ALU out.
4) Reverse the procedure, to install the rectifier and ALU.

6.4 Shelf Wiring

The shelf comes fully assembled and is equipped with the ALU and the distribution module. All internal connections are made at the factory. No internal, shelf, or module wiring is required.

6.5 AC Input Connections

The power system is equipped with one power terminal located at the center rear of the shelf. Please refer to figure 7.

Warning: ***1. Failure to use the appropriate power wire causes safety hazards.***

2. Each shelf requires a (1) properly grounded AC input feeds.

3. The system operates at AC voltages that can produce fatal electrical shock. Installation and maintenance personnel must observe all safety precautions.

4. Confirm the operating voltage and proper grounding of the incoming line before proceeding.

6.6 Battery String Connections

Warning: ***1. Verify the polarity of the battery leads prior to connecting the battery cables to the system. Failure to connect the battery cables correctly to the system can cause damage to batteries and the system.***

2. While connecting the battery cables inside the distribution module, make sure the system is

completely disenergized (that is, the AC lines are turned off and the battery cables are disconnected at the battery end).

3. The system voltage (rectifier output voltage) is –48 VDC. Connect the positive battery cable(s) to the "BATTERY & FAA DC 0V" (BATT+) and connect the negative battery cable(s) to the "BATT – Load" (BATT-).

6.7 Alarm Connections

Alarm Terminal Block Pin Assignments

Alarm	Description
ACF	AC Failure
MAJ	Major Alarm
FA	Fuse Alarm
HVSD	High Voltage Shutdown
HV	DC High Voltage Alarm-Minor
LV	DC Low Voltage Alarm-Minor
LVDS	Low Voltage Disconnect Open
Min	Minor Alarm

Each alarm connection is provided with a normally close relay contact. This contact is capable of carrying 1 Amp DC at 30VDC on a continuous basis.

Warning: All external circuits connected to these alarm relay terminals must be secondary and properly isolated from the incoming line.

7 System Start-Up Procedure

7.1 Initial Start-Up Preparation

1. Verify all connections prior to starting this section.
2. Confirm the operating voltage before proceeding.
3. Ensure that the AC line is properly grounded.
4. Ensure the battery DC circuit breaker is switched to the “OFF” position

7.2 No Load Start-Up

The system can be started up without a load. To start up the system, perform the following steps:

1. Switch all DC distribution circuit breakers to the “OFF” position and/or remove all the fuses. If there is the AUX. PDU in the system.
2. Verify that the battery is not connected to the system battery bus or ensure the battery switch in the “OFF” position.
3. Check the ALU for alarm and status conditions.

7.3 Basic Functional Verification

After system start-up, basic functional verification should proceed as follows:

1. Check the ALU status and alarm LEDs.
2. Compare the rectifier DC voltage readings at the ALU with the output voltage of each rectifier by using digital multimeter (measure at the V+ and V– points located on the front of each rectifier).

7.4 DC Load Connections

1. Connect the positive load wires to the Load +.
2. Connect the negative load cable to the Load -.

Please refer to section 5 DC Distribution.

7.5 System Functionality Check

Control and supervisory functional testing can be performed at the ALU after the basic functional testing is completed and the DC load is connected.

7.5.1 System Status and Alarms

Check the status of the equipment by viewing the ALU alarm and status LEDs.

7.6 System Operation

Upon completion of the system functional testing, the system is operational.

8 System Alarms and Troubleshooting

8.1 AC Fail Voltage Alarm Description

8.1.1 Description

If the ALU detects an input AC voltage below 50 VAC, the ALU sends an AC Fail alarm signal and activates the dry contact. The AC Fail LED on the ALU panel lights up. When AC voltage is restored to the nominal input voltage, the ALU extinguishes the AC Fail LED, and returns the contact to the normally closed position.

8.1.2 Troubleshooting

The AC Fail alarm is normally caused by a commercial AC interruption due to a storm or maintenance. If commercial AC is detected at the AC panel, check the rectifier input breakers in the AC panel for a tripped or failed breaker.

Warning: The ALU senses the AC line through the AC Input terminal. If this connection is missing, the system generates an AC Fail alarm.

8.2 High Voltage Shutdown Alarm

8.2.1 Description

When the ALU detects the output DC voltage exceeding the HVSD threshold setting, the ALU sends an HVSD alarm signal and activates the dry contact. The ALU lights the HVSD LED located on the ALU panel and shuts down each rectifier. At this point, the system is running on reserve batteries. When the DC voltage falls below the HVSD threshold voltage, and push the HVSD RST Button, then the system recovers. The ALU extinguishes the HVSD LED, returns the rectifiers to service, and closes the normally closed set of contacts.

8.2.2 Troubleshooting

High voltage shutdown occurs when the output voltage exceeds the HVSD threshold. This can be caused by a rectifier failure, the system equalize voltage exceeding the HVSD threshold, or temperature compensation exceeding the HVSD threshold setting.

1. Restart the rectifiers by resetting the HVSD RST button located on the ALU.
2. Verify the output voltage of each rectifier in both float and equalize.
3. Verify that the equalize voltage setting does not exceed the HVSD threshold setting.
4. Verify the temperature compensation voltage setting. Ensure that Temp Comp does not exceed the HVSD threshold setting when operating in cold temperatures.

8.3 Low Voltage Alarm

8.3.1 Description

The Low Voltage alarm (LV) is a minor alarm activated when the DC output voltage decreases below the LV threshold setting. When the system voltage decreases below the LV LED located on the ALU panel, and activates the LV alarm contact. The rectifiers remain on line during this minor alarm condition. When the system voltage increases above the threshold setting, the ALU extinguishes the LV LED and deactivates the LV alarm contact.

8.3.2 Troubleshooting

The LV alarm condition occurs during a brownout condition or prior to a complete AC Fail condition caused

by commercial AC problem conditions.

Another probable cause is that the temperature compensation voltage decreases the float voltage below the LV threshold during hot temperature operation. During this alarm condition, the system continues to operate.

8.4 Fuse Fail Alarm (or Breaker Trip Alarm)

8.4.1 Description

If the DC load output breaker trip off (or Fuse) opens or battery switch trip off, the ALU sends the alarm condition, lights the LED on the ALU panel, and activates the Fuse Fail alarm.

8.4.2 Troubleshooting

To troubleshoot the fuse/circuit breaker fail alarm condition, perform the following steps:

1. Verify that the fuse/circuit breaker is the proper size (use 80% de-rating guide).
2. Verify that the external fault that might cause fuse/circuit breaker tripping is removed.
3. Replace the blown fuse with a fuse with the same rating or of the corrected value. In case of a circuit breaker, turn it on. If necessary replace with the correct size fuse.

If the fuse/circuit breaker continues to trip, perform the following steps:

1. Check the DC branch load to ensure tat the fuse/ circuit breaker is the correct size.
2. If the branch load exceeds the fuse/circuit breaker rating, the device must be changed to a higher rating.
3. Install a fuse/circuit breaker with a higher rating.

Warning: Ensure that the device rating does not exceed the branch load wire capacity. If the device rating is higher than the branch load wire rating, the branch load wire must be changed to a larger wire. Failure to protect the branch load wire may result in overheating and fire.

8.5 Alarm Unit Fail

8.5.1 Description

During an ALU fail condition, the ALU fail and status LEDs are extinguished, and all alarm contacts open. During an ALU failure, the rectifiers status changes from equalize to float or remains in the float condition. The LVBD does not open during an ALU failure.

8.5.2 Troubleshooting

To troubleshoot the ALU fail condition, perform the following steps:

1. Check the input fuse located on the rear of the ALU. Replace if blown.
2. Check the DC input connectors for proper connections.
3. Replace with a spare and send the faulty unit to Delta for repair.

8.6 Rectifier Fail Alarm

If one rectifier fails, the RF LED on the ALU lights up. When the rectifier goes recovery, the RF LED will shut off automatically.

Warning: Do not open the rectifier unit. There are no serviceable parts..

9 Maintenance

9.1 Cleaning and Maintenance

9.1.1 General

Special maintenance is not necessary for this system, unless the system is being operated in a severely harsh environment (dusty environment). The front panels and the cover of the DC distribution cabinet were treated with a special coating. Do not use organic cleanser or volatile solvent because corrosion damage may occur. For periodic cleaning, brush the dust from the cover and panel. If necessary, use a gentle cleanser or a lightly dampened lint free cloth to remove any dirt or smudges.

9.1.2 Periodic Maintenance

Periodic maintenance is not required for normal operation. If necessary, wipe dust from the front of the power system using a lint free, soft cloth and gently wipe the front of the distribution module, the ALU, and the rectifiers. If necessary, use a gentle detergent to clean.

Warning: Do not use a spray cleanser to clean the equipment. Using a spray cleanser directly on the equipment can result in serious equipment damage.

9.2 Removing and Replacing a Rectifier Unit

9.2.1 Removing a Rectifier

Warning: Do not touch the DC output bus when pulling out the PSU module.

To remove a rectifier, perform the following steps.

1. Turn off the SW on the front of the rectifier, Loosen the captive retaining screws located on the bottom of the front panel.
2. Pull out the rectifier unit slowly from the shelf.

9.2.2 Replacing a Rectifier

To replace a rectifier, perform the following steps:

1. Install the rectifier unit carefully. Place the rectifier on the shelf, ensuring that the rails are on the track.

Warning: Do not force the module into the slot. If does not slide in and connect easily, remove and reset the unit.

2. Lock the rectifier into position by screwing in the captive retaining screws located at the bottom of the rectifier.
3. Turn on the SW on the front of the rectifier. AC ON LED lights.

10 Local & Remote Monitoring and Control

10.1 Description

The Remote Monitoring System (RMS) software version 2.93 or higher allows maintenance personnel to access the MCS 1800 system's CSU without having to be in front of the power system. Using a Windows based PC and the RS-232 interface port on the power system's CSU the craftsperson can gain access to the system. If the CSU is connected to a modem or a web server the power system can be controlled and monitored remotely. The RMS software is needed to access the system remotely via a modem connection and a web server browser program is needed to access the system via the web. The following sections will explain how and what can be access using the RMS software.

10.2 RMS Input Password

The RMS software provides two levels of security: a monitor level and a maintenance level. In the monitoring level of the RMS a craftsperson can access all screens of the program with activity being limited to view-only. In the maintenance level the craftsperson again can access all levels of the program but additionally has the ability to modify passwords, change the rectifier voltage modes (float or equalize), change parameter settings, turn individual rectifiers "on" or "off" or perform other control functions.

The following picture shows the password screen, which is used to access the software. *The password is 56031*

10.3 RMS Main Screen

After the technician supplies the appropriate password, the main setup screen will appear. This screen is used to setup the information for a specific site. From this screen, the technician can set the site name, system type and see how many events are in the system's history log.

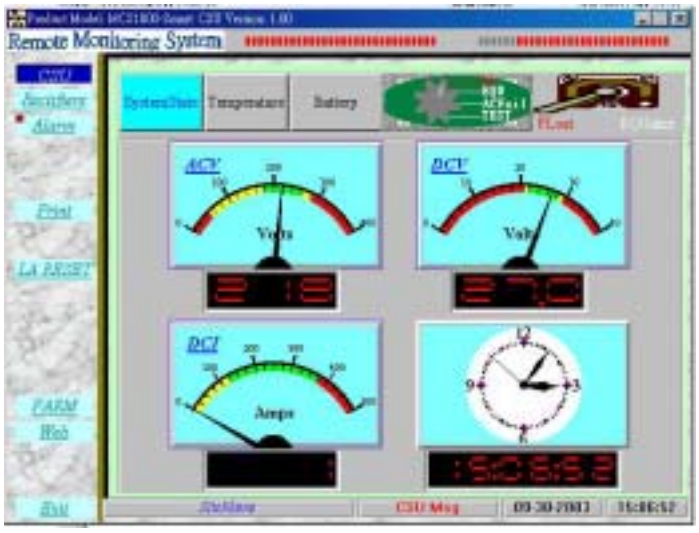
After all the correct information has been entered for the site, the technician must connect to the system. By pressing the button with two computer terminals on it the software will allow the user access to the system to see real time data and alarms.

10.4 RMS CSU Screen

The CSU screen displays a visual real time condition of how the system is functioning. This screen contains all of the information, which can be seen on the main page display.

The indicators listed on the CSU screen include:

AC input voltage
DC output voltage
DC output current
Current time
Battery state: Float, Equalize, or Discharge
Ambient temperature
Battery temperature
Battery discharge current



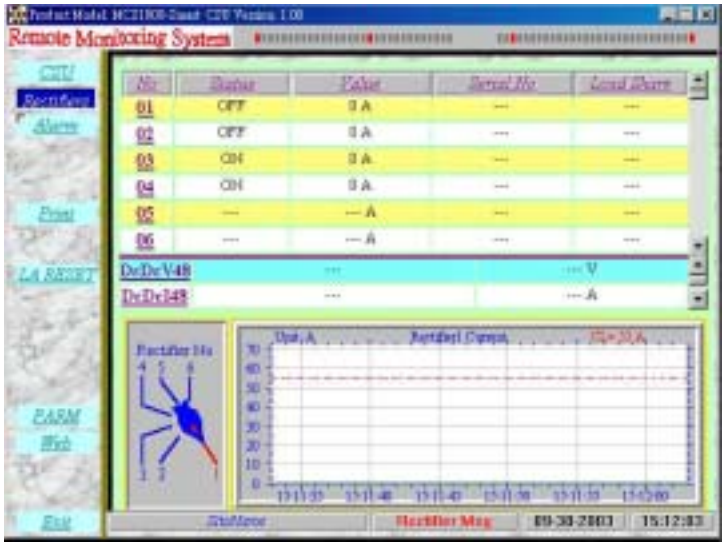

Remote Monitoring System
SystemState
Temperature
Battery
Float
Env Temp
Bat1Temp
Bat2Temp
CSU
Rectifiers
Alarm
Print
LA RESET
PARM
Web
Exit


Remote Monitoring System
SystemState
Temperature
Battery
Float
Bat1Cur
Bat2Cur
Bat Cap
Amps
Est Time
Hour
CSU
Rectifiers
Alarm
Print
LA RESET
PARM
Web
Exit

10.5 RMS Rectifier Screen

The rectifier screen of the software contains the status and output information for each rectifier in the system. Along with the real time status for each rectifier, the current limit that is being determined by the CSU is displayed. This screen also displays the total voltage and output current of the DC-DC converters, if any are installed.

If the technician has logged into the system under the maintenance level then the technician can turn specific rectifiers off, if the need arises. The program will ask for confirmation about this request to make sure it was not made by mistake.

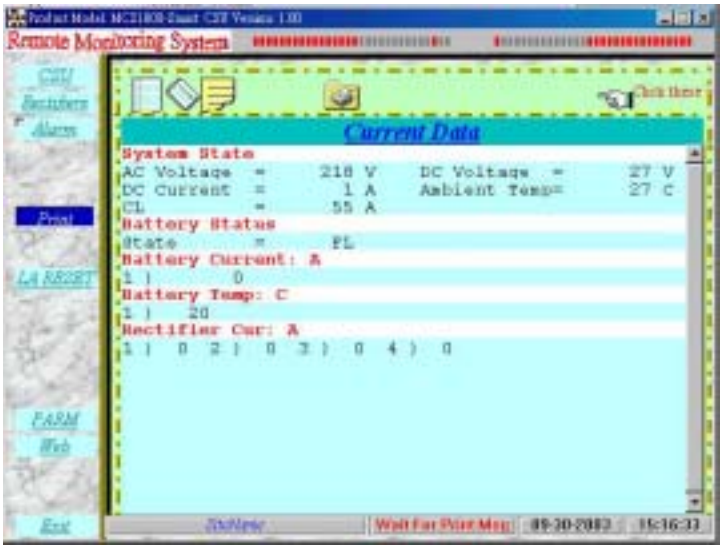


10.6 RMS Alarm Screen

The alarm screen shows the system's alarm status. A red, blinking LED indicates an alarm is currently taking place. The LED is located beside the corresponding alarm or rectifier. Along with the active alarms, this screen will tell you if a circuit breaker has tripped and which breaker it is.

10.7 RMS Print Screen

Utilizing the print screen a technician can print the system's status at that current time. Also from this section the craftsperson can print the alarm history, system settings and the alarms at the current time. Because the software can be used locally or remotely this section allows the technician to print the data to file, which can then be opened at another time or when the technician can access a printer.



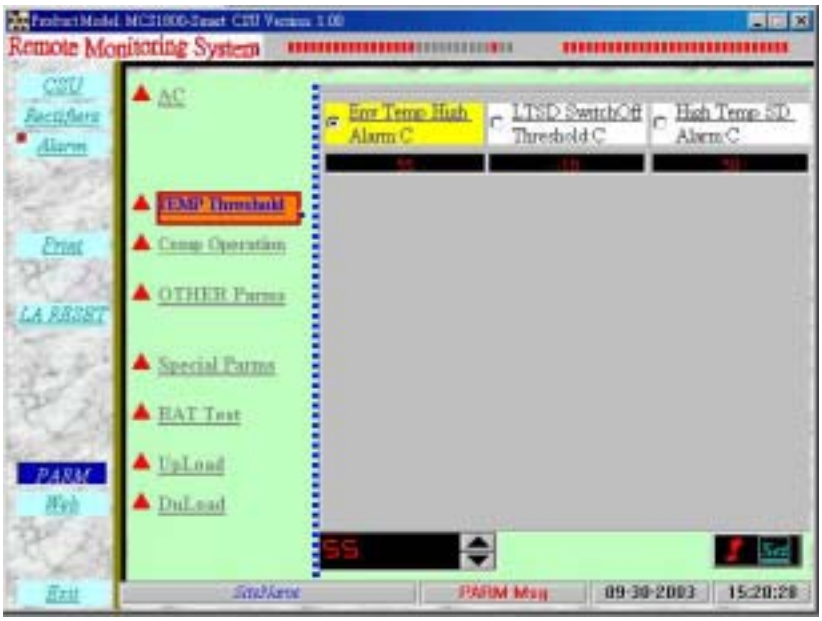
10.8 RMS LA Reset Button

This button allows the user to turn "off" the audible alarm signal on their PC.

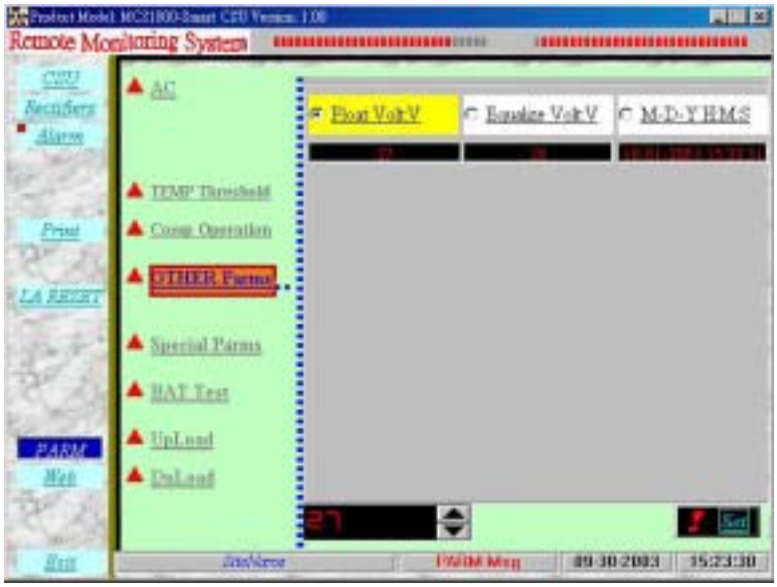
10.9 RMS PARM Screen

The PARM section allows the technician the ability to remotely monitor and/ or change the system parameter settings. The following list shows which parameters the user can modify remotely.

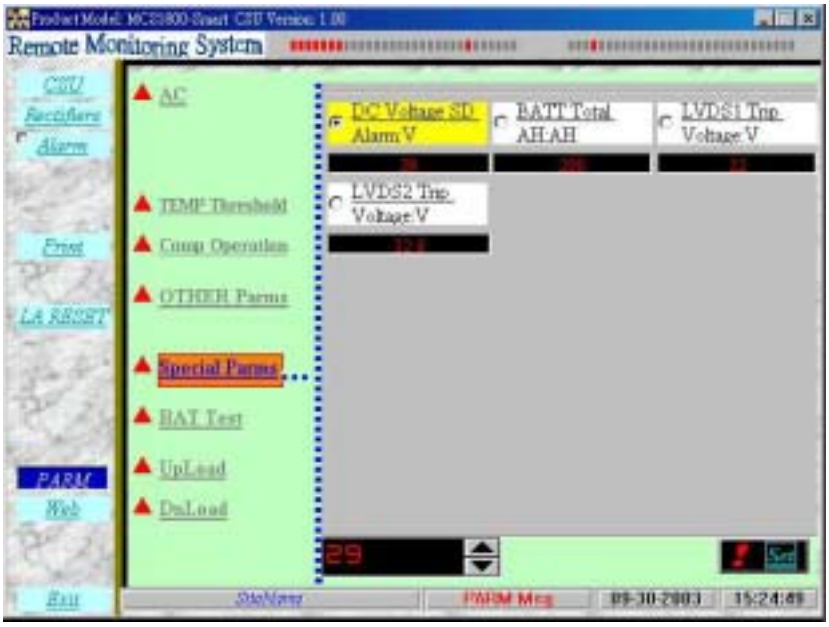
To modified AC voltage



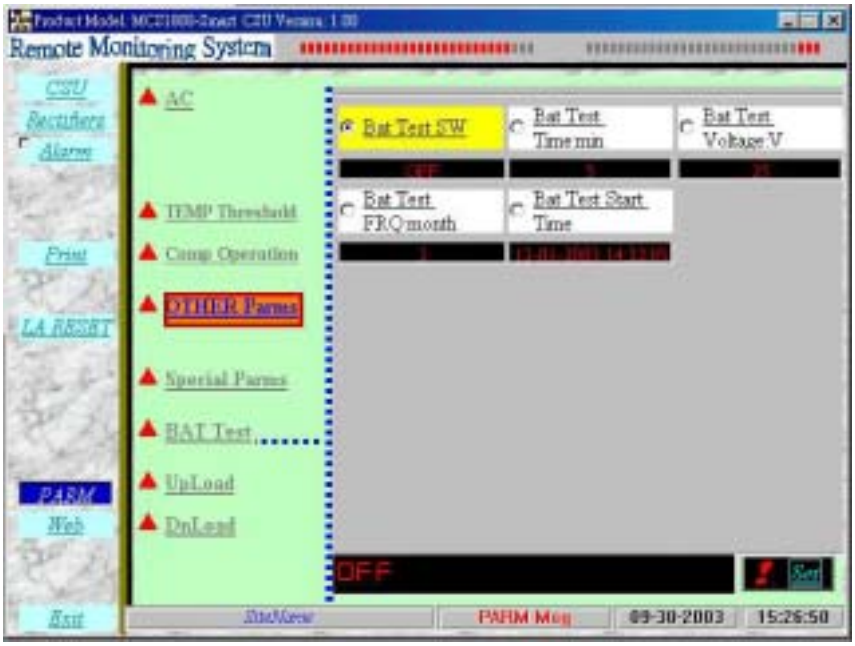
To modified the temperature threshold



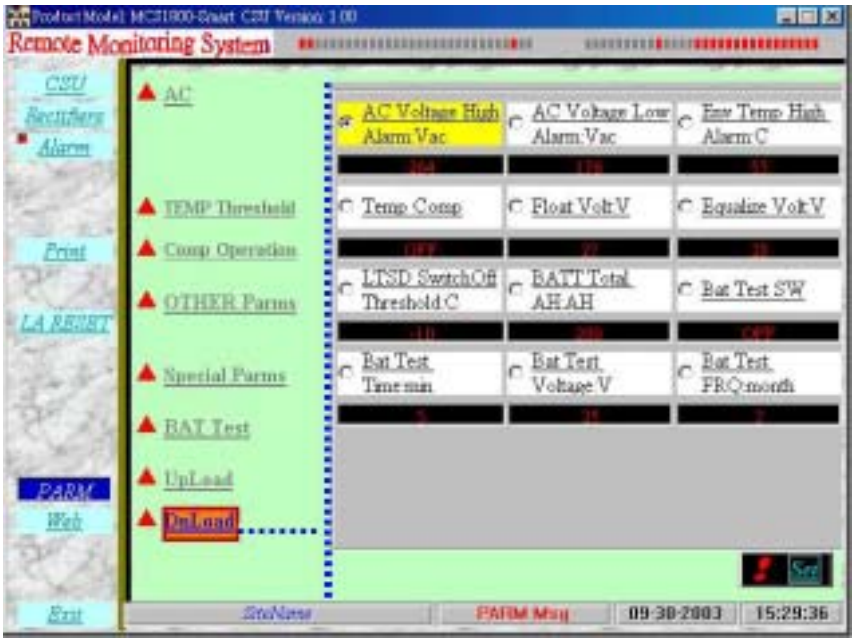
To modified other parameters



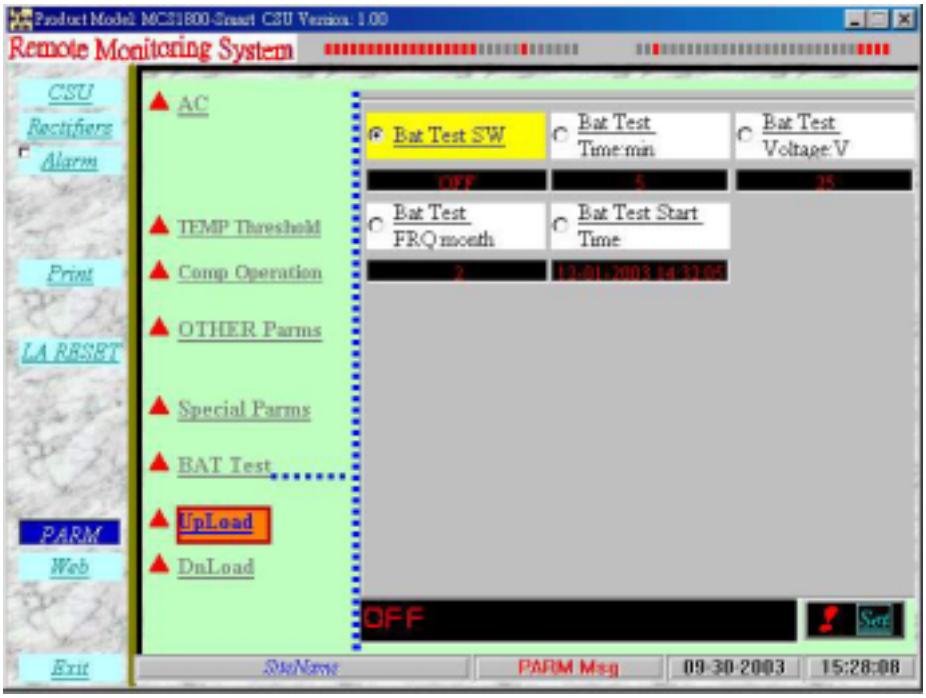
To modified special parameters



To modified battery test



To download



To upload

11 Acronyms and Abbreviations

--- A ---

ALU	Alarm Control Unit
Amp	Ampere
ANSI	American National Standards Institute

--- B ---

BS	British Standard
BTU	British Thermal Unit

--- C ---

C	Centigrade
CB	Circuit Breaker
CE	European Community
CISPR	International Special Committee on Radio Interference
CL	Current Limit
C^{UL}	Canadian Underwriters Laboratory

--- D ---

--- E ---

EMI	Electro-Magnetic Interference
ESD	Electrostatic Discharge

--- F ---

F	Fahrenheit
FCC	Federal Communications Commission
Ft.	Foot

--- G ---

GND	Ground

--- H ---

HL	High Line
HV	High Voltage
HVSD	High Voltage Shutdown
Hz	Hertz

--- I ---

IEC	International Electronics Commission
IEEE	Institute of Electrical and Electronics Engineers
In.	Inch

--- J ---

--- K ---

Kg.	Kilogram
KHz	Kilohertz

KHz	Kilohertz
KV	Kilovolt
KW	Kilowatt

--- L ---

Lb.	Pound
LED	Light-Emitting Diode
LL	Low Line
LV	Low Voltage
LVD	Low Voltage Disconnect
LVBD	Low Voltage Battery Disconnect
LVDS	Low Voltage Disconnect Switch

--- M ---

M	Meter
Max.	Maximum
MHz	Megahertz
Mm	Millimeter
Ms	Millisecond
MTBF	Mean Time Between Failure
MV	Millivolt
mVrms	Millivolt root root mean square

--- N ---

NEMA	National Electrical Manufacturers Association
No.	Number

--- O ---

--- P ---

PF	Power Factor
PFC	Power Factor Correction
PSU	Power Supply Unit

--- Q ---

Qty.	Quantity

--- R ---

RFA	Rectifier Failure Alarm
RFI	Radio Frequency Interference
RH	Relative Humidity
RMA	Return Material Authorization

--- S ---

--- T ---

TB	Terminal Block
THD	Total Harmonic Distortion

--- U ---

UL	Underwriters Laboratory

--- V ---

V	Volt
VAC	Volts AC
VDC	Volts DC

--- W ---

W	Watt

--- X ---

--- Y ---

--- Z ---

Figure 1: Functional Blocks Power Shelf

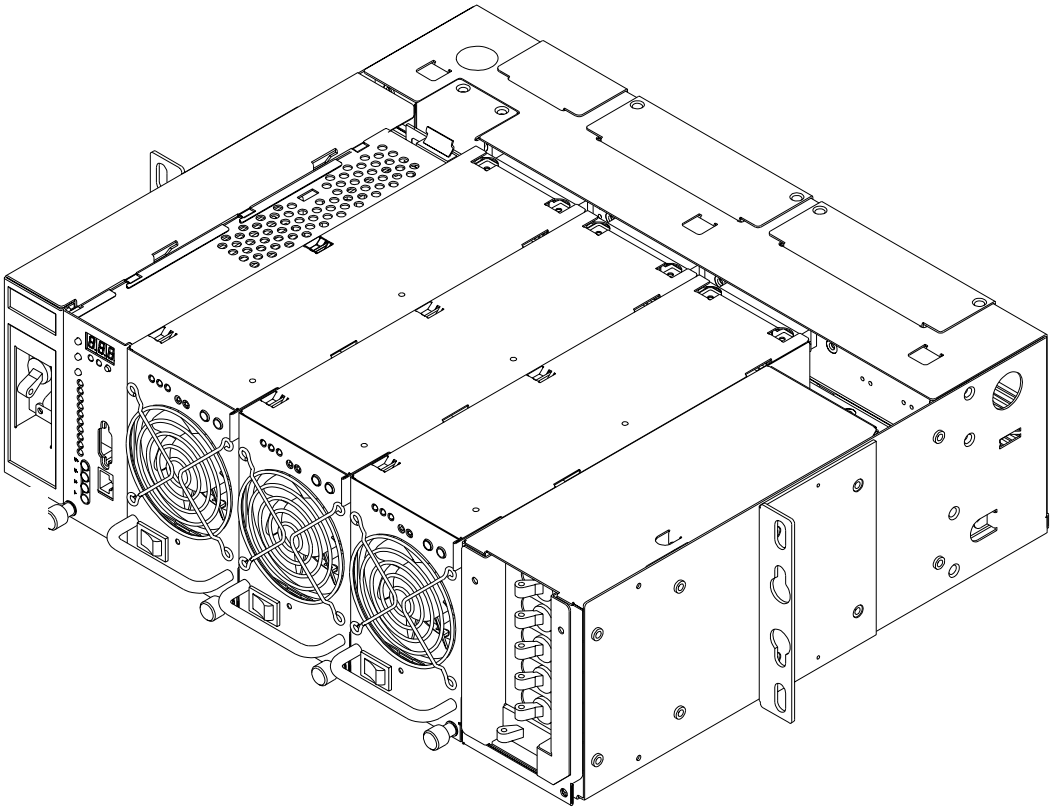


Figure 2: Control Supervisory Unit

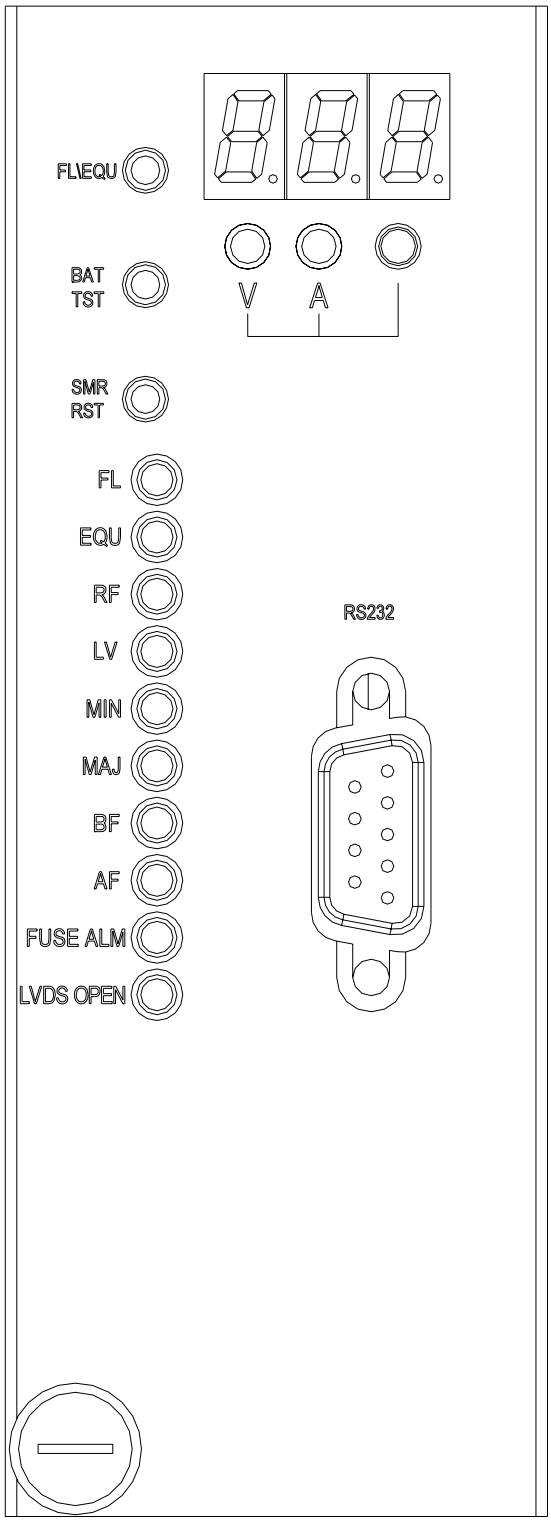


Figure 3: Switching Mode Rectifier

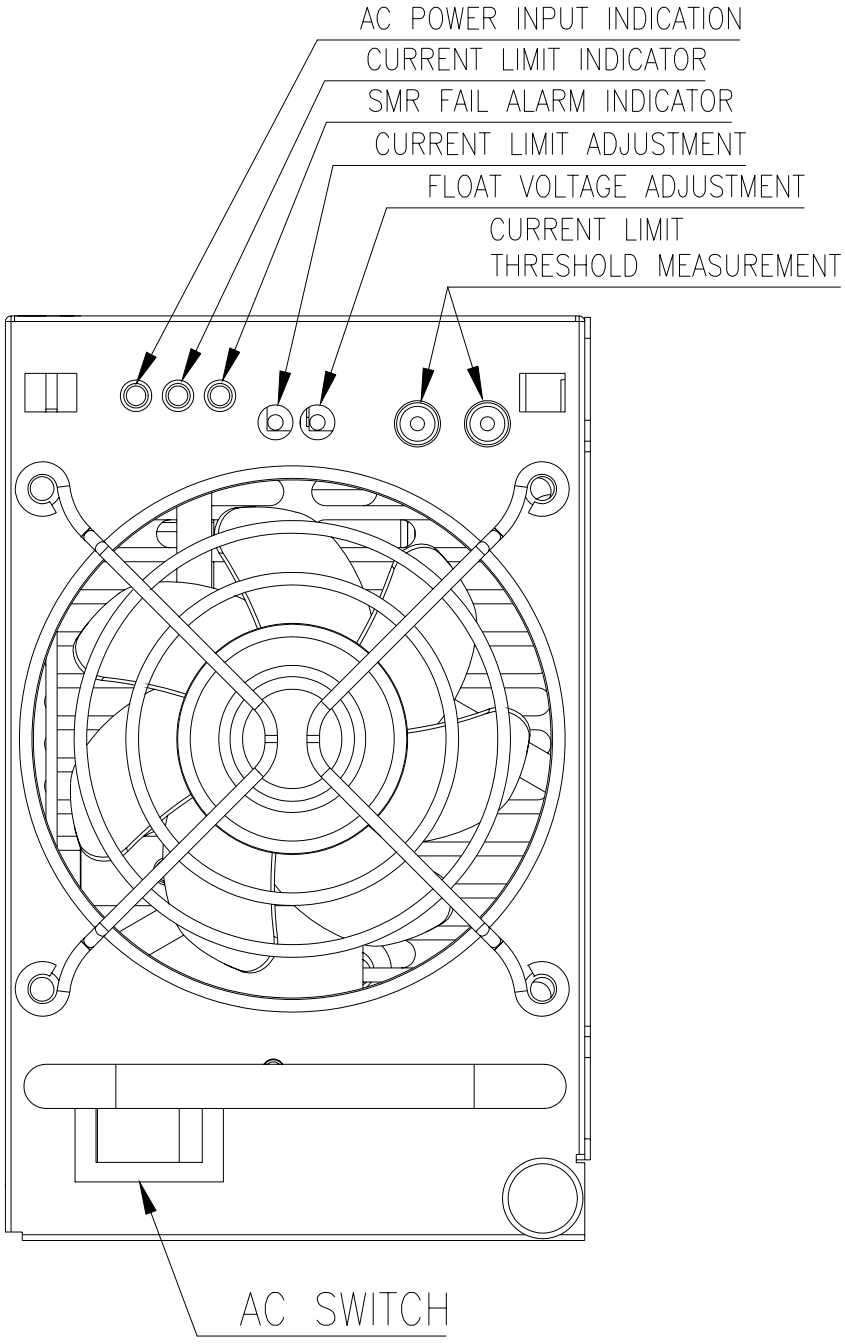


Figure 4: PSU Block Diagram

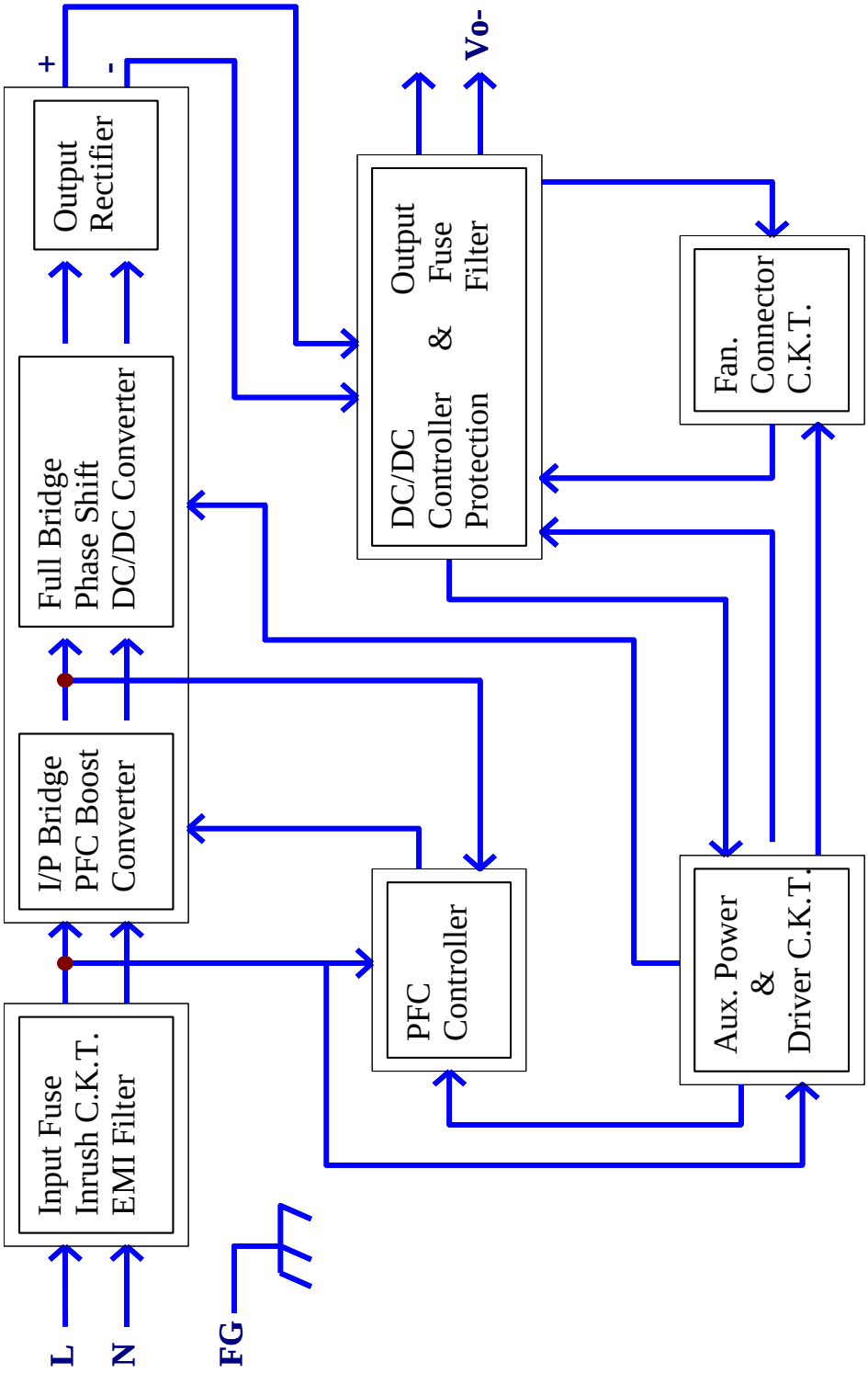


Figure 5: ALU Block Diagram

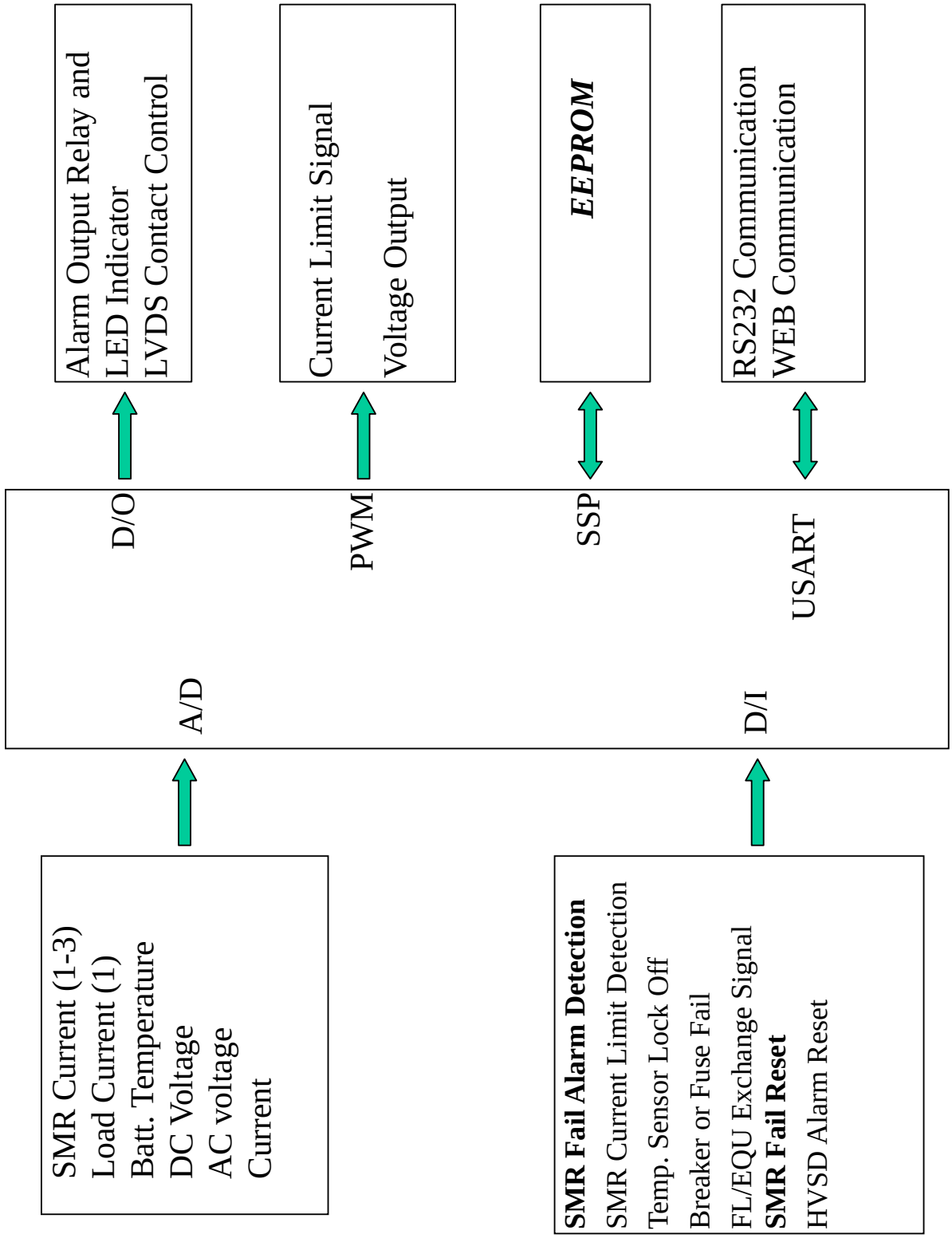


Figure 6: System Schematic

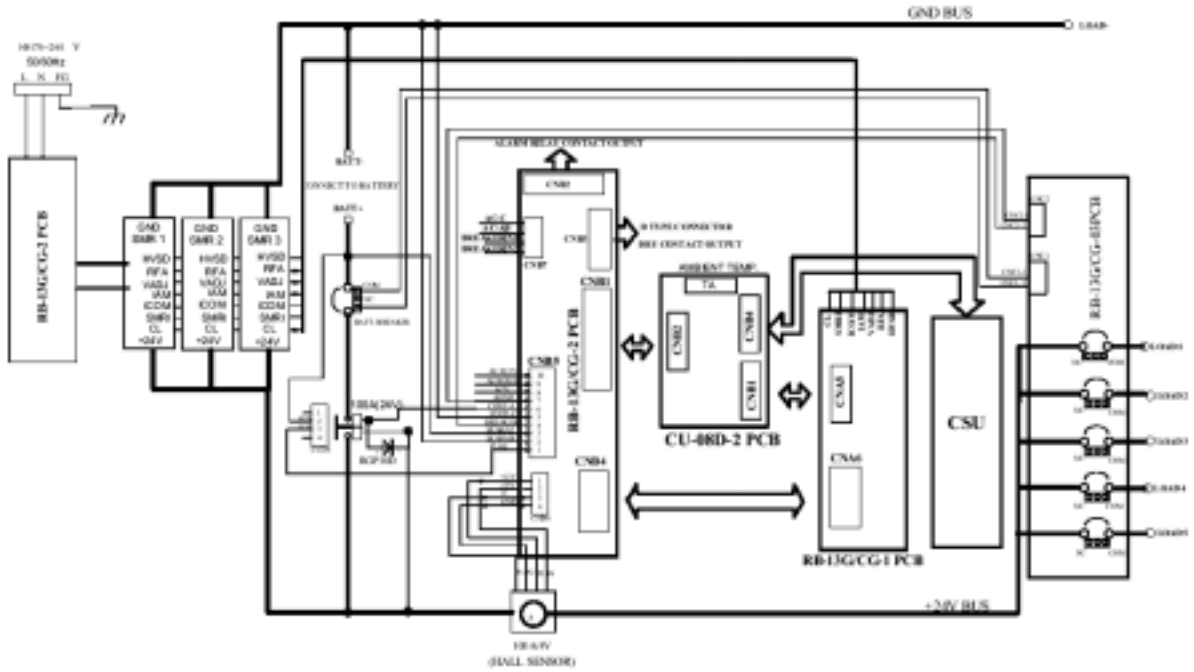


Figure 7: Dimensions