

Delta MCS-1800 Power Shelf

Model: ES24/200 JBA series

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 Unit (ALU) and the 24V Power Supply Unit (PSU). Additional information is provided on system status and alarms, troubleshooting, and system maintenance. Appendix figures of this manual contain drawings, simple block diagram 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

Delta Electronics Inc. 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 Rectifier module and Alarm Unit (ALU). Up to four 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, and alarm thresholds are set from RMS. Fig. 1 and 2 shows the system outlook.

2.2 Product Main Features

The Power Shelf has the following main features:

- 24V/50~200A system (rectifier * 1~4)
- Complete power plant in one shelf including rectifier and alarm unit
- Hot swappable 1800 Watts rectifiers, wide range PFC input
- All modules are front accessible
- High power density in N+1 configuration
- Battery breakers
- Load breakers
- Low voltage disconnect for battery (LVDS)
- Low voltage disconnect for low priority load
- Battery temperature compensation voltage control
- Equalize charge timer
- Temperature sensors (Ambiance temperature, battery temperature)
- User friendly operation interface
- RS232 Interface local access
- RJ-45 remote management Web Server function
- Safety: CE
- Wide operating temperature range: 14 ~140 / -10 ~+60

2.3 System Specifications

2.3.1 Power Shelf Configuration

- | | |
|----------------------|--|
| (1) AC Input: | 90VAC ~ 264VAC, Single phase or three phases |
| (2) System Capacity: | 24V/50~200Amps. |
| (3) Rectifier: | 24V/50A×1~4 |
| (4) Alarm Unit | |



- (5) Battery Breakers 200A * 2
- (6) Load Breaker 63A * 2, 25A * 2, 16A * 2

Figure 1 shows a front view of shelf and Figure 10 shows the schematic of the system.

2.3.2 Electrical Data

2.3.2.1 Input

Table 1 displays the system input specifications.

Table 1 System Input Specifications

Specification	Value
Nominal range	90Vac.~264Vac.
Operational range	176Vac.~264Vac 100% Load 90Vac.~175Vac 50% Load
Frequency	45Hz~65Hz
Power Factor	>0.99 @ 220VAC, Full Load
THD	<5% @ 220VAC, Full Load
Efficiency	>90% @ 220VAC, Full Load

2.3.2.2 Output

Table 2 displays the system output specifications.

Table 2 System Output Specifications

Specification	Value
DC Voltage	24Vdc.~29Vdc
Load regulation	<0.5%
Line regulation	<0.1%
Current Limit	110%
Current share	<5%

2.3.2.3 Status/Alarm Indicators

The Power Shelf has the following LEDs for status/alarm indicators:

- AC OK (AC)
- DC OK (DC)
- Battery Fail Alarm (BAT_F)
- Temperature Abnormal Alarm (TEMP)
- Low Voltage Disconnect For Low Priority Load (LVDC)
- System In Equalized Condition (EQU)
- Minor Alarm (MIN)
- Major Alarm (MAJ)
- Low Voltage Disconnect For Battery (LVDS)
- DC Output and battery breaker Tripped (BRK)

The following LEDs are on the rectifier



- AC OK
- Current Limit
- Rectifier Fail Alarm

2.3.2.4 Buttons

There are 3 push buttons on the front panel. These push buttons are used to control the alarm unit.

Table 3 Buttons function

Button	Description
SD-RST	All rectifier will recover when push the “SD-RST” button
Rough Test	This button is used to manually execute the battery rough test. This button switches start or stop battery rough test function.
FL/EQU	This button is used to manually select SMR into float or equalize state. This button switches float or equalize mode.

2.3.2.5 Mechanical Data

Table 4 Displays the system mechanical data.

Table 4 System Mechanical Data

Dimension	Value
Height	12.2 in. (309.6mm)
Depth	15.01 in. (381.4mm)
Width	19.01 in. (482.6mm)

2.3.2.6 Environmental Data

Table 5 displays the system environmental data.

Table 5 System Environmental Data

Specification	Value
Operating temperature	-10 to +60
Storage temperature	-30 to +80
Humidity	0% to 95% RH
Altitude	-500 ft. to 10,000 ft.
Safety	CE
MTBF	> 100K hours (25 °C)



3. Power Supply Unit (PSU)

3.1 Description

This rectifier units are rated at full load when operated from high line. For Low operation, the output is de-rated to half load. This de-rating is automatically activated from the Alarm Unit (ALU). However, the rectifier can operate on a stand-alone basis, if this ALU is removed or nonfunctional.

Warning: *In the absence of the ALU, the automatic de-rating of the rectifiers at Low Line 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. Figure 4 shows a front view of PSU.

Note: *The equipment is only for installation in a Restricted Access Location.*

The equipment is used on a stationary equipment/unit only.

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 6 displays the rectifier input specifications.

Table 6 Rectifier Input Specifications

Specification	Value
Input Voltage	90VAC to 275VAC, Single Phase or three phases, (during 90 to 175 VAC de-rated to 50% Load)
Input Current	12 Amps(at 176 VAC, Full Load or at 90VAC,Half Load)
Line Frequency	45 to 65 Hz
Power Factor	>0.99, at 220 VAC Input, Full Load
THD	<5%, at 220 VAC Input, Full Load
Efficiency	>90%, 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 7 displays the rectifier output specifications.

Table 7 Rectifier Output Specifications

Specification	Value
DC Output Voltage	24 to 29 VDC (factory preset at 27 VDC, 50 Amps)
Output Power	1400 W Maximum
Regulation:	
Load	<0.5% (Load 0 to 100%)
Line	<0.1%
Current Limit	110% Max. of Rated Output Current
Noise:	
Audio Band	<2mV
Wide Band	<20 mVrms (10 KHz to 100 MHz)
Acoustic	<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 8 displays the protection specifications.

Table 8 Protection Specifications

Condition	Response	Specification
High Output Voltage (Exceeds Preset Value)	Automatic Shutdown and Latch	29.5Vdc ± 0.5Vdc
Over Current/Output Short	Automatic Shutdown and Recovery	120%~135% Of Rated Current s
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 9 displays the adjustments.

Table 9 Adjustments

Adjustment	Description
Test Points (I+,I-)	Current (10A ⇔ 0.8V)
Float Voltage (FLO)	Variable Resistor or Setting on ALU
Current Limit (CL)	Variable Resistor or Setting on ALU



3.2.2 Environmental

Table 10 displays the environmental specifications.

Table 10 Environmental Specifications

Specification	Value
Operating temperature	14 to +140 (-10 to +60)
Storage temperature	-22 to +176 (-30 to +80)
Humidity	0% to 95% RH Non-condensing
Altitude	-500~10,000ft
Weight	3.3 Kg (7.26 lbs.)
EMI/FRI suppression	Conforms to EN 55022, BS 6527 FCC Part 15 Subpart J, and CISPR 22 Class A
Current harmonic	Conforms to EN 61000-3-2/A12, EN 60555-2, IEC 1000-3-2 Class A
Voltage fluctuation	Conforms to EN 61000-3-3M, 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} /CE Approval
MTBF	>150 K hours (25 °C)
Cooling	Fan cooling
Heat dissipation	682 BTU/hour max. per module

3.2.3 Status/Alarm Indicators

Table 11 displays the status alarm indicators

Table 11 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 12 displays the rectifier mechanical data.

Dimension	Value
Height	3.3 in. (83.6mm)
Depth	9.2 in. (233mm)
Width	5.2 in. (132mm)

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 different 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

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 multimeter probe in the V+ and V- output voltage connector.
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/50 Amp rectifier, the computation for the current limit is $1.1 \times 50 = 55$ Amps.

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 Fig.6.

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 $<5\%$.

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 Unit (ALU)

4.1 Description

The Alarm Unit (ALU) with RS232 & LAN interface and remote monitoring function provides output alarms, alarm threshold adjustments, equalize voltage adjustments, low voltage disconnect voltage threshold settings, and system alarm LEDs. In addition, the ALU automatically derates the system output current according to the following table:

Figure 3 shows a front view of Alarm Unit.

Table 13 Voltage Ranges

Input Voltage Range	Output
90Vac ~175Vac	50% Load
176Vac ~ 264Vac	100% Load

The module is hot-swappable.

4.2 Specifications

4.2.1 Input Characteristics

Table 14 displays the input characteristics.

Table 14 Input Characteristics

	Value
Input Voltage Range	24V to 29.5V
Input Current	<0.5 Amps

4.2.2 Push Buttons

This alarm unit has 3 push buttons on the front panel. These push buttons are used to control the alarm unit. Following are possible functions these buttons will act:

- SD-RST
- Rough Test
- FL/EQU

4.2.3 Indicators

Table 15 displays the ALU indicators.

Table 15 ALU Indicators

LED	Description	COLOR
AC	AC OK LED	Green
DC	DC OK LED	Green
BAT-F	Battery Fail Alarm LED	Red
TEMP	Temperature Abnormal Alarm LED	Red
LVDC	Low priority LVDS LED	Yellow
EQU	System in Equalized condition LED	Yellow
MIN	Minor Alarm LED	Yellow
MAJ	Major Alarm LED	Red
LVDS	Priority LVDS LED	Red
BRK	DC output and battery breaker tripped LED	Red

4.2.4 Relay Output

Table 16 displays the relay output

Table 16 Relay Output

Relay	Function	Description
Relay1	MAJ	Major Alarm (More than one battery charger fault and high priority breaker trip)
Relay2	ACF (include: ACH,ACL)	Mains Breakdown (AC Fail)
Relay3	LVDC	Low priority LVDS trip
Relay4	MIN	Minor Alarm (One battery charger fault and low priority breaker trip)
Relay5	Temp	Temp. sensor fail or out of specific range.
Relay6	DC	DC-Output Voltage out of specified range.
Relay7	LVDS	Priority LVDS trip
Relay8	FB	Breaker Trip (Battery or Load)

4.2.5 ALU Alarm Signal Descriptions

Alarm		Description
ACF		<p>Mains Breakdown:</p> <p>Alarm is activated when mains breakdown condition occurs. Mains breakdown condition includes:</p> <ol style="list-style-type: none"> 1). AC down (AC below 80V), 2). AC high voltage (AC over default setting: 264V±1V, Recovery: under 261V±1V) @ system mains input voltage: 220Vac 3). AC low voltage (AC under default setting: 176V±1V, Recovery: over 179V±1V) @ system mains input voltage: 220Vac
LVDC		<p>LVD (low priority) relay trip alarm:</p> <p>The alarm is activated if battery low voltage relay is disconnected in case the magnitude of the battery voltage is below 23V±0.5V. The alarm is recovered when mains voltage is recovered and rectifier is on.</p>
TEMP-F	OTA	<p>Environment Over Temperature Alarm:</p> <p>The alarm is activated while environment temperature over 50 , the alarm is recovered when temperature is lower than OTA default 5</p>
	LTA	<p>Environment Under Temperature Alarm:</p> <p>The alarm is activated while environment temperature below -1 , the alarm is recovered when temperature is over 5</p>
	HTSD	<p>System High Temperature Shutdown Alarm:</p> <p>The alarm is activated while environment temperature over 60 and trigger system shutdown. All rectifiers will recover when environment temperature is lower than HTSD default 5</p>
	LTSD	<p>System Low Temperature Shutdown Alarm:</p> <p>The alarm is activated while environment temperature below -10 and trigger system shutdown. All rectifiers will recover when environment temperature is higher than LTSD default 5</p>
	ETSF	<p>Environment Temperature Sensor Fails Alarm:</p> <p>The alarm is activated while environment temperature sensor fails.</p>
DCF		<p>DC-Output Voltage out of specified range</p> <p>High voltage alarm</p> <p>Low voltage alarm</p>
MIN		<p>Minor Alarm: (One battery charger fault and low priority breaker trip)</p> <ul style="list-style-type: none"> ■ The alarm is activated when one of the AC/DC rectifier module fail. ■ DC output voltage lower (< 23V) ■ DC output voltage higher (> 28.5V) ■ LVDC trip (low priority) (23V±0.5V) ■ Breaker trip (low priority) ■ DCF



MAJ	<p>Major Alarm: (More than one battery charger fault and high priority breaker trip)</p> <ul style="list-style-type: none"> ■ The alarm is activated when more than one of the AC/DC rectifier modules fails. ■ ACF/ ACH(> 264V)/ ACL (< 176V) ■ Temperature out of range or fail (disconnect) ■ LVDS trip (priority): 22V±0.5V ■ HTSD (higher environment temperature shutdown all rectifiers): > 60 ■ LTSD (lower environment temperature shutdown all rectifiers): < -10 ■ Higher temperature (> 50) ■ Lower temperature (< -1) ■ Priority Breaker trip <p>Note: The system can't work in EQU state if system happened major alarm</p>
LVDS	<p>LVD (priority) relay trip alarm:</p> <p>The alarm is activated if battery low voltage relay is disconnected in case the magnitude of the battery voltage is below 22V±0.5V. The alarm is recovered when mains voltage is recovered and rectifier is on.</p>
BRK	<p>Load Breaker or Battery Breaker Trip:</p> <p>The alarm is activated if breaker is tripped.</p>

- Note:**
1. The default setting of LVDC must be higher than the default of LVDS
 2. "HTSD" and "LTSD" function are abnormally when the system is without back-up battery..
 3. The accuracy of the temperature display in the system is ± 2 .
 4. The accuracy of the ACV display in the system is ± 3V.

4.2.6 DC Output Voltage and Current Display

Table 17 DC output voltage and current display

Item	Description	Remark
V	System DC Output Voltage	Error: ± 0.1V
A	System DC Output Current	Error: ± 3A

Note: To use voltage meter to detect measurement point, 1Amp equal 0.08 voltage, 50 Amps equal 4 voltage.

4.2.7 Environmental

Table 18 displays the environmental specifications.

Table 18 Environmental Specifications

Specification	Value
Operating temperature	14 to +140 (-10 to +60)
Storage temperature	-22 to +176 (-30 to +80)
Humidity	0% to 95% Relative Humidity Non-condensing
Altitude	-500 to 10,000 ft.
Weight	2.64 lbs. (1.2Kg)

4.2.8 System Remote monitoring

The power system provides three different methods to monitor and control the power system:

- (1). **Local Access** - RS232 interface for PC connection
- (2). **Internet/Intranet** - RJ45 interface on the Delta Web Server Card

Users can access the system via:

- (1). Delta Remote Management Software (RMS) – *Refer to RMS Function*
- (2). Commercial Internet Browser – Ex. Microsoft Explorer ...

If the CSU is connected Delta Web Server Card, it can remote control and monitoring by Internet.

	Local Access	Internet/Intranet
RMS	Support	Doesn't Support
Internet Browser	Doesn't Support	Support

4.2.9 Settings Parameter by RMS

Items	Descriptions	Default Setting	RMS Range
ACHT	AC high voltage alarm threshold	264V	221 ~ 330V
ACLT	AC low voltage alarm threshold	176V	110 ~ 219V
LTSD Point	Low environment temperature shut down	-10	-20 ~ -7
HTSD Point	High environment temperature shut down	60	45 ~ 65
HT Point	High environment temperature alarm	50	20 ~ 65
EQU setting	Battery Equalization Voltage Setting	28V	26.2 ~ 28.3V
EQU switch	Battery Equalization State Switch	OFF	ON/OFF
Current Time	Current Time Display	Current Time	
Alarm Release Time	Alarm Release Delay Time: ms	500ms	
Battery Compensation parameter	Battery Compensation Default (mV/)	60 mV/	0~60mV
Battery Rgh Test Sw	Battery Rough Test Switch (ON/OFF)	OFF	ON/OFF
Battery Rgh Test Time	Battery Rough Test Time	20min	0~255min
Bat Rgh Test Voltage	Battery Rough Test Voltage	24V	22~25V
Bat Cap	Battery Capacity	120AH	0~1275AH
Deep DC output voltage	After system had AC breakdown and recover. CSU will detect whether DC output voltage is below deep DC output voltage or not. If DC output voltage is below deep output voltage. The system will change float to equalize mode automatically.	23V	
LVDC	LVD for Low Priority Load	23V	19~23V
LVDS	LVD for Battery	22V	19~23V
Bat. Test Frq. month	Battery Periodic Test Time	2 month	0~6month
Bat. Test Start Time	Battery Rough Test Start Time	Current time + 2 month	
M-D-Y H:M:S	Current Time	Current time	

4.3 Alarm Control Unit Block Diagram

Please refer to Figure 7.



4.4 Battery Temperature Compensation

Temperature Compensation Formula:(depend on battery temperature)

- a. If battery temperature is higher than 25 °c, the compensation formula is:
Output Voltage =
(Float Voltage)+(Coefficient)*(Battery temperature-25)
- b. If battery temperature is lower than 25 °c, the formula is:
Output Voltage =
(Float Voltage)+(Coefficient)*(25- Battery temperature)
- c. Output voltage will follow the formula above to realize temperature compensation.
- d. Besides above, CSU also have temperature compensation switch if this switch is off temperature compensation is off and at this situation output voltage equal to float voltage.
- e. The unit of compensation coefficient is mv/°C.

Some items will terminate temperature compensation and they are:

- a. Temperature compensation switch is off
 - b. The number of SMR equal to zero
 - c. SMR current limit
- Battery temperature sensor unlocked

4.5 Battery Rough Test

Test Condition

- 1) The rectifier voltage will auto be decreased to lower than the rough test voltage 2V.
- 2) The test can't be activated or interrupted if alarm occurs as below.
 1. AC out of specified range alarm.
 2. DC out of specified range alarm.
 3. Temp protection alarm.
 4. Temp sensor fail alarm.
 5. LVD open alarm.(LVDC,LVDS)
 6. Breaker trip alarm.
 7. Temp alarm.(Over temp and Under temp)
 8. Battery capacity equals zero.
 9. Battery fail alarm
 10. Dc High or Dc Low
 11. Major alarm
- 3) After the a time of setting the battery voltage is measured, if still above a predefined value of software then the test result is considered as "OK" otherwise the result is "Faulty".
- 4) The result is reported via the software on the "Alarm" screen.
- 5) Push again the "Battery test" button in the front of CSU or set the "Bat Test SW" of RMS to "ON" can



eliminate test fail alarm if system happened battery test fail alarm.

PS: *The system has battery test function, if system happened low priority breaker trip or/and one rectifier fail.*

4.6 Floating/Equalize Charge Function

- (1) The test can't be activated or interrupted if alarm occurs as below.
 1. AC out of specified range alarm.
 2. DC out of specified range alarm.
 3. Temp protection alarm.
 4. Temp sensor fail alarm.
 5. LVD open alarm.(LVDC,LVDS)
 6. Breaker trip alarm.
 7. Temp alarm.(Over temp and Under temp)
 8. Battery capacity equals zero.
 9. Battery fail alarm
 10. Dc High or Dc Low
 11. Major alarm
 12. Battery temperature over 35 or below 10
- (2) System floating/equalize state can be set through the CSU control and RMS. (Users can manually set rectifier to floating or equalize mode from CSU or RMS)
- (3) After system had in breakdown and then recovered, CSU will detect whether DC output voltage is below 23V or not, if it is below 23V, system will switch float to equalize mode for a period of 30 minutes.



5 DC Distribution

5.1 DC Cabling

You can find DC output which marked Load + and Load – in front of the shelf. Please refer to Figure 5.

5.2 Low Voltage Battery Disconnect (LVDS)

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 Low Priority Load Disconnect (LVDC)

The low voltage disconnect contactor is installed in front of the low priority load connection bus. When LVDC open, it disconnects the low priority load from system bus.

5.4 Battery Breaker

200A * 2, single pole

5.5 Load Breaker

Priority load: 63A, 25A, 16A, 16A (Optional)

Low priority load: 63A, 25A (Optional)



6. Installation

- Note:**
- 1. All input and output terminal and wiring please refer to Figure 5.*
 - 2. Indication or caution label position please refer to Figure 8 and 9.*

6.1 Preliminary Inspection and Tool required

6.1.1 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.

6.1.2 The following tools are recommended for installation:

1. Phillips screwdriver (#2, #3)
2. Metric socket wrenches with extensions
3. Insulated side cutter
4. Hydraulic lift

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. 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 5.

- Warning:**
- 1. AC power wire could not less than AWG 10 and failure to use the appropriate power wire causes safety hazards.*
 - 2. Each shelf requires a properly grounded AC input feeds supplied by Delta.*



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 Temperature and Alarm Connections

6.6.1 Battery Temperature Sensors

The battery temperature probe senses the battery temperature and sends the signal back to the ALU. The temperature is used to determine the temperature compensation voltage. A temperature sensor is included with each Power Shelf. To connect the temperature sensor, perform the following steps:

1. Connect the sensor to the connector labeled TB located in front of the shelf.
2. Attach the copper lug sensor to the center position.

6.6.2 External Alarm Connections

1. Alarm Terminal Block Pin Assignments please refer to 4.2.4
2. Each alarm connection is provided with a normally close relay contact. This contact is capable of carrying 0.5 Amp DC at 24VDC 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
5. Ensure the PSU 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 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
3. The “BRK” LED on the panel light because the battery breaker is switched to “OFF”.

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 80 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 DC Alarm Description

8.2.1 Description

The DC is a minor alarm activated when the DC output voltage exceeds the HV or LV threshold setting. When the system voltage exceeds the HV or LV setting value, the ALU sends the alarm signal, and activates the DC alarm contact. The rectifiers remain on line during this minor alarm condition. When the system voltage decreases below the threshold setting, the ALU deactivates the DC alarm contact.

8.2.2 Troubleshooting

The DC alarm is usually caused when the equalize voltage exceeds the HV or LV threshold setting. Another probable cause that the temperature compensation voltage exceeds the HV or LV threshold during temperature operation. During this alarm condition, the system continues to operate.

8.3 Priority Low Voltage Disconnect Alarm (LVDS)

8.3.1 Description

During an AC Fail condition, the rectifiers are shut down and the reserve batteries begin to discharge. When the battery cells discharge below the LVDS setting, the ALU lights the LVDS LED on the ALU panel, activates the LVDS OPEN alarm contact, and opens the LVDS contactor. When the AC recovers, the LVDS recovers automatically. The ALU extinguishes the LVDS LED and resets the normally closed set of alarm contacts.

8.3.2 Troubleshooting

If the battery disconnect switch remains open after voltage is restored to the rectifiers, one of the following is occurring:

1. The ALU may be faulty. Swap out the ALU with a spare and verify voltage settings.
2. The LVDS coil windings may be open. With a digital multimeter, check the LVDS coil windings.



8.4 Low Priority Low Voltage Disconnect Alarm (LVDC)

8.4.1 Description

During an AC Fail condition, the rectifiers are shut down and the reserve batteries begin to discharge. When the battery cells discharge below the LVDC setting, the ALU lights the LVDC LED on the ALU panel, activates the LVDC OPEN alarm contact, and opens the LVDC contactor. When the AC recovers, the LVDC recovers automatically. The ALU extinguishes the LVDC LED and resets the normally closed set of alarm contacts.

8.4.2 Troubleshooting

If the battery disconnect switch remains open after voltage is restored to the rectifiers, one of the following is occurring:

1. The ALU may be faulty. Swap out the ALU with a spare and verify voltage settings.
2. The LVDC coil windings may be open. With a digital multimeter, check the LVDC coil windings.

8.5 BRK Alarm

8.5.1 Description

If the DC load output fuse opens or battery switch trip off, the ALU sends the alarm condition, lights the LED on the ALU panel, and activates the FB alarm.

8.5.2 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% derating 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 that 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.*

8.6 Alarm Unit Fail

8.6.1 Description

During the ALU fail condition, all alarm contacts open. During an ALU failure, the rectifier status changes from equalize to float or remains in the float condition. The LVDS does not open during the ALU failure.

8.6.2 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.

8.7 Rectifier Fail Alarm

- (1) If one rectifier fails, the MIN contacts open, and the MIN LED on the ALU lights. When two or more rectifiers fail, the MAJ alarm contact is opened, and the MAJ LED lights.

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

- (2) If you insert the above rectifier back to the slot, then pull out after the “FL” LED on the SMR panel light up. The system will alarm in the “MIN” mode.



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 system 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. Switch off PSU module.
2. Loosen the captive retaining screws located on the bottom of the front panel.
3. Pull out the rectifier unit slowly from the shelf.

9.2.2 Replacing a Rectifier

To replace a rectifier, perform the following steps:

1. Make sure the breaker on the front panel of PSU is switched off.
2. 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.*

3. Lock the rectifier into position by screwing in the captive retaining screws located at the bottom of the rectifier.
4. Switch on the PSU and check the AC ON LED lights on the front of the PSU 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 | Battery state: Float, Equalize, or Discharge |
| DC output voltage | Ambient temperature |
| DC output current | Battery temperature |
| Current time | Battery discharge current |





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.



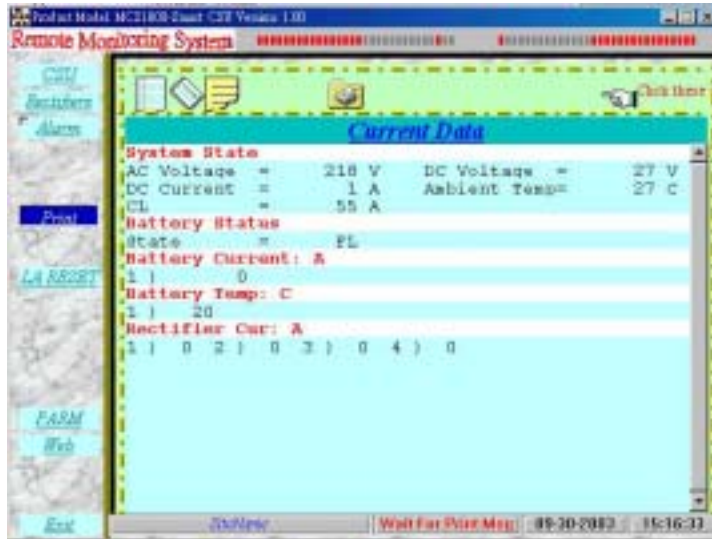
10.6 RMS Alarm Screen

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

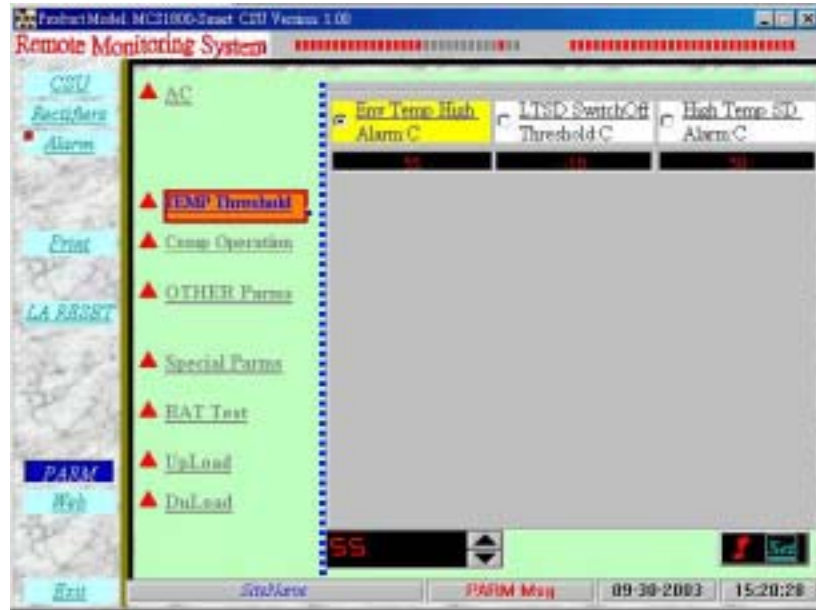
This button allows the user to turn "off" the audible alarm signal on their PC.

10.9 RMS PARM Screen

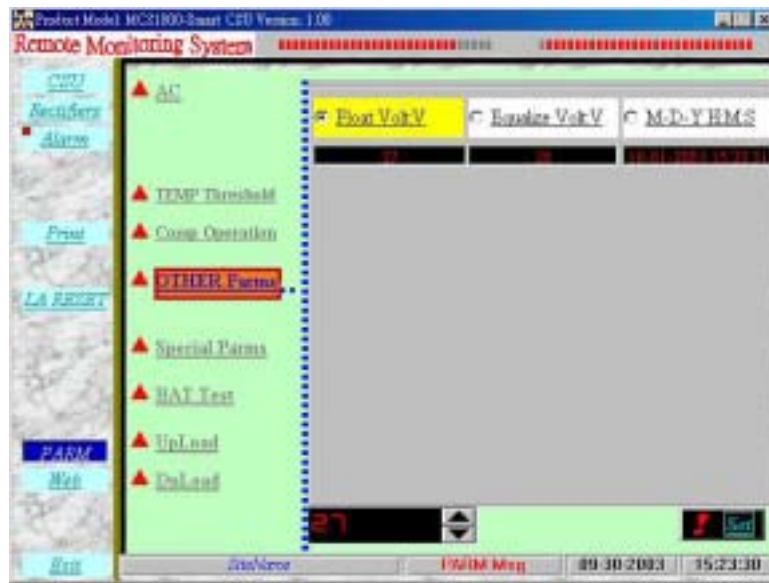
The PARM section allows the technician the ability to remotely monitor and/ or change the system parameter settings. The following list shows which parameters the user can modify remotely.



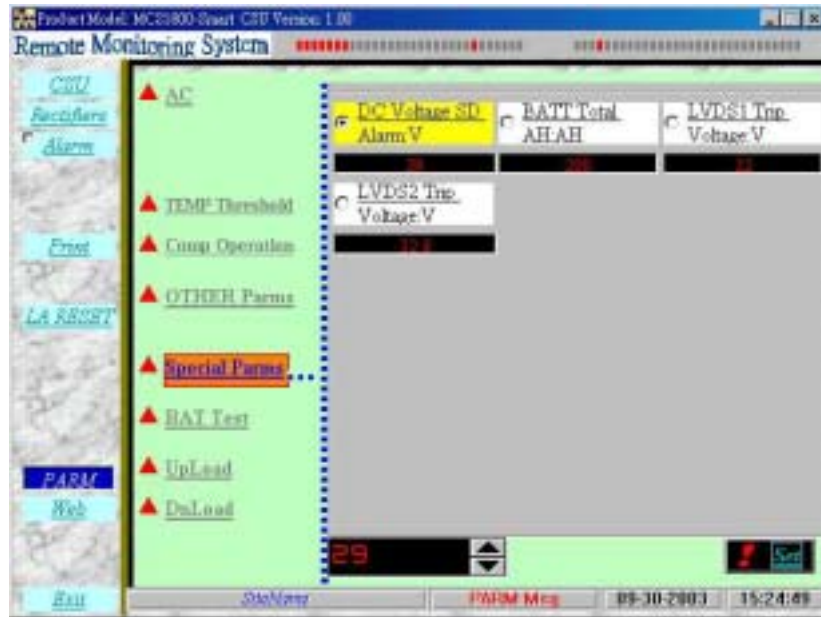
To modified AC voltage



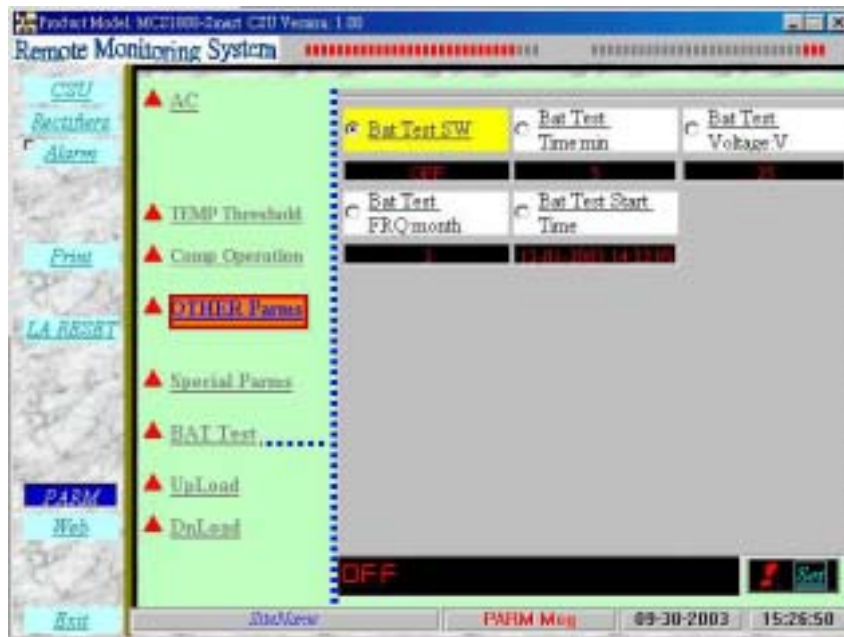
To modified the temperature threshold



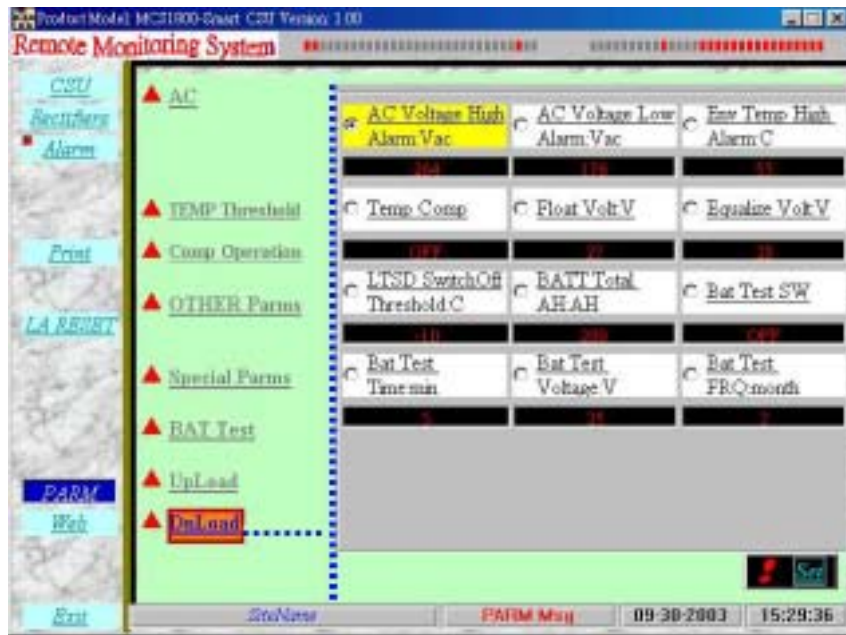
To modified other parameters



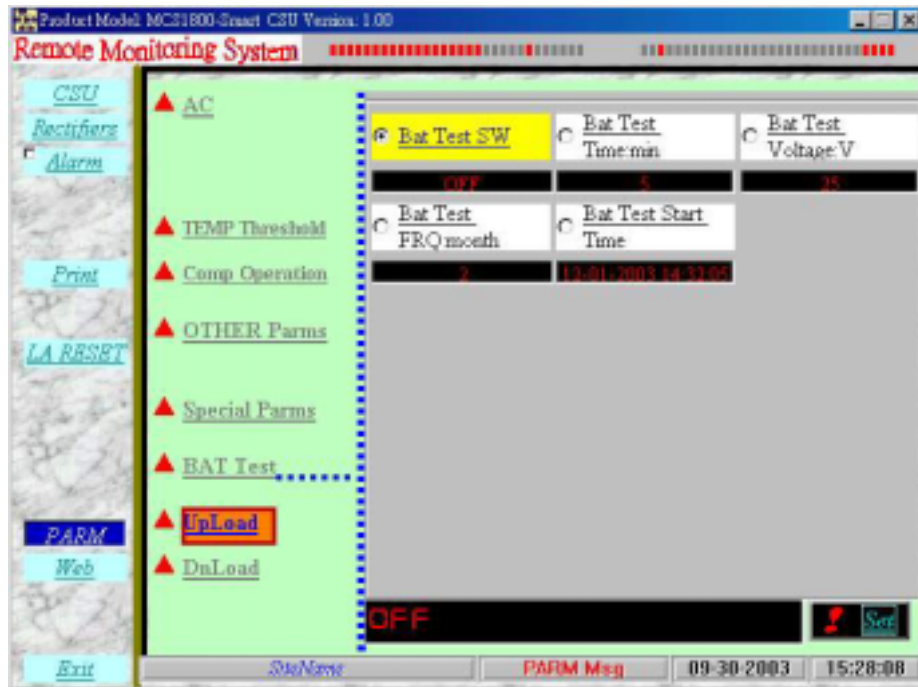
To modified special parameters



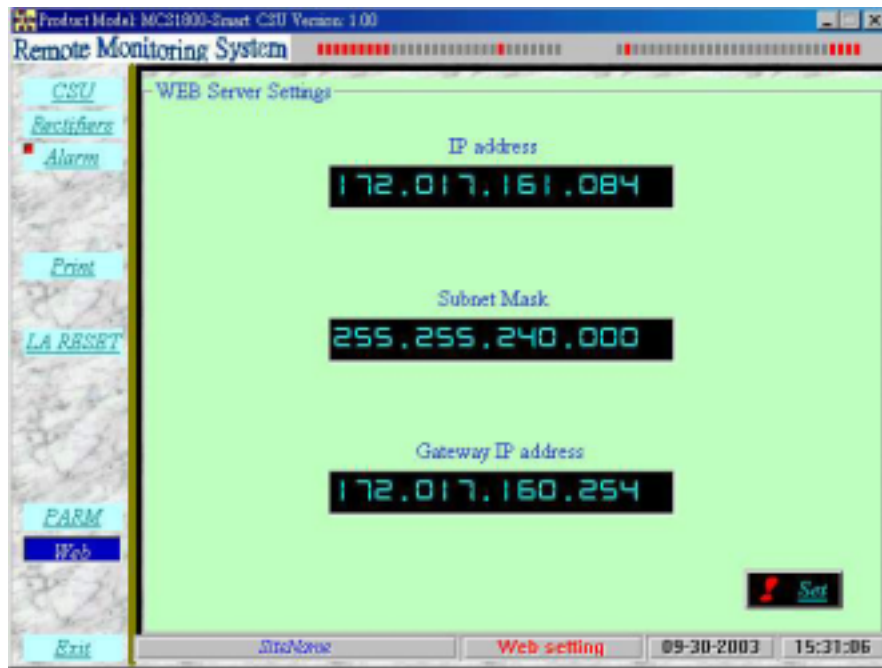
To modified battery test



To download



To upload



To access WEB server



Items	Descriptions	Default Setting	RMS Range
ACHT	AC high voltage alarm threshold	264V	221 ~ 330V
ACLT	AC Low voltage alarm threshold	176V	110 ~ 219V
LTSD Point	Low environment temperature shutdown	-10	-7 ~ -20
HTSD Point	High environment temperature shutdown	60	45 ~ 65
HT Point	High environment temperature alarm	50	20 ~ 65
EQU setting	Battery Equalization Voltage Setting	28V	26.2~ 28.3V
EQU switch	Battery Equalization State Switch	OFF	ON/OFF
Alarm Release Time	Alarm Release Delay Time: ms	500ms	
Battery Rgh Test Sw	Battery Rough Test Switch (ON/OFF)	OFF	ON/OFF
Battery Rgh Test Time	Battery Rough Test Time	20min	0 ~ 255min
Bat Rgh Test Voltage	Battery Rough Test Voltage	24V	22~25V
Bat Cap	Battery Capacity (Battery Charge Current = Battery Cap / 10)	120AH	0 ~ 1275 AH
Deep DC output voltage	After system had in AC breakdown and recovered, CSU will detect whether DC output voltage is below deep DC output voltage or not, if it is below deep output voltage. The system will change float to equalize mode.	23V	
LVDC	Low Voltage Disconnect for Low Priority Load	23V	19 ~ 23V
LVDS	Low Voltage Disconnect for Battery	22V	19 ~ 23V
Bat. Test FRQ: month	Battery periodic test time	2 months	0~6month
Bat. Test Start Time	Battery rough test start time	Current time + 2 months	
M-D-Y H-M-S	Current time	Current time	
HVSD	High voltage shutdown	29V	29~30V



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
CUL	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 ---

Delta MCS-1800 Power Shelf

Model: ES24/200 JBAXX

ATTACHMENT



Figure 1: System Outlook

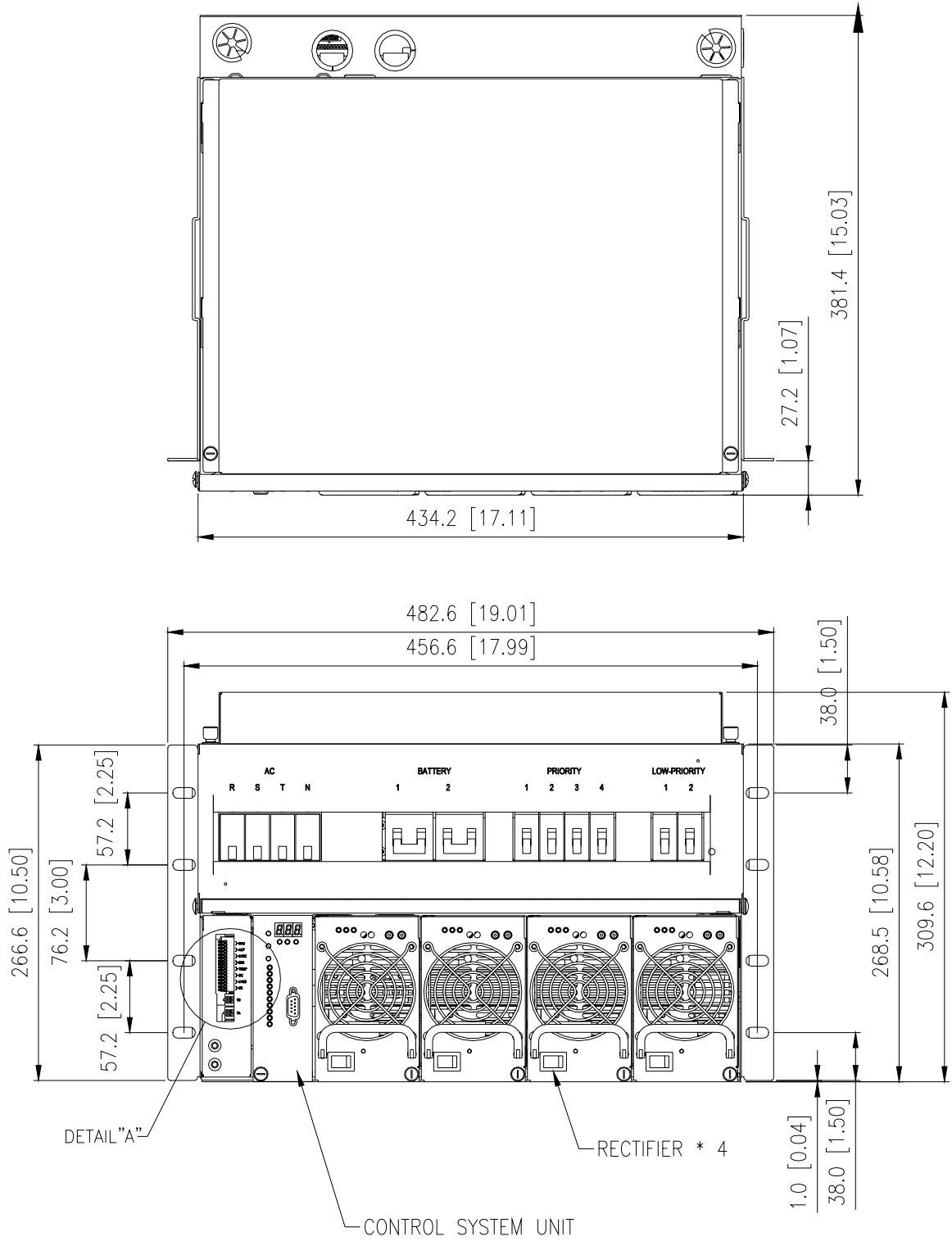


Fig-1

Figure 1-1: System Outlook

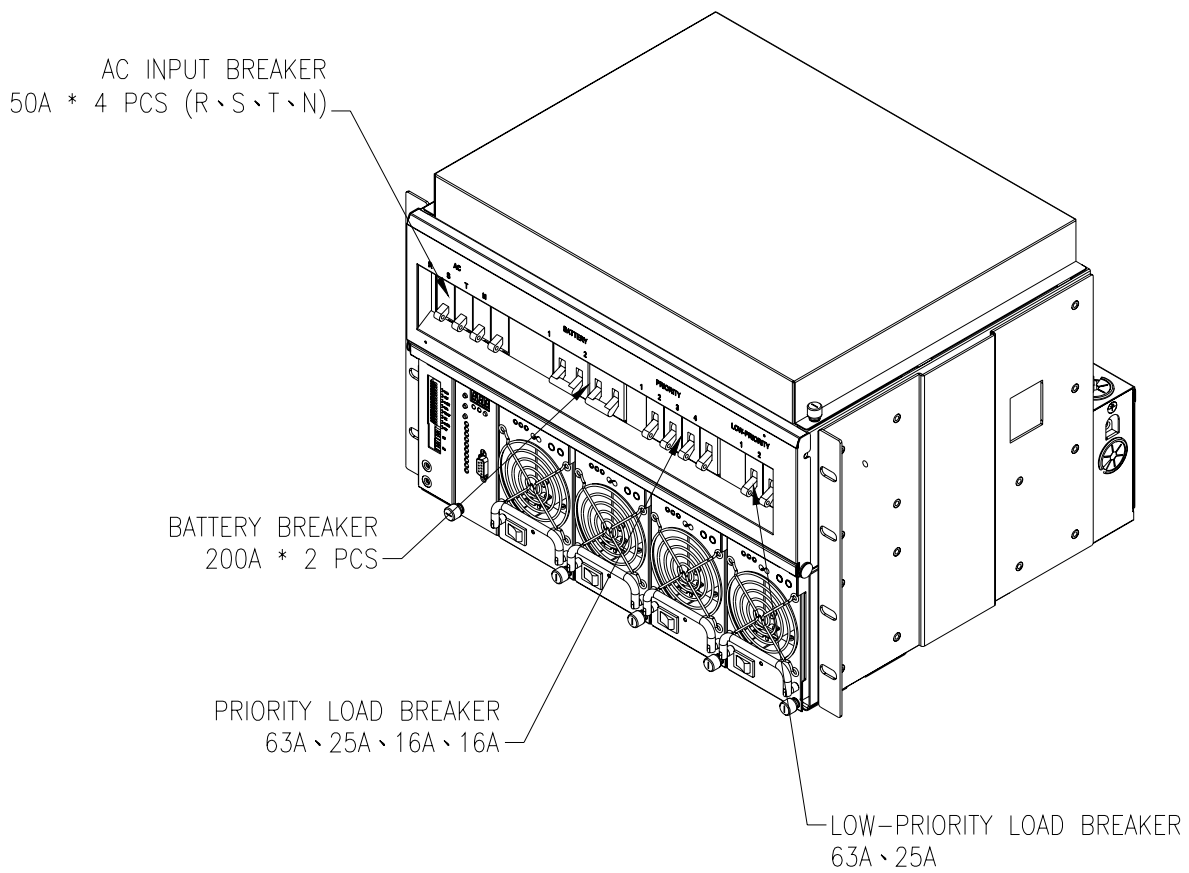
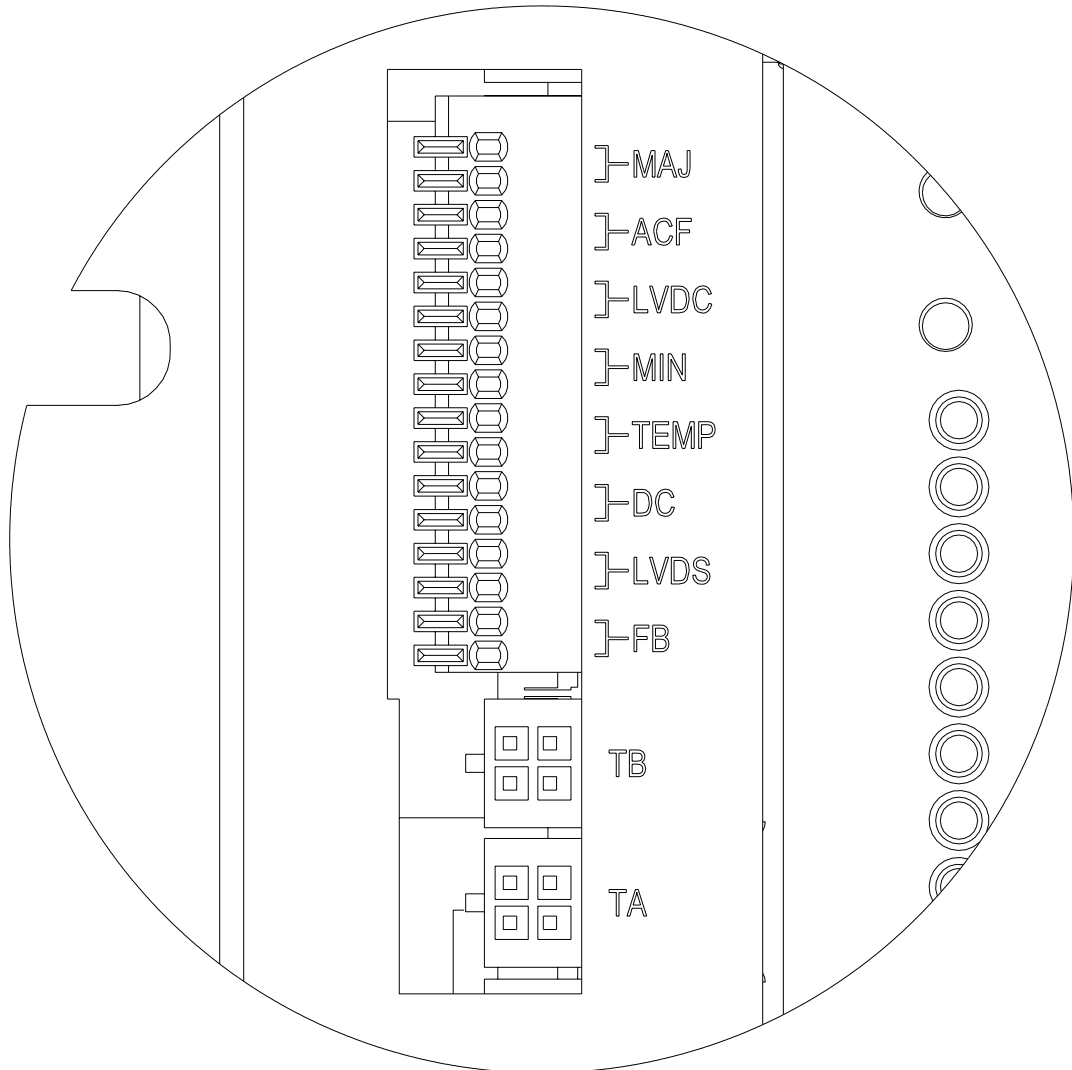


Figure 2: System Outlook (Detail A)



DETAIL "A"

Figure 3: Alarm Unit (ALU)

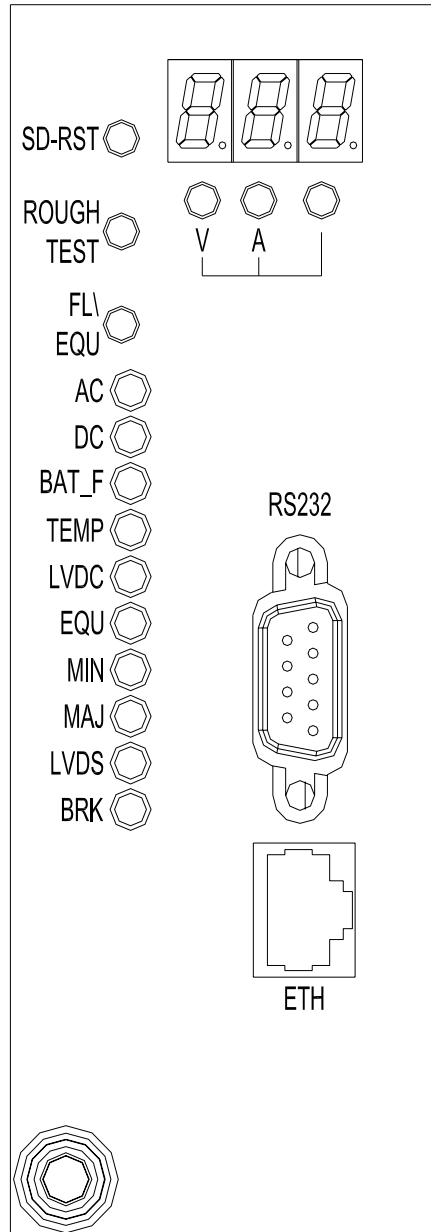


Figure 4: Power Supply Unit

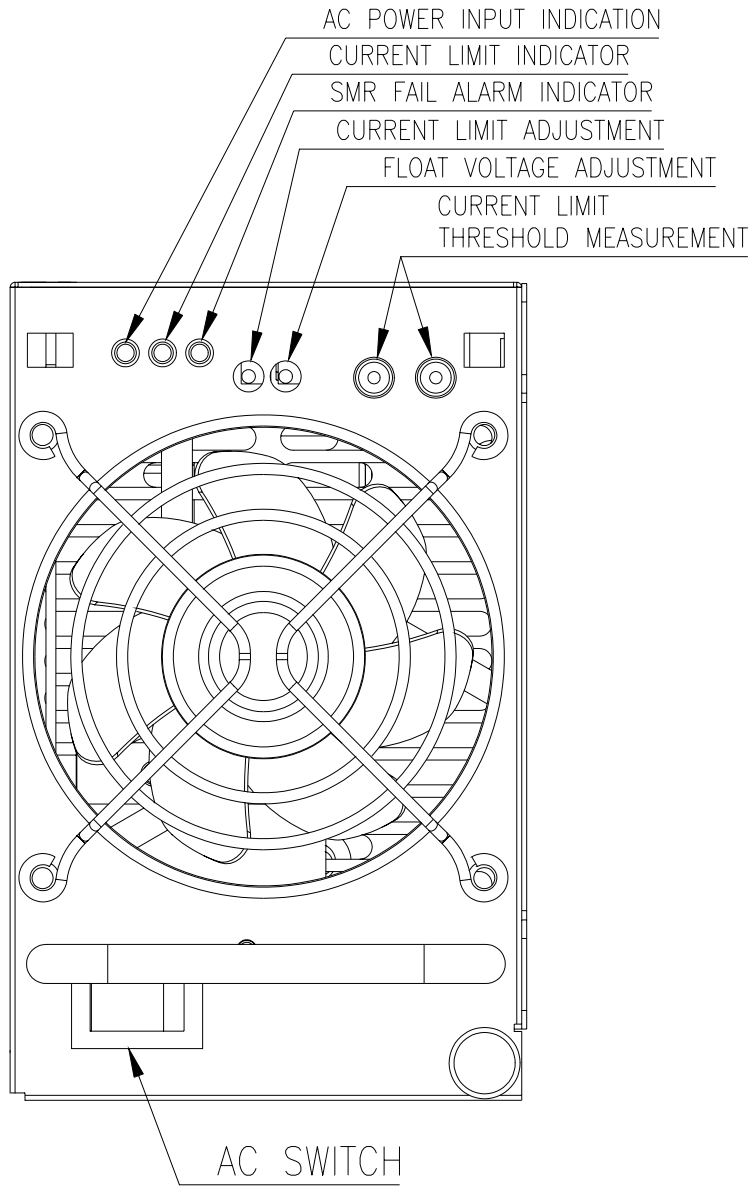
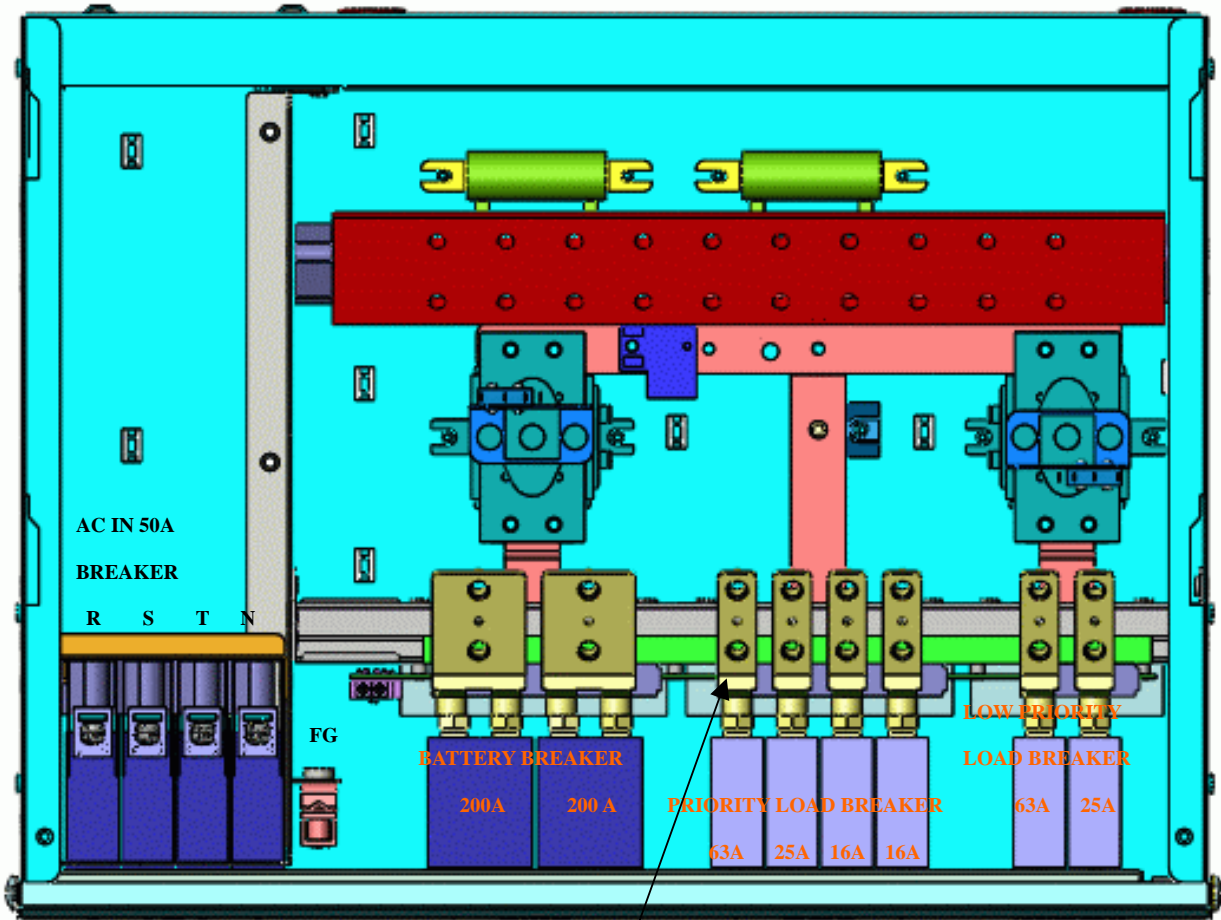


Figure 5: AC Input Terminal and DC Output Distribution



TOP VIEW

8 * 1/4-20UNC Two-Hole Lug
 PITCH=1 inch

RECOMMEND WIRING:

AC INPUT --- AWG#6~8

DC OUTPUT --- 63A AWG#6
 25A AWG#12
 16A AWG#14

Figure 6: SMR Block Diagram

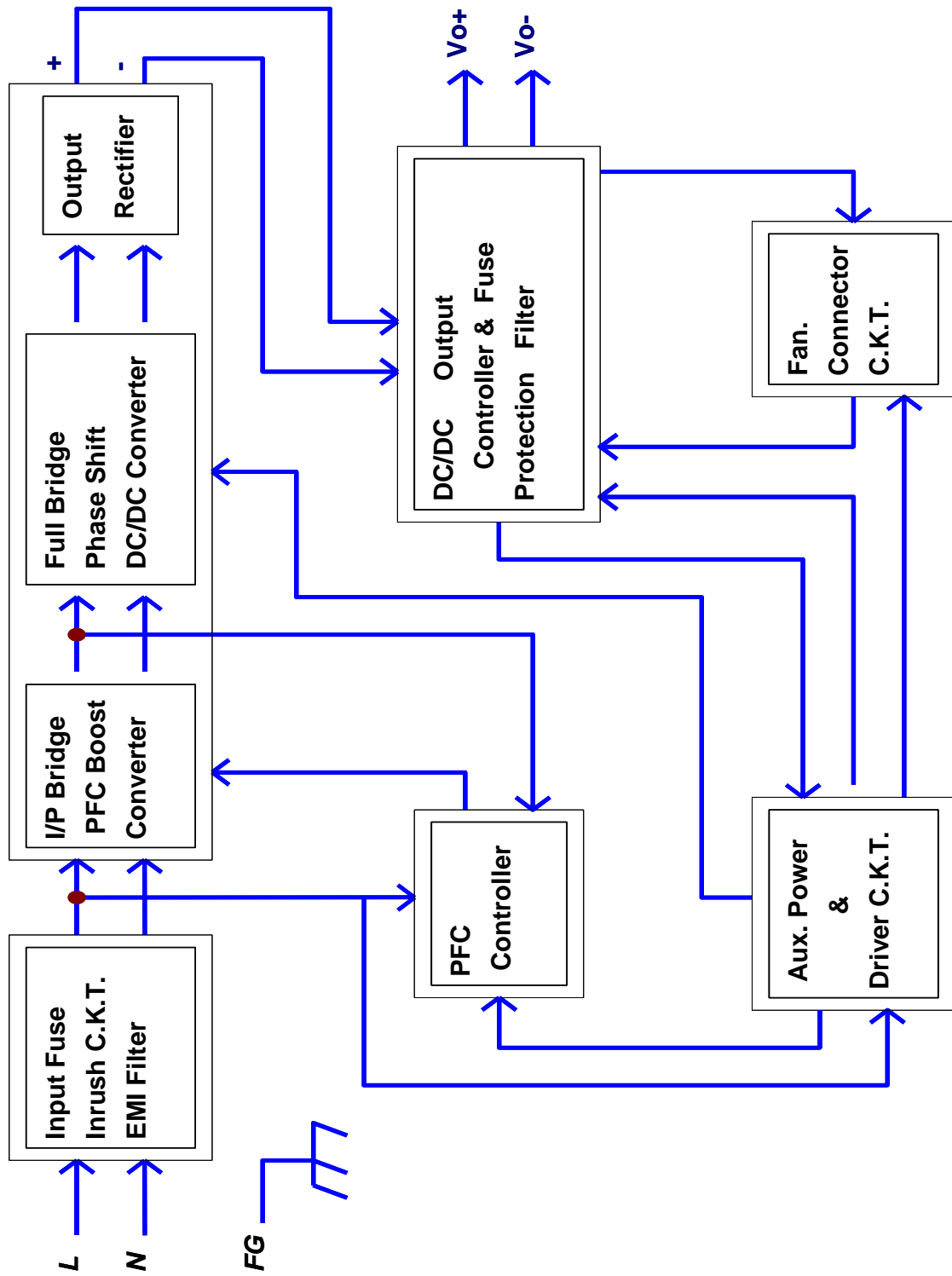


Figure 7: ALU Block Diagram

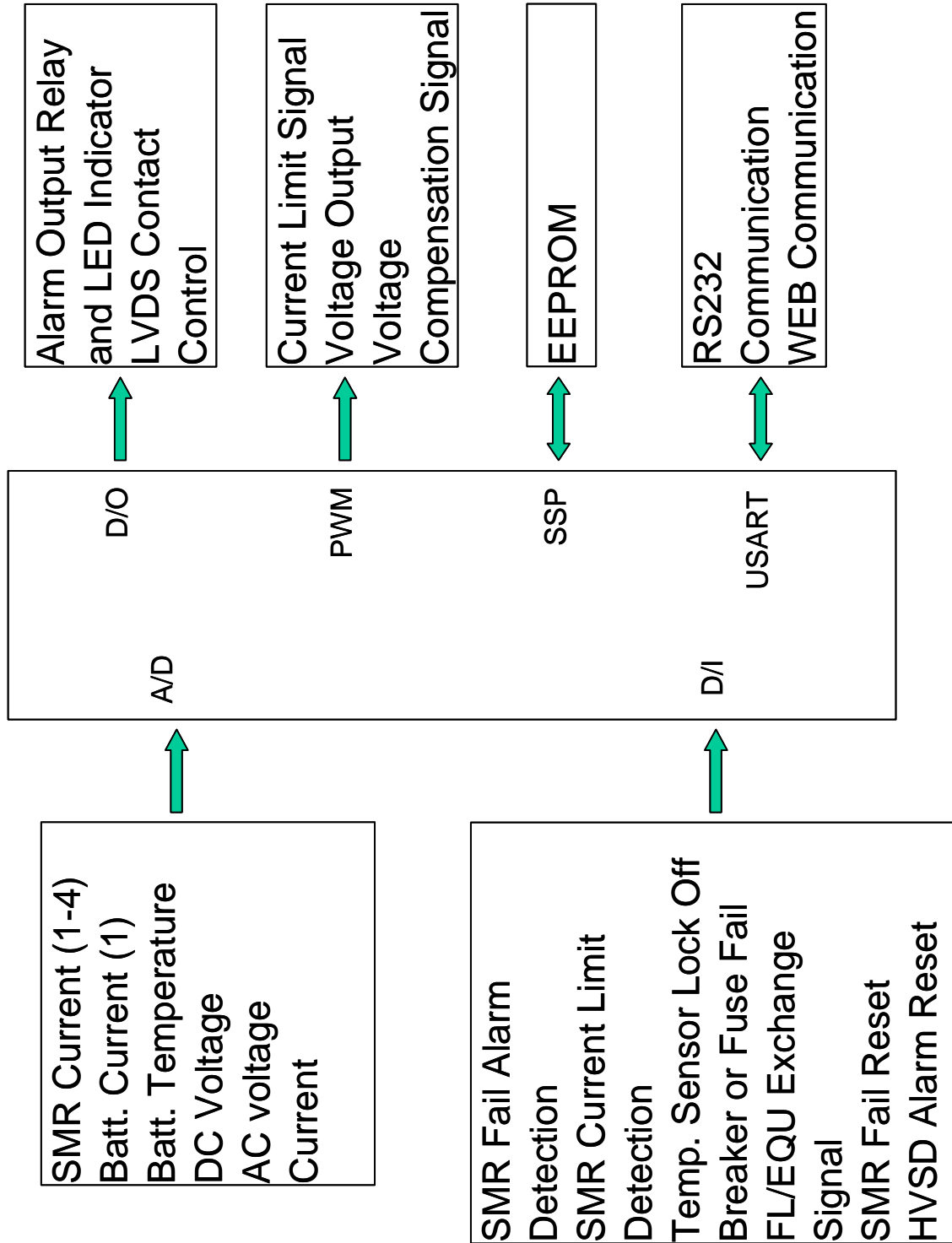


Figure 8: System Label position

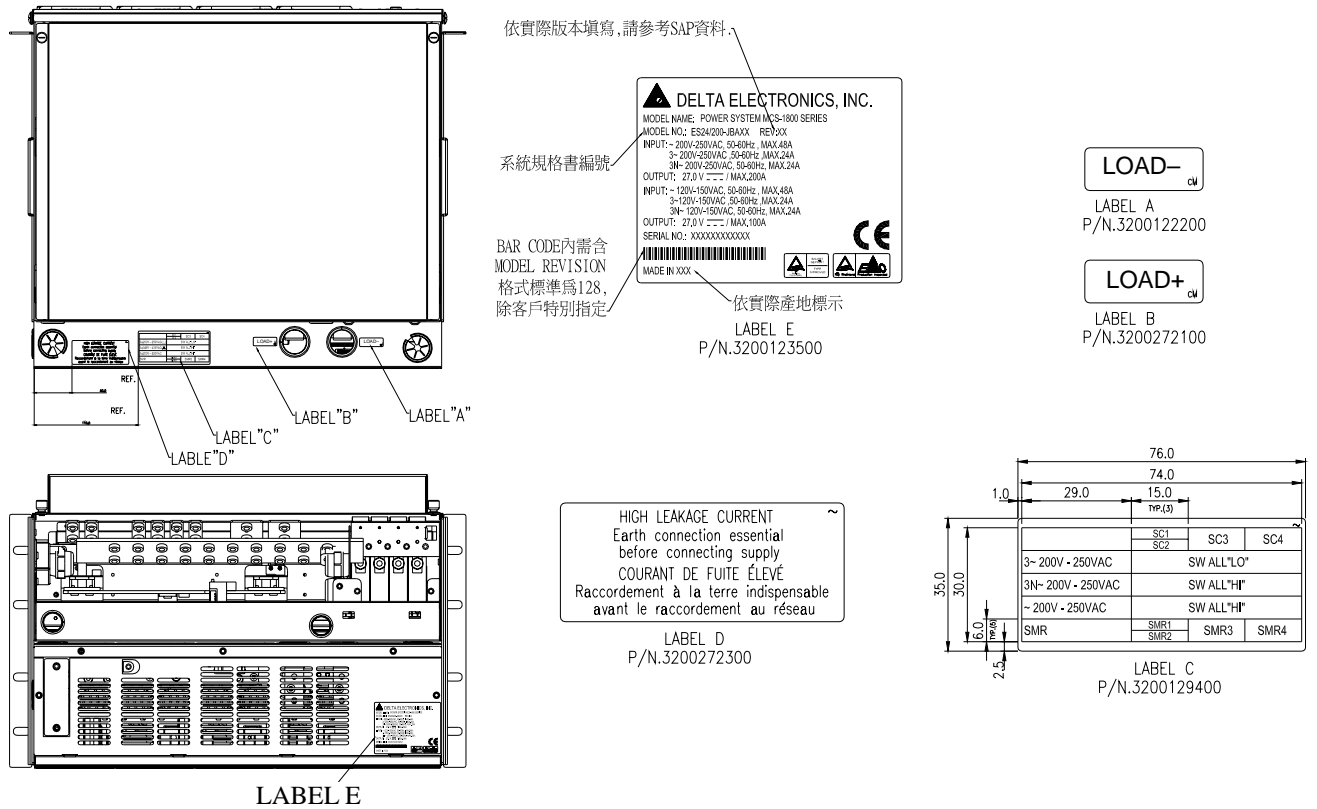


Figure 9: PDU Label Position

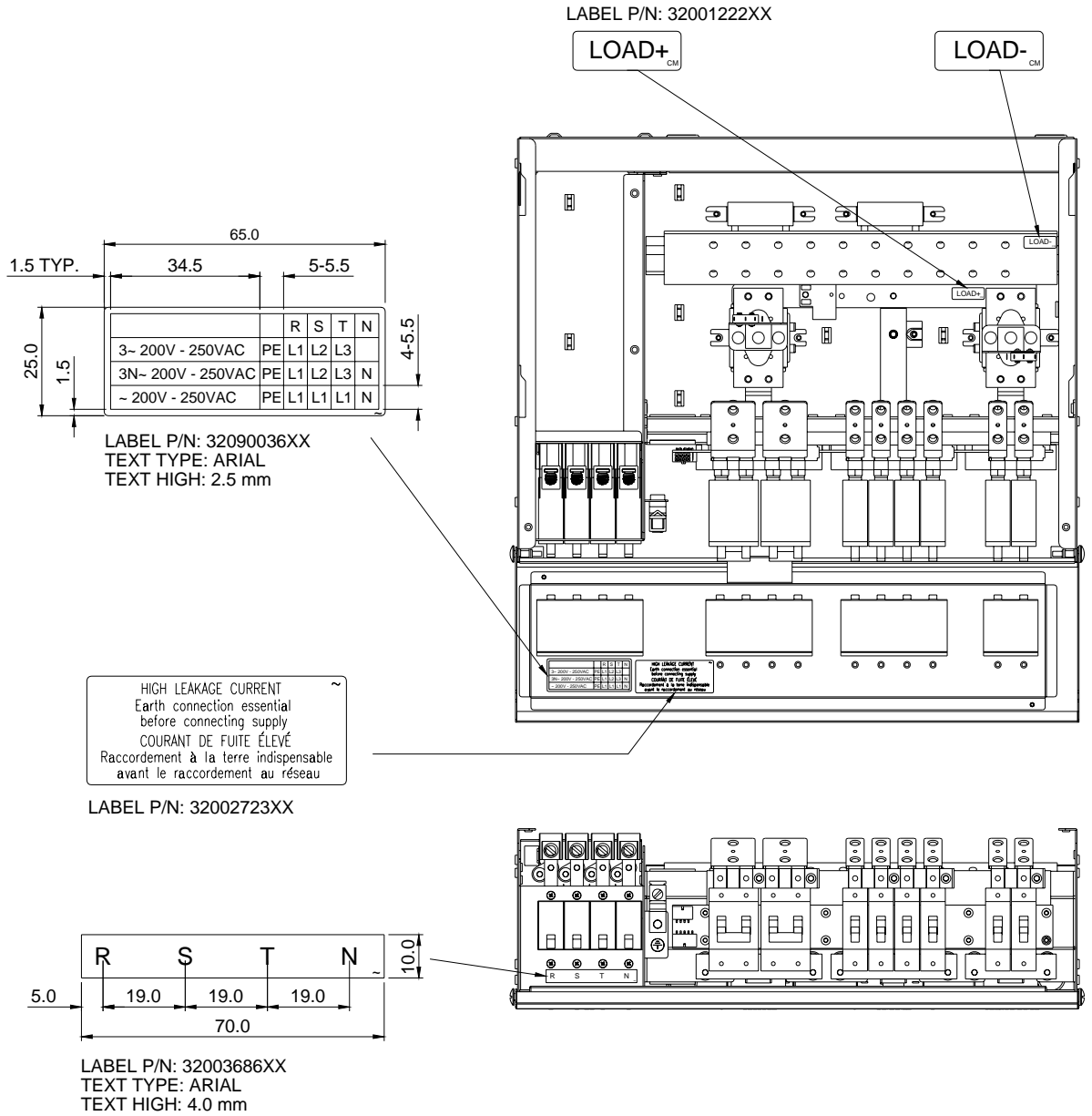


Fig-10

Figure 10: System schematic

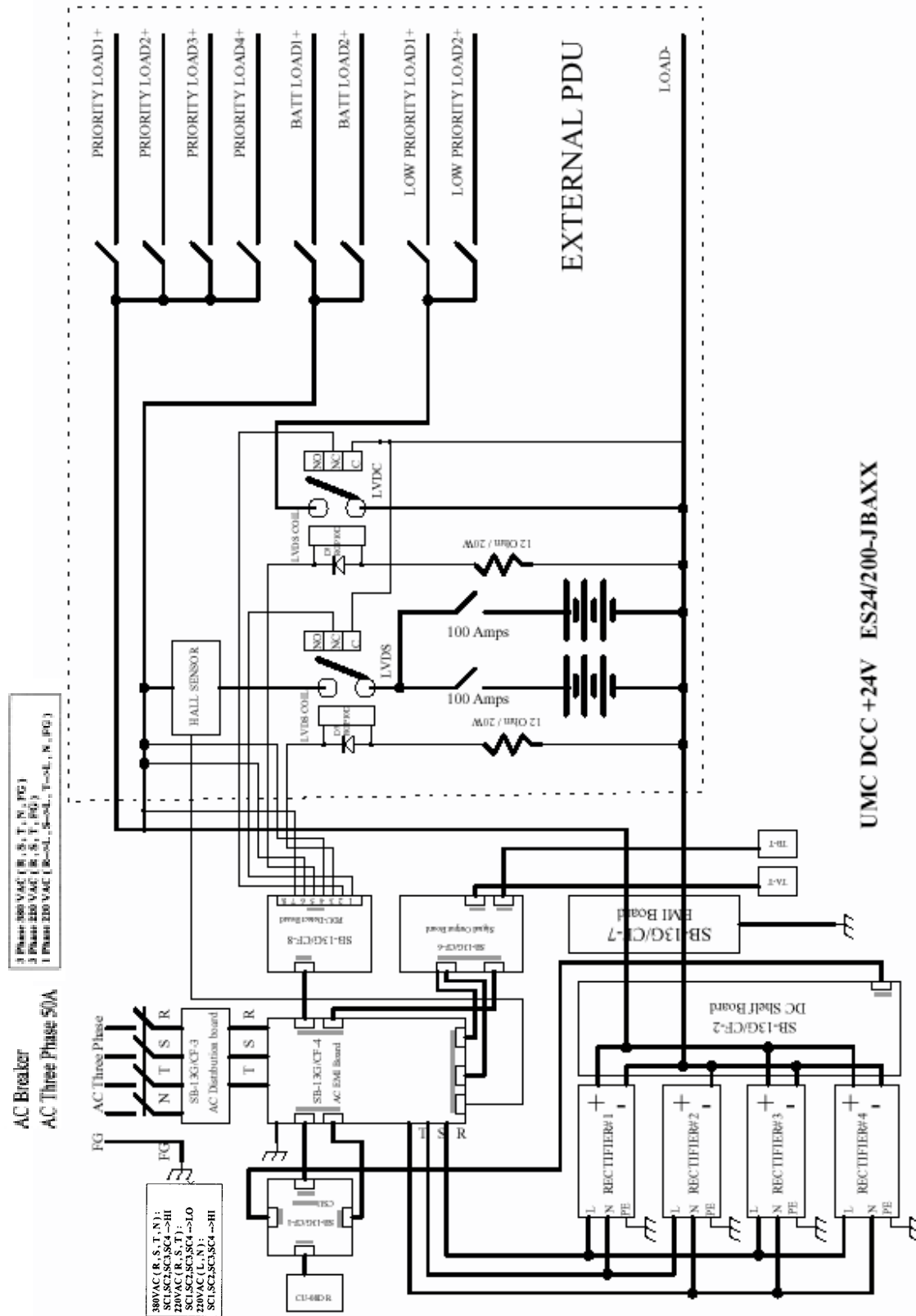


Fig-11

Figure 11: TA and TB sensor wiring indication

