FULL REDUNDANCY POWER SYSTEM

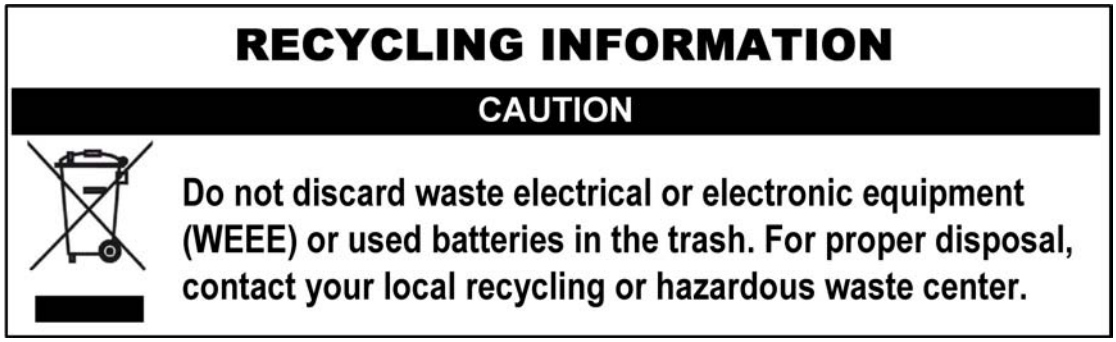
MODEL PS1006

User Guide and Instruction Manual

Release 5.0

January 2008

The equipment described in this document is not intended to be used in connection with any application requiring fail-safe performance, unless the application design includes appropriate redundancy. This exclusion includes, but is not limited to, the direct operation of any life support system or any other system whose failure could lead to serious injury, death, environmental damage or mass destruction.



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1. INTRODUCTION

The PS1006 power system:

- Provides clean dc power to sensitive equipment such as telecom exchanges and other switching systems.
- Charges the battery bank that provides backup power during a mains failure. Thus, this system is essentially a dc-UPS with a battery connected to it. The size of the battery determines the backup and charging time. Since the system is current limited, the maximum battery size is based on that limit *(see Battery Design, page 26)* for battery size determination and example).

2. SYSTEM DESCRIPTION

2.1 Overview

The system comprises four stages:

- **Rectifier module(s)**: Convert(s) ac input to dc output.
- **Electronic Low Voltage Disconnect (ELVD) device**: Disconnects the battery from the load, preventing damage to the battery when it is over-discharged. The PS1006 has a true semiconductor-based LVD that does not use any mechanical devices (such as relays or contactors). This ensures a reliable operation for several years. The PS1006 ELVD uses power MOSFETs to perform the switching.

The ELVD has two branches that handle two independent battery sets.

- **System controller:** Monitors and controls the system and also communicates with a PC or network. This is done by an RS232 serial port (standard) or via PPP/SNMP/TCP-IP protocol (optional).
- **Motherboard**

The rectifiers are “hot plugged” and operate in parallel. This enables the user to define an “N+1” or “N+2” redundant system.

Each rectifier has its own current sharing system, and provides complete, precise sharing among rectifiers.

Output terminals for connecting the load and battery sets are mounted on the motherboard, located behind the removable metal rear panel.

2.2 Block Diagram

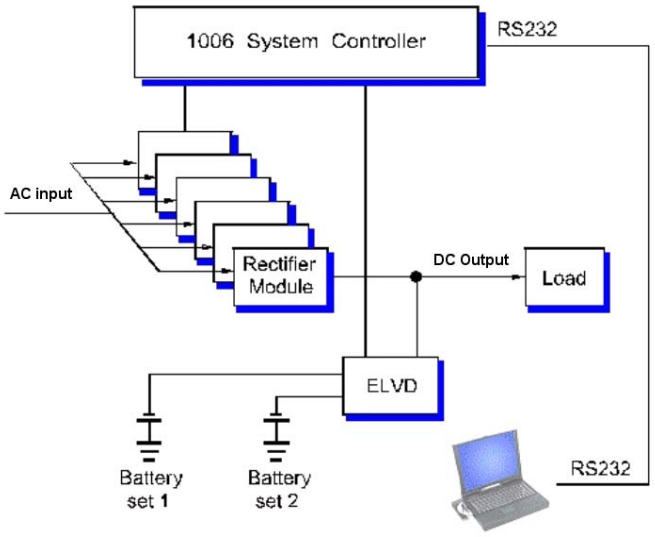

Figure 1: Block Diagram of Power System PS1006

2.3 Main Features

- 1-6 parallel “hot-plug” rectifiers.
- Universal input voltage (100 Vac to 240 Vac continuous, no selectors or switches) for some of the models *(see Technical Specifications for PS1006, page 7)*.
- A built-in dual 60 A ELVD for battery protection.
- A high performance, hot-plugged system controller (SC1006/SC1006Net) to measure and monitor voltages, currents, power, temperature, battery parameters and other data. The system can work with or without the controller.
- Battery temperature compensation is employed to enhance battery life.
- Two battery sets are handled in one system.
- Automatic and programmed battery test (for each battery set).
- Remote control and monitoring of the system using a dedicated graphical user interface (GUI). All parameters are displayed on the PC GUI.
- Dry-contact signals (3 alarms).
- Battery terminals protected by a dedicated thermal-magnetic circuit breaker.
- Load terminals protected by a dedicated thermal-magnetic circuit breaker.
- Active current sharing between all the rectifiers for optimum performance.

2.4 Front Panel View

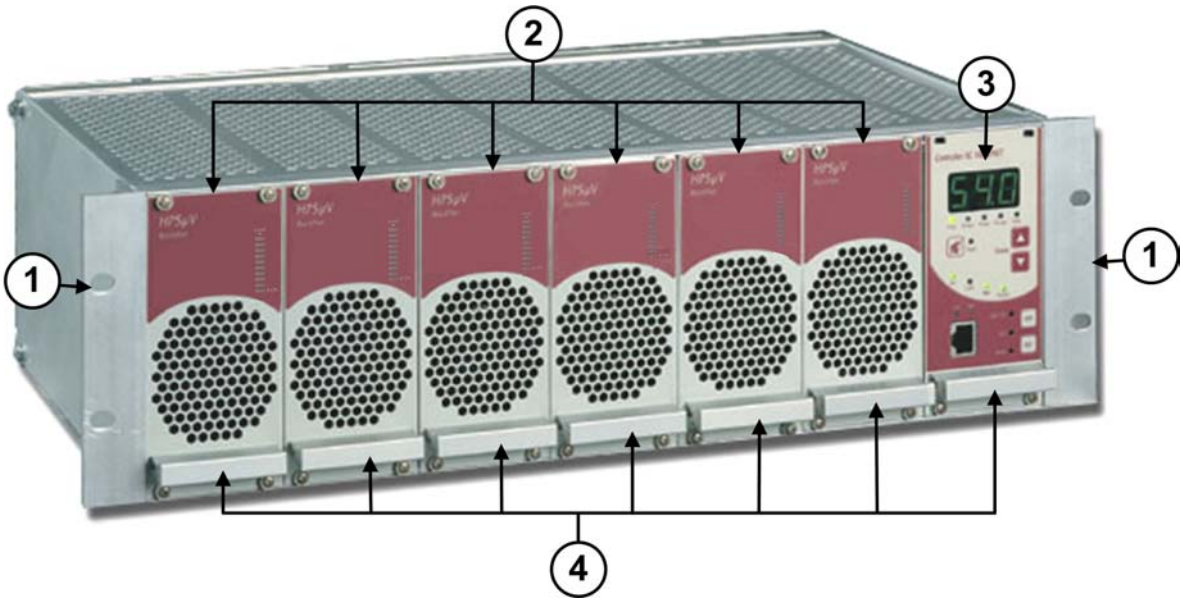

Figure 2: Front Panel of PS1006

Figure 2 illustrates the following system components:

1. Adjustable 19" mounting flange
2. Rectifier modules
3. System controller
4. Handles

2.5 Rear Panel View

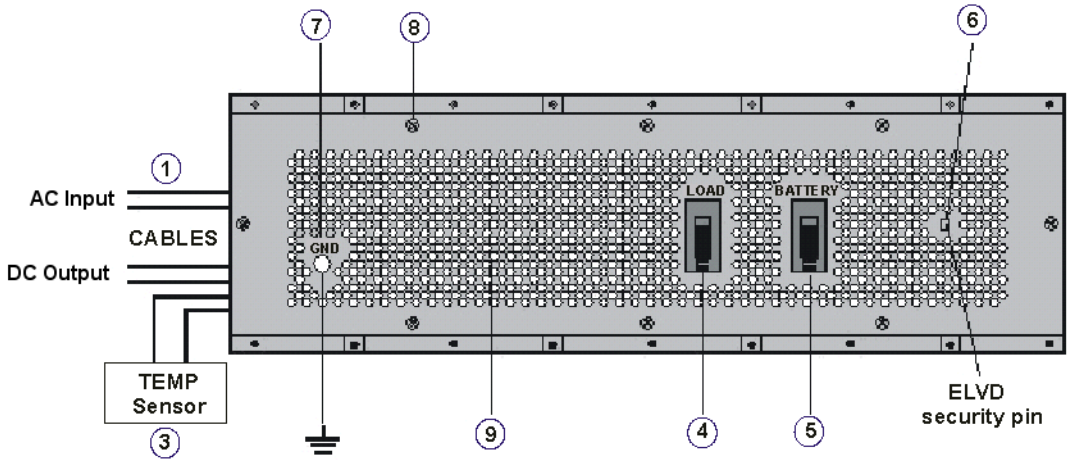

Figure 3: Rear Panel of PS1006

Figure 3 illustrates the following system components:

Line input ac cord (use the top aperture of the case)

Dc output terminals (battery and load, use the case's lower aperture)

Temperature sensors (optional-2 sensors, use the case's lower aperture)

Load input circuit breaker

Battery input circuit breaker

ELVD module (behind the cover)

Ground terminal connection

Screws for fastening the rear cover

Rear cover

2.6 ELVD

The ELVD is mounted on the motherboard and can be accessed from the rear of the system after first removing the rear metal cover.

The device, which contains two LVDs mounted on one board, is capable of disconnecting two separate battery sets.

The aim of the ELVDs is to disconnect the battery set(s) from the load when the output voltage falls below a specified value (i.e. the battery is deeply discharged), thus protecting the battery from permanent damage.

The ELVD in the PS1006 system uses power MOSFETs for switching. (These solid-state devices replace the traditional electromechanical relays and contactors that have a lower MTBF.)

The ELVD is inserted into the motherboard and can easily be replaced, if necessary.

2.7 Battery Test

Both batteries are tested periodically and automatically. The length of time between tests is defined by the software.

The battery is tested by lowering the rectifier's dc voltage for a pre-defined time and simultaneously measuring the battery voltage.

If the battery is efficient and fully charged, the voltage reading will be above a predetermined level.

If the battery is inefficient or weak, the voltage reading will be low (i.e. a weak battery cannot maintain full voltage).

Since the PS1006 system can manage two battery sets, each battery set is tested separately while the other is disconnected by the ELVD.

The message "passed the test" is displayed on the controller's LCD screen if each battery set status is normal.

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3. TECHNICAL SPECIFICATIONS FOR PS1006

RECTIFIER MODULES (Volts-Amps)[6]		12-30	24-30	48-12	48-25	48-30	60-15
INPUT							
Nominal Voltage (-15%,+12%)		100 ~ 240 V_{AC}					
Voltage range		85 V_{AC} to 270 V_{AC}					
Maximum current (at full load) [1]		N*6 A	N*10 A	N*6 A	N*10 A		
Frequency		47 Hz to 63 Hz					
Power factor (at full load)		≥ 0.99					
OUTPUT							
Voltage (default)		13.5 ±0.2 V_{DC}	27 ±0.2 V_{DC}	54 ±0.2 V_{DC}			67.5±0.2 V_{DC}
Adjustable range		10 – 15 V_{DC}	20 - 30 V_{DC}	47 - 60 V_{DC}			60 – 75 V_{DC}
Regulation (line & load)		± 0.5%					
Nominal Current [1]		N*30 A	N*30 A (Vin>100 V) N*20 A (Vin<100 V)	N*12 A (Vin>150 V) N*8 A (Vin<150 V)	N*25 A (Vin>165 V) N*18A (165>Vin>120V)[5]	N*30 A (Vin>200 V) N*16 A (Vin=110 V)	N*15 A (Vin>100 V) N*10 A (Vin<100 V)
Ripple & noise @ BW=30 MHz		200 mV p-p, 20 mVrms					
Psophometric noise		-52 dbm over 600Ω (<2mV)					
Efficiency (nominal load)		86 % @230 V_{AC} 82 % @115 V_{AC}	88 % @230 V_{AC} 84 % @115 V_{AC}	90 % @230 V_{AC} 87 % @115 V_{AC}	92 % @ 230 V_{AC} 89 % @ 115 V_{AC}	91 % @ 230 V_{AC} 87 % @ 115 V_{AC}	92 % @ 230 V_{AC} 89 % @ 115 V_{AC}
Overload current [1] (Short circuit current, Vo=0)		< N*7 A N*6 A<I_{SC}<N*8 A	<N*31 A (Vin>100 V) <N*21 A (Vin<100 V) N*6 A<I_{SC}<N*8 A	<N*13 A (Vin>150 V) <N*9 A (Vin<150 V) N*3 A<I_{SC}<N*5 A	<N*26 A (Vin>165 V) <N*19A(165V >Vin>120 V) N*4 A<I_{SC}<N*6 A	N*31 A(Vin>200 V) <N*14 A(Vin+230 V)	<N*18 A N*3 A<I_{SC}<N*5 A
Over-voltage protection		15 V	30 V	60 V			75 V
Walk-in time		< 1 sec					
Hold-up time (fully loaded)		20 ms	10 ms	15 ms	10ms		
Output current indication		10 LED bar-graph (1st LED indicates operation only)					
Active current sharing		±10% accuracy at full load					
GENERAL							
System controller [2]		Full status monitoring and communication with a PC, dedicated GUI					
Withstand voltage (1 min) [3]		3000 V_{AC} INPUT/OUTPUT, 1500 V_{AC} INPUT/GND, 1000 V_{DC} OUTPUT/GND					
Operating temperature		-10 to 65°C	-10 to 45°C	-10 to 65°C	-10 to 40°C	-10 to 45°C	-10 to 40°C
Humidity		<95% non-condensing, equipped with standard PS1006 rack					
Storage temperature		-20 to 80°C					
EMC		EN 300 386-2 V1.1.3 (1997), EN55022, EN 6100 –4-2,3,4,5,6,11 EN 61000-3-2 and EN 61000-3-3					
Safety		Conforms to IEC950, EN60950					
Dimensions	Subrack	19”(W) x 3U(H) x 320mm(D) w/o terminals (360mm with terminals)					
	Rectifier module	60mm(W) x 135mm(H) x 235mm (D)mm					
Weight (Kg)	Subrack [1]	(N*1kg)+4.2 kg (fully equipped system – max. 10.2 kg)					
	Rectifier module	1 kg					
ELVD							
Max. current withstand		2x60 ADC or 1x100 A					
Trip voltage levels [4]		Disconnect: 42 ± 0.5 V_{DC}, Reconnect (AC line recovers): 49 ± 0.5 V_{DC}					

Notes:

1. N=number of modules
2. Basic shelf 1 has V/A meter. Basic Shelf 2 has a system controller.
3. Equivalent dc test voltage is applied to overcome Y-capacitors leakage current to ground. Output is floating (not grounded during test).
4. Programmable with SC1006 if included
5. N*18 A to N*12 A decreases linearly for Vin<120 V [N*12 A (for Vin=85 V)]
6. Additional configurations also available: 12-18, 24-15, others.

4. BASIC RECTIFIER MODEL

The rectifier module is the heart of the full-redundancy power system. It is a plug-in module designed specifically for modular systems. The power factor correction (PFC) device at the input enables clean, harmonic-free, sinusoidal current consumption from the ac input. This converter produces a 380 V_{DC} output, which is then down-converted to the dc output (12 / 24 / 48 / 60 V).

A current sharing circuit is responsible for accurate current sharing among the rectifiers. This enables each one of the rectifiers to change its output voltage slightly until sharing is achieved.

The output current is indicated by the LED bar graph shown on the front panel *(see* Figure 4*)*. This bar graph is used to verify the current sharing operation, as well as to indicate the percentage of the full load.

The rectifier module requires forced cooling. The speed of the fan used for evacuating the heat from internal components is variable. A special circuit changes the speed of the fan according to the load level. This prolongs the life of the fan, thus increasing the MTBF of the rectifier module itself. Other benefits include reduced audible noise and induced internal dust deposits.

4.1 Simplified Block Diagram of a Rectifier

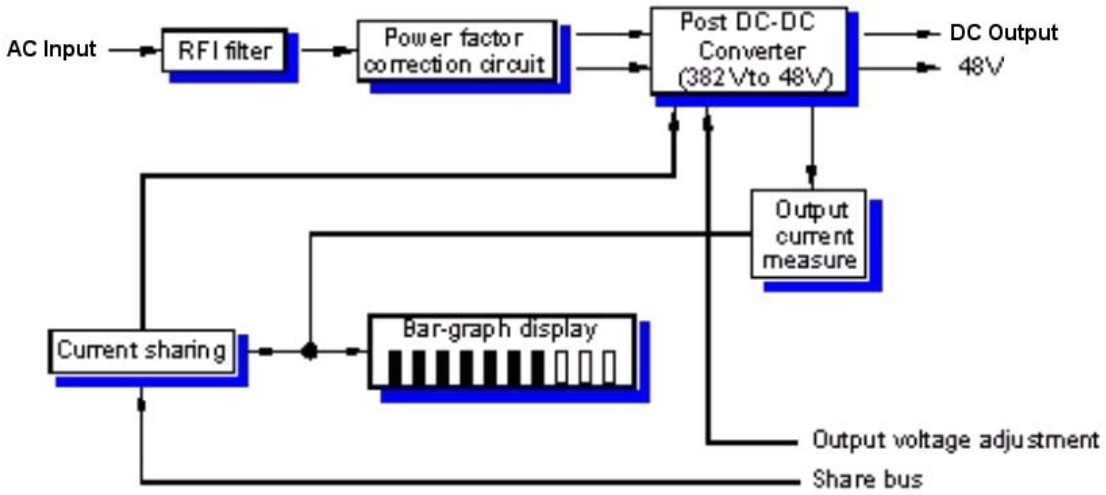

Figure 4: Simplified Block Diagram of a Rectifier (48 V output is shown)

4.2 Front Panel of a Basic Rectifier

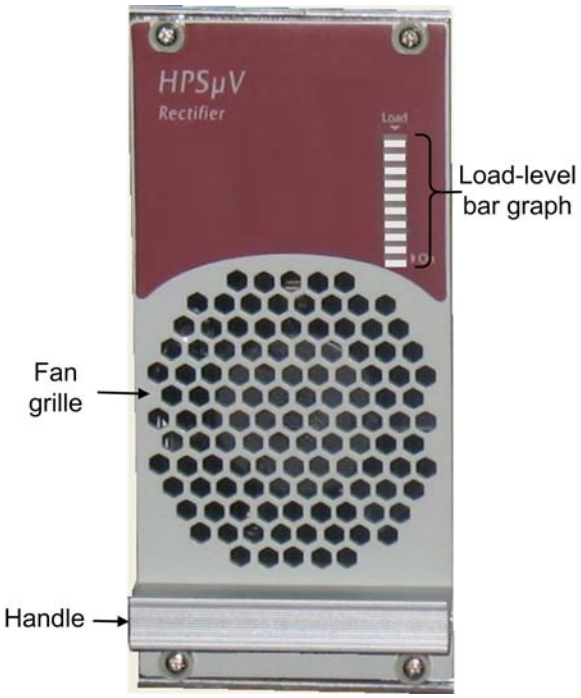

Figure 5: Front panel of a rectifier module

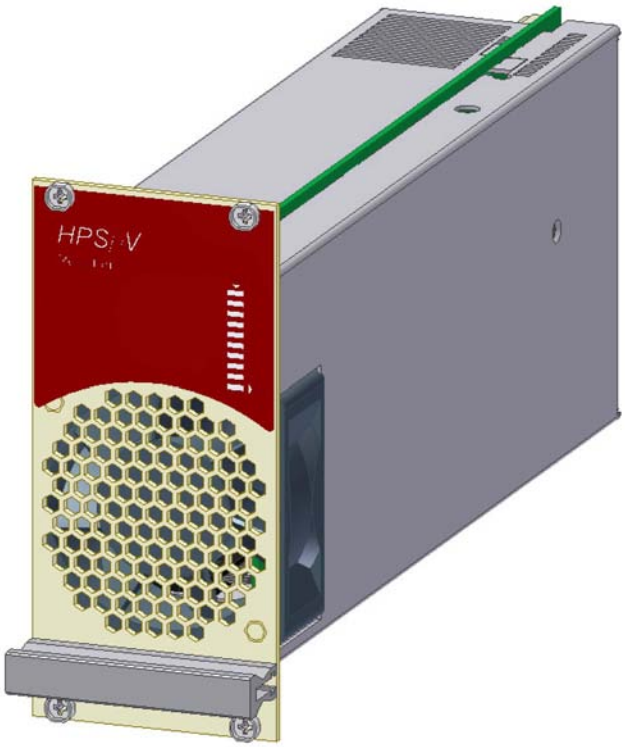

Figure 6: Perspective view of a rectifier module

4.3 Rear Panel of a Basic Rectifier

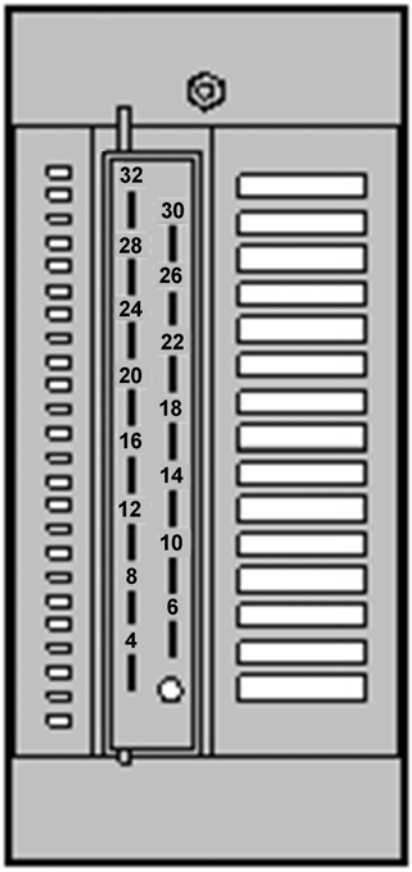

Figure 7: Rear panel of a rectifier module

The following table describes the assignments and functions of Pins on a Rectifier's Rear Panel:

PIN #	NAME	DESCRIPTION	SIGNAL LEVEL
32	PE	Protective Earth (Ground)	0 V
30	Phase	Ac input Phase	85-270 Vac
28	Neutral	Ac input Neutral	0 V
26	Not Connected	---	---
24	PE	Protective Earth (Ground)	0 V
22	+24V1	Internal 24 Vdc	24 Vdc
20	ALRM1	Faulty Module Signal (-) (open emitter type)	See pin 18
18	ALRM2	Faulty Module Signal (+) (open collector type)	Max. 35 Vdc / 5 mA referenced to ALRM1
16	SHR	Current Sharing Bus	0-5 V
14	COM	Internal Common	0 V
12	V-ADJ	Vout Adjust Pin	0~5 V referenced to -Vout
10	+Vout	Dc Output Positive	60/48/24/12 Vdc
8	-Vout	Dc Output Negative	0 V
6	+Vout	Dc Output Positive	48 Vdc / 24 Vdc
4	-Vout	Dc Output Negative	0 V

4.4 Rectifier Specifications (Single Module)

RECTIFIER MODULE (Volts-Amps)[4]	12-30	24-30	48-12	48-25	48-30	60-15
INPUT						
Nominal Voltage (-15%,+12%)	100 ~ 240 V_{AC}					
Voltage range	85 V_{AC} to 270 V_{AC}					
Maximum current (at full load)	6 A	10 A	6 A	10 A		
Frequency	47 Hz to 63 Hz					
Power factor (at full load)	≥ 0.99					
OUTPUT						
Voltage (default)	13.5 ±0.2 V_{DC}	27 ±0.2 V_{DC}	54 ±0.2 V_{DC}			67.5±0.2 V_{DC}
Adjustable range	10 – 15 V_{DC}	20 - 30 V_{DC}	47 - 60 V_{DC}			60 – 75 V_{DC}
Regulation (line & load) [1]	± 0.5%					
Nominal Current [1]	30 A	30 A (Vin>100 V) 20 A (Vin<100 V)	12 A (Vin>150 V) 8 A (Vin<150 V)	25 A (Vin>165 V) 18 A (165>Vin>120 V)[5]	30 A (Vin>200 V) 16 A (Vin=110 V)	15 A (Vin>100 V) 10 A (Vin<100 V)
Ripple & noise @ BW=30 MHz	200mV p-p, 20mVrms					
Psophometric noise	-52 dbm over 600Ω (<2mV)					
Efficiency (nominal load)	86%@230 V_{AC} 82%@115 V_{AC}	88%@230 V_{AC} 84%@115 V_{AC}	90%@230 V_{AC} 87%@115 V_{AC}	92% @ 230 V_{AC} 89% @ 115 V_{AC}	91% @ 230 V_{AC} 87% @ 115 V_{AC}	92% @ 230 V_{AC} 89% @ 115 V_{AC}
Overload current (Short circuit current, Vo=0)	<7 A 6 A<I_{SC}<8 A	< 31 A (Vin>100 V) < 21 A (Vin<100 V) 6 A<I_{SC}<8 A	< 13 A (Vin>150 V) < 9 A (Vin<150 V) 3 A<I_{SC}<5 A	< 26 A (Vin>165 V) <19 A(165V>Vin>120V) 4 A<I_{SC}<6 A	31 A (Vin>200 V) 14 A(Vin=230 V)	< 18 A 3 A <I_{SC}<5 A
Over-voltage protection [2]	15 V	30 V	60 V			75 V
Walk-in time	< 1 sec					
Hold-up time (fully loaded)	20ms	10ms	15ms	10ms		
Output current indication	10 LED bar-graph (1st LED indicates operation only)					
Active current sharing	±10% accuracy at full load					
GENERAL						
Withstand voltage (1 min) [3]	3000 V_{AC} INPUT/OUTPUT, 1500 V_{AC} INPUT/GND, 1000 V_{DC} OUTPUT/GND					
Operating temperature	-10 to 65°C	-10 to 45°C	-10 to 65°C	-10 to 40°C	-10 to 45°C	-10 to 40°C
Humidity	<95% non-condensing, equipped with standard PS1006 rack					
Storage temperature	-20 to 80°C					
EMC	EN 300 386-2 V1.1.3 (1997), EN55022, EN 6100 –4-2,3,4,5,6,11 EN 61000-3-2 and EN 61000-3-3					
Safety	Conforms to IEC950, EN60950					
Dimensions	60mm(W) x 135mm(H) x 235mm (D)mm					
Weight (Kg)	1 kg					

Notes:
1. Shared bus is grounded and disabled, single rectifier test.
2. Hiccup operation mode.
3. Equivalent DC test voltage is applied to overcome Y-capacitors leakage current to ground. Output is floating (not grounded during test).
4. Additional configurations also available: 12-18, 24-15, others.

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4.5 Rectifier Calibration

Calibration of the PFC module is simple and involves a single trimmer, which adjusts the output voltage.

To calibrate the rectifier:

Access the trimmer (see no. 1 in Figure 8) via the small opening at the top of the cover.

Set the output voltage precisely, using a DMM (54 V to 48-xx models, 27 V to 24-xx models, 13.5 V to 12-xx models and 67.5 V to 60-xx models).

***Note**: Other voltages are possible. Please consult with your vendor for information regarding specific models.*

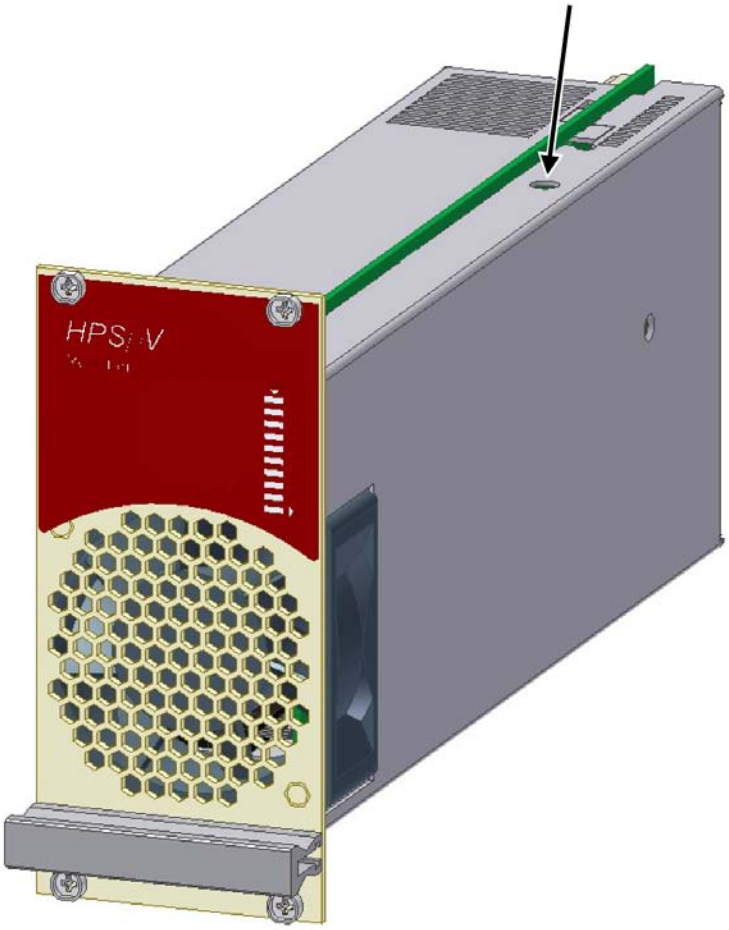

Figure 8: Rectifier Calibration Point

5. SC1006 SYSTEM CONTROLLER

The PS1006 system uses a special SC1006 system controller.

A comprehensive description of this controller is provided in a separate manual supplied with this documentation.

The SC1006 controller is designed to be used with a PC monitor, so the indication buttons on the front panel are limited.

Only the most important indications are provided on the front panel, plus the audible alarm.

System controller SC1006 also corrects the system's dc output voltage by measuring and correcting it in a negative feedback loop. This ensures a 0.5% absolute error in all conditions.

Two versions are available:

Standard RS232 serial communication

NET version - both standard RS232 serial communication and PPP/SNMP/TCP-IP communication

***Note**: The standard version can be upgraded to the NET version. Check your SC1006 manual for details.*

The SC1006 controller is shown in Figure 9.

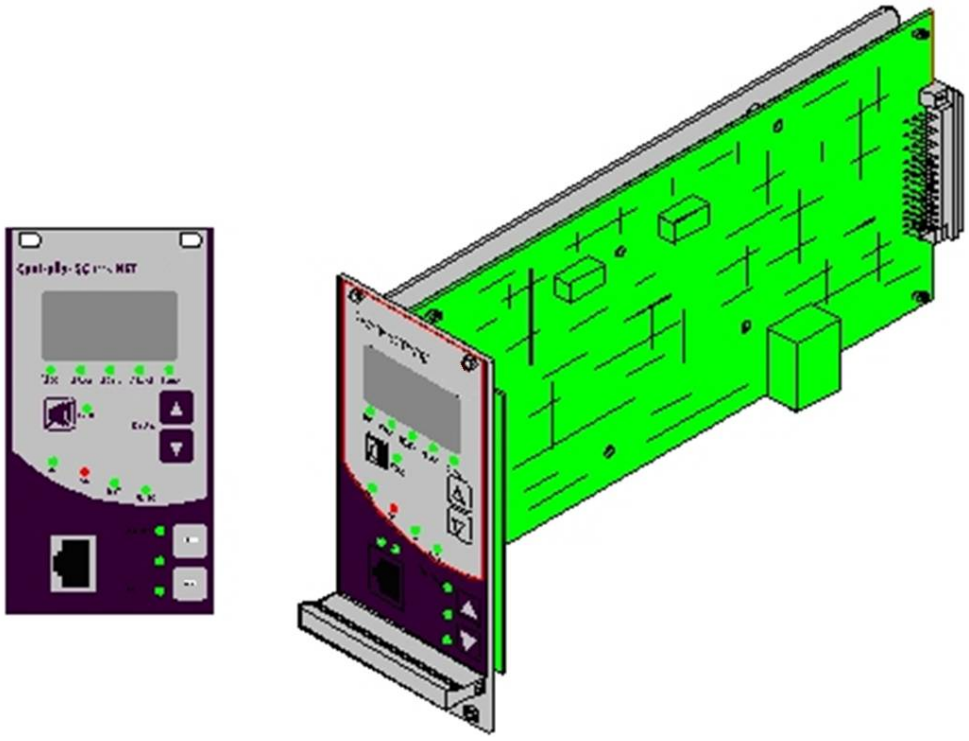

Figure 9: SC1006 System Controller

5.1 Front Panel

The SC1006NET front panel includes the following features:

1. A three-digit 7-Segment Display panel
2. Five LED indicators under the 7-Segment Display that indicate which parameters are currently being displayed or reconfigured
3. Five LEDs to indicate the real-time status of the power system.
4. Two LEDs to indicate the current communications status.
5. Seven control buttons for managing the controller
6. An audible alarm buzzer that warns of a fault or faults in the system
7. An RJ45 Communication Port that allows remote communication with the controller, via the RS232 or 10Base-T/Ethernet protocols. The protocol used by the SC1006 controller depends on the cable used and the data received by the SC1006.

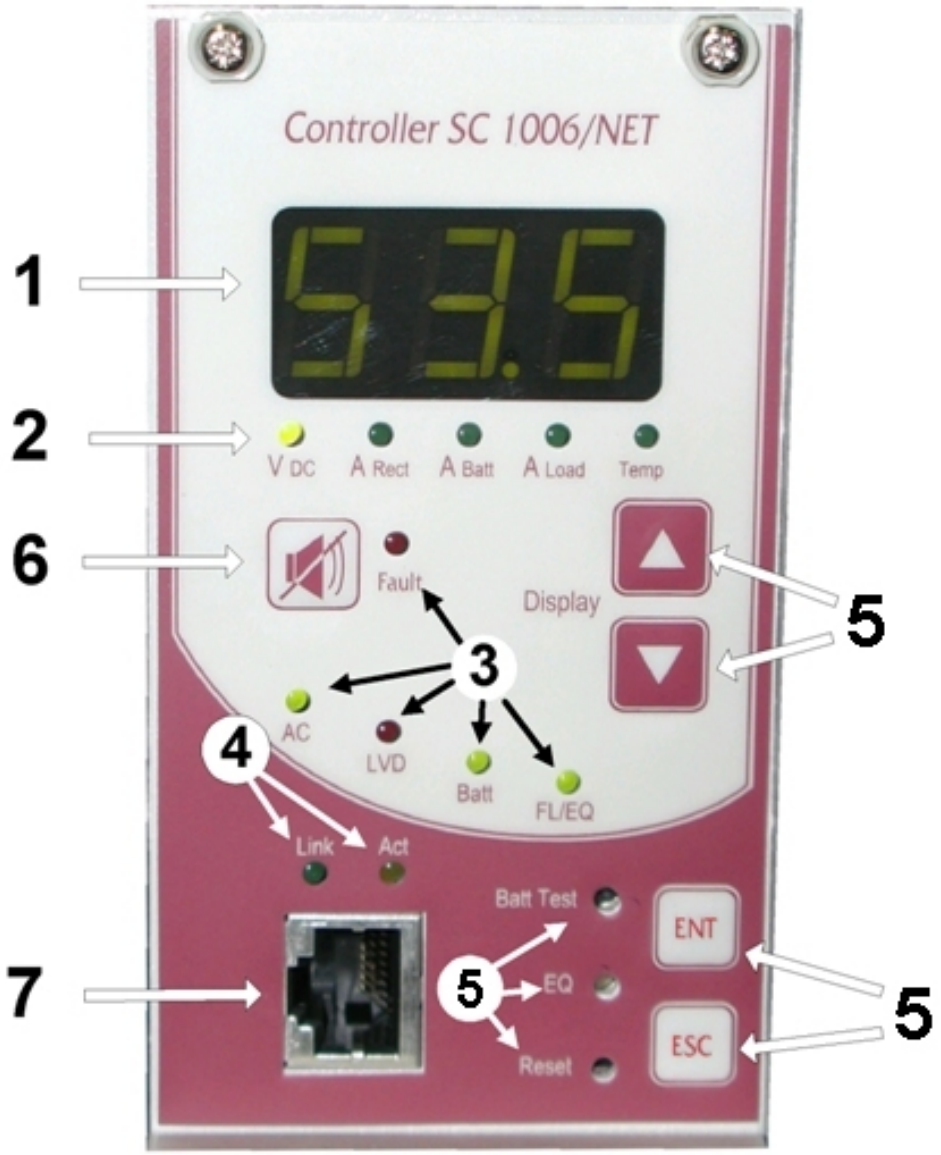

Figure 10: SC1006 Front Panel

5.1.1 7-Segment Display

In Monitoring mode, the 7-Segment Display digitally displays the real-time status of a system parameter. The user can change the nominal values of the parameter displayed on the 7-Segment Display with the Up and Down arrow buttons.

5.1.2 7-Segment Display LEDs

The lit LED under the 7-Segment Display indicates which system parameter is currently being monitored or modified. The relationship between the LED, the 7-Segment Display and the parameter modifications is described in the following table:

Table 1: 7-Segment Displays

LED	7-SEGMENT DISPLAY	SETTING MODIFICATION
Vdc	Dc voltage measurements (output voltage)	Adjusting the output voltage in Floating Mode
Arect	Total dc current output from the rectifiers	None
Abatt	Battery output current	Adjusting threshold voltage for opening the 2 LVDs
Aload	Current drawn by a load	None
TEMP	Battery temperature	Adjusting the coefficient by which the charge voltage for batteries is modified to compensate for high or low battery temperature

5.1.3 LED Status Indicators

The color-coded LED lights indicate the real-time status of system components, as described in the following table:

Table 2: LED Status Indicators

LED	COLOR	MEANING
AC	Green	A steady light indicates normal input voltage from the mains
AC	Unlit	No voltage from the mains
LVD	Red	A steady light indicates that the LVD is open (either the controller system opened the LVD to prevent battery damage or the user manually opened the LVD)
LVD	Unlit	An unlit LED indicates a normal operation mode.
BATT	Green	1. A steady light indicates that the last battery test passed 2. A flashing light indicates a battery test in progress
BATT	Unlit	An unlit LED indicates the last battery test failed.
FAULT	Red	1. A steady light indicates that there is a fault in the system. 2. A flashing light indicates that there is a rectifier fault plus the possibility of another fault as well.
FAULT	Unlit	An unlit LED indicates that there are no active faults in the system.
FL / EQ	Green	1. A steady light indicates normal dc voltage and that the system is in Floating mode. 2. A flashing light indicates that the system is in Equalizing mode.
FL / EQ	Unlit	Indicates a fault in the dc voltage
LINK	Lit	The controller is communicating with a remote application via a Serial or Net connection: 1. 10BaseT (Ethernet) - Indicates that the link is OK 2. Serial - Indicates serial Line activity
ACT	Lit	10BaseT (Ethernet) - Net Activity

5.1.4 Control Buttons

The following table describes the results of pressing each of the control buttons.

Table 3: Control Buttons

BUTTON	DESCRIPTION
BATT TEST	1. Manually initiates a battery test. 2. Aborts an ongoing battery test.
 **(ALARM OFF)**	1. Silences the beep tone that signals an active alarm. 2. Manually initiates a test of the controller's LEDs, display, and alarm beep tone if it is pressed when the alarm is silent. (Note: This does not test the LINK and ACT LEDs.)
UP / DOWN ARROW BUTTONS	1. Browses measurements and parameters 2. Modifies parameters
ENT	1. Enters Setup mode 2. Saves changes made in Editing or Setup modes
 **+ ENT**	Enters Editing mode (enhanced setup mode)
ESC	1. Exits Setup or Editing mode. 2. Pressing this key for a few seconds displays the F Indicator codes on the 7-Segment Display screen.
EQ	1. Manually switches the Charge mode from Equalizing to Floating when the controller is in Equalizing mode. 2. Manually switches the Charge mode from Floating to Equalizing when the controller is in Floating mode.
Reset	Resets the controller

5.1.5 Audible alarm buzzer

The audible alarm buzzer warns users of the existence of a fault or faults in the power system. It continues to sound until the fault no longer exists or until the  button is pressed. The ***Fault*** LED remains lit until the fault is no longer active, even if the alarm buzzer has stopped.

5.1.6 RJ45 Communication Port

This port enables remote communication with the controller, allowing remote monitoring and control of operation, status, and parameter setting. The following communication protocols may be used with it:

8. RS232 serial port
9. SNMP (TCP/IP – Ethernet)
10. SNMP (TCP/IP – PPP)

5.2 Fault Detection and Alarms

The controller generates alarms in response to the power system faults described in the following table. When an alarm becomes active the ***Fault*** LED lights up, the alarm buzzer sounds, and an alarm message - marked by a Time Stamp - is recorded in the Event Log. One of the LED status indicators may light up too.

Each alarm remains active for as long as the fault remains active. It disappears as soon as the fault no longer exists. The exception to this is a failed battery test. Batteries must pass the battery test for their alarm status to revert to normal.

The alarm message associated with each fault is described in the following table:

Table 4: Alarm Messages

ALARM MESSAGE	FAULT
Ac Low	Mains voltage is low.
Ac High	Mains voltage is high.
Dc High Voltage	Dc output voltage high.
Dc Low Voltage	Dc output voltage low.
Dc LowLow Volt	Dc output voltage too low (LVD is opened).
Batt#1 Test Fault	Fault in Battery 1
Batt#2 Test Fault	Fault in Battery 2
LVD-2 Driven open	Low Voltage Detector 2 opened due to low output voltage (batteries disconnected from system)
LVD-1 Driven open	Low Voltage Detector 1 opened due to low output voltage (batteries disconnected from system)
Aux Contact open	Auxiliary input dry contact open
Aux Breaker open	Auxiliary input circuit breaker open
Battery Breaker open	Battery circuit breaker open (batteries disconnected from system - no system backup or charging)
Load Breaker open	Load circuit breaker open (load disconnected from system)
Inv/Conv fault	Fault in Inverter/Converter module (if installed)
Rectifier Fail	Rectifier is not OK
Over Temperature	Battery temperature high

5.2.1 Alarm LOG

Each event is recorded in an event LOG which contains the history of up to 192 power system faults along with information describing each event and when it occurred.

5.2.2 Alarm Dry Contacts

Three dry contacts are used for direct alarm activation. The user can connect a dry contact to any (or none) of the 16 listed alarms. An alarm can be connected to more than one dry contact and a dry contact can be connected to more than one alarm. When an alarm assigned to a dry contact is activated, the dry contact is also activated.

The default (set by the manufacturer) connections between alarms and dry contacts are indicated by the darkened squares in Figure 11.

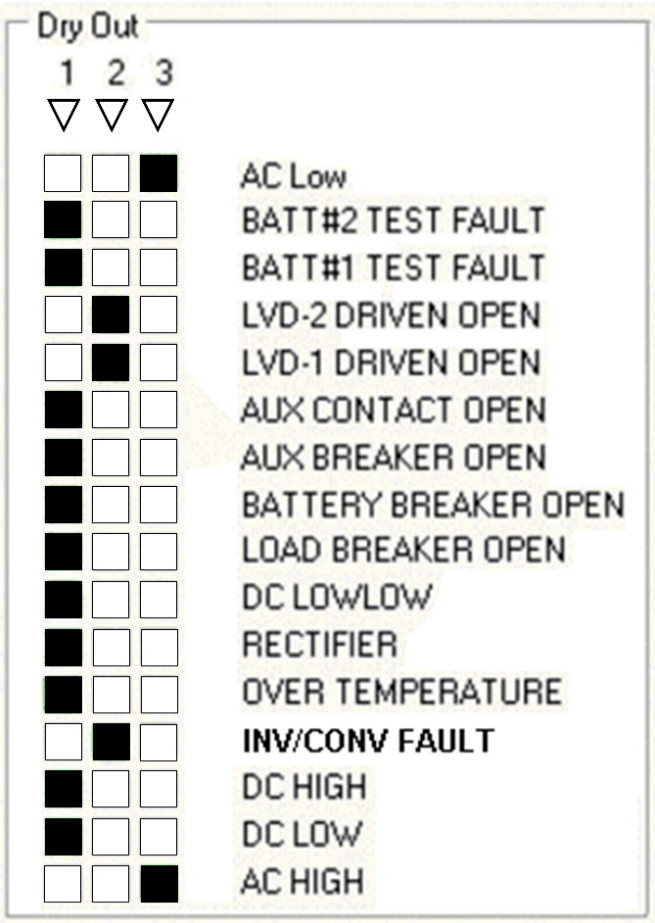

Figure 11: Default Dry Contacts-Alarms Connections

6. V/A METER (OPTIONAL)

The PS1006 system has a low-cost alternative to the advanced controller that contains a 3-digit dc voltmeter and dc ammeter.

This meter:

- Displays the output voltage and current simultaneously.
- Includes the ELVD and an audible alarm.
- Allows the system dc voltage to be set by the hidden potentiometer at the bottom (VOLT ADJ).
- Has LED alarm indicators that light when:
    - Dc voltage low.
    - Dc voltage high.
    - LVD disconnects the batteries.
- Activates a dry contact in the event of a failure of one or more rectifiers, or ac input failure.

Optionally, an additional two dry contacts are available:

- Dc voltage low.
- LVD disconnect of the batteries.

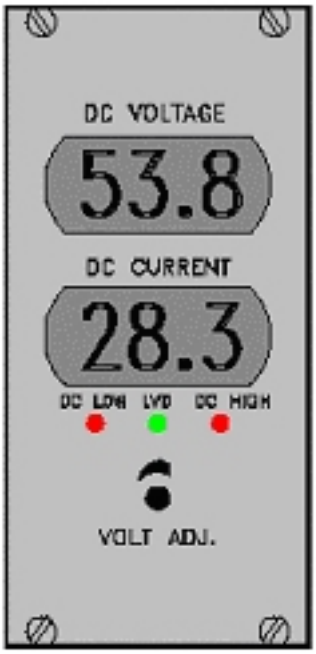

Figure 12: V/A Meter

7. INSTALLATION PROCEDURES

7.1 Safety Instructions

ATTENTION

Read the following safety information carefully before using this power supply

CAUTION identifies conditions and actions that may damage the power supply.

WARNING identifies conditions and actions that expose the user to hazard(s).

- **WARNING** - Restricted Access Location: This power system should be used with the specific cabinet only. The cabinet provides a fire and electrical enclosure for the system and also enhances EMI/RFI performance. Safety standards are applicable to this unit providing that it is enclosed in a prescribed cabinet.
- **WARNING** - This power supply must be grounded to the protective earth (PE). The unit receives the connection from the power cord and from the rack itself.
- **WARNING** - Do not allow any object to be inserted into the unit through the ventilation holes.
- **WARNING** - Do not allow any liquids to get into the unit through the ventilation holes.
- **WARNING** - Always switch off the power switch and detach the ac cord before you remove the power supply from the rack.
- **WARNING** - Do not open the unit. Danger of electrical shock exists for several minutes after unplugging from the mains.
- **WARNING** – While replacing fuses always use the same type and rating as the original.
- **CAUTION** – Do not block the ventilation holes. This may cause a high temperature rise in the unit and, as a result, damage it or shorten its life.

7.2 General

The system should be wired to the load(s) and battery set(s) as illustrated in Figure 13.

In order to gain access to the motherboard terminals, the rear cover must first be removed.

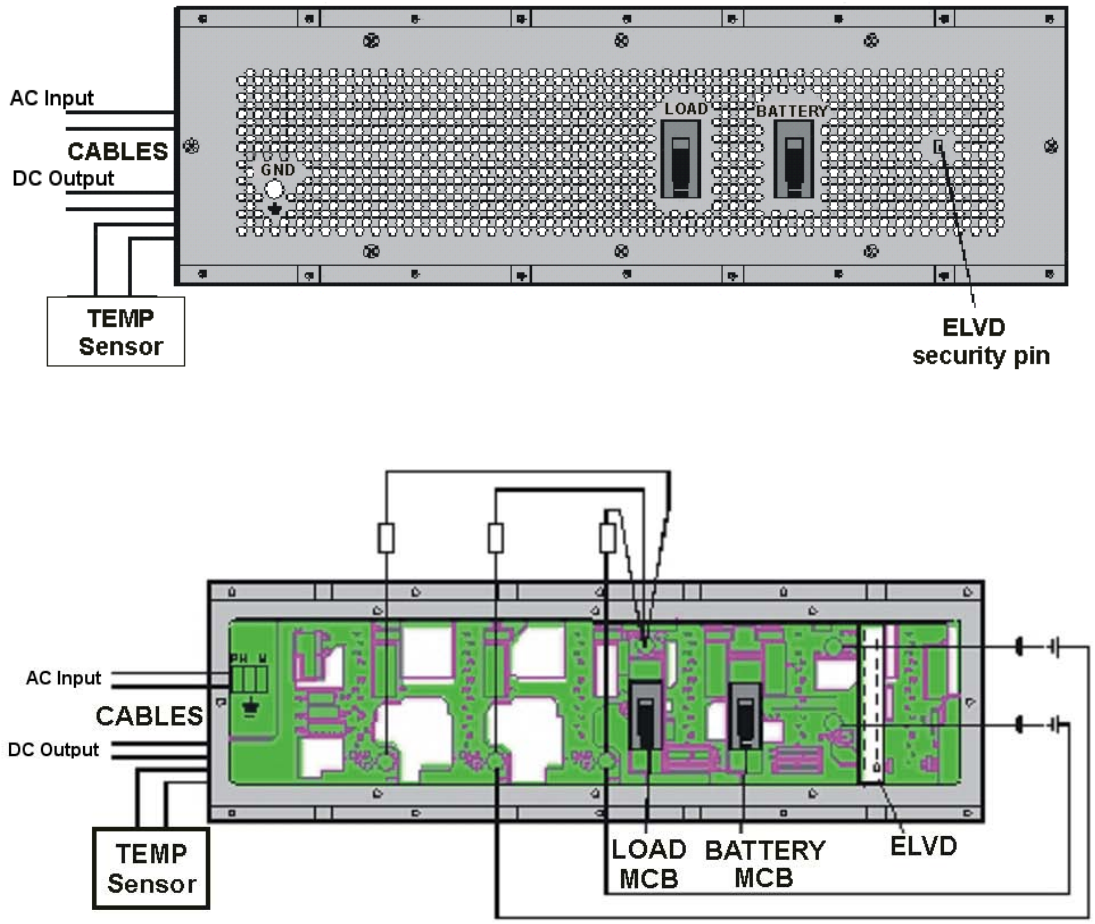

Figure 13: Battery and Load Wiring Connections

7.3 Installing the System

Verify that the load, battery and line input's circuit breakers are disconnected. Access the internal connections by carefully opening the rear cover.

Connect the shelf to the battery and load via the battery and load terminals on the rear panel *(see Figure 13)* and close the rear cover with its screws.

Plug the ac input cord into the mains.

Turn on the line circuit breaker and verify that the modules' display is activated. Verify that the system controller (right-handed) is operating.

Install the GUI software "**PSM1006 AMIGA**" on your PC.

Connect the communication cable from the controller's RS232 terminal to the PC. The GUI should indicate normal communications and measurements.

Verify that no red LEDs are lit.

Switch on the load and battery circuit breakers.

The system is ready for use.

Use the software to change the system's settings (e.g. float/boost charging voltage) if necessary.

7.4 Dry Contact Signalization

The system also provides 3 floating output signals for system status indication (in addition to the data provided by the controller via the RS232 terminal).

These 3 output signals are accessible via output dry contact connections on the motherboard.

The output dry contacts are assignable to a variety of system events and their behavior can be defined through the software. Refer to the SC1006 controller booklet for details.

The system has either one of two styles of output dry contacts connections: Option A (shown in Figure 14) or Option B (shown in Figure 15).

In Option A the output dry contacts are located in a single component, labeled P16 on the circuit board. These dry contacts are Normally Open, and close when the designated system event occurs. Ratings for the switches SWa, SWb, and SWc in Figure 14 are 50 V / 1 A maximum.

In Option B, the output dry contacts are in three separate connectors located adjacent to one another, labeled P41, P42, and P43 on the circuit board. Each of these dry contacts can be used as either Normally Open or Normally Closed.

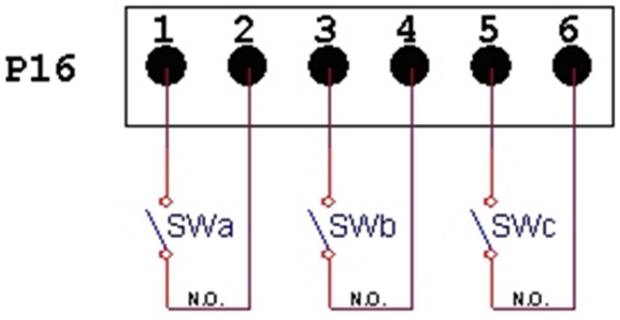

Figure 14: Output dry contacts – Option A

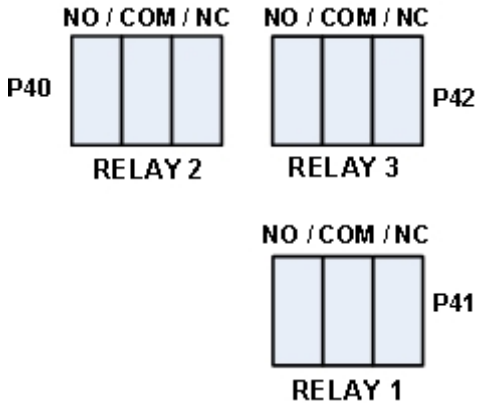

Figure 15: Output dry contacts – Option B

7.5 Temperature Compensation

As in similar advanced dc systems, the PS1006 includes battery temperature compensation. This means that the temperature of the batteries measured by the system compensates the output voltage.

Note: Both sensors are of the current-source type and are polarized. Take care that the polarity is not reversed.

The calculated temperature is the average of the two measurements. In case one sensor is absent or defective, the system will ignore this sensor and treat the normal sensor only. The temperature value is displayed on the PC screen and is used to calculate the compensation. The compensation coefficient is negative and is programmable by the software. Typical compensation value is [–72mV/°C].

The sensors' connections, marked as "P14" on Figure 16 below, are mounted on the motherboard.

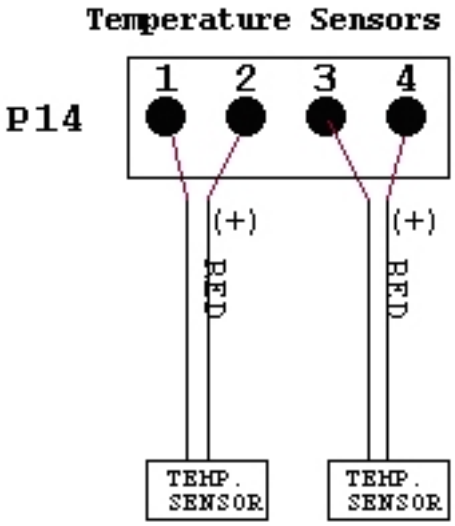

Figure 16: P14 Sensor Connections

8. BATTERY DESIGN

8.1 Determining the Battery Size

This section explains how to determine the correct size of the battery to be connected to the system.

The role of the battery is to power the load during a mains failure and then continue to be recharged by the system when the mains recovers.

At this point, the rectifiers are loaded to maximum, as they have to provide power to both the load and the empty battery.

8.2 Design Example

Assuming that the requirement for long battery backup time is 8 hours, then: TBACKUP = 8 hours

Assuming that the load current is 20 A at 48 V, then: ILOAD = 20 A

The required capacity of the battery is the following: TBACKUP * ILOAD = 160 Ah

This means that a bank of four 12 V 160 Ah batteries is required to receive a total of 48 V 160 Ah.

After the line recovers, the battery's recharge time is calculated as 20 hours.

A 15% safety margin is added to the recharge time.

The current that recharges the battery is as follows: IRECHARGE = 160 Ah * 1.15 / TRECHARGE = 184 Ah / 20 H = 9 A

The rectifiers must now provide a total current of: ITOTAL = IRECHARGE + ILOAD = 20 A + 9 A = 29 A

A minimum of 3 rectifier modules are needed for the specified current consumption: N = ITOTAL / 6 A (12 A is the maximum capacity of one module)

Therefore, for an N+1 redundant system we need: N+1 = 4 rectifier modules.

9. ADDITIONAL INFORMATION

9.1 Troubleshooting

The table below solves some of the problems which may arise. Refer to this table before calling for service.

SYMPTOM	POSSIBLE CAUSE	REMEDY
ELVD LED is on	1. No ac input. 2. Output voltage is too low.	1. Check that the line MCB is on. 2. Check that the system is connected to the mains.
No backup time when ac is absent	Battery is not connected.	Check battery cables and circuit breaker.
Load is not operating	Load is not connected.	Check load cables. Check load circuit breaker.
No current sharing among rectifiers (more then 2 segments difference between any two modules).	1. Load is too high (rectifiers are in current-limit mode). 2. Rectifier(s) are not properly adjusted.	1. Decrease the load or add rectifiers to the system. 2. Re-adjust the voltage of the problematic rectifier(s).
Battery backup time is too low	1. Battery is too small for the application. 2. Charging voltage is too low. 3. Weak battery.	1. Increase battery capacity 2. Raise the system output voltage from the PC. 3. Replace the battery and check ambient temperature according to manufacturer's instructions.

9.2 Ordering Information

ITEM	Catalog number
Main rack frame (rectifier not included)	102041006-3UG
48 V – 12 A Rectifier/ Power Supply module	1020480012F
48 V – 25 A Rectifier/ Power Supply module	1020480025F
48 V – 30 A Rectifier/ Power Supply module	1020480030F
60 V – 15 A Rectifier/ Power Supply module	1020600015F
24 V – 15 A Rectifier/ Power Supply module	1020240015F
24 V – 30 A Rectifier/ Power Supply module	1020240030U
12 V – 18 A Rectifier/ Power Supply module	1020120018
12 V – 30 A Rectifier/ Power Supply module	1020120030U
SC1006 System Controller - standard	102SC1006
SC1006 System Controller - NET	102SC1006NET
Dual Electronic LVD board (ELVD)	29CA513
Motherboard	29CA510
PSM1006 AMIGA Software CD	19990070
(Cabinet for 6 rectifiers + V/A meter)	102SH61519"-1