EXPANDABLE DC POWER SUPPLY

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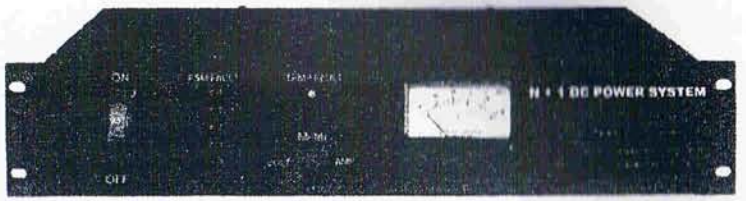
N+1 DC Power System

with Battery Backup / Charging Function

MODELS : SEC-40BRM
SEC-60BRM
SEC-80BRM
SEC-100BRM

INSTALLATION & OPERATING MANUAL

Please read this manual before operating your power supply.



- PROVIDES N + 1 REDUNDANCY
- ALLOWS CONNECTION OF EXTERNAL BATTERIES FOR BACKUP
- EXPAND OUTPUT POWER BY ADDING POWER MODULES
- UP TO 100 AMPS CONTINUOUS POWER
- VOLT / AMPERE METER
- OPERATION STATUS L.E.D.
- FAN FAILURE ALARM AND WARNING L.E.D.
- REMOTE MONITORING AND INDICATION
- 19" RACK MOUNT
- 1 YEAR WARRANTY / TOLL FREE TECHNICAL SUPPORT

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IMPORTANT SAFETY INSTRUCTIONS

Please read before using your power supply.

CAUTION !

ALL ELECTRICAL INSTALLATIONS MUST MEET LOCAL AND NATIONAL WIRING CODES AND SHOULD BE PERFORMED BY A QUALIFIED ELECTRICIAN.

OPERATION OF COOLING FAN

THE HEAT PRODUCED IS EXTRACTED BY FORCED AIR COOLING. IN CASE ANY OF THE FANS FAILS, LIGHT AND SOUND ALARMS WILL BE ACTIVATED. IMMEDIATELY **SWITCH OFF** THE POWER TO THE UNIT TO PREVENT DAMAGE DUE TO OVER HEATING

CONNECTION TO AC OUTLET

THE POWER SUPPLY SHOULD BE OPERATED ONLY FROM A STANDARD 3 PIN 120 V AC/ 60 HZ OUTLET WITH PROPER GROUNDING CONNECTION.

SEC-100BRM AND **SEC-80BRM** MUST BE POWERED FROM A 20A CIRCUIT AND MUST BE PLUGGED INTO A 20A AC OUTLET WHICH WILL ACCEPT THE 20A MOULDED PLUG PROVIDED WITH THE POWER CORD. **SEC-60BRM** AND **SEC-40BRM** MAY BE POWERED FROM A 15A CIRCUIT. A 15A PLUG HAS BEEN PROVIDED SEPARATELY WHICH CAN BE USED TO REPLACE THE 20A PLUG.

CAUTION ! REPLACEMENT SHOULD BE DONE BY A QUALIFIED ELECTRICIAN. PLEASE ENSURE PROPER POLARITY OF THE CONNECTIONS AS FOLLOWS :

" L " LIVE	**BLACK WIRE**
" N " NEUTRAL	**WHITE WIRE**
EARTH GROUND	**GREEN WIRE**

DO NOT USE EXTENSION CORD UNLESS ABSOLUTELY NECESSARY. IF AN EXTENSION CORD MUST BE USED , MAKE SURE :

1) THE PINS ON THE EXTENSION CORD'S PLUG ARE OF THE SAME NUMBER, SIZE AND SHAPE AS THOSE OF THE PLUG OF THE POWER SUPPLY CORD. NEVER USE AN EXTENSION CORD WITH A 2 PIN PLUG (THERE WILL BE NO GROUNDING CONNECTION IN THIS TYPE OF PLUG WHICH IS A SHOCK AND FIRE HAZARD)

2) THE EXTENSION CORD WIRE SIZE SHOULD BE MINIMUM 12 AWG, 20 A.

LOAD AND BATTERY CONNECTIONS

ALWAYS ENSURE THAT THE POSITIVE AND NEGATIVE CONNECTIONS ARE SECURE AND THE SCREWS ARE TIGHTENED PROPERLY. **LOOSELY TIGHTENED CONNECTIONS RESULT IN EXCESSIVE VOLTAGE DROP AND MAY CAUSE OVERHEATED WIRES AND MELTED INSULATION.**

USE PROPER SIZE OF WIRE, AS INDICATED BELOW, TO CONNECT ANY DEVICE TO THE POWER SUPPLY. THESE WIRE SIZES ARE VALID WHEN THE DEVICE IS WITHIN 4 FT. DISTANCE FROM THE POWER SUPPLY. THICKER WIRING WILL BE REQUIRED FOR LONGER DISTANCES.
THINNER WIRES WILL CAUSE OVERHEATING AND EXCESSIVE VOLTAGE DROP :

FOR 5 MODULES - 100 A	# 2 AWG |	NEOPERENE
FOR 4 MODULES - 80 A	# 4 AWG |	WELDING
FOR 2 OR 3 MODULES - UPTO 60 A	# 6 AWG |	CABLE

ENSURE THAT THE AC POWER IS SWITCHED OFF WHEN ANY DEVICE IS BEING CONNECTED TO THE POWER SUPPLY.

DO NOT ALLOW THE ENDS OF THE POSITIVE AND NEGATIVE WIRES TO TOUCH EACH OTHER.

FUSE REPLACEMENT

ENSURE PROPERLY RATED FUSE (125 V, 4A) IS USED IN EACH OF THE MODULES.

ENVIRONMENT

DO NOT EXPOSE POWER SUPPLY TO RAIN, SNOW OR WATER SPRAY

DIS-ASSEMBLY AND REPAIR

THE POWER SUPPLY SHOULD BE DISASSEMBLED OR REPAIRED BY A QUALIFIED TECHNICIAN. INCORRECT REASSEMBLY OR REPAIR MAY RESULT IN A RISK OF ELECTRIC SHOCK OR FIRE WHICH MAY RESULT IN PERSONAL INJURY AND PROPERTY DAMAGE.

DESCRIPTION

This is a 19 inch Rack Mount Power Supply which converts 120 V , 60 Hz. AC power into regulated 14.2 V DC , +/- 1% (At module output*) delivering up to a maximum of 100 A continuous (up to 115 A surge) with 5 Base Level PCB Modules. There is provision to connect the power supply to an external battery for backup power in the case of an AC power failure and re-charge the battery when AC power resumes.

*Voltage at output terminals L1 & L2 will be 13.8V minus 15mV per Ampere (Please see page 7 for explanation.)

APPLICATIONS

The unit is designed for the following applications :

1. N+1 redundant systems
2. Future power level expansion
3. Uninterrupted DC output when used in conjunction with an external battery backup .

DESIGN AND PRINCIPLE OF OPERATION

The unit is designed using advanced switch mode technology and load share circuitry for high reliability, high efficiency and minimum size and weight. It is modular in construction consisting of up to 5 Base Level PCB Modules (referred to as PSM "POWER SUPPLY **MODULES**") that are connected for parallel operation with true current sharing . Each module is a stand alone power supply which delivers up to a maximum of 20 A continuous (23A surge) . By equalizing the output currents, uniform thermal stress of the individual modules is also ensured which has utmost importance for long term reliability of electronic components. The operating principle of the load share mechanism is to measure the output current of each individual module and to be able to modify the output voltage of the units until all the participating modules deliver equal output currents. Each module is required to be inter-connected with each other to a common "**SHARE BUS**" through a pair of parallel pins marked "**JUMP1**" and jumper wires. Typically, the output currents for the paralleled units will be within 10% of each other at full output current. The output is delivered through schottky isolating diodes to enable connection of external battery for uninterrupted back-up power.

COOLING AND WARNING FOR FAN FAILURE

The heat generated due to internal power dissipation is removed by forced cooling through two high power D.C. fans mounted at the back of the unit which blow air from the outside into the unit. The forced air is exhausted out through the vent holes provided on the two sides of the unit.

IT IS EXTREMELY IMPORTANT THAT THE SUCTION SIDE OF THE FANS AND THE DISCHARGE SIDES OF THE VENT HOLES ARE NOT BLOCKED. "

A warning circuit monitors the operational condition of the fans. In case of a fan failure, a buzzer will sound and the red LED indicating "TEMP. FAULT" will light up. The unit should be switched off immediately and the defective fan should be replaced. **NEVER LOAD THE UNIT WHEN THERE IS AN AUDIBLE ALARM AND THE TEMP. FAULT LED IS ILLUMINATED.**

FRONT PANEL CONTROLS AND INDICATORS

The following controls and indicators are provided on the front panel :

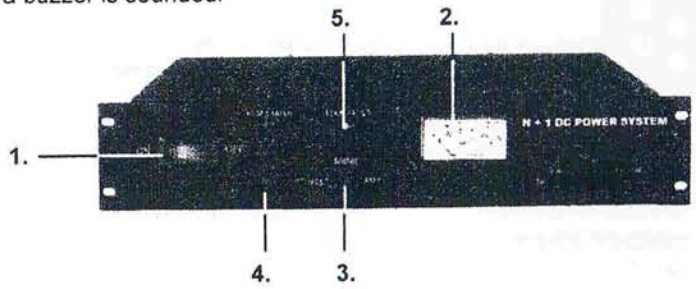
1. POWER ON/OFF SWITCH / BREAKER. The rocker switch will illuminate when switched on. A 20A circuit breaker is built in to provide protection on the input side against overload

2. VOLTMETER / AMMETER. A combined voltmeter and ammeter are provided. The function can be switched by the volt / amp switch

3. METER CHANGE-OVER SWITCH. Switches the combined meter between ammeter and voltmeter

4. L.E.D " PSM STATUS ". During normal operation, the green LED of each **P**ower **S**upply **M**odule (PSM) will light. In case a power supply module (PSM) fails, its corresponding LED will go off.

5. L.E.D " TEMP. FAULT " : In case of fan failure, this red LED lights up and a buzzer is sounded.

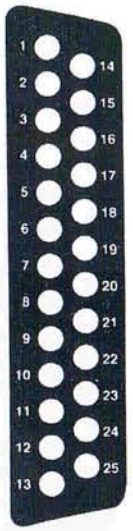


REAR PANEL CONNECTORS

The following output connectors have been provided.

1. L1 (Red positive), L (white negative) LOAD CONNECTORS. For connecting to the D.C. Load
2. B1 (Red positive), B2 (white negative) BATTERY CONNECTORS. For connecting external battery for un-interrupted D.C. power to the load.

3. REMOTE MONITORING AND INDICATIONS . A 25 pin D-sub connector has been provided for remote monitoring and indication. Pin connections are given below. Pins 2 and 16 are meant to indicate availability of input AC power. Current indication on pins 18 & 6 is 25mV per 1mA.



ITEM	NUMBER	ID	FUNCTION
1	Pin 2	Black	AC 5V 0.25A
	Pin 16	White	AC 5V 0.25A
2	Pin 12	Orange	Temp Fault Led +
	Pin 19	Green	Temp Fault Led -
3	Pin 7	Gray	PCB 1 Power LED+
	Pin 20	Violet	PCB 1 Power LED-
4	Pin 8	Violet	PCB 2 Power LED+
	Pin 21	Blue	PCB 2 Power LED-
5	Pin 9	Blue	PCB 3 Power LED+
	Pin 22	Green	PCB 3 Power LED-
6	Pin 10	Green	PCB 4 Power LED+
	Pin 23	Yellow	PCB 4 Power LED-
7	Pin 11	Yellow	PCB 5 Power LED+
	Pin 24	Orange	PCB 5 Power LED-
8	Pin 25	Red	DC Volt Output +
	Pin 13	Black	DC Volt Output -
9	Pin 18	Gray	DC Current +
	Pin 6	Blue	DC Current -

PROTECTIONS

SHORT CIRCUIT PROTECTION : In the event of a short circuit, the PWM controller will be shut down and the output will drop to near 0 V. The green LEDs will flash. The unit will reset automatically once the short circuit condition is removed

CURRENT LIMITING : The unit will enter this mode when the load tries to draw more than the limiting values of currents as shown in the specifications. Under this condition, there will be loss of voltage regulation and the output voltage will drop. The "PSM STATUS" LED will, however, remain illuminated . **The unit will reset automatically as soon as the overload condition is removed .**

INPUT SURGE PROTECTION : The unit is protected against input voltage surges.

FAN FAILURE WARNING INDICATOR AND ALARM : If forced air cooling is stopped due to failure of any one or both the fans, the red " TEMP. FAULT " LED will be illuminated and an alarm buzzer will be activated. The unit is required to be switched off immediately as loss of forced air cooling may result in major damage to the unit.

INSTALLATION AND OPERATION

1. Ensure that the space where the unit is to be installed has adequate air supply for cooling. There should be no obstruction on the suction side of the fans at the back or on the discharge side vent holes on the two sides of the unit.

2. Switch off the on/off switch on the front panel.

3. Switch off all the D.C. load(s) to be connected to this unit.

4. Connect the L1 and L2 at the back of the unit to the D.C. load(s) or the DC bus. Ensure the wire or bus bar used to connect the load or the D.C. bus is of proper cross-section to carry the desired load current. Tighten the screws to ensure firm connection.

5. In case external battery is required for battery back-up, connect the positive of the battery to B1 and negative of the battery to B2. (See details under "operation of the battery back-up")

6. Plug the unit into the 120 V, 60 Hz standard AC outlet . The outlet should be rated for at least 20 A.

7. Switch on the unit by pressing the power on/off switch to on position. The switch will be illuminated confirming that input power is available.

8. A short beep may be generated by the temperature fault alarm circuit on powering on the unit . This is normal. Please disregard.

9. Switch the volt/amp change-over switch to the "**VOLT**" position. The voltmeter should read 13.8 V. (On no load)

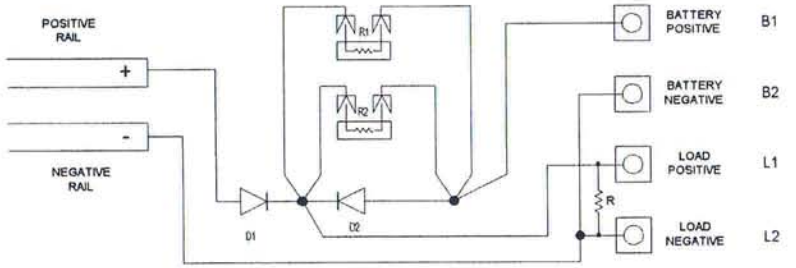
10. Switch on the D.C. loads. The output voltage should be 13.8V minus 15mV per Ampere (please see explanation on Page 7)

11. Switch the volt/amp meter switch to "**AMP**" position to read the load current. Ensure that the load current is within the total rated continuous load of the modules installed.

OPERATION OF BATTERY BACK-UP

WARNING!

THE BATTERY SHOULD BE LOCATED IN A WELL VENTILATED AREA TO SAFELY DISSIPATE HYDROGEN GAS PRODUCED DURING THE CHARGING PROCESS.



D1,D2	SCHOTTKY DIODE, 175BGQ030 BY INTERNATIONAL RECTIFER
R1,R2	POWER RESISTOR 1R3 (1.3OHM), 25 TO 35 WATTS
R	STATIC LOAD RESISTOR

FIGURE A

Please refer to the schematic at fig. A above.

Regulated output voltage of 14.2V from the modules is fed through the positive and negative rails. Isolating schottky diodes D1 & D2 introduce a forward voltage drop of approx. 0.4V on load. Voltage available at output terminals L1 & L2 on no load will be 13.8V (14.2 minus 0.4V drop across D1) On load, the output voltage will be will be 13.8 minus 15mV per Ampere of load current due to voltage drop across the rails, schottky diode and internal wiring.

When there is a requirement of un-interrupted D.C. power to the load, an external battery may be connected at the terminals B1(+) and B2(-). When the input A.C. power is available, the load current is supplied by the power supply through isolating schottky diode D1. At the same time, the battery is charged through resistors R1 & R2. (These resistors will limit the maximum charging

current to about 5 Amperes.) If the input A.C. power is interrupted, the external battery feeds the load instantaneously through the schottky diode D2 (D2 will by-pass the resistors R1 & R2). Voltage available to the load will be approximately 0.4V lower than the battery voltage due to forward voltage drop across D2.

When the input A.C. power returns, the battery will be isolated and the load current will once again be supplied by the power supply. The discharged battery will recharge through R1 & R2

NOTE: The value of charge limiting resistors is based on a typical 100AH deep cycle marine battery. If a different type of battery is used, the value of the resistor should be adjusted to meet associated charging requirements.

INSTALLATION AND REMOVAL OF POWER SUPPLY MODULES

NOTE: INSTALLATION AND REMOVAL OF POWER SUPPLY MODULES SHOULD BE PERFORMED ONLY BY QUALIFIED PERSONNEL

CAUTION !

Before removing a defective module or installing a new one, switch off the 120 V , 60 Hz input power and unplug the power cord from the mains outlet.

NOTE :

Please refer to the layout diagram of the module at Figure. 1 located on page 13

INSTALLING A NEW MODULE

1. Remove the top cover plate by unscrewing the 10 screws.

2. Locate a vacant space for the module and also the 4 stand-offs for holding the module (relative to the holes S1 to S4) and 2 stand-offs on the positive and negative output bus bars (relative to holes S5 and S6) Remove the 6 screws from these 6 stand-offs.

3. Place the module on the stand-offs such that the L and N terminals are towards the front panel. Align holes S1 to S6 with the holes in the stand-offs. Fix the module with the 6 screws. ENSURE THAT SCREWS S5 AND S6 ARE VERY TIGHT.

4. Locate the spare pair of input power supply wires (black for live (L) and white for neutral (N)) with female quick connect terminals. Connect the black wire to the "L" terminal and the white wire to the "N" terminal on the module.

5. Remove the plastic cover from the spare hole under "PSM STATUS" on the control panel. Insert the L.E.D. connected to "LED1" terminal on the module into this spare hole. Use a cable tie to properly secure the LED wire to the cable bundle.

6. A "daisy chaining" wire connector with 5 female socket terminals is provided for "daisy chaining" of each "JUMP1" terminal of the 5 modules. In case there are less than 5 modules, the unused female socket terminal(s) is shorted with a shorting link. Locate nearest unused female socket terminal, remove the shorting link and insert the female socket terminal into the male **"JUMP1"** plug terminal of the new module being installed. See Figure 3. On page 14.

IMPORTANT !

THE TWO MALE PINS OF THE "SHARE BUS" TERMINAL "JUMP1" ARE IN PARALLEL (SHORTED ON THE PCB). IT IS MANDATORY THAT ALL THE "JUMP1" CONNECTORS ARE INTER-CONNECTED OR "DAISY-CHAINED" AS REPRESENTED IN FIGURE. 2 . IT IS TO BE ENSURED THAT ALL THE UNUSED FEMALE SOCKET TERMINALS IN THE DAISY CHAIN CONNECTOR WIRE SHOULD BE SHORTED WITH THE SHORTING LINK AS SHOWN IN FIGURE 3 ON PAGE 14.

7. Replace the top cover.

8. Plug the power cord into the power mains outlet.

9. Switch on the unit from the power switch.

REMOVING A DEFECTIVE MODULE

1. Remove the top cover plate by unscrewing the 10 screws.

2. Locate defective module. Remove the 6 screws from S1 to S6.

3. Remove the input power supply wires from terminals "L" and "N".

4. Remove the LED wire connection from terminal "LED 1" .

5. Remove the "SHARE BUS" wire female socket connector from the terminal "JUMP1". If the defective module is not being replaced immediately and if the unit is required to be operated without this defective module, **IT IS MANDATORY TO SHORT THE TWO FEMALE SOCKETS ON THIS UNUSED FEMALE CONNECTOR WITH A SHORTING LINK. (SEE FIG. 3) THIS WILL ENSURE THAT THERE IS NO BREAK IN THE "SHARE BUS" DAISY CHAIN AND THAT ALL THE "JUMP1" TERMINALS ARE INTERCONNECTED.**

6. The module can now be removed.

TROUBLE SHOOTING

POWER ON/OFF SWITCH DOES NOT LIGHT WHEN SWITCHED ON

- Check that power is available in the AC outlet
- Check that the power cord plug is properly plugged in

POWER SWITCH TRIPS

- The breaker , which is a part of the power on/off switch, has tripped due to abnormal condition . Call technical support

"TEMP. FAULT" LED LIGHTS UP AND BUZZER IS SOUNDED

- Forced cooling has failed due to defect in the cooling fan(s). Switch off the unit immediately . Fan(s) needs to be replaced. **DO NOT USE THE UNIT TILL THE DEFECT IS RECTIFIED. IT IS PROHIBITED TO USE THE UNIT WITHOUT FORCED COOLING.** Call technical support.

- If both the fans are running, the small fan status monitoring PCB may be defective. Call technical support.

" PSM STATUS " LED(S) DOES NOT LIGHT UP

The associated module has become defective. The unit will still operate normally as the remaining working modules will share a higher load. The unit will go into current limit and the output voltage will drop if the load drawn is more than the combined maximum rated output of the remaining modules. Reduce the load so that the maximum load drawn is less than the combined maximum rated output of the working modules.

OUTPUT VOLTAGE DROPS

The unit has gone into current limit as the load being drawn is more than the combined maximum rating of the working modules. This may also result if one or more modules has failed . Check that all the modules are operating properly. If a module has failed, its green LED would extinguish. Reduce the load drawn to a value less than the combined maximum rated output of the working modules. If the voltage does not rise to the rated voltage of 13.8 V, then switch off all the loads. If the voltage in this condition is also low, switch off the unit and contact technical support

NO OUTPUT VOLTAGE, GREEN LEDs ARE FLASHING

- There is a short circuit on the output side
- Switch off the unit. Disconnect the load from the output terminals. Switch on the unit. If the unit now operates normally, there is a short circuit in the external load circuit and should be removed .
- If short circuit condition persists even after removal of external load, switch off the unit and contact technical support

SPECIFICATIONS

NO. OF MODULES	2	3	4	5
INPUT VOLTAGE RANGE	105 TO 125 V AC, 60 HZ			
OUTPUT VOLTAGE (At terminals L1 & L2)	-NO LOAD—13.8V -ON LOAD—13.8 V minus 15m V per Ampere of load current			
OUTPUT REGULATION (At module output)	1%			
OUTPUT CURRENT				
CONTINUOUS	40A	60A	80A	100 A
SURGE	46A	69A	92A	115A
OUTPUT CURRENT LIMIT	48A	72A	96A	120A
OUTPUT RIPPLE	LESS THAN 150mV PEAK TO PEAK			
OUTPUT NOISE	LESS THAN 2V PEAK TO PEAK			
COOLING	FORCED AIR, 2 FANS			
OPERATING TEMPERATURE	0 TO 40 C			
PROTECTIONS				
- SHORT CIRCUIT	YES			
- CURRENT LIMIT	YES			
- FAN FAILURE	LED AND BUZZER			
- INPUT SURGE SUPRESSION	YES			
- FUSE	MODULE FUSE – 125V 4 A UNIT HAS SWITCH / BREAKER 125 V, 20 A			
DIMENSIONS	19" X 14" X 3.6"			
WEIGHT, LBS	20.5	22	23.5	25