samlexpower®

Switch Mode DC Power Supply with Battery Backup

SEC-1223P-BBM

Owner's Manual

Please read this manual BEFORE installing unit

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SECTION 1 | Important Safety Instructions

1.1 CAUTION!

RISK OF ELECTRIC SHOCK! DO NOT OPEN!

WARNING—TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE. THERE ARE NO USER SERVICEABLE PARTS INSIDE — REFER TO QUALIFIED SERVICE PERSONNEL.

ATTENTION!

RISQUE DE CHOC ÉLECTRIQUE ! N'OUVREZ PAS !

Avertissement — POUR RÉDUIRE LE RISQUE D'INCENDIE OU DE CHOC ÉLECTRIQUE, NE PAS EXPOSER CET APPAREIL À LA PLUIE OU L'HUMIDITÉ. Il N'Y A AUCUNE PIÈCE RÉPARABLE PAR L'UTILISATEUR — REPORTEZ-VOUS À UN PERSONNEL QUALIFIÉ.

1.2 SYMBOLS

The following safety symbols will be used in this manual to highlight safety and information:

WARNING!
Indicates possibility of physical harm to the user in case of non-compliance.

MISE EN GARDE!
L'utilisateur pourrait se blesser lorsque les consignes de sécurité ne sont pas suivies.

CAUTION!
Indicates possibility of damage to the equipment in case of non-compliance.

ATTENTION!
Il y a un risque d'endommager l'équipement lorsque l'utilisateur ne suit pasles instructions.

INFO
Indicates useful supplemental information.

1.3 GENERAL

Please read before using your power supply:

a) It Is recommended that you return your power supply to a qualified Samlex dealer for any service or repair. Incorrect assembly may result in electric shock or fire.

b) To reduce the risk of electric shock, unplug the power supply from the outlet before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.

c) An extension cord should not be used unless absolutely necessary. **If an extension cord must be used, make sure that the pins on the plug are the same number, size and shape as those of the country specific power cord plug. Also, the voltage and current specs of the extension cord should match the voltages and current capacities of the power supply.**

d) Place the unit in an area that will allow air to flow freely around the unit. **DO NOT BLOCK OR OBSTRUCT** vent openings on the sides of the unit.

e) Keep the unit away from moisture and water.

f) **NEVER operate the units in parallel.**

1.4 GROUNDING



WARNING!

a) Your power supply should be grounded to reduce the risk of electric shock. The power supply is equipped with grounding provision in the IEC 320-C14 Power Cord Inlet.

b) Country specific power cord must be plugged into an outlet that is properly installed and grounded in accordance with all local codes and ordinances. Improper connection can result in risk of electric shock.



MISE EN GARDE!

a.) Votre alimentation doit être mis à la terre pour réduire le risque de choc électrique. L'alimentation est équipé d'un disposition de la mise à la terre IEC 320-C14 Cordon d'Inlet.

b) Le cordon doit être branché dans une prise de courant correctement installée et mise à la terre conformément à tous les codes et règlements locaux. Une connexion incorrecte peut entraîner un risque de choc électrique.

1.5 PRECAUTIONS WHEN WORKING WITH BATTERIES



WARNING!

a) Batteries contain very corrosive diluted Sulphuric Acid as electrolyte. Precautions should be taken to prevent contact with skin, eyes or clothing.

b) Batteries generate Hydrogen and Oxygen during charging resulting in evolution of explosive gas mixture. Care should be taken to ventilate the battery area and follow the battery manufacturer's recommendations.

C) NEVER smoke or allow a spark or flame near the batteries.

d) Use caution to reduce the risk of dropping a metal tool on the battery. It could spark or short circuit the battery or other electrical parts and could cause an explosion.

e) Remove metal items like rings, bracelets and watches when working with batteries. The batteries can produce a short circuit current high enough to weld a ring or the like to metal and thus cause a severe burn.

f) If you need to remove a battery, always remove the Negative Ground Terminal from the battery first. Make sure that all the accessories are off so that you do not cause a spark.

MISE EN GARDE!

a) Les batteries contiennent de très corrosif de l'acide sulfurique dilué comme électrolyte. Des précautions doivent être prises pour éviter tout contact avec la peau, les yeux ou les vêtements.

b) Générer de l'hydrogène des batteries et de l'oxygène au cours de la charge résultant de l'évolution du mélange de gaz explosifs. Il faut prendre soin de bien aérer la zone de la batterie et de suivre les recommandations du fabricant.

c) NE JAMAIS fumer ou permettre qu'une étincelle ou une flamme à proximité des batteries.

d) Procédez avec précaution pour réduire le risque de chute d'un outil métallique sur la batterie. Il pourrait déclencher ou court-circuit de la batterie ou d'autres pièces électriques et pourraient provoquer une explosion.

e) Retirer les objets métalliques tels que bagues, bracelets et montres lors de travaux avec des batteries. Les piles peuvent produire un courant de court-circuit suffisamment haut pour souder un anneau ou similaires à metal et donc provoquer des brûlures sévères.

f) Si vous avez besoin de retirer la batterie, retirez toujours la borne de masse négatif de la batterie en premier. S'assurer que tous les accessoires sont off afin de ne pas provoquer une étincelle.

1.6 REVERSE POLARITY & TRANSIENT SUPPRESSION

CAUTION!

a) Please refer to Fig 2.1. Please ensure that the battery is connected with correct polarity - Positive of the battery to the "Battery +" terminal (6) and the Negative of the battery to the "Battery -" terminal (5). Reversal of polarity will blow external Fuse F1. Reversal of polarity may result in permanent damage to the unit and to the load. **DAMAGE DUE TO REVERSE POLARITY IS NOT COVERED UNDER WARRANTY.**

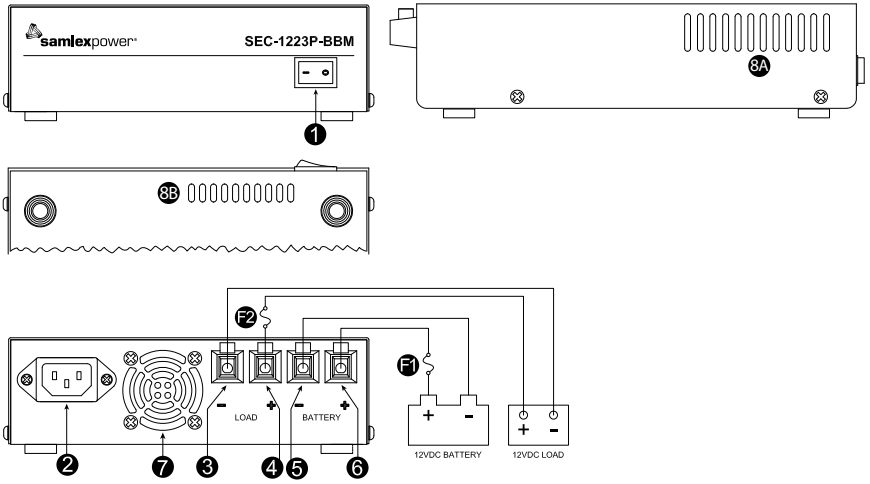
b) Protect the unit against AC line input transients. Use Transient Suppressor in line with the AC input.

ATTENTION!

a) Veuillez vous référer à la figure 2.1. Veuillez vous assurer que la batterie est connectée avec la polarité positive - La batterie de "positif à la borne +" de la batterie (6) et le négatif de la batterie à la borne "Battery -" (5). L'inversion de polarité fera sauter le fusible externe F1. L'inversion de polarité peut entraîner des dommages permanents à l'appareil et à la charge. **LES DOMMAGES DUS A LA POLARITE INVERSE NE SONT PAS COUVERTS PAR LA GARANTIE.**

b) Protégez l'appareil contre les transitoires d'entrée de ligne CA. Utilisez le suppresseur de transitoire en ligne avec l'entrée CA.

SECTION 2 | Layout, Output Connections & Dimensions



LEGEND

1. Lighted Power ON /OFF Rocker Switch (Lights Red when ON)
2. AC Power Cord Inlet – Type "IEC 320-C14" (Detachable Power Cord with "IEC 320-C13" connector on one end and NEMA5-15P Plug on the other end is provided with the unit)
3. Black Negative (-) DC Load Terminal
   - Tubular hole Dia 5mm/0.2"and set screw (5/64" Hex Socket Head, #10, 24 TPI, 5/16" long)*
4. Red Positive (+) DC Load Terminal
   - Tubular hole Dia 5mm/0.2"and set screw (5/64" Hex Socket Head, #10, 24 TPI, 5/16" long)*
5. Black Negative (-) Battery Terminal
   - Tubular hole Dia 5mm/0.2"and set screw (5/64" Hex Socket Head, #10, 24 TPI, 5/16" long)*
6. Red Positive (+) Battery Terminal
   - Tubular hole Dia 5mm/0.2"and set screw (5/64" Hex socket head, #10, 24 TPI, 5/16" long)*
7. Grille for cooling fan discharge (Fan is located behind the grille)

8A. Air intake ventilation slotes on the sides of the top cover

8B. Air intake ventilation slots on the bottom housing

F1. External Fast blow Fuse: 32V, 25A
F2. External Fast blow Fuse: 32V, 25A

***NOTE:** 5/64" Hex Key and 2 spare screws have been provided.

Fig. 2.1 Layout and Output Connections

SECTION 2 | Layout, Output Connections & Dimensions

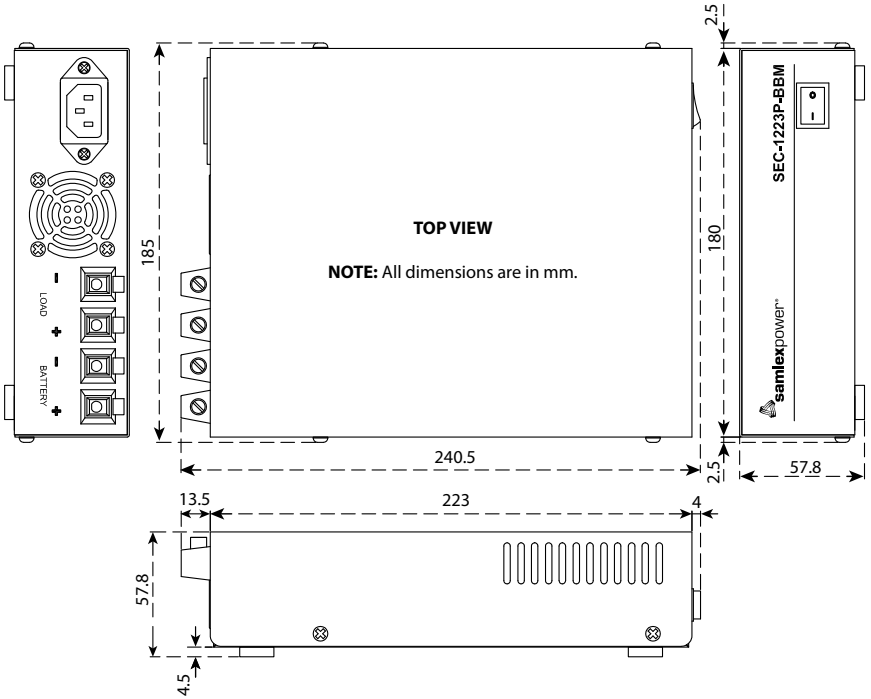


Fig 2.2 Dimensional Drawing

SECTION 3 | Description & Principle of Operation

3.1 DESCRIPTION

SEC-1223BBM is a Power Factor Corrected Switch Mode Power Supply (SMPS), which converts 100-240 VAC, 50/60 Hz to regulated 14.0 VDC at 23A continuous. It has additional provision for battery backup with charging in conjunction with external 12V Lead Acid Battery. The battery is float charged to 13.5 ± 0.2V (when fully charged).

3.2 FEATURES

- Consists of 2 Sections – (i) Highly efficient Switched Mode Power Supply (SMPS) Section and (ii) Battery Charger / Battery Backup Section
- SMPS Section meets Minimum Energy Performance Standard (MEPS) for External Power Supplies and associated Directives issued by: CEC (USA) / DoE (USA) / NRCan (Canada) / GEMS - MEPS (Australia and New Zealand) / ErP Directive (European Union) / International Efficiency Marking Protocol Level Ⓥⓘ

- Universal AC input range of nominal 100 VAC to 240 VAC, 50 to 60 Hz allows international application without changing jumpers / switch positions
- Power Factor (PF) corrected to > 0.9 allows lower input current and line losses, lesser harmonic distortion and lower RF noise
- Uses highly integrated Switched Mode Controller combining PWM Control & Active Power Factor Correction for lower component count, higher efficiency and reliability
- Cooling by temperature controlled fan - improves efficiency and prolongs life of the fan

3.3 PRINCIPLE OF OPERATION

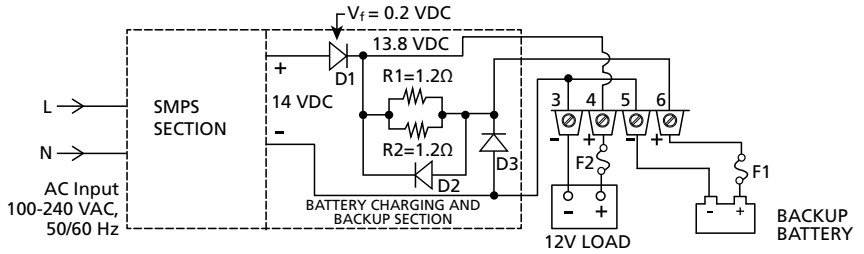


Fig 3.1 Schematic Diagram - Battery Charging / Backup

Please refer to the schematic diagram at Fig 3.1.

The unit consists of 2 Sections:

a) High efficiency Switched Mode Power Supply (SMPS) Section (See details at Section 3.3.1)
b) Battery Charging and Backup Section (See details at Section 3.3.2)

3.3.1 High Efficiency Switched Mode Power Supply (SMPS) Section

Refer to Fig 3.1

This Section is a high efficiency SMPS that converts 100-240 VAC, 50/60Hz to regulated DC voltage of 14.0V. It uses highly integrated Switched Mode Controller combining Pulse Width Modulation (PWM) Control and Active Power Factor Correction for lower component count, very high efficiency and reliability. AC input Power Factor is corrected to > 0.9 which ensures lower reactive AC input current and line losses and also, lower harmonic distortion and RF noise.

This SMPS meets Minimum Energy Performance Standard (MEPS) for External Power Supplies and associated Directives issued by CEC(USA) / DoE (USA) / NRCan (Canada) / GEMS-MEPS (Australia and New Zealand) / ErP Directive (European Union) / International Efficiency Marking Protocol Level (VI).

3.3.2 Battery Charging and Backup Section

Refer to Fig 3.1

3.3.2.1 In battery charging and backup application, the SMPS Section (details at Section 3.3.1 above) will supply the load current as well as the battery charging current to keep the battery charged to Float Voltage of 13.5V± 0.2V as long as AC input to the SMPS is available and the SMPS is working normally. If the AC input to the SMPS Section fails or if the SMPS Section itself fails, the battery will act as backup power source and instantaneously supply power to the load.

3.3.2.2 Regulated 14.0VDC from the SMPS Section (details at Section 3.3.1 above) is fed to the Battery Charging / Backup Section through Schottky Diode "D1" that provides isolation between the SMPS Section and the battery to prevent the battery from feeding back into the SMPS Section. When current passes through a diode, there will be a non-linear Forward Voltage Drop (Vf) across it. As the power dissipated across the diode will be equal to Forward Voltage Drop (Vf) multiplied by the diode current, it is desirable that the Forward Voltage Drop (Vf) has a lower value to reduce power dissipation and hence, improve efficiency. Therefore, "Schottky" type of diode has been used that has lower Forward Voltage Drop (Vf) of 0.4A at 23A. Schottky Diode "D1" has a non linear Forward Voltage Drop (Vf) as follows:

TABLE 3.1 FORWARD VOLTAGE DROP (VF) AND VOLTAGE AT CATHODE OF SCHOTTKY DIODE "D1" (FIG 3.1)

(Column 1)	Diode "D1" current = 0A (Column 2)	Diode "D1" current =0.1 to 5A (Column 3)	Diode "D1" Current = 19 to 23 A (Column 4)
Forward Voltage Drop (Vf) for Diode "D1"	0V	0.25V	0.4V
Voltage at Cathode of Diode "D1" (14.0V – Vf)	14V	13.75V	13.6V

It will be seen from Table 3.1 above that the Forward Voltage Drop (Vf) of Schottky Diodes "D1" " varies from 0V at 0A (no load) to 0.4V at 23A. Hence, the voltage at the Cathode of Schottky Diode "D1" will be = 14.0VDC – Forward Voltage Drop across "D1" and will range from 14.0 V to 13.6V (or say 13.8 ± 0.2V).

3.3.2.3 14.0V to 13.6V (or say 13.8 ± 0.2V) from the Cathode of Schottky Diode "D1" is fed to 2 branches as follows:

a) **Branch 1 for DC Load:** To the Positive Load Terminal (4, Figs 2.1 and 3.1) directly
b) **Branch 2 for Battery Charging and Backup:** To the Battery Positive Terminal (6 in Figs 2.1 and 3.1) through 2 x 1.2 Ohm parallel connected resistances R1 and R2 (2 x 1.2 Ohm parallel connected resistances will present effective series resistance of 1.2 Ohm ÷ 2= 0.6 Ohm). The battery charging current will be determined by the following approximate equation:

Charging Current = [Voltage at Cathode of Diode "D1" – Voltage at the Battery Terminals] ÷ 0.6 Ohm …**Equation 1**

3.3.2.4 Using Equation 1 above, it will be seen that the effective series resistance of 0.6 Ohm will limit the charging current. The charging current will be higher when the battery is more discharged and will progressively reduce as the battery voltage rises when charged. The rated charging current of 4A is based on the unit supplying 19A to load and at the same time, charging a typical 100 Ampere Hour (Ah) battery discharged to 11.1V (70% discharged at Discharge Rate of 23A i.e. at around 5 Hr Discharge Rate of C/5). When the battery is charged to Float Voltage of 13.5V± 0.2V, the charging current will reduce to a very low value of around 0.1% of its Ampere Hour (Ah) capacity to compensate for its self discharge. For example, assuming that 100Ah capacity battery is being used, the Float Charging Current will be 0.1% of 100Ah or, 0.1A. Therefore, applying Equation 1 at Section 3.3.2.3 above, the voltage at the Battery Terminals (5, 6 in Figs 2.1 and 3.1) will be as given in Tables 3.2.1 and 3.2.2 below:

TABLE 3.2.1 CHARGING VOLTAGE AT BATTERY TERMINALS – LOAD CURRENT 0A

	• **Load Current = 0A** • **Float Charging Current = 0.1A** • **Total SMPS Current = 0.1A**	• **Load Current = 0A** • **Full Charging Current = 4.0A** • **Total SMPS Current = 4.1A**
Column (1)	**Column (2)**	**Column (3)**
Voltage at Battery Terminals based on Equation 1 (Section 3.3.2.3)	13.75V * – (0.1A x 0.6 Ohm) = 13.69V *Based on Table 3.1, Column (3)	13.75V * – (4.0A x 0.6 Ohm) = 11.35V *Based on Table 3.1, Column (3)

TABLE 3.2.2 CHARGING VOLTAGE AT BATTERY TERMINALS – LOAD CURRENT 19A

	• **Load Current = 19A** • **Charging Current = 4.0A** • **Total SMPS Current = 23A**	• **Load Current = 19A** • **Charging Current = 0.1A** • **Total SMPS Current = 19.1A**
Column (1)	**Column (2)**	**Column (3)**
Voltage at Battery Terminals based on Equation 1 (Section 3.3.2.3)	13.6V** – (4.0A x 0.6 Ohm) = 11.2V **Based on Table 3.1, Column (4)	13.6V** – (0.1A x 0.6 Ohm) = 13.54V **Based on Table 3.1, Column (4)

3.3.2.5 When the AC input to the SMPS Section fails or if the SMPS itself fails, the battery will provide backup power to the load instantaneously through Schottky Diode "D2". Please note that current from the battery to the load will NOT pass through Resistors R1 and R2 because Schottky Diode "D2" will bypass these resistors due to its lower resistance.

3.3.2.5.1 Current flow through Schottky Diode "D2" will produce non-liner Forward Voltage Drop (Vf) as given in Table 3.3 below:

TABLE 3.3 FORWARD VOLTAGE DROP (VF) OF SCHOTTKY DIODES "D2"			
(Column 1)	Diode "D2" Current = 0A (Column 2)	Diode "D2" Current = 0.1A (Column 3)	Diode "D2" Current = 19 to 23A (Column 4)
Forward Voltage Drop (Vf) for Diode "D2"	0V	0.25V	0.4V
Voltage at Cathode of Diode "D2"	Battery Voltage – 0V	Battery Voltage – 0.25V	Battery Voltage – 0.4V

3.3.2.6.1 The voltage available at the Load Terminals (3,4 in Figs 2.1 and 3.1) during battery backup will be as per Equation 2 below:

Voltage at Load Terminals when battery is supplying the load = Battery Voltage – Forward Voltage Drop across Schottky Diode "D2" ...**Equation 2**

3.3.2.6.2 Examples of voltages at the Battery Terminals (5, 6 in Fig 3.1) at different states of charge / discharge are given at Table 3.4 below:

TABLE 3.4 VOLTAGE AT BATTERY TERMINALS WHEN AC INPUT POWER HAS FAILED AND THE BATTERY IS SUPPLYING THE LOAD		
	• **Load current = 19A** • **Battery voltage at Floating Voltage of 13.55V**	• **Load current = 19A** • **Battery voltage of say 11.4V at 80% discharged state based on 100Ah capacity discharging at 5 Hr Discharge Rate of C/5**
Column (1)	**Column (2)**	**Column (3)**
Voltage at battery terminals (5, 6 in Fig 3.1) when AC input power has failed and the battery is supplying the load [Based Equation 2 (Section 3.3.2.6.1)]	13.54V* – 0.4**V = 13.14V *Based on Table 3.2.2, Column (3) ** Based on Table 3.3, Column (4)	11.4V – 0.4*V = 11.0V * Based on Table 3.3, Column (4)

3.3.3 Output Voltage Adjustment at No Load

The no load output voltage is factory preset at 14.0V (13.8VDC ± 0.2V) at both the Load and Battery Terminals. Potentiometer marked "VR1" is provided in the SMPS Circuit Board for no load output voltage adjustment range of 12.5 VDC to 15VDC.

3.3.4 Normal Power Supply Function when Battery Backup is not used

If battery backup function is not used (external backup battery is not connected), the unit will work as a normal power supply with ability to supply 23A continuous at 13.8 ± 0.2 V at the Load Terminals (3, 4 in Figs 3.1 and 2.1). The maximum overload current will be limited to less than 27.6 to 29A. Hiccup Mode of over current and short circuit protections will be provided as detailed at Section 4.1.1.2

3.3.5 Protections

Details of various protections are given in Section 4.

SECTION 4 | Protections

4.1 OVERLOAD / SHORT CIRCUIT PROTECTION

4.1.1 Unit is used as a Power Supply without Battery Backup (12V Battery is not Connected to the Battery Terminals)

4.1.1.1 Refer to Fig 3.1 under Section 3

4.1.1.2 The SMPS Section is provided with Hiccup Mode of Overload and Short Circuit protections. Output load current from the SMPS is fed through a series connected, 0.1875 Ohm Load Sense Resistor inside the SMPS. Output load current produces voltage drop across the Load Sense Resistor. This voltage drop is proportional to the value of the load current. Protections are triggered based on the voltage drop sensed across the Load Sense Resistor as follows:

a) **Hiccup Mode Overload Protection**: When the voltage drop across the Load Sense Resistor in the SMPS Section is more than 5.18 to 5.44V (output current > 27.6 to 29A) and is sustained for 40-50ms, Hiccup Mode Overload Protection is triggered. The output of the SMPS is shut down. After 3 to 4 sec, the SMPS Section is switched ON again. If the overload still exists for 40-50ms, the SMPS will shut down again. Hence, for a continuous overload of > 27.6 to 29A, the SMPS Section switches ON and OFF (hiccup) every 3 to 4 sec. The average output voltage of the SMPS during this protection will be nearly 0V.

b) **Hiccup Mode Short-Circuit Protection**: When the voltage drop across the Load Sense Resistor inside the SMPS Section is more than 7.5V (output current > 40A) and is sustained for 4 to 6.5 ms, Hiccup Mode Short Circuit Protection is triggered. The output of the SMPS is shut down. After 2 to 3 sec, the SMPS is switched ON again. If the short circuit still exists for 4 to 6.5 ms, the SMPS will shut down again. Hence, for a continuous short circuit, the SMPS switches ON and OFF (hiccup) every 2 to 3 sec. The average output voltage of the SMPS during this protection will be nearly 0V.

4.1.1.3 When backup battery is NOT connected and the unit is operating as a power supply without battery backup, the entire load current is provided by the SMPS Section of the unit. In this case, Hiccup Modes of overload and short circuit protections will be provided as explained at Sections 4.1.1.2 (a) and (b).

4.1.2 Unit is used as a Power Supply with Battery Backup (12V Battery is Connected to the Battery Terminals)

4.1.2.1 Refer to Fig 3.1 under Section 3

4.1.2.2 When the unit is used as a power supply with battery backup (12V battery is connected to the Battery Terminals), overload and short circuit protections will be provided as follows:

a) **Overload**: When the value of load current + battery charging current is more than the Hiccup Mode Overload Protection Threshold of 27.6 to 29A [Section 4.1.1.2(a)], the SMPS Section will shut down (hiccup) and generate an average voltage of nearly 0V. Schottky Diode "D2" will, thus, be forward biased and the load will now see a lower voltage = [Battery voltage corresponding to its State of Charge – Forward Voltage Drop of 0.2V across Schottky Diode D2]. As Schottky Diode "D2" will be forward biased, the entire load current will be supplied by the battery through "D2" bypassing Charging Current Limiting Resistors R1 and R2. As the battery is an unlimited source of current, it can supply extremely large overload currents. However, as the load side is protected by external 25A Fuse F1 (Figs 3.1 and 2.1), this fuse will blow if there is a sustained overload of 25A for more than around 100 sec.

b) **Short Circuit**: A short circuit is actually an overload condition that is created when the Load Terminals are loaded through very low impedance path that results in very high current as compared to the rated / overload current of the source. The symptoms will, therefore, be same as in overload condition explained at Section 4.1.2.2(a) above. The difference is that the external 25A Fuse F1(Figs 3.1 and 2.1) will blow almost instantaneously under short circuit conditions due to extremely large value of short circuit current as compared to the value of overload current.

INFO

A Thermal Fuse like the 25A Fuse "F1" / "F2" (Figs 3.1 and 2.1) will allow higher values of short duration surge currents determined by its Time Versus Current Characteristic. For example, based on Time Versus Current Characteristics of 32V, 25A Thermal Fuse Type ATC-25 from Cooper Bussmann, the fuse will pass extremely high surge currents for shorter durations as follows:

- 550A for 10 ms
- 170A For 100 ms
- 40A for 1 sec

SECTION 4 | Protections

4.2 PROTECTION AGAINST REVERSE POLARITY ON THE BATTERY CONNECTION

Refer to Fig 3.1 under Section 3

In case the polarity of battery connection is reversed, Diode "D3" will be forward biased and external 25A Fuse F1 will blow.

4.3 COOLING FAN

The unit is cooled by convection and in addition, it has a temperature controlled cooling fan located at the back of the unit (7, Fig 2.1). The fan draws cool air from intake ventilation slots in the side of the top cover (8A, Fig 2.1) and in the bottom housing (8B, Fig 2.1) and discharges the hot air out from the fan grille (7, Fig 2.1).

A Negative Temperature Coefficient Resistor (marked NTC 2 on the SMPS Circuit Board) mounted on the Secondary Heat Sink on the SMPS Circuit Board is used to control the On/Off operation of the cooling fan as follows:

- The fan is switched on when the Secondary Heat Sink temperature rises to 55°C ± 5°C
- The fan will be switched off when the Secondary Heat Sink temperature drops to 45°C ± 5°C

INFO

The fan may not switch on at all in case of low loads or in colder ambient temperatures because the temperature of the Secondary Heat Sink in the SMPS Circuit Board may not rise to 55°C ± 5°C

4.4 OVER TEMPERATURE PROTECTION

CAUTION!

To prevent premature shut of the unit due to activation of over temperature protection, please ensure the following:

- Install the unit in a well ventilated, cool, dry and open area
- The fan draws cool air from intake ventilation slots in the side of the top cover (8A, Fig 2.1) and in the bottom housing (8B, Fig 2.1) and discharges the hot air out from the fan grille (7, Fig 2.1). Please ensure that these ventilation slots / fan grille are not obstructed.

SECTION 4 | Protections

ATTENTION!

Pour empêcher l'arrêt prématuré de l'unité en raison de l'activation de la protection de surchauffe, veuillez vérifier les points suivants :

- Installer l'appareil dans un endroit bien aéré, frais et sec, à l'aire ouverte
- Le ventilateur aspire l'air frais de la prise d'orifices de ventilation sur le côté du capot supérieur et dans le boîtier inférieur et décharge l'air chaud à l'extérieur de la grille du ventilateur (7, figure 2.1). Veuillez vous assurer que ces fentes de ventilation / grille du ventilateur ne sont pas obstruées.

The unit is protected against over temperature. Over temperature condition can occur due to one or more of the following operating conditions:

- Fan failure
- Inadequate cooling due to higher ambient temperature, poor air circulation or blockage of ventilation slots / fan grille

A Negative Temperature Coefficient Resistor (marked NTC 1 on the SMPS Circuit Board) mounted on the bigger, Primary Heat Sink on the SMPS Circuit Board is used to control shut down of the output of the SMPS Section in case of over temperature as follows:

- The output of the SMPS Section is switched off when the Primary Heat Sink temperature rises to 105°C ± 5°C
- The output will be restored when the Primary Heat Sink temperature drops to 75°C ± 5°C

4.5 OVER VOLTAGE PROTECTION

Over voltage protection is provided through the internal PWM Controller. Over voltage limit is 16.5 ± 0.5VDC.

SECTION 5 | Installation

WARNINGS!

PLEASE READ "Section 1 - Important Safety Instructions" for safe installation.

MISE EN GARDE!

VEUILLEZ LIRE "Section 1 - Instructions de sécurité importantes" pour la sécurité de l'installation.

5.1 LAYOUT & DIMENSIONAL DRAWINGS

Please refer to the following:

- Layout Drawing: Fig 2.1
- Dimensional Drawing: Fig 2.2

5.2 LOCATION, MOUNTING AND SAFETY

The unit is required to be installed in a safe, well-ventilated and dry location. Please see details given under Section 1 "Important Safety Instructions". The unit can be mounted horizontally or vertically. When mounting vertically, please ensure that the Output Terminals are pointing up.

5.3 AC INPUT CONNECTION

A detachable power cord with North American NEMA5-15 Plug has been supplied. Connect the power cord to the AC Power cord Inlet (2, Fig 2.1). Plug the power cord to the AC outlet. Please ensure that the voltage of AC input power at the outlet is 100-240 VAC, 50/60 Hz.

For other countries, use power cord with country specific plug on one side and "IEC 320-C13" connector on the other to mate with IEC 320-C14 inlet on the unit (2, Fig 2.1).

5.4 DC OUTPUT CONNECTIONS

The Load Terminals (3,4 in Fig 2.1) and the Battery Terminals (5,6 in Fig 2.1) have 5mm / 0.2" diameter tubular hole with set screw (#10, 24 TPI, 5/16" long with 5/54" Hex Socket Head). **NOTE:** 5/64" Hex Key and 2 spare screws have been provided.

For ensuring firm connection under the set screw, 4 pieces of Pin Type of Terminal Lugs "PTNB10-12" have been provided for crimping to the bare ends of stranded wires for the load and battery connections. The terminal can accept wire of up to 10 mm^2 / AWG #8. After crimping the Terminal Lugs, use insulating heat shrink tubing or tape to insulate the bare cylindrical portion of the lug.

Load Connection: The load is connected to the terminals marked "Load +" (4 in Fig 2.1) and "Load - " (3 in Fig 2.1) through 32V, 25A Fuse (F2) (See details below under heading "External Fuses"). Please ensure that the polarity of the connection is correct - Positive of the load to the "Load +" terminal (4 in Fig 2.1) and the Negative of the load to the "Load - " terminal (3 in Fig 2.1).

Battery Connection: The Positive of the battery is connected to the "Battery +" terminal (6 in Fig 2.1) and the Negative of the battery to the "Battery - " terminal (5 in Fig 2.1) through 32V, 25A Fuse (F1) (See details, see Section 5.6 "External Fuses on Battery and Load Sides").

Recommended Battery Capacity: Battery should not be charged at very high current. Normally, as a Rule of Thumb, the maximum charging current should be limited to 10% of the Ah capacity at 20 Hour Rate (C/20) unless higher current is allowed by the manufacturer. Higher charging current produces higher heating which reduces the life of the battery. Further, higher charging current will not re-charge the battery to full 100% capacity unless the charging voltage is increased proportionately. It is recommended that the capacity of the battery used with this unit should be in the range of 40 to 100Ah.

5.5 DC OUTPUT WIRE SIZING

Use AWG #10, 90°C / 194°F insulation wire for the load and battery connections for a distance of up to 3 ft. Thicker wire will be required for distance longer than 3 ft. (See Table 5.1). **USE THICKER WIRE OUT THE 2 SIZES CALCULATED BASED ON THE FOLLOWING 2 CONSIDERATIONS:**

1. **Safety of Conductor Insulation**
   Current (I) flowing through resistance (R) of conductor produces power loss (I^2R) in the form of heat which results in temperature rise in the conductor. Temperature rise is higher for higher current, higher resistance (longer length and thinner cross section produce higher resistance) and higher ambient temperature. Temperature rise higher than the temperature rating of conductor insulation will melt / burn the insulation resulting in possibility of electrical shock and fire. The National Electrical Code specifies maximum current flow (Ampacity) through a particular wire size [normally specified as cross-section in American Wire Gauge (AWG)] for a particular temperature rating of conductor insulation, ambient temperature and type of surrounding medium (like free air, raceway, etc.). NEC further specifies that the Ampacity of the wire should be 1.25 times the maximum current flow. The maximum output current in the unit is 25A.
   - The maximum output current in the unit is 25A. Hence, the Ampacity of the wires as per NEC should 1.25 x 25 = 31.25A or say 40A
   - As per NEC Table 310.15(B)(17) for 90°C / 194°F conductor insulation, free air, 40°C / 104°F ambient and Ampacity of 40A, the minimum conductor size should be AWG #10.
2. **Limiting Voltage Drop along the Length of the Wiring**
   Current flowing through resistance produces voltage drop. Voltage drop is higher for higher resistance (longer length and thinner cross section produce higher resistance). Excessive voltage drop across the length of wires connecting the power source to the load produces excessive power loss and may also shut down the load due to under voltage created at the load end. Hence, the voltage drop should be kept to the minimum at around 2% by using thicker wires for longer distances. Table 5.1 shows thickness of wire for 2% voltage drop consideration for 12 V battery / load when carrying 25A:

TABLE 5.1: RECOMMENDED WIRE SIZES FOR 3 FT., 6FT. AND 10 FT. DISTANCES			
	Size of Wiring for 2% Voltage Drop		
Rated Current	3 ft.	6 ft.	10 ft.
25A	AWG #10	AWG #8	AWG #6

As mentioned above, the calculated wire size is AWG #10 when considering safety of conductor insulation. Hence, use AWG #10, 90°C / 194°F insulation wire for the load and battery connections for a distance of up to 3 ft. If the distance of the Load / Battery is > 3 ft., the size on account of 2% voltage drop and 25A current flow consideration will be thicker than AWG #10 as shown in Table 5.1 above and these thicker sizes should be used.

5.6 EXTERNAL FUSES ON THE BATTERY AND LOAD SIDES

A battery is an unlimited source of current that can drive thousands of Amperes of current into a short circuit leading to overheating and burning of wiring / circuit components along the path from the battery terminals to the point of short circuit. This can cause injury and is a fire hazard. Similarly, a power source is also capable of driving considerably high value of current into a short circuit on the load side and causing damage as above (the current will, however, be limited to the maximum rated overload current and not unlimited as in the case of a battery). Appropriate fuse should, therefore, be used in series with the battery Positive post / Load terminal of power source to protect against the above safety hazard. **FOR EFFECTIVE PROTECTION, APPROPRIATE SIZES OF FUSES SHOULD BE LOCATED AS FOLLOWS:**

- External Battery Side Fuse (F1, Fig 2.1) should be LOCATED as close to the battery Positive post as possible, preferably within 7" of the battery Positive post
- External Load Side Fuse (F2, Fig 2.1) should be installed as close as possible to the Positive Load Terminal (4, Fig 2.1)

For this unit, external fuses must be used for protection against reverse polarity and short circuit as follows (Please see Fig 2.1)

- 32V, 25A fast acting Fuse (F1, Fig 2.1) in series with the Positive battery wire within 7" from the battery Positive post. This fuse provides the following protections:
  - Prevents overheating and burning of wiring due to very heavy current fed from the battery into a short circuit along the length of wiring from the battery to the Battery Input Terminals (5, 6, Fig 2.1).
  - Prevents damage to the unit and to the load due to reverse polarity of battery connection
- 32V, 25A fast acting Fuse (F2, Fig 2.1) in series with the Positive load wire and within 7" of the Positive Load Terminal (4, Fig 2.1). This fuse protects against overload and short circuit on the load side.

SECTION 6 | Operation

6.1 PREVENTING DISCHARGE OF BACKUP BATTERY WHEN AC INPUT IS NOT AVAILABLE

CAUTION!

If AC input power is NOT available and a battery has been connected for backup function, the load will be powered by the battery and the battery will continue to discharge as long as the load is in ON condition. When the load is not delivering power, it still draws current for its self-consumption (called "No Load Current"). When AC input power is NOT available, switch OFF the load if not required, otherwise the battery will get discharged because of the "No Load Current" drawn by the load.

ATTENTION!

Si l'alimentation d'entrée n'est pas disponible et d'une batterie a été connecté pour la fonction de sauvegarde, la charge va être alimenté par la batterie et la batterie va continuer à s'acquitter tant que la charge est dans l'état. Lorsque la charge n'est pas offrant puissance, il attire encore courant pour son auto-consommation (appelé "Pas de charge"). Lorsque l'alimentation d'entrée n'est pas disponible, couper la charge si pas nécessaire, sinon la batterie sera déchargée car des "Pas de charge" dessiné par la charge.

6.2 SWITCHING ON / OFF

6.2.1 Switching ON - The unit is operating as AC-DC power supply with battery backup (external battery is connected)

- Check that the load has been connected to the Load Terminals (3, 4 in Fig 2.1) through external 25A Load Side Fuse (F2, Fig 2.1). Switch off the load.
- Check that the external battery has been connected to the Battery Terminals (5, 6 in Fig 2.1) through external 25A Battery Side Fuse (F1, Fig 2.1). Voltage at the Battery Terminals will be = the initial sate of charge voltage of the battery.
- Switch ON the unit with the help of the Red Power ON / OFF Switch (1). If AC power is available and the internal AC side fuse is intact, the ON / OFF Switch will be lighted Red indicating that the Power Supply Section is in ON condition
- After a few milli sec, 13.8V ± 0.2V will be available at the Load Terminals (3, 4 in Fig 2.1) and the external battery will start charging at current of up to 4A based on its initial Standing Voltage. 100% discharged battery will have Standing Voltage of 11.4 ± 0.2V and will draw 4A initially when unit is switched on. A fully charged battery with Standing Voltage of 12.7 ± 0.2 will draw around 1.8A initially and will soon reach Float Voltage of 13.5 ± 0.2V.
- Switch ON the load

- The Power Supply Section will supply all the current consumed by the load and the external battery will be maintained in charged condition all the time at Float Voltage of 13.5V ± 0.2V. The voltage at the Load Terminals (3, 4 in Fig 2.1) will be 13.8 ± 0.2V.

6.2.2 Switching ON (Without Battery Backup - The unit is operating as normal AC-DC power supply (external battery is not connected)

- Check that the load has been connected to the Load Terminals (3, 4 in Fig 2.1) through the external 25A load side fuse (F2, Fig 2.1). DO NOT connect the load to the Battery Terminals (5,6 in Fig 2.1). Switch off the DC load.
- Switch ON the unit with the help of the Red Power ON / OFF Switch (1, Fig 2.1). If AC power is available and the internal AC side fuse is intact, the ON / OFF Switch (1, Fig 2.1) will be lighted Red indicating that the Power Supply Section is in ON condition.
- After a few milli sec, no load voltage of 14V will be available at the Load and Battery Terminals
- Switch ON the load. The voltage at the Load Terminals will be in the range of 13.8 ± 0.2 based on the load current. The voltage at the Battery Terminals will be the same as the voltage at the Load Terminals.

6.2.3 Switching OFF:

- Switch OFF the load first
- Switch OFF the unit with the help of the Red Power ON / OFF Switch (1, Fig 2.1). Red light inside the ON /OFF switch will switch OFF

6.3 CHARGING AND BACKUP OPERATION

For details and principle of operation of battery charging and backup, please refer to Section 3.3.2

Charging current will be proportional to the discharged state of the battery and is limited to 4A when the battery is discharged to 11.2V and supplying 19A load at the same time (See Table 3.2.2, Column 2). The current will taper down from 4A as the battery gets charged and its voltage rises. When the battery is fully charged, the current will drop down to 0.1% of the Ah capacity of the battery to compensate for self-discharge. When fully charged, the voltage at the Battery Terminals (5, 6 in Fig 3.1) will be the Float Voltage of 13.5V ± 0.2V.

Battery should not be charged at very high current. Normally, as a Rule of Thumb, the maximum charging current should be limited to 10% of the Ah capacity at 20 Hour Rate unless higher current is allowed by the manufacturer. Higher charging current produces higher heating, which reduces the life of the battery. Further, higher charging current will not re-charge the battery to full 100% capacity unless the Charging Voltage is increased proportionately. This may not be possible with chargers that do not have programmable charging voltages. It is, therefore, recommended that the capacity of the battery used with this unit should be in the range of 40 to 100Ah which is appropriate for 4A charging current.

The voltage seen at the Battery Terminals (5, 6 in Fig 3.1) will be the actual terminal voltage of the battery (assuming no voltage drop in the battery cables) and will be proportional to its State of Charge. When the battery is fully charged, the voltage at the Battery Terminals will approach Float Voltage of 13.5 ± 0.2V.

If AC input power fails, the DC load(s) will be instantaneously transferred to the external 12V backup battery and the battery will start discharging. When the battery is supplying the load, the voltage seen at the Load Terminals (3,4 in Fig 3.1) will be up to 0.4V less than the voltage at the Battery Terminals (see Table 3.4). When AC input power is restored, the DC load will once again be transferred instantaneously to the Power Supply Section and the external backup battery will be recharged and kept in charged condition all the time at Float Voltage of 13.5V ± 0.2V.

6.4 SURGE POWER CAPABILITY IN DC UPS BATTERY BACKUP MODE

When operating in DC UPS Battery Backup Mode (external 12V battery is connected), the unit is capable of providing short term surge current of up to 50A for < 1 sec (external 25A fuse on the load side will not blow for this short duration). As the Power Supply Section will shut down due to Hiccup Overload Protection at 27.6 to 29A (Section 4.1.1.2), all the surge current will be provided by the battery. During the period of this short term overload, the voltage seen by the load will be = (battery voltage – 0.49V).

6.5 OPERATION AS NORMAL POWER SUPPLY WITHOUT EXTERNAL BATTERY

If battery backup function is not used (external backup battery is not connected), the unit will work as a normal power supply with ability to supply 23A continuous at 13.8V ± 0.2VDC at the Load Terminals (3, 4 in Fig 2.1). The maximum overload current will be limited 27.6 to 29A. Overload and short circuit protection will be activated at current > 27.6 to 29A (See Section 4.1.1.2).

SECTION 7 | Limiting Electro-Magnetic Interference (EMI)

7.1 CAUTION!

Conducted and radiated noises in this unit are limited as per the applicable National / International Standards as detailed under Compliance: EMC in Section 9.

This unit generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, this does not guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the measures recommended in the following paragraphs.

ATTENTION!

Bruits et rayonnement dans cette unité sont limitées que par la législation nationale / normes internationales comme détaillé dans le cadre de conformité : EMC dans la section 9.

Cet appareil génère, utilise et peut émettre une énergie de fréquence radio et, s'il n'est pas installé et utilisé conformément aux instructions, peut causer des interférences nuisibles aux communications radio. Cependant, cela ne garantit pas qu'aucune interférence ne se produira dans une installation particulière. Si cet équipement provoque des interférences nuisibles à la réception radio ou télévision, ce qui peut être déterminé en éteignant l'équipement, l'utilisateur est encouragé à essayer de corriger les interférences en prenant une ou plusieurs des mesures recommandées dans les paragraphes suivants.

7.2 UN-INTENTIONAL RF NOISE GENERATED BY SWITCHED MODE POWER SUPPLIES (SMPS)

Switched Mode Power Supplies (SMPS) employ high frequency switching (75 to 150 KHz in this unit) and thus, are a source of radio interference, a recipient of radio interference and a conduit of radio interference. (Older Linear Type, low frequency 50 / 60 Hz transformer based power supplies do not employ high frequency switching voltages and will be quieter as compared to SMPS).

The emission sources originate in the switching devices due to their fast switching current transitions: harmonics of the switching frequency and broadband noise created by under-damped oscillations in the switching circuit. The noise is both conducted and radiated through the input power cord and the DC output wiring to the radio.

SECTION 7 | Limiting Electro-Magnetic Interference (EMI)

7.3 FILTRATION OF CONDUCTED NOISE

The conducted RF noise from this SMPS unit is limited to the maximum allowable levels by internal filtration. The filtered RF noise currents (< few hundred micro Amps) are bypassed to the chassis of the power supply. The chassis is, in turn, connected to the Earth Ground pin of the AC input power cord (for Class 1 units). Thus, the filtered noise currents are intentionally leaked to the Earth Ground. This is termed as the "Earth Leakage Current".

7.4 EXCESSIVE RF OUTPUT INTERFERENCE BY SMPS DUE TO INCOMING RF INTERFERENCE WHEN POWERING RADIO TX / RX

SMPS are also recipients of radio interference. The normal operation of the power supply can be disturbed due to RF noise getting coupled into the power supply. Thus, the power supply may generate excessive RF noise and lose output voltage regulation due to excessive transmitter energy being coupled through the AC / DC lines to the power supply's regulator feedback path. This may be due to antenna being too close or due to the antenna or feed system not radiating properly. First, check the antenna system SWR. Then, if necessary, relocate either the antenna or the power supply farther apart. The receiver may "hear" the power supply. A slowly moving, slightly buzzing carrier heard in the receiver may be caused by the antenna being too close. As with the transmitter related noise pick up, a loose coaxial connector or a broken or a missing ground may aggravate this problem. Normally, this noise will be below the background or "band" noise. Increase the separation between the power supply and the receiving antenna. Use an outdoor antenna. This will reduce the amount of signal picked up from the power supply and also increase the amount of the desired signal.

7.5 ADDITIONAL GUIDELINES FOR REDUCING RF NOISE

- Use additional appropriate AC Radio Frequency Interference (RFI) Power Line Filter rated for minimum 10A immediately before the AC input of the power supply. Filtered, Ferrite Coated Cord Set is another choice. These cord sets, with integral line interference filters, reduce Common and Differential Mode Interferences over a wide frequency range. Because they are shielded, they are also effective against radiated interferences. In addition to the built-in filter networks, the cable conductors are coated with an RF absorbing ferrite compound. This provides additional attenuation at high frequencies that is lacking in most regular LC filters. The RF absorption of the ferrite-coated cable avoids resonances at high frequencies, reducing the conducted and radiated RF noises even further.
- Use additional appropriate DC radio frequency interference (RFI) power line filter rated for minimum 30 A immediately after the DC output of the power supply.
- Twist the Positive and Negative wires from the output of the power supply to the radio.
- The DC side Positive and Negative outputs of these power supplies are isolated from the chassis. As explained earlier, the noise currents are filtered to the chassis of the unit and the chassis is connected to the Earth Ground through the Earth Ground Pin

of the AC power outlet receptacle. Avoid connecting (referencing) the DC Negative output terminal of the power supply to the Earth Ground.

- Connect a ¼" wavelength of wire on the Negative terminal of the power supply. Connect one end of the wire to the Negative terminal and leave the other end free. The wavelength corresponds to the wavelength of the interfering frequency. (May not be practical for long wave lengths).

  [Formula: Wave length (Meters) = 300 / frequency in MHz]

7.6 COMBINED FILTERED NOISE CURRENTS FROM MULTIPLE SMPS ON A BRANCH CIRCUIT MAY TRIP GROUND FAULT CIRUIT INTERRUPTER (GFCI)

During malfunction or an accident, the metal chassis of a device may get energized to unsafe voltage due to internal high voltage section coming in contact with the chassis. If a person standing on Earth touches this energized chassis, a leakage current proportional to the person's skin resistance will flow through the person's body to Earth Ground. The leakage current through the body is higher when the skin contact resistance is lower i.e. if the skin is wet or wounded. This leakage current does not return to the power source but is dissipated in Earth Ground. A leakage current of > 4-6mA could produce lethal electrical shock. Ground Fault Circuit Interrupter (GFCI) is used for safety against electrical shock due to leakage. GFCI measures the difference between the current sent to the load and returned from the load and will trip and disconnect the power circuit if the difference is > 4-6 mA. GFCIs are normally installed in AC Branch Circuits feeding power outlets in wet areas like marine craft, RVs, spas, hot-tubs, kitchens, washrooms, etc.

As explained earlier, RF noise filtration circuits in SMPS generate intentional Earth Leakage Current. SMPS are used extensively as DC power sources in modern day electrical / electronic devices e.g. Audio / Video / Computing devices, power supplies, battery chargers etc. A single GFCI outlet / GFCI breaker may be serving multiple SMPS loads and therefore, will be sensing the sum of all the Earth Leakage Currents and, if the sum is > 4-6mA after connecting this unit, the GFCI will trip. In such a case, disconnect other SMPS based device(s) being served by this GFCI one by one till the net leakage current is reduced to < 4mA and the GFCI does not trip. **Other solution is to power this unit from a GFCI outlet / GFCI breaker that does not have any SMPS load or power from an outlet that is not protected by GFCI.**

SECTION 8 | Troubleshooting Guide

8.1 TROUBLESHOOTING GUIDES ARE GIVEN AT TABLE 8.1 AND 8.2 BELOW:

a) **TABLE 8.1:** This Table is based on operation as a simple power supply i.e. there is no external battery connected to the unit for battery backup.

b) **TABLE 8.2:** This Table is based on battery backup operation with external battery connected to the unit.

TABLE 8.1 TROUBLESHOOTING GUIDE (OPERATION AS A SIMPLE POWER SUPPLY - NO BATTERY BACKUP)

Symptom	Possible Cause	Remedy
ON / OFF Switch is ON • Switch is NOT lighted • No DC output	No AC power from the AC outlet supplying the unit Internal AC side fuse is blown	Check AC power is available at the AC outlet. Breaker feeding the AC outlet may have tripped. Open the top cover and check the 4A AC side fuse. Replace if blown. If the fuse blows again, the input section is damaged. Please call Tech Support.
ON / OFF Switch is ON • Switch is lighted • No DC output	Unit has shut down due to over temperature – Temperature of primary heat sink is ≥ 105°C ± 5°C / 221°F ± 9°F	Check that the fan is running. If not, the fan / fan control circuit may have been damaged. Call Tech Support. Check that the fan suction vents on the sides and bottom of the unit and the discharge vents of the fan grille are not blocked The unit will reset automatically when the primary heat sink cools down to ≤ 75°C ± 5°C / 167°F ± 9°F
ON / OFF Switch is ON • Switch is lighted • DC output voltage is available when the load is in switched OFF condition but shuts down when the load is in ON condition	The output of the AC to DC Power Supply Section has been shut down and is in Hiccup Mode due to: • Overload > 27.6 to 29A, or • Short circuit on the load side	Reduce the current drawn by the load to less than the continuous rating of 23A Remove short circuit on the load side
GFCI outlet / GFCI breaker supplying AC power to the unit trips when the unit is switched ON	Additional RF noise currents from the unit that are filtered to Earth Ground increase the net Leakage Current on the GFCI outlet / GFCI breaker to > 5mA	Switch OFF other SMPS devices operating from the same GFCI outlet / GFCI breaker to reduce the net leakage current to < 5mA Move the unit to another GFCI outlet / GFCI breaker that has lesser number of SMPS load(s) or no SMPS load Power the unit from normal, non GFCI outlet or from an outlet not protected by GFCI breaker

TABLE 8.2 TROUBLESHOOTING GUIDE (BATTERY BACKUP WITH EXTERNAL BATTERY)

Symptom	Possible Cause	Remedy
ON / OFF Switch is ON • Switch is NOT lighted • Load is ON and is operating normally • Output voltage at the Battery Terminals is < 13.5 ± 0.2V and is dropping • Output voltage at the Load Terminals is up to 0.4V lower than the Battery Terminals and is dropping	No AC power from the AC outlet feeding the unit Internal AC side fuse of the Power Supply Section is blown	Check AC power is available at the AC outlet. Breaker feeding the AC outlet may have tripped. Open the top cover and check the 4A AC side fuse. Replace if blown. If the fuse blows again, the input section is damaged. Please call Tech Support.
ON / OFF Switch is ON • Switch is lighted • Load is ON and is operating normally • Output voltage at the Battery terminals is <13.5V ± 0.2V and is dropping • Output voltage at the Load Terminals is up to 0.4V lower than the Battery Terminals and is dropping	The output of the AC to DC Power Supply Section of the Unit has shut down due to over temperature – Temperature of the primary heat sink is ≥ 105°C ± 5°C / 221°F ± 9°F.	Check that the fan is running. if not, the fan / fan control circuit may have been damaged. Call Tech Support. Check that the fan suction vents on the sides and on the bottom of the unit and the discharge vents on the bottom of the unit are not blocked. The Power Supply Section will reset automatically when the heat sink cools down to ≤ 75°C ± 5°C / 167°F ± 9°F. During the time the Power Supply Section is OFF, the battery will supply the load and will discharge during this period.
	The output of the AC to DC Power Supply Section has been shut down and is in Hiccup Mode due to: • Overload > 27.6 to 29A, or • Short circuit on the load side	Remove the cause of overload / short circuit
ON / OFF Switch is ON • Switch is lighted • Voltage at the Load Terminals is 13.8 ± 0.2V • There is no voltage at the at the load end [after fuse F2 (Fig 3.1)] and the load is shut down • Voltage at Battery Terminals is 13.8 to 11.4V	25A Fuse F2 (Fig 3.1) in the Load circuit is blown due to: - Excessive short time overload current > 25A exceeding the Time Current Characteristics of the 25A fuse, or - Short circuit in the load circuit	Remove the cause of the overload or short circuit on the load side

TABLE 8.2 TROUBLESHOOTING GUIDE (BATTERY BACKUP WITH EXTERNAL BATTERY)

Symptom	Possible Cause	Remedy
ON / OFF Switch is ON • Switch is lighted • Load is ON • Voltage at the Load Terminals is 13.8 ± 0.2V • Voltage at Battery Terminals is the same as the Load Terminals • Battery backup function does not operate – Load shuts OFF when AC power is interrupted	25A Fuse F1 (Fig 3.1) in the battery circuit is blown due to: - Reversal of battery input connections - Short circuit in the battery wiring	Check that the polarity of battery connections is correct. Replace the fuse. Check for short circuit in the battery wiring and remove the short circuit.
GFCI outlet / GFCI breaker supplying AC power to the unit trips when the unit is switched ON	Additional RF noise current from the unit that is filtered to Earth Ground increases the net Leakage Current on the GFCI outlet / GFCI breaker to > 4-6mA	Switch OFF other SMPS devices operating from the same GFCI outlet / GFCI breaker to reduce the net leakage current to < 5mA. Move the unit to another GFCI outlet / GFCI breaker that has lesser number of SMPS load(s) or no SMPS load. Power the unit from normal, non GFCI outlet or from an outlet not protected by GFCI breaker.

SECTION 9 | Specifications

Item	Parameter			Input: 115VAC	Input: 230VAC
AC INPUT	AC Input Voltage Range			100-240 VAC	
	AC Input Frequency			50/60Hz	
	AC Input Current			3.01A at 120 VAC	1.49A at 240 VAC
				3.15A at 115 VAC	1.55A at 230 VAC
				3.68A at 100 VAC	
	AC Input Inrush Current on Switching ON			30A (Cold start)	60A (Cold start)
	AC Input Power Factor at Full Load			0.99PF	0.97PF
	AC Input No Load Power Draw			< 0.17W	< 0.45W
	AC Input PFC Switching Frequency			25 – 68KHz	
OUTPUT	Output Voltage at Load Terminals		AC Input is available	13.8 ±0.2 VDC	
			AC input is not available - unit is in Battery Backup Mode	12.0 ± 1.5 VDC	
	Output Voltage at Battery Terminals (AC Input is available)		No battery	13.8 ±0.2 VDC	
			Battery fully charged and floating	13.5V ± 0.2V	
			Battery not fully charged	Up to 11.2V at charging current of 4A	
	Output Current at Load Terminals (Without Battery)		Rated	23A	
			Internal Current Limit	27.6~29A	
			External Current limit	25A for 100 sec (External 25A Load Side Fuse will blow after around 100sec)	
			Surge Current	>25A as permitted by the Time Current Characteristics of the 25A Load Side Fuse	
	Output Current (Battery connected)	At Load Terminals	Rated	19A with simultaneous charging at 4A through Battery Terminals	
			Current Limit	25A for 100 sec (External 25A Battery / Load Side Fuse(s) will blow after around 100sec)	
			Surge Current	>25A as permitted by the Time Current Characteristics of the 25A Battery and Load Side Fuses	
		At Battery Terminals	During Charging	4A with battery discharged to 11.15V	
	Output Power			317.4W	
	Average Efficiency with Battery Backup			> 86 % (Load:19A / Batt:4A)	> 88 % (Load:19A / Batt:4A)
	Average Efficiency without battery backup (As Power Supply only)			> 87.5 % (Load : 23A)	> 89.5 % (Load : 23A)
	PWM Switching Frequency			75 – 150KHz	
	Output Ripple and Noise			100mV peak to peak at full load	70mV peak to peak at full load
	Output Voltage Adjustment Range			12.5-15 VDC	
	Output Voltage Tolerance at No Load			± 0.05 VDC	

SECTION 9 | Specifications

Item	Parameter		Input: 115VAC	Input: 230VAC
PROTECTIONS	Overload and Short Circuit	Without Battery	Hiccup Mode at 27.6A to 29A. • Auto reset when fault is removed.	
		With Battery	External 25A Battery Side / Load Side Fuses will blow	
	Reverse Polarity Connection on the Battery Side		External 25A Battery Side Fuse will blow	
	Output Over Voltage Protection		By PWM Controller (16.5±0.5 VDC)	
	Cooling		Temperature controlled fan: • ON when the temperature of Secondary Heat Sink reaches 55°C ± 5°C • Off when the temp. drops to 45°C ± 5°C.	
	Over Temperature Protection		The unit will shut down when the Primary Heat Sink temperature rises to 105°C ± 5°C. • Reset when temp. drops to 75°C ± 5°C	
	Internal AC Side Fuse		250V, 4.0A; Time Delay Type; 5mm x 20mm	
ENVIRONMENTAL	Operating Temperature	At 100% Rated Power	-20 °C to +50°C: 100% rated power	
		At 80% De-Rating	50 ~ 60°C: Linearly de-rate from 100% power at 50°C to 80% power at 60°C.	
	Storage Temperature		-30 °C to +70°C	
	Relative Humidity		Maximum 90%, Non Condensing	
COMPLIANCE: SAFETY	UL Safety Listed	USA	UL 62368-1,2014-12-1	
		Canada	CSA C22.2 No. 62368-1-14, 2014-12	
	European, CE Safety Marked		EN 62368-1: 2014+A11:2017	
COMPLIANCE: EMC	USA		• FCC Part 15 Sub Part B Class B • ANSI C63.4-2014 • CISPR 22: 2008 Class B	
	Canada		• ICES-003 Issue 6:2016 Class B • CISPR 22:2008 Class B • CAN/CSA-CISPR 22-10 Class B • ANSI C63.4-2014	
			• EN 55032: 2015+AC: 2016 Class B • CISPR 32: 2015 Class B • EN 61000-3-2: 2014 Class D • EN 61000-3-3:2013 • EN 55024: 2010+A1: 2015 • EN 61000-4-2:2009 • EN 61000-4-3: 2006+A1: 2008+A2: 2010 • EN 61000-4-4: 2012 • EN 61000-4-5: 2014 • EN 61000-4-6: 2014+AC: 2015 • EN 61000-4-8: 2010 • EN 61000-4-11: 2004	
COMPLIANCE: RoHS2	For European CE Mark		2011/65/EU (RoHS2)	
DIMENSIONS / WT.	Dimensions (W x D x H)		185 x 240.5 x 57.8mm / 7.28 x 9.47 x 2.28 in	
	Weight		1.81 kg / 4 lb	

SECTION 10 | Warranty

3 YEAR LIMITED WARRANTY

SEC-1223P-BBM manufactured by Samlex America Inc. (the "Warrantor") is warranted to be free from defects in workmanship and materials under normal use and service. The warranty period is 3 years for the United States and Canada, and is in effect from the date of purchase by the user (the "Purchaser").

Warranty outside of the United States and Canada is limited to 6 months. For a warranty claim, the Purchaser should contact the place of purchase to obtain a Return Authorization Number.

The defective part or unit should be returned at the Purchaser's expense to the authorized location. A written statement describing the nature of the defect, the date of purchase, the place of purchase, and the Purchaser's name, address and telephone number should also be included.

If upon the Warrantor's examination, the defect proves to be the result of defective material or workmanship, the equipment will be repaired or replaced at the Warrantor's option without charge, and returned to the Purchaser at the Warrantor's expense. (Contiguous US and Canada only)

No refund of the purchase price will be granted to the Purchaser, unless the Warrantor is unable to remedy the defect after having a reasonable number of opportunities to do so. Warranty service shall be performed only by the Warrantor. Any attempt to remedy the defect by anyone other than the Warrantor shall render this warranty void. There shall be no warranty for defects or damages caused by faulty installation or hook-up, abuse or misuse of the equipment including exposure to excessive heat, salt or fresh water spray, or water immersion.

No other express warranty is hereby given and there are no warranties which extend beyond those described herein. This warranty is expressly in lieu of any other expressed or implied warranties, including any implied warranty of merchantability, fitness for the ordinary purposes for which such goods are used, or fitness for a particular purpose, or any other obligations on the part of the Warrantor or its employees and representatives.

There shall be no responsibility or liability whatsoever on the part of the Warrantor or its employees and representatives for injury to any persons, or damage to person or persons, or damage to property, or loss of income or profit, or any other consequential or resulting damage which may be claimed to have been incurred through the use or sale of the equipment, including any possible failure of malfunction of the equipment, or part thereof. The Warrantor assumes no liability for incidental or consequential damages of any kind.

Samlex America Inc. (the "Warrantor")
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