



samlexpower®

**SAM Series
Inverter /
Charger**

SAM-1500C-12

Owner's
Manual

Please read this
manual BEFORE
installing your
inverter

OWNER'S MANUAL | Index

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SECTION 1 | Safety Instructions

1.1 IMPORTANT SAFETY INSTRUCTIONS

This manual contains important information regarding safety, operation, maintenance and storage of this product. Before use, read and understand all cautions, warnings, instructions and product labels, plus your vehicle's battery manufacturer's guidelines. Failure to do so could result in injury and / or property damage. 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.



CAUTION!

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



INFO

Indicates useful supplemental information.



WARNING!

To reduce the risk of fire, electric shock, explosion or injury:

1. Do not connect in parallel with another AC source e.g. Utility AC Distribution Wiring / generator. This is NOT a Grid Tied Inverter!
2. When working with Multiple Outlet Power Strips, disconnect appliance plug from outlet strip or turn off the inverter before working on the appliance. Multiple Outlet Power Strips with switches and circuit breakers interrupt power only to the "Hot" receptacle terminals.
3. Precautions when working with batteries
 - Batteries contain very corrosive diluted Sulphuric Acid as electrolyte. Precautions should be taken to prevent contact with skin, eyes or clothing.
 - 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.
 - Never smoke or allow a spark or flame near the batteries.
 - 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.
 - Remove metal items like rings, bracelets and watches when working with batteries and also use caution when working with metal tools. Batteries can produce a short circuit current high enough to melt / weld metals and thus, cause severe burn.

SECTION 1 | Safety Instructions

- If you need to remove a battery, always remove the Ground (Negative) terminal from the battery first. Make sure that all the accessories are off so that you do not cause a spark.
4. Do not make any electrical connections or disconnections in areas designated as **IGNITION PROTECTED**. This includes 12VDC Power Plug (Cigarette Plug) connections and terminal connections.
 5. This is not a toy - keep away from children.
 6. Do NOT insert objects into the ventilation air vents.



CAUTION!

1. Please ensure that the Grid AC Power input is fed from 15A/20A GFCI protected outlet to provide Ground Fault Protection when the unit is operating in Charger / Grid AC Pass Through Mode
2. Connect the external Chassis Ground Connection (15, Fig 3.1) to Earth Ground using at least AWG #8 wire.
3. When Inverter is supplying AC loads, the voltage on the Neutral and Line Socket of the NEMA5-15R AC outlet with respect to the Ground Socket / metal chassis of the unit / metal chassis of the AC loads will be a pulsing DC voltage with average DC value of up to 50V (will falsely read 75 VAC on AC scale of the Voltmeter because of pulsing nature of DC voltage). **DO NOT TOUCH THE NEUTRAL SOCKET / NEUTRAL CONDUCTORS OF THE AC OUTLETS!**
4. Do not connect AC output from NEMA5-15R outlets to AC distribution wiring where the Neutral is bonded to Earth Ground. The inverter will see this as abnormal condition of Ground Fault and will shut down.
5. Do not use with Positive Grounded Electrical Systems (the majority of modern automobiles, RVs, trucks and boats use Negative Grounded Electrical Systems).
6. Observe correct polarity when connecting the DC input terminals of the inverter to the battery. Connect Positive of the battery to the Positive input connector of the Inverter and the Negative of the battery to the Negative input terminal of the Inverter. **Reverse polarity connection will result in a blown fuse and may cause permanent damage to the inverter. Damage due to reverse polarity is not covered under warranty.**
7. This Inverter will not operate high wattage appliances that exceed the output power limit or the surge power limit.
8. Do not operate this Inverter if it is wet.
9. Do not install in engine compartment – please install in a well-ventilated area.
10. This Inverter is not tested for use with medical devices.

SECTION 2 | Features, Applications & Principle of Operation

2.1 GENERAL

This unit is a Modified Sine Inverter / Charger with a Transfer Relay with primary function of Backup AC Power Source. The unit consists of the following 3 components integrated into a single unit:

- Modified Sine Wave Inverter for AC back up when Grid AC Power fails:
 - Input: 12V Nominal Lead Acid Battery (10.5V to 15.5V \pm 0.5V)
 - Output: 1500W (At Power Factor =1) at 115 VAC, 60Hz
- AC Battery Charger to charge batteries when Grid AC Power is available:
 - Input: 120 VAC, 60Hz
 - Output: 13.8 VDC, 15A to charge 12V Lead Acid Batteries - Flooded, AGM or Gel Cell
 - 2-Stage Charging - Bulk and Float
- AC Input Pass Through to load when Grid AC Power is available
 - Input: 120 VAC, 60Hz, 15A
 - Transfer Relay Rating: 30A

2.2 APPLICATIONS

- Backup AC Power Source or Off-Line AC UPS to provide AC power during power outages
- 12V Lead Acid Battery charging
- RVs, trucks and remote housing

2.3 FEATURES

- Integrated 1500W Modified Sine Wave Inverter, 30A rated Transfer switch, and 2 Stage 12 VDC, 15A Battery Charger
- High Inverter peak efficiency of 87%, lightweight, and compact for easy installation
- Soft Start Technology for better surge performance
- Separate ON/OFF control for Inverter and Battery Charger for selectable operation as Inverter/Charger (Backup AC Power Source) or Stand-alone Inverter or Stand-alone Battery Charger
- 4 LED indicators to monitor operational status
- Load controlled fan for efficient cooling when required
- Allows use of higher capacity external 12V battery bank for longer backup time
- Cool Surface Technology for cooler and safer touch temperature
- Electronic protections including GFCI when in Inverter Mode

SECTION 2 | Features, Applications & Principle of Operation

- Low Interference Technology for controlled RF noise
- Ideal for RV's, Trucks and remote housing

2.3.1 Soft Start Technology

This feature offers the following advantages:

- When the Inverter is switched ON, the voltage ramps up to 115 VAC in around 2 sec. If the load was already ON at the time of switching ON of the Inverter, starting surge current demanded by certain reactive devices like motors etc. will be reduced and there will be less likelihood of the Inverter shutting down due to overload.
- If the Inverter is switched ON first and then a load with higher starting / inrush current like SMPS / motor is switched ON, the voltage will dip momentarily and then recover to reduce inrush / starting surge current in the load as above.
- Similar overload reduction will be initiated during any other sudden higher loading conditions.

2.3.2 Low Interference Technology

Innovative circuit design and noise filtration circuitry reduces RF interference in TV picture, audio and radio equipment.

2.3.3 Cool Surface Technology

Normally, heat dissipating components are mounted directly on internal metal chassis surface of the unit and hence, the chassis surface may rise to unsafe touch-temperature. In this unit, heat-dissipating components are not mounted directly on the chassis of the unit but on PCB (Printed Circuit Board) mounted heat sink and, there is air gap between the heat sink and the chassis surface. The heat sink is cooled by load-controlled fan. As there is no direct contact between the heat sink and the chassis, the chassis surface remains much cooler and is safer to touch.

2.3.4 Load Controlled Cooling Fans

Cooling is carried out by convection and by forced air circulation by 2 load-controlled fan. The fan will normally be OFF and will be switched ON automatically as follows:

- Inverter supplying AC load(s): When load(s) $\geq 85W$
- Battery Charging/AC Pass Through Mode: When charging current $\geq 3A \pm 1A$

This will reduce energy consumption by the fan and will increase overall efficiency.

2.4 PRINCIPLE OF OPERATION - INVERTER

Conversion of 12 VDC from the battery / other DC source to 115 VAC takes place in 2 stages. In the first stage, the 12 VDC is converted to high voltage DC (around 160 VDC) using high frequency switching and Pulse Width Modulation (PWM) technique. In the 2nd stage, the 160V high voltage DC is converted to 115V, 60 Hz Modified Sine Wave AC. (**NOTE:** 115V is the RMS value of the Modified Sine Wave AC voltage. The peak value of the Modified Sine Wave AC voltage will be equal to the value of the above high voltage of around 160V. See the Fig 2.1).

SECTION 2 | Features, Applications & Principle of Operation

2.4.1. Modified Sine Waveform - Characteristics & Comparison with Pure Sine Waveform

Please refer to Fig 2.1 below which shows one cycle of Modified Sine Wave and Pure Sine Wave for comparison. (Both with RMS voltage of 115 VAC)

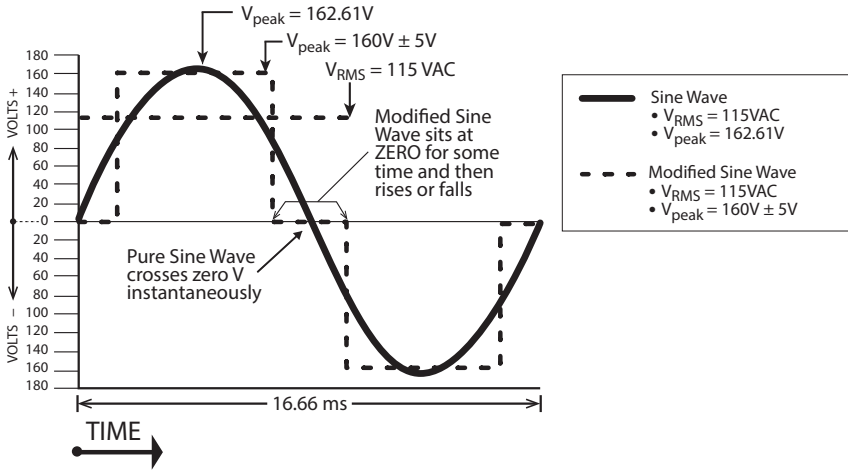


Fig 2.1 Modified Sine Wave and Pure Sine Wave - Comparison

The output waveform of the Inverter is a Modified Sine Wave. In a Modified Sine Wave, the voltage waveform consists of rectangular pulses that approximate sine wave pulses of a Pure Sine Wave. The voltage rises and falls abruptly at a particular phase angle and **sits at 0 Volts for some time before changing its polarity**. In a Pure Sine Wave, the voltage rises and falls smoothly with respect to phase angle and the **voltage changes its polarity instantly when it crosses 0 Volts**.



CAUTION!

Certain devices (few examples given below) may malfunction when powered from Modified Sine Wave. Check with the manufacturer of the device for suitability of powering with Modified Sine Wave:

- Devices utilizing zero voltage crossing for timing control: Some clocks used in consumer electronic items (will not keep accurate time)
- Devices using modulation of RF signals on AC lines during zero crossing e.g. X-10 System for Home Automation
- Devices utilizing Triac based phase control for transformer less voltage step down e.g.:
 - Small battery chargers for hand tools, flashlights, night-lights, shavers etc.
 - Variable motor speed control in hand tools
 - Light dimmers

SECTION 2 | Features, Applications & Principle of Operation

- Temperature controllers e.g.:
 - Temperature Controlled Electric Blankets
- Devices using high capacitance based voltage multipliers for generating high voltage (will create very high surge currents) e.g.:
 - Photographic Strobe Lights
 - Laser Printers

2.4.2 Measuring Modified Sine Wave Voltage with a "True RMS" Voltmeter

As mentioned above, Modified Sine Wave voltage is a type of square wave that has an RMS (Root Mean Square) value of 115 VAC in this Inverter. A general-purpose AC voltmeter is calibrated to accurately measure the RMS value of a Pure Sine Wave and NOT of a Modified Sine Wave. If this general-purpose voltmeter is used to measure Modified Sine wave voltage, it will indicate a lower value (96 VAC to 104 VAC). For accurately measuring the voltage of a Modified Sine Wave, use a voltmeter which is designed to measure "True RMS Values" like Fluke 87, Fluke 8060A, Fluke 77 / 99, Beckman 4410 etc.

2.5 PRINCIPLE OF OPERATION AND CHARGING ALGORITHM - BATTERY CHARGER

The battery charger is a 2 Stage, Switched Mode Design using Fly Back Topology. 120 VAC from the AC Input is rectified to high voltage DC of around 170 VDC, which is then converted to high frequency pulses using MOSFET Switch and then stepped down through switching transformer. The transformed voltage is rectified and filtered. A sample of the output voltage is used as feedback signal for the drive circuit for the switching Mosfet to achieve desired voltage regulation of 13.8 VDC using Pulse Width Modulation (PWM). It is designed to provide maximum charging current of 15A.

2.5.1 Charging / Discharging Curves for Lead Acid Batteries

Fig. 2.2 shows the charging and discharging characteristics of a typical 12V / 24V Flooded Lead Acid battery at electrolyte temperature of 80°F / 26.7°C. The curves show the % State of Charge (X-axis) versus terminal voltage (Y-axis) during charging and discharging at different "C-Rates". **Please note that X-axis shows % State of Charge. State of Discharge will be = 100% - % State of Charge.** The value of charging / discharging current is expressed as "C-Rate" which is a ratio as defined below:

C-Rate in Amperes = $\frac{C}{T}$ where,

C = Capacity of the battery in Ampere Hours (Ah)

T = Time in Hours over which the battery is discharged from fully charged condition to 10.5V (12V battery) or 21V (24V battery) at constant current = C-Rate e.g. if 100Ah battery (C = 100) is discharged in 5 Hours (T = 5) the C-Rate = $\frac{100}{5} = 20$ Amperes

SECTION 2 | Features, Applications & Principle of Operation

Typical Flooded Lead-Acid Battery Chart - 80°F / 26.7°C

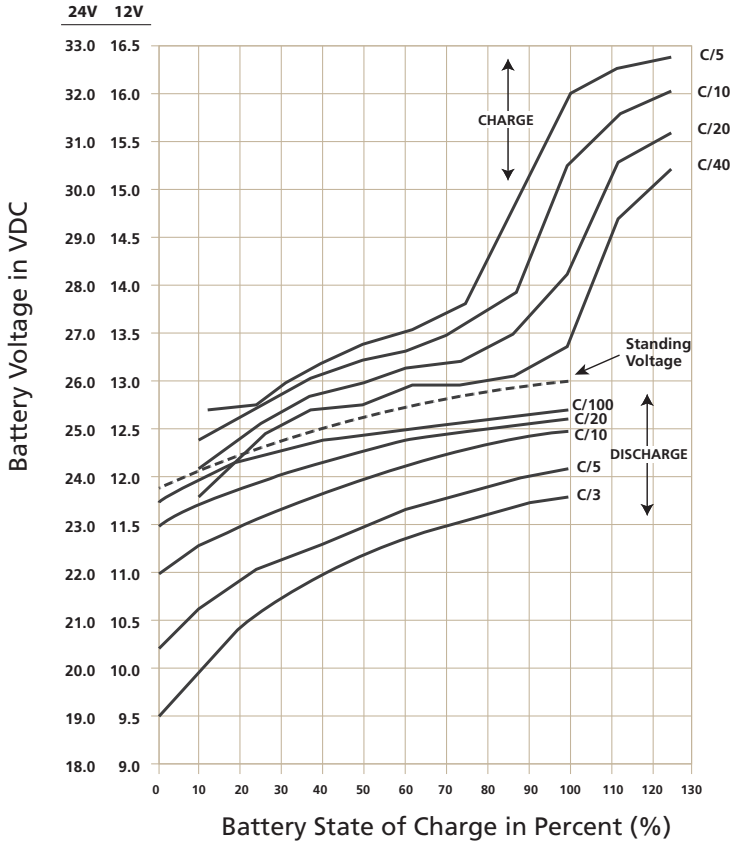


Fig 2.2 Charging / Discharging Curves for Typical Flooded Lead Acid Battery

SECTION 2 | Features, Applications & Principle of Operation

2.5.2 2 Stage Charging - Bulk Charge and Float Charge Stages

The built-in Battery Charger is a "2 stage charger".

Working of a 2 Stage Charger is explained below. Please refer to Fig 2.3.

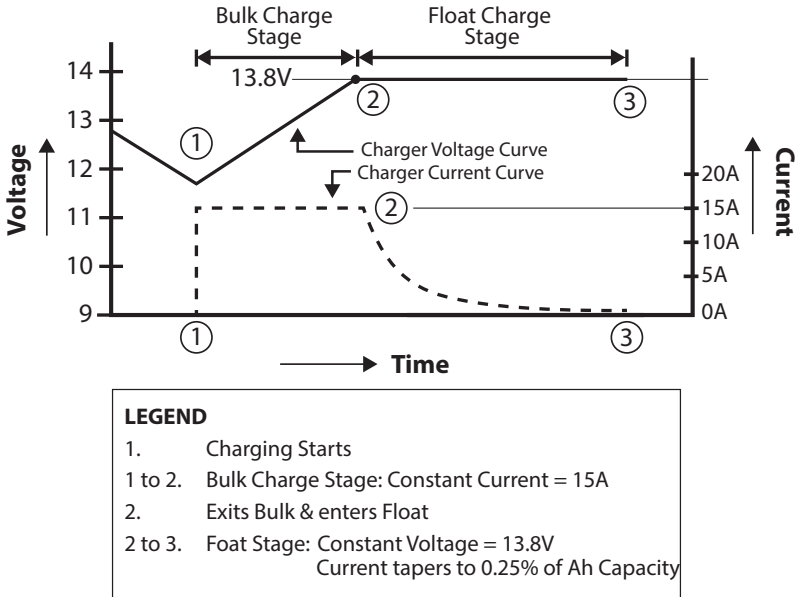


Fig. 2.3 Battery Charger Stages and Voltage/Current Curves

2 Stages of Charging are (i) Constant current Bulk Stage and (ii) Constant voltage Float Stage. A 2-Stage Charger is able to recharge a battery to around 80% capacity. This type of charger is used in Backup / UPS applications where the battery remains charged, is floating most of the times and will discharge at lesser frequency only during power outages. Charging details are given below:

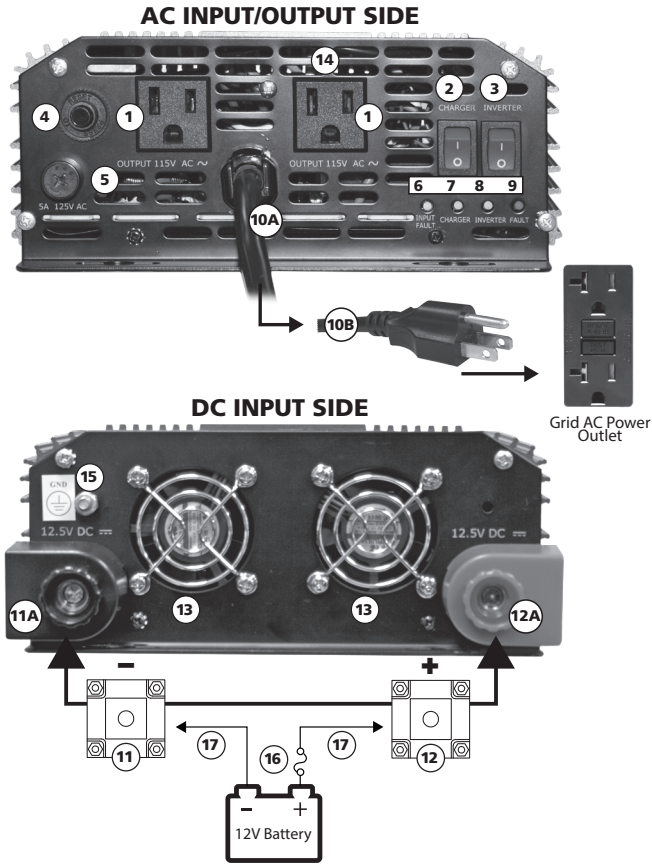
- The charger outputs a constant, regulated voltage of 13.8V (Float Charge Stage Voltage) and can deliver up to 15A of maximum charging current (Bulk Charge Stage Current). If the battery tries to draw current higher than 15A due to its discharged condition, the charger enters Current Limit Condition. Under Current Limit Condition, the charger will supply constant current of 15A, its output voltage will no longer be regulated and will drop below 13.8V. However, its output voltage will get clamped to the battery voltage corresponding to the State of Charge of the battery.
- The input resistance of a healthy battery is very low – around 16 milli Ohm at completely discharged condition to less than 8 milli Ohm when fully charged

SECTION 2 | Features, Applications & Principle of Operation

- iii. The “Standing Voltage” of a battery is the terminal voltage of the battery after it has “rested” for at least 4 hours (no charging or discharging during resting period of 4 hours). The Standing Voltages of 12V Lead Acid battery are as follows (See Fig 2.2):
 - Fully Charged: Around 12.8V
 - Fully discharged: Around 11.8V
- iv. Before the charger is switched ON (before Point 1 in Fig 2.3), the battery is almost completely discharged to “Standing Voltage” of around 11.8V (Fig 2.2) and its internal resistance is, say 16 milli Ohm. Assuming 4 milli Ohm of battery wire resistance, a resistance of 20 milli Ohm will be seen by the charger when it is initially switched ON. When the charger is switched ON (Point 1 in Fig 2.3), 13.8 V from the charger is fed to the battery. Voltage difference of 2.0V (13.8V-11.8V) will initially TRY to drive very large charging current of around 100A into the battery ($2.0V \div 20 \text{ milli Ohm} = 100A$). However, the charger will limit the current to 15A will enter Current Limit Condition as explained at paragraph (i) above and its voltage will be clamped to the actual battery voltage i.e. 11.8V. This is the start of the “Bulk Charge Stage”
- v. Continuous 15A constant current charging in the “Bulk Charge Stage” (Points 1 to 2 of Fig 2.3) will slowly raise the battery voltage. As the battery voltage rises, the voltage difference between the charger’s Float Stage Voltage setting of 13.8V and the battery’s actual voltage reduces. The internal resistance of the battery also reduces. When the battery voltage rises to around 13.6V, the charging current will reduce below 15A and the charger will exit Current Limit Condition - its voltage will rise to constant, regulated Float Voltage of 13.8V (Point 2 in Fig 2.3). At this point, the charger will exit the constant current “Bulk Charge Stage” and enter the constant voltage “Float Charge Stage”.
- vi. During the “Float Charge Stage” (Points 2 to 3 in Fig 2.3), the battery is charged at constant voltage of 13.8V. The charging current tapers from 15A to low steady state Float Charge Current of around 0.25% of the Ampere Hour (Ah) capacity of the battery (Point 3 in Fig 2.3). At 13.8V, the battery is charged to around 80% of its rated capacity at C/10 Charge Rate (Fig 2.2).

SECTION 3 | Layout

3.1 LAYOUT



LEGEND

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. AC Outlet - NEMA5-15R 2. ON/OFF Switch - marked "CHARGER" 3. ON/OFF Switch - marked "INVERTER" 4. Breaker for AC Input - 15A 5. Fuse for Charger Section <ul style="list-style-type: none"> - 5 mm x 20 mm, Fast Acting Glass Tube Fuse - 5A, 125V ; Bussman GMA-A or equivalent 6. YELLOW LED marked "INPUT FAULT" 7. GREEN LED marked "CHARGER" 8. GREEN LED marked "INVERTER" 9. RED LED marked "FAULT" 10A. AC input power cord; 3x AWG#14, 105°C 10B. NEMA5-15P Plug for the power cord 11. Negative Input Terminal (M9) for 12V Battery Negative | <ol style="list-style-type: none"> 11A. BLACK plastic cover for Negative Input Terminal 12. Positive Input Terminal (M9) for 12V Battery Positive 12A. RED plastic cover for Positive Input Terminal 13. Opening for cooling fan discharge 14. Ventilation slots for air inlet 15. Chassis Ground Connection, M5 16. 200A, Class-T / MRBF Fuse (within 7" of Positive Battery Terminal)* 17. AWG#2 Battery Cables (see Table 4.1 for voltage drops)* <p>* Not included</p> |
|---|--|

Fig 3.1 Layout and Input/Output Connections

SECTION 3 | Layout

3.2 DIMENSIONS AND MOUNTING ARRANGEMENT

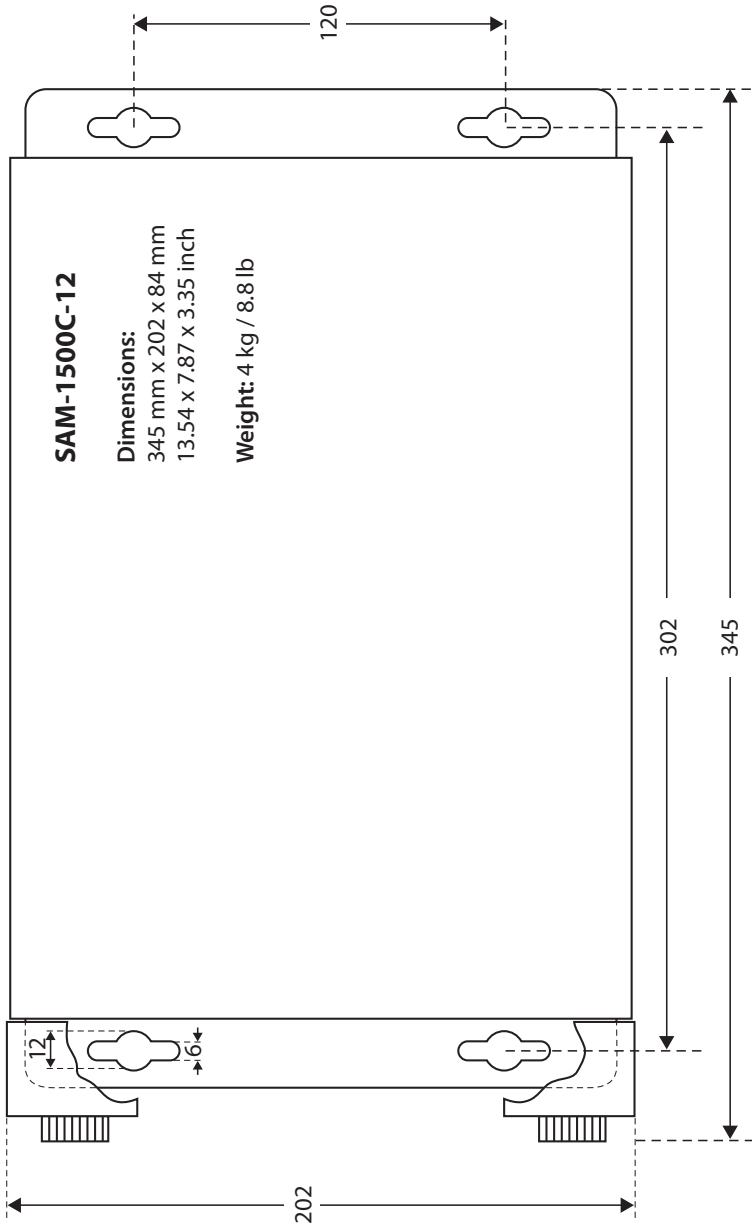


Fig 3.2 Dimensions & Mounting Arrangement

SECTION 4 | Installation

4.1 SAFETY OF INSTALLATION



WARNING!

Please read safety instructions in Section 1 before commencing installation. When using the unit as a backup AC Power Source, Grid AC Power Input should be fed from 15A/20A, GFCI Protected outlet.

4.2 INSTALLATION ENVIRONMENT

For best operating results, the unit should be placed on flat surface, such as the ground, car floor, or other solid surface. The power cord allows easy positioning of the unit. The unit should only be used in locations that meet the following criteria:

Dry- Do not allow water and/or other liquids to come into contact with the unit. In all marine applications, do not install the unit below or near the waterline and keep the inverter away from moisture or water.

If Flooded / Wet Cell Type of battery is being used, ensure that the unit is not installed very close to the battery to avoid contact with acid / acid vapors

Cool - Ambient air temperature should be between 0°C (32°F) to 25°C (77°F) for full rated power. At higher temperature of 26°C (79°F) to 35°C (95°F), the output power should be de-rated to 80%. Do not place the unit on or near a heating vent or any piece of equipment which is generating heat above room temperature. Keep the unit away from direct sunlight.

Ventilated - The unit is cooled by 2 load-controlled fans. The fans will switch ON automatically at load $\geq 85W$ when the Inverter is supplying power, and at $3A \pm 1A$ charging current when in Battery Charging/AC Pass Through Mode. The fans draw cool air from the air intake ventilation slots on the AC outlet side (14, Fig 3.1) and discharge hot air out of the fan openings (13, Fig 3.1) on the DC Input Terminal side. Keep the areas surrounding the inverter clear by at least 10 cm to ensure free air circulation around the unit. Ensure that the air intake ventilation slots and fan openings for air discharge are not blocked. Do not place other items on or over the unit during operation.

4.3 MOUNTING ORIENTATION

Two (2) flanges on the bottom with 2 mounting slots each are provided for mounting, as shown in Fig 3.2.

If the unit is required to be mounted on a vertical surface like a wall, please ensure that the fan axis is horizontal as shown in Fig 4.1(a).

The DC input side has larger ventilation openings (13, Fig 3.1) for fan air discharge. Mounting with the fan side facing up or down as shown in Figs 4.1(b) or 4.1(c) is NOT permitted due to safety considerations. If mounted as in Fig 4.1(b), metallic or other conductive object(s) may accidentally fall inside the unit through the fan ventilation openings and create hazardous condition resulting from short circuit of internal high voltage section(s). If mounted as in Fig 4.1(c), hot / molten material from damaged internal portion of the unit due to malfunction may fall on combustible material on the floor and may create fire hazard.

SECTION 4 | Installation

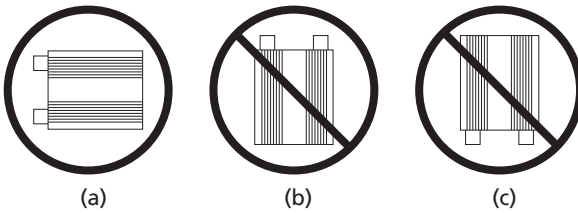


Fig 4.1
Mounting Orientation
on Wall

4.4 GROUNDING AND GROUND FAULT / LEAKAGE PROTECTIONS

4.4.1 DC Side Grounding and Ground Fault Protection

For DC side grounding and protection against Ground Fault, an M5 Bolt and Nut (15, Fig 3.1) has been provided. Connect this to the Earth Ground in shore based installations / Vehicle Chassis Ground using minimum AWG #8 wire.

4.4.2. AC Side Grounding and Leakage Protection

AC Side Grounding and Leakage Protection are provided as follows:

- (i) **Condition 1: AC input cord is plugged into GFCI protected Grid AC Outlet and Grid Voltage is available at this outlet:**

The Grounding Conductor of the AC input cord (Green wire) is internally connected to the metal chassis of the unit. Hence, the metal chassis of the unit will also get connected to the Earth Ground in the Grid AC Supply Panel through the above mentioned Grounding Conductor of the AC input cord. On detecting availability of Grid input voltage, internal Ground Switching Relay K2 will be de-energised and the grounding sockets of the two NEMA5-15R AC outlets (1, Fig 3.1) will be connected to the metal chassis of the unit. Hence, the metal chassis of the unit and the metal chassis of the AC loads will be bonded to the Earth Ground in the Grid AC Supply Panel. Leakage protection will be provided by the GFCI in the AC outlet providing AC input power to the unit. On detecting leakage, the external GFCI supplying Grid AC power to the unit will trip and disconnect AC input power. When loss of Grid AC input power is detected, the load will be transferred to the Inverter through the internal Transfer Relay K1. As there is leakage in the load, the Inverter will also be shut down by the internal GFCI circuitry due to leakage as explained at Condition 2 (ii) below. Under this condition, Green LED "CHARGER" (7, Fig 3.1) will be OFF and Red LED "FAULT" (9, Fig 3.1) will be ON (Refer to Section 6, Table 6.1)



CAUTION!

Please note that when Grid input power is available, Ground Switching Relay K2 will be de-energized and will disconnect the internal GFCI protection circuitry for protection against leakage on the load side. Hence, it is to be ensured that the AC input cord is plugged into 15A, GFCI protected AC outlet to ensure leakage protection on the load side.

SECTION 4 | Installation

- (ii) **Condition 2: AC input cord is plugged into GFCI protected AC outlet and Grid voltage is NOT available at this outlet (Either Grid voltage has shut down or the breaker / switch feeding this outlet has been switched OFF):** The Grounding conductor of the AC input cord (Green wire) is internally connected to the metal chassis of the unit. Hence, the metal chassis of the unit will also get connected to the Earth Ground in the Grid AC Supply Panel through the above mentioned grounding conductor of the AC input cord. On detecting loss of Grid AC input voltage, internal Ground Switching Relay K2 will be energised, its Normally Opened (NO) contacts will close and the grounding sockets of the two NEMA5-15R AC outlets (10, Fig 3.1) will get disconnected from the metal chassis of the unit and get connected to the internal GFCI circuitry. Hence, the metal chassis of the AC loads will be protected against leakage through the internal GFCI circuitry in the Inverter. The internal GFCI circuitry will shut down the AC output of the Inverter if it detects leakage of $> 5.8\text{mA}$. Under this condition, Green LED "CHARGER" (7, Fig 3.1) will be OFF and Red LED "FAULT" (9, Fig 3.1) will be ON (Refer to Section 6, Table 6.1)
- (iii) **Condition 3: AC input cord is unplugged from the GFCI protected Grid AC Outlet:** On detecting loss of Grid power, internal Ground Switching Relay K2 will be energised, its Normally Opened (NO) contacts will close and the Grounding Sockets of the two NEMA5-15R AC outlets (10, Fig 3.1) will get disconnected from the metal chassis of the unit and get connected to the internal GFCI circuitry. Hence, the metal chassis of the AC loads powered from the Inverter will be protected from leakage through the internal GFCI circuitry in the Inverter. The internal GFCI circuitry will shut down the AC output of the Inverter if it detects leakage of $> 5.8\text{mA}$. Under this condition, Green LED "CHARGER" (7, Fig 3.1) will be OFF and Red LED "FAULT" (9, Fig 3.1) will be ON (Refer to Section 6, Table 6.1)

4.5 SWITCHING OF BONDING OF GROUNDING SOCKETS OF AC OUTLETS

The following conditions will be applicable when the unit is being used as (i) a Stand-alone Inverter (AC power cord is NOT plugged into the Grid power) or as (ii) a backup AC power source (AC UPS) with the AC power cord plugged into the Grid outlet but Grid power OFF:

- Internal Ground Switching Relay K2 will be in energized condition. Its Normally Opened (NO) contacts will be closed and the Grounding Sockets of the two NEMA5-15R AC outlets (10, Fig 3.1) will get disconnected from the metal chassis of the unit and get connected to the internal GFCI circuitry. The Line and Neutral Sockets of the NEMA5-15R AC outlets on the unit will be isolated from its Grounding Socket. Thus, the metal chassis of the AC loads and the metal chassis of the unit will also be isolated from the Line and Neutral sockets of the NEMA5-15R AC outlets.
- Due to the above implementation, the voltage on the Neutral and Line Sockets of the NEMA5-15R AC outlets with respect to the Grounding Socket will be a pulsing DC voltage with average DC value of up to 50V (will falsely read 75 VAC on AC scale of the Voltmeter because of the pulsing nature of DC voltage). **DO NOT TOUCH THE NEUTRAL SOCKETS / NEUTRAL CONDUCTORS OF THE AC OUTLETS!**

SECTION 4 | Installation



CAUTION!

Do not connect AC output from the NEMA5-15R outlets to AC distribution wiring where the Neutral is bonded to Earth Ground. The Inverter will see this as abnormal condition of Ground fault / leakage and will shut down!

4.6 DC SIDE CONNECTIONS

4.6.1 General Information

1. Ensure that the unit is connected to 12V battery system. **CONNECTION TO 24V BATTERY SYSTEM WILL DAMAGE THE UNIT.**
2. Do not use additional external charging source to charge the battery at voltage > 15.5V.
3. Do not use with Positive Grounded Electrical Systems (the majority of modern automobiles, RVs, trucks and boats use Negative Grounded Electrical Systems).
4. Observe correct polarity when connecting the DC input terminals of the unit to the battery. Connect Positive of the battery to the Positive input terminal of the unit and the Negative of the battery to the Negative input terminal of the unit. Reverse polarity connection will result in a blown fuse and may cause permanent damage to the unit. **Damage due to reverse polarity is not covered under warranty.**

4.6.2 Requirements of DC Input Power Source

Approx. DC Input Current required by Inverter = Power consumed by the AC Load in Watts ÷ 10.

DC current drawn from the battery when delivering the rated power of 1500W is 150A.

12 VDC input to the unit should be fed from a 12V Battery System or from a 12.5 VDC to 15 VDC Regulated DC Power Supply. If a DC Power Supply is used, its output current capacity should be more than 2 times the maximum DC input current drawn by the inverter. **Further explanation of operation is based on DC input power from a 12V battery.** It is recommended that Deep Cycle Type Batteries are used. For detailed technical information on types, construction, specifications, sizing, connections and charging / discharging of Lead Acid Batteries, **please read online White Paper titled "Batteries, Chargers and Alternators"**.

4.6.3 DC Input Power Terminals

Custom made DC input terminals using M9 Nut / Bolt arrangement have been provided for connecting DC input cables (11, 12 in Fig 3.1). The terminals are protected by plastic covers (11A, 12A in Fig 3.1).

4.6.4 Important Wiring/Cabling Information

Although wires and cables are good conductors of electric current, they do have some resistance, which is directly proportional to the length and inversely proportional to the thickness (diameter) i.e. resistance increases in thinner and longer wires. Current flowing through resistance produces heat. Cables and wires are covered with insulating material that can withstand a specified temperature of the conductor under specified conditions. To ensure that the insulation is not damaged due to excessive overheating, each wire size has a maximum allowable current carrying capacity called "Ampacity" which is

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specified by NEC Table 31.15 (B) (17). Further, NEC also specifies that wire size should be based on Ampacity - 1.25 times the rated current flow.

Resistance of wires and cables produces another undesirable effect of voltage drop. Voltage drop is directly proportional to the resistance and the value of current flow. Voltage drop produces loss of power in the form of heat. In addition, excessive voltage drop from the battery to the Inverter may prematurely shut down the Inverter due to activation of the Low Input Voltage Protection Circuitry of the inverter ($10.5 \pm 0.5V$). DC cables should be sized to ensure maximum voltage drop is limited to less than 5%.

4.6.5 Effects of Low Voltage on Common Electrical Loads:

Lighting Circuits – Incandescent and Quartz/Halogen: Loss in light output because the bulb not only receives less power, but the cooler filament drops from white-hot towards red-hot, emitting much less visible light.

Lighting Circuits – Fluorescent: Voltage drop causes an early proportional drop in light output.

AC Induction Motors: These are commonly found in power tools, appliances, etc. They exhibit very high surge demands when starting. Significant voltage drop in these circuits may cause failure to start and possible motor damage.

4.6.6 Requirement of Fuse in Battery Connection

A battery is a very large source of current. If there is a short circuit along the length of the cables that connect the battery to the unit, thousands of Amperes of current can flow from the battery to the point of shorting and that section of the cable will overheat, the insulation will melt and is likely to cause fire. To prevent occurrence of hazardous conditions under short circuit, fuse with Ampere rating ≥ 1.25 times the maximum continuous current drawn by the inverter but \leq the Ampacity of the connecting cable should be used for battery connection. The fuse should be fast acting Class-T or Marine Rated Battery Fuse Type MRBF. Rating of fuse is shown in Table 4.1 below. The fuse should be installed as close to the Battery Positive terminal as possible, preferably within 7". Please note that this fuse is required to protect the cable run from the battery to the unit against short circuit. The unit has its own internal DC side fuses for internal DC side protection.

4.6.7 Making DC Side Connections

Recommended cable and fuse sizes for connecting battery are given in Table 4.1.

The maximum current for cable sizing / fuse rating has been considered at 1.25 times rated continuous current draw at the rated output power.

Table 4.1 Recommended Cable and Fuse Sizes for Battery Connection

Rated DC Input Current	1.25 Times Rated Current for Sizing	Cable Size ¹ (Ampacity)	Max Fuse Size ²	Distance between Inverter, Battery and % Voltage Drop ³			Samlex Fuse (Optional)	Samlex Cable + Fuse Kit (Optional)
				3 ft.	6 ft.	10 ft.		
150A	187.5A	AWG#2 (215A)	200A	1.2%	2.3%	3.8%	DC-FA-200	DC-2000-KIT

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NOTES:

1. Cable Size

- As per NEC, size is based on Ampacity ≥ 1.25 times the rated DC Input Current
- Conductor / Insulation rating : 105 °C

2. Fuse Size

- Type: Class-T or Marine Rated Battery Fuse (MRBF)
- The rating of the fuse should not exceed the Ampacity of the Cable

3. Distance between Inverter and Battery and % Voltage Drop

- Voltage drop is calculated based on length of cable = $2 \times$ Distance to consider total length of Positive and Negative cables
- % drop is calculated with respect to rated battery voltage of 12.5V



CAUTION!

- Please ensure that the recommended external fuse specified in Table 4.1 above (Fuse is not supplied) is installed in series with the Positive cable and is as close to the Battery (+) terminal as possible (preferably within 7”).
- Please ensure that all the connections are tight. Loose connections may cause overheated wires and melted insulation.

4.6.8 Connecting Batteries

Series Connection

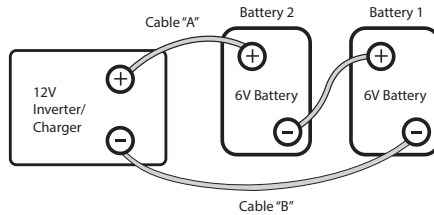


Fig. 4.2 Series Connection

When two or more batteries are connected in series, their voltages add up but their Ah capacity remains the same. Fig. 4.2 above shows 2 pieces of 6V, 200 Ah batteries connected in series to form a battery bank of 12V with a capacity of 200 Ah. The Positive terminal of Battery 2 becomes the Positive terminal of the 12V bank. The Negative terminal of Battery 2 is connected to the Positive terminal of Battery 1. The Negative terminal of Battery 1 becomes the Negative terminal of the 12V battery bank.

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Parallel Connection

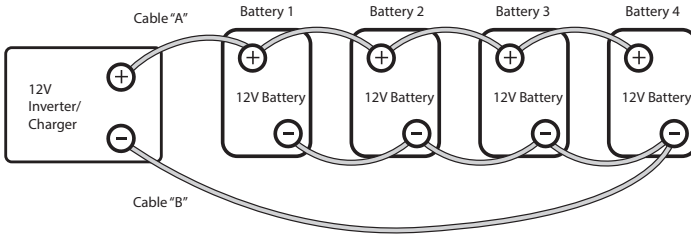


Fig. 4.3 Parallel Connection

When two or more batteries are connected in parallel, their voltage remains the same but their Ah capacities add up. Fig. 4.3 above shows 4 pieces of 12V, 100 AH batteries connected in parallel to form a battery bank of 12V with a capacity of 400 Ah. The four Positive terminals of Batteries 1 to 4 are paralleled (connected together) and this common Positive connection becomes the Positive terminal of the 12V bank. Similarly, the four Negative terminals of Batteries 1 to 4 are paralleled (connected together) and this common Negative connection becomes the Negative terminal of the 12V battery bank.

Series – Parallel Connection

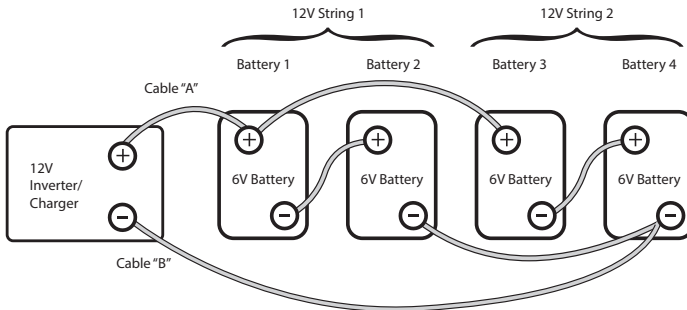


Fig. 4.4 Series-Parallel Connection

Figure 4.4 above shows a series – parallel connection consisting of four 6V, 200 Ah batteries to form a 12V, 400 Ah battery bank. Two 6V, 200 Ah batteries, Batteries 1 and 2 are connected in series to form a 12V, 200 Ah battery (String 1). Similarly, two 6V, 200 Ah batteries, Batteries 3 and 4 are connected in series to form a 12V, 200 Ah battery (String 2). These two 12V, 200 Ah Strings 1 and 2 are connected in parallel to form a 12V, 400 Ah bank.



CAUTION!

When 2 or more batteries / battery strings are connected in parallel and are then connected to an Inverter Charger (See Figs. 4.3 and 4.4 given above), attention should be paid to the manner in which the Inverter Charger is con-

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nected to the battery bank. Please ensure that if the Positive output cable of the Inverter Charger (Cable "A") is connected to the Positive battery post of the first battery (Battery 1 in Fig. 4.3) or to the Positive battery post of the first battery string (Battery 1 of String 1 in Fig. 4.4), then the Negative output cable of the Inverter Charger (Cable "B") should be connected to the Negative battery post of the last battery (Battery 4 as in Fig. 4.3) or to the Negative Post of the last battery string (Battery 4 of Battery String 2 as in Fig. 4.4). This connection ensures the following:

- The resistances of the interconnecting cables will be balanced.
- All the individual batteries / battery strings will see the same series resistance.
- All the individual batteries will charge at the same charging current and thus, will be charged to the same state at the same time.
- None of the batteries will see an overcharge condition.

If the Positive output cable of the Inverter Charger (Cable "A") is connected to the Positive battery post of the first battery (Battery 1 in Fig. 4.3) or to the Positive battery post of the first battery string (Battery 1 of String 1 in Fig. 4.4), and the Negative output cable of the Inverter Charger (Cable "B") is connected to the Negative battery post of the first battery (Battery 1 as in Fig. 4.3) or to the Negative Post of the first battery string (Battery 1 of Battery String 1 as in Fig. 4.4), the following abnormal conditions will result:

- The resistances of the connecting cables will not be balanced.
- The individual batteries will see different series resistances.
- All the individual batteries will be charged at different charging current and thus, will reach fully charged state at different times.
- The battery with lower series resistance will take shorter time to charge as compared to the battery which sees higher series resistance and hence, will experience over charging and its life will be reduced.

4.6.9 Sizing Inverter Battery Bank

The following basic rules are used to determine the size of the battery bank:

- Active Power in Watts (W) =
Voltage in Volts (V) x Current in Amperes (A) x Power Factor **Formula 1**
- For an Inverter running from a 12V battery system,
the DC current required from the 12V batteries is the
AC power delivered by the inverter to the load in Watts (W)
divided by 10 **Formula 2**
- Energy required from the battery =
DC current to be delivered (A) x time in Hours (H) **Formula 3**
- As a Rule of Thumb, Ah capacity of the batteries required =
2 x Energy required from the battery **Formula 4**

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An example of this calculation for a 12V Inverter is given below:

Let us say that the total continuous AC Watts delivered by the 12V Inverter = 1500W.

Then, using Formula 2 above, the DC current to be delivered by the 12V batteries = $1500W \div 10 = 150$ Amperes.

Next, the energy required by the load in Ampere Hours (Ah) is determined:

For example, if the load is to operate for 3 Hours, then as per Formula 3 above, the energy to be delivered by the 12V batteries = 150 Amperes \times 3 Hours = 450 Ampere Hours.

Finally, as per Rule of Thumb at Formula 4, the Ah capacity of the batteries should be twice the energy required by the load in Ah = 450 Ah \times 2 = 900 Ah.

4.7 AC SIDE CONNECTIONS

Feeding Grid AC Power - Use as Backup AC Power Source

- Power cord with NEMA5-15 Plug (10A, B in Fig 3.1) is used to feed AC input power to the unit when the unit is used as a Backup AC Power Source.
- Use 15A/20A, GFCI protected AC outlet for this connection.

Connecting AC Loads

Connect the AC loads to the NEMA5-5R outlet(s) (1, Fig 3.1).



CAUTION!

1. Do not connect the AC output of the unit to AC distribution wiring where the Neutral is bonded to Ground. The inverter will see this as abnormal condition of Ground Fault and will shut down.
2. The AC output of this unit can not be used in parallel with another AC Power Source – SEVERE DAMAGE WILL OCCUR!

4.8 LIMITING ELECTRO-MAGNETIC INTERFERENCE (EMI)

This unit contains internal switching devices that generate conducted and radiated electromagnetic interference (EMI). The EMI is unintentional and cannot be entirely eliminated. The magnitude of EMI is, however, limited by circuit design to acceptable levels to provide reasonable protection against harmful interference. This unit can conduct and radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. The effects of EMI will also depend upon a number of factors external to the unit like proximity of the unit to the EMI receptors, types and quality of connecting wires and cables etc. EMI due to factors external to the unit may be reduced as follows:

- Ensure that the unit is firmly grounded to the ground system of the building or the vehicle.
- Locate the unit as far away from the EMI receptors like radio, audio and video devices as possible.
- Keep the DC side wires between the battery and the unit as short as possible.

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- Do not keep the battery wires far apart. Keep them taped together to reduce their inductance and induced voltages. This reduces ripple in the battery wires and improves performance and efficiency.
- Shield the DC side wires with metal sheathing / copper foil /braiding: - Use coaxial shielded cable for all antenna inputs (instead of 300 ohm twin leads) - Use high quality shielded cables to attach audio and video devices to one another.
- Limit operation of other high power loads when operating audio/video equipment.

4.9 BUZZING SOUND IN AUDIO SYSTEMS

Some inexpensive sound stereo systems and “Boom Boxes” may emit a buzzing sound from their speakers when operated from this unit. This is likely to occur because the power supply in the electronic device does not adequately filter higher frequency harmonics generated by Modified Sine Wave produced by this unit. The solution is to use higher quality sound system that incorporates higher quality of interference suppression in its power supply.

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5.1 OPERATING MODES



INFO

Please note that Transfer Relay K1 is a Single Pole Double Throw (SPDT) type of a relay. Hence, during switching from the Grid to the Inverter and vice versa, the Transfer Relay K1 switches only the Line connection of the AC outlets. The Neutral conductor of the Grid AC input and the Inverter Section are common and are NOT switched.

5.1.1 Inverter/Charger Mode

This is the Main Operating Mode. In this mode, the unit is fed with 12V battery power on the DC input side and with 120VAC, 60Hz Grid AC power on the AC input side. The unit could be operating in the following sub-modes:

- (i) **Battery Charger / Grid Pass through Mode:** As long as 120V Grid AC power is available, the unit operates in this mode as follows:
- Inverter Section will be in OFF condition. Green LED “INVERTER” (8, Fig 3.1) will be OFF
 - Battery Charger Section will be in ON condition. Green LED “CHARGER” (7, Fig 3.1) will be ON. It will provide 2-Stage Charging of the 12V Lead Acid Battery at up to 15A at Float voltage of 13.8V (See Section 2.5.2 for details)

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- Transfer Relay K1 will be in de-energized condition, and through its normally closed (NC) contacts, the Line Sockets of the AC outlets will be connected to the Line conductor of Grid input for Grid pass-through.
- Ground Switching Relay K2 will also be in de-energized condition and through its Normally Closed (NC) contacts, the Grounding Sockets of the two AC outlets will be connected to the metal chassis of the unit

(ii) **Inverter Mode:** If the incoming Grid input fails or if the breaker / switch supplying the Grid AC outlet is switched OFF, the unit transfers to Inverter Mode. The following is carried out as soon as Grid power failure is detected:

- Battery Charging Section will switch OFF and Green LED "CHARGER" (7, Fig 3.1) will also switch OFF. The battery will start discharging at current = Power of AC load(s) in Watts \div 10
- Starting of the Inverter will be initiated. Green LED marked "Inverter" (8, Fig 3.1) will be switched ON.
- Within a time delay of 2 to 3 sec from the time the Grid AC input failed:
 - Transfer Relay K1 will be energized, its Normally Open(NO) will close and will transfer connection of the Line Sockets of the AC outlets from Line conductor of the Grid input to the Line conductor of the Inverter output
 - Ground Switching Relay K2 will also be energized, its Normally Opened (NO) contacts will close and the Grounding Sockets of the two NEMA5-15R AC outlets (10, Fig 3.1) will get disconnected from the metal chassis of the unit and get connected to the internal GFCI circuitry

5.1.2 Stand-alone Battery Charger Mode / Grid AC Pass-through Mode

In this mode, the unit is used just as a stand-alone battery charger with additional ability to pass-through Grid AC to the AC loads, if desired. The unit is fed with 12V battery power on the DC input side and with 120VAC, 60Hz Grid AC power on the AC input side. The Inverter is kept in OFF condition by keeping the Inverter ON/OFF switch "INVERTER" (3, Fig 3.1) in OFF position.

As long as 120V Grid AC power is available, the unit operates in this mode as follows:

- Inverter Section will be in OFF condition. Green LED "INVERTER" (8, Fig 3.1) will be OFF
- Switch ON the Battery Charger Section by switching the Battery Charger ON/OFF Switch (2, Fig 3.1) to ON condition. Green LED "CHARGER" (7, Fig 3.1) will be ON. It will provide 2-Stage Charging of the 12V Lead Acid Battery at up to 15A at Float voltage of 13.8V (See Section 2.5.2 for details)
- Transfer Relay K1 will be in de-energized condition, and through its normally closed (NC) contacts, the Line Sockets of the AC outlets will be connected to the Line conductor of Grid input for Grid pass-through.
- Transfer Relay K2 will also be in de-energized condition and through its Normally Closed (NC) contacts, the Grounding Sockets of the two AC outlets will be connected to the metal chassis of the unit

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5.1.3 Stand-alone Inverter Mode

In this mode, the unit is used just as a stand-alone inverter. The unit is fed with 12V battery power on the DC input side. The AC input cord is NOT connected to Grid AC outlet. The position of the Charger ON/OFF switch "CHARGER" (2, Fig 3.1) does not matter

The unit operates as follows:

- As there is no AC input from the Grid, the Charger Section will be in OFF condition. Green LED "CHARGER" (7, Fig 3.1) will be OFF
- Switch ON the Inverter Section by switching ON the Inverter ON/OFF Switch "INVERTER" (3, Fig 3.1) to ON position. Green LED "INVERTER" (8, Fig 3.1) will be ON. 115V, 1500W power will be available at the AC outlets
- Transfer Relay K1 will be energized, its Normally Open(NO) will close and will connect the Line Sockets of the AC outlets to the Line conductor of the Inverter output
- Ground Switching Relay K2 will also be energised, its Normally Opened (NO) contacts will close and the Grounding Sockets of the two AC outlets will get connected to the internal GFCI circuitry

5.2 SIZING CHART FOR TYPICAL LOADS THAT REQUIRE HIGH STARTING SURGE

Certain types of AC loads described in Table 5.1 below will require higher starting surge power as compared to their running power.

The manufacturers' specifications for power rating of appliances and devices indicate only the Running Power required. The Surge Power required by some specific types of devices as explained above has to be determined by actual testing or by checking with the manufacturer. This may not be possible in all cases and hence, can be guessed at best, based on some general Rules of Thumb.

Table 5.1 lists some common loads that require high surge power on start up. A "Sizing Factor" has been recommended against each which is a Multiplication Factor to be applied to the rated running Watt rating of the load to arrive at the Continuous Power Rating of the inverter (**Multiply the running Watts of the device/ appliance by the Sizing Factor to arrive at the size of the inverter**).

Table 5.1 Inverter Sizing Factor

Type of Device or Appliance	Inverter Sizing Factor ¹
Air Conditioner / Refrigerator / Freezer (Compressor based)	5
Air Compressor	4
Sump Pump / Well Pump / Submersible Pump	3
Dishwasher / Clothes Washer	3
Microwave (where rated output power is the cooking power)	2
Furnace Fan	3
Industrial Motor	3

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Type of Device or Appliance	Inverter Sizing Factor ¹
Portable Kerosene / Diesel Fuel Heater	3
Circular Saw / Bench Grinder	3
Incandescent / Halogen / Quartz Lamps	3
Laser Printer / Other Devices using Quartz Lamps for heating	4
Photographic Strobe / Flash Lights ²	4

NOTES FOR TABLE 5.1

1. Multiply the Running Active Power Rating {Watts} of the appliance by this Factor to arrive at the Continuous Power Rating of the inverter for powering this appliance.
2. For Photographic Strobe / Flash Unit, the surge power of the inverter should be > 4 times the Watt Sec rating of photographic strobe / flash unit

5.3 CONNECTION AND OPERATION – INVERTER/CHARGER MODE

Please refer to Section 5.1.1 for description of this mode

5.3.1 Connection and Switching ON Procedure:

1. Make sure that the maximum single / combined AC side load is less than 1500W. Please refer to the Sizing Chart at Table 5.1 for guidance
2. Disconnect all AC side loads
3. Switch OFF the Inverter using the Inverter ON/OFF Switch “INVERTER” (3, Fig 3.1)
4. Switch OFF the Battery Charger using the Battery Charger ON/OFF Switch “CHARGER” (2, Fig 3.1)
5. Connect 12V batteries to the Battery Terminals (11, 12 in Fig 3.1)
6. As the Inverter ON/OFF Switch “INVERTER” (3, Fig 3.1) is in OFF position, the following will be seen:
 - The Inverter will be in OFF condition
 - The Green LED “INVERTER” (8, Fig 3.1) will be OFF
 - Transfer Relay K1 will be in de-energized condition and, through its normally closed (NC) contacts, the Line Sockets of the AC outlets will be connected to the Line conductor of Grid input for AC pass-through.
 - Ground Switching Relay K2 will also be in de-energised condition and, through its normally closed (NC) contacts, the Grounding Sockets of the two AC outlets will be connected to the metal chassis of the unit
7. Switch ON the Inverter using ON/OFF Switch “INVERTER” (3, Fig 3.1).
 - Transfer Relay K1 will be energized, its normally open (NO) contacts will close and will transfer connection of the Line Sockets of the AC outlets from Line Conductor of the Grid input to the Line conductor of the Inverter output.
 - Ground Switching Relay K2 will also be energized, its Normally Opened (NO) contacts will close and the Grounding Sockets of the two AC outlets will get disconnected from the metal chassis of the unit and get connected to the internal GFCI circuitry

SECTION 5 | Operation

- The unit will start operating in Inverter Mode. The Inverter will switch ON and will provide 115VAC to the AC outlets.
 - The Green LED "Inverter" (8, Fig 3.1) will be switched ON
 - The 2 cooling fans will switch ON momentarily for around 6 seconds and then switch OFF if the load connected to the AC outlets is less than 85W. The fans are load controlled and will be switched ON automatically when the AC load in the Inverter Mode is more than 85W
8. Wait for a few minutes and then Switch ON the AC side load(s). If more than one load is used, switch ON one by one so that starting surges are staggered to prevent overload shut down.
- If the AC load is more than 85W, the 2 cooling fans will switch ON
9. Under normal operation, the AC load(s) will be powered from the Inverter. In case any abnormal operation is observed, refer to Troubleshooting Guide in Table 6.1 – Section 6.
10. Plug the AC input cord to the 120 VAC, 15A GFCI protected Grid AC outlet.
11. As soon as Grid input is detected, the Inverter will be switched OFF, 115VAC output will be cut-off from the AC outlets and the Green LED "INVERTER" (8, Fig 3.1) will be switched OFF. **NOTE: This Green LED will NOT be switched OFF immediately but will dim slowly and extinguish fully in around 1 minute**
12. Within 1 sec from the time the Grid power is detected, the following will be initiated:
- Transfer Relay K1 will be de-energized, and through its normally closed (NC) contacts, the connection of the Line Sockets of the AC outlets will be transferred from the Line conductor of the Inverter to the Line Conductor of the Grid input for Grid pass-through.
 - Transfer Relay K2 will also be de-energized and through its Normally Closed (NC) contacts, the Grounding Sockets of the two AC outlets will be transferred from the internal GFCI circuitry to the metal chassis of the unit
13. Switch ON the Battery Charger using ON/OFF Switch "CHARGER" (2, Fig 3.1).
- Green LED "CHARGER" (7, Fig 3.1) will be switched ON. The battery will start getting charged as described in Section 2.5.2
 - The 2 cooling fans will switch ON for a short duration of around 6 sec and then switch OFF. These fans are load controlled and will switch ON automatically when the charging current is more than $3 \pm 1A$
14. When Grid power fails or if the breaker / switch supplying Grid power to the Grid AC outlet is switched OFF, the unit will transfer to Inverter Mode. The following actions will be carried out on transfer to this Mode:
- As soon as Grid power failure is detected, starting of the Inverter is initiated. Green LED "INVERTER" (8, Fig 3.1) is switched ON.
 - Within a time delay of 2 to 3 sec from the time the Grid AC failed:
 - Transfer Relay K1 will be energized, its Normally Open(NO) will close and will transfer connection of the Line Sockets of the AC outlets from Line conductor of the Grid input to the Line conductor of the output of the Inverter

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- Ground Switching Relay K2 will also be energised, its Normally Opened (NO) contacts will close and the Grounding Sockets of the two AC outlets will get disconnected from the metal chassis of the unit and get connected to the internal GFCI circuitry
- The Battery Charger will switch OFF. Green LED "CHARGER" (7, Fig 3.1) will also be switched OFF
- The battery will start discharging at current = Power of AC load(s) in Watts ÷ 10

5.3.2 Switching OFF Procedure:

1. Switch OFF the Charger using ON/OFF Switch marked "Charger" (2, Fig 3.1)
2. Switch OFF the load(s)
3. Switch OFF the Inverter using ON/OFF Switch marked "Inverter" (3, Fig 3.1)
4. Disconnect AC input Power Cord

5.4 CONNECTION AND OPERATION AS STAND-ALONE INVERTER

Please refer to Section 5.1.3 for description of this mode

1. As battery charging / Grid AC pass-through is not used in this mode, do not connect the AC input cord to Grid AC outlet
2. Make sure that the maximum single / combined AC side load is less than 1500W. Please refer to the Sizing Chart at Table 5.1 for guidance
3. Disconnect all AC side loads
4. Switch OFF the Inverter using the Inverter ON/OFF Switch "INVERTER" (3, Fig 3.1)
5. Switch OFF the Battery Charger using the Battery Charger ON/OFF Switch "CHARGER" (2, Fig 3.1)
6. Connect 12V batteries to the Battery Terminals (11, 12 in Fig 3.1)
7. As the Inverter ON/OFF Switch "INVERTER" (3, Fig 3.1) is in the OFF position, the following will be seen:
 - The Inverter will be in OFF condition
 - The Green LED "INVERTER" (8, Fig 3.1) will be in OFF condition
 - Transfer Relay K1 will be in de-energized condition and its Normally Closed (NC) contacts will connect the Line Sockets of the AC outlets to the Grid AC input (if available)
 - Ground Switching Relay K2 will also be in de-energised condition and, through its Normally Closed (NC) contacts, the grounding sockets of the two AC outlets will be connected to the metal chassis of the unit
8. **Switching ON the Inverter:** Switch the Inverter ON/OFF Switch "INVERTER" (3, Fig 3.1) to ON position
 - Transfer Relay K1 will be energized, its Normally Open (NO) contacts will close and will transfer the connection of the Line Sockets of the AC outlets from the Line conductor of the Grid input to the Line conductor of the output of the Inverter

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- Ground Switching Relay K2 will also be energised, its Normally Opened (NO) contacts will close and the Grounding Sockets of the two NEMA5-15R AC outlets (10, Fig 3.1) will get disconnected from the metal chassis of the unit and get connected to the internal GFCI circuitry
 - The Inverter will switch ON and will provide 115VAC to the AC outlets.
 - The Green LED "INVERTER" (8, Fig 3.1) will be switched ON
 - The 2 cooling fans will switch ON for a short duration for around 6 seconds and then switch OFF if the load connected to the AC outlets is less than 85W. The fans are load controlled and will be switched ON automatically when the AC load in the Inverter Mode is more than 85W
9. Wait for a few minutes and then Switch ON the AC side load(s). If more than one load is used, switch ON one by one so that starting surges are staggered to prevent overload shut down.
- If the AC load is more than 85W, the 2 cooling fans will switch ON
10. Under normal operation, the load(s) will be powered from the Inverter. In case any abnormal operation is observed, refer to Troubleshooting Guide in Table 6.1 – Section 6.
11. **Switching OFF the Inverter:** Switch the Inverter ON/OFF Switch "INVERTER" (3, Fig 3.1) to OFF position.
- 115VAC output will be switched OFF.
 - The Green LED "INVERTER" (8, Fig 3.1) will NOT be switched OFF immediately but will dim slowly and extinguish fully in around 1 minute

5.5 CONNECTION AND OPERATION AS STAND-ALONE BATTERY CHARGER WITH PASS THROUGH

Please refer to Section 5.1.2 for description of this mode

1. Disconnect all AC side loads
2. Switch OFF the Inverter using the Inverter ON/OFF Switch "INVERTER" (3, Fig 3.1)
NOTE: In this application of just a stand-alone battery charger, the Inverter is NOT used and this switch will always be in OFF condition
3. Switch OFF the Battery Charger using the Battery Charger ON/OFF Switch "CHARGER" (2, Fig 3.1)
4. Connect 12V batteries to the Battery Terminals (11, 12 in Fig 3.1)
5. As the Inverter ON/OFF Switch "INVERTER" (3, Fig 3.1) is in the OFF position, the following will be seen:
 - The Inverter will be in OFF condition
 - The Green LED marked "INVERTER" (8, Fig 3.1) will be in OFF condition
 - Transfer Relay K1 will be in de-energised condition and its normally closed (NC) contacts will connect the Line Sockets of the AC outlets to the Line conductor of the Grid AC input (if available)
 - Ground Switching Relay K2 will also be in de-energised condition and, through its Normally Closed (NC) contacts, the grounding sockets of the two NEMA5-15R AC outlets (10, Fig 3.1) will be connected to the metal chassis of the unit

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6. Plug the AC input cord to the 120 VAC, 15A GFCI protected Grid AC outlet.
7. **Switching ON the Battery Charger:** Switch the Battery Charger ON/OFF Switch "CHARGER" (2, Fig 3.1) to ON position.
8. The Battery Charger will switch ON and start charging the batteries.
9. The Green LED "CHARGER" (7, Fig 3.1) will be switched ON
10. The 2 cooling fans will switch ON for a short duration of around 6 sec and then switch OFF. These fans are load controlled and will switch ON automatically when the charging current is more than $3 \pm 1A$
11. **Switching OFF the Battery Charger:** Switch the Battery Charger ON/OFF Switch "CHARGER" (2, Fig 3.1) to OFF position.
12. The Battery Charger will switch OFF and stop charging the batteries.
13. The Green LED marked "Charger" (7, Fig 3.1) will be switched OFF

SECTION 6 | Protections, Monitoring & Troubleshooting

6.1 PROTECTIONS AND MONITORING IN INVERTER MODE

NOTE: Please refer to Table 6.1 for status of monitoring LEDs and Buzzer for various protections / operational conditions explained below.

6.1.1 Load Controlled Cooling Fan

Cooling is carried out by convection and by forced air circulation by 2 load-controlled fans. The fans will normally be OFF and will be switched ON automatically as follows:

- Inverter supplying AC load(s): When load(s) $\geq 85W$
- Battery Charging/AC Pass Through Mode: When charging current $\geq 3A \pm 1A$

This will reduce energy consumption by the fan and will increase overall efficiency.

6.1.2 Over Temperature Protection

As explained above, the unit is cooled by load-controlled fans - will switch ON at load $> 85W$ or when charging current is $> 3A \pm 1A$. In case the fan(s) fail or if the cooling is inadequate due to higher ambient temperature or restricted airflow, the temperature of hot spot inside the Inverter will exceed the safe temperature threshold of $88^{\circ}C$ to $115^{\circ}C$ and the Inverter will automatically shut down. Yellow LED "INPUT FAULT" (6, Fig 3.1) will be lighted and Green LED "INVERTER" (8, Fig 3.1) will switch OFF. The Inverter will reset automatically when the hot spot cools down by $10^{\circ} - 15^{\circ}C$ below the above threshold.

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6.1.3 Low Battery Voltage Protection

This condition is not harmful to the Inverter but could damage the 12V battery. The Inverter automatically shuts down when input voltage drops to $10.5 \pm 0.3V$. The Yellow LED "INPUT FAULT" (6, Fig 3.1) will be lighted and the Green LED "INVERTER" (8, Fig 3.1) will switch OFF. The unit will reset automatically when the battery voltage rises to $11.7 \pm 0.3V$.

6.1.4 Over Voltage Protection

The Inverter will automatically shut down when the input voltage exceeds $15.5 V \pm 0.2V$. The Yellow LED "INPUT FAULT" (6, Fig 3.1) will be lighted and the Green LED "INVERTER" (8, Fig 3.1) will be switched OFF. The unit will reset automatically when voltage drops to 15.0V. Input voltage exceeding 16 volts could damage the inverter.

6.1.5 Overload / Short Circuit Protection

The Inverter will automatically shut down under (i) short circuit and (ii) continuous overload of 110% (1650W). Red LED "FAULT" (9, Fig 3.1) will be lighted and Green LED "INVERTER" (8, Fig 3.1) will be ON. The unit will latch in shut down condition. To reset, switch OFF the inverter ON/OFF Switch (3, Fig 3.1), wait for 3 minutes and switch ON again.



INFO

Some high capacitive loads like Compact Fluorescent Lamp (CFL) or Switched Mode Power Supply (SMPS) will draw very high inrush current due to very fast voltage rise of the square wave nature of the Modified Sine Wave and shut down the inverter. Try using a small resistive load in parallel to reduce high inrush current to prevent overloading.

6.1.6 Low Input Voltage Alarm

An alarm will sound when the voltage at the input terminals of the Inverter drops to $10.8V \pm 0.3V$. This is an indication that either the battery terminal voltage has dropped due to its discharged condition and needs to be re-charged or there is an excessive voltage drop across the cables connecting the Inverter to the battery (due to use of thinner and longer length of cables that will produce higher voltage drop at higher loads or due to loose connections). The user should stop operation of the electronic device at this time since the Inverter will shut down automatically shortly thereafter, when the input voltage at the Inverter further drops to $10.5V \pm 0.3V$.



INFO

It is normal for the alarm to sound while the unit is being connected to or disconnected from the power source. This is not indicative of a problem.

6.1.7 Ground Fault Protection - General

Due to loss of insulation as a result of aging of insulating materials, accident or malfunction, voltage source inside an electrical device can come into contact with its metal chassis. If the energized metal chassis is touched by a person standing on Earth Ground (consid-

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ered to be at 0V), the person will get a shock due to current leaked through the body to Earth Ground (called Leakage Current). Such condition is called "Ground Fault" / "Leakage". As this Leakage Current is diverted to Earth Ground, it does not return to the electrical power source supplying the AC device. Severity of electrical shock will depend upon the value of the fault voltage on the metal chassis and the impedance in the current path to Earth Ground, primarily the impedance of the human body (100 k Ω when dry and 1 k Ω when wet). Human body can tolerate leakage current of up to 5ma for 15 to 30 msec.

6.1.7.1 Ground fault protection in Inverter Mode:

- The Grounding Sockets of the NEMA5-15R AC outlets (1, Fig 3.1) are connected to the internal GFCI circuitry through energized condition of Ground Switching Relay K2.
- The Line and Neutral Sockets of the NEMA5-15R AC outlets (1, Fig 3.1) are isolated from their Grounding Sockets. Thus, the metal chassis of the inverter and the AC loads will also be isolated from the Line and Neutral conductors.
- The Grounding Sockets of the NEMA5-15R AC outlets are connected to the input section of the Electronic Ground Fault Protection Circuit on the power circuit board.
- **Due to the above implementation, the voltages on the Line and Neutral sockets of NEMA5-15R Outlets (1, Fig 3.1) with respect to the Grounding Sockets will be pulsing DC voltage with average DC value of up to 50 VDC (will read 75 VAC on the AC scale of the Voltmeter because of pulsing nature of DC Voltage). DO NOT touch the Line / Neutral Sockets!**
- If there is a short circuit between the Line / Neutral to metal chassis in the Inverter / load, up to 75V AC will be fed to the Electronic Ground Fault Protection Circuit and the AC output of the Inverter will shut down.
- **Ground Fault protection will also operate if the Neutral and Ground of the NEMA5-15R AC outlets of the inverter are connected (bonded) intentionally like in Service Entrance / Load Center for AC distribution wiring.**



CAUTION!

Connecting the AC output of the unit to utility AC distribution wiring with Neutral to Ground connection (bond) is not permitted. In AC utility distribution wiring, the Neutral conductor is connected (bonded) to the Equipment Grounding Conductor at the Load Center / Service Entrance. Both these conductors are then bonded to the Earth Ground (Ground Rod). Thus, if the output of the Inverter is connected to the Grid AC distribution wiring, it will see a Neutral to Ground connection and the Inverter will trip due to activation of the Ground Fault Protection Circuit as explained above.

6.1.8 Failure to Start Some Devices on Load

Some high capacitance loads like Compact Fluorescent Lamp (CFL) or Switched Mode Power Supply (SMPS) will shut down the Inverter under overload condition if the Inverter is switched ON with these loads in ON condition. However, if these loads are switched OFF first and switched ON only after around 10 sec after the Inverter is switched ON (as already recommended under switching ON procedure), the Inverter may not shut down. Hence, do not switch ON the Inverter with such loads in ON condition.

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6.1.9 Monitoring of Operational Status & Protections - Inverter Mode

Normal / abnormal behavior can be monitored by observing Green LED "INVERTER" (8, Fig 3.1), Yellow LED "INPUT FAULT" (6, Fig 3.1), Red LED "FAULT" (9, Fig 3.1) and Buzzer. Details are given in Table 6.1 below:

Table 6.1 Protections and Monitoring: Inverter is Supplying Power

Operating Condition/Protection	Threshold/Reason	Green LED "INVERTER" (8, Fig 3.1)	Yellow LED "INPUT FAULT" (6, Fig 3.1)	Red LED "FAULT" (9, Fig 3.1)	Buzzer	Remedy/Reset
Normal	-	ON	OFF	OFF	OFF	-
Low DC input alarm	10.8V ± 0.3V	ON	OFF	OFF	ON	Check battery voltage and input voltage drop. Auto reset when voltage > 10.5 V ± 0.3V.
No output due to Low DC input voltage shutdown	10.5V ± 0.3V	OFF	ON	OFF	ON	Check battery voltage and input voltage drop. Auto reset when voltage rises to >11.5V.
No output due to high DC input voltage shut down	15.5V	OFF	ON	OFF	OFF	Check charger voltage. Auto reset when voltage < 15.5V.
No output due to high temperature shut down	Internal hot spot > 88°C to 115°C	OFF	ON	OFF	OFF	Check ambient temperature, fan and loss of cool replacement air. Auto reset when hot spot cools down 10°C to 15°C below the threshold.

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Table 6.1 Protections and Monitoring: Inverter is Supplying Power (continued)

Operating Condition/Protection	Threshold/Reason	Green LED "INVERTER" (8, Fig 3.1)	Yellow LED "INPUT FAULT" (6, Fig 3.1)	Red LED "FAULT" (9, Fig 3.1)	Buzzer	Remedy/Reset
No output due to over load shut down	Output power is > overload of 110%	ON	OFF	ON	OFF	<p>Check starting surge rating of load. If happens with low power CFL or SMPS, try adding small resistive load.</p> <p>If happens when Inverter is switched ON with high capacitance load already in ON condition, try switching ON the load 10 sec after the inverter has been switched ON.</p> <p>Manual Reset. Unit will latch in shut down condition. To reset, switch OFF the INVERTER ON/OFF Switch (3, Fig 3.1), wait for 3 minutes and switch ON again.</p>
No output due to Ground fault shut down	<p>(i) 5.8 mA leakage from Line / Neutral in the load to metal chassis of the load</p> <p>(ii) Neutral and Ground are bonded on the load size</p>	ON	OFF	ON	OFF	<p>(i) Check if there is Neutral to Ground bond or Ground Fault.</p> <p>(ii) Check there is no leakage / short from Line / Neutral in the load to chassis of the load.</p> <p>Manual Reset. Unit will latch in shut down condition. To reset, switch OFF the inverter ON/OFF Switch (3, Fig 3.1), wait for 3 minutes and switch ON again.</p>
No output	No DC input voltage due to blown DC Input Fuse	OFF	OFF	OFF	OFF	Check fuse in the 12V battery input line.

SECTION 6 | Protections, Monitoring & Troubleshooting

6.2 PROTECTIONS AND MONITORING IN CHARGER / GRID PASS THROUGH MODE

NOTE: Please refer to Table 6.2 for status of monitoring LEDs for various protections / operational conditions explained below:

In this mode, Grid AC Power is available, is being passed through to the Load(s) and Battery Charger is charging the batteries:

6.2.1 Overload / Short Circuit Protection in AC Load(s)

15A Breaker (4, Fig 3.1) in the AC Input Circuit of the unit provides protection against overload and short circuit in the AC loads when the unit is in Grid AC Power Pass Through Mode.

6.2.2 Overload / Short Circuit Protection in AC Input Circuit of Battery Charger

5A, 250V fuse (5, Fig 3.1) is provided in the AC input circuit of the Battery Charger to protect the Battery Charger against overload and short circuit.

6.2.3 Protection Against Ground Fault in AC Loads

AC input to the unit is required to be fed from 15A GFCI protected AC outlet of Grid AC Power. In case of Ground fault in the AC load(s), the GFCI in the 15A GFCI protected AC outlet of Grid AC Power will trip.

Table 6.2 Protections & Monitoring: Battery Charger / Grid AC Power Pass Through Mode

LED Display	Other Symptoms	Possible Cause(s)	Remedy
Green LED "CHARGER" (7, Fig 3.1) is ON	<ul style="list-style-type: none"> Charging is normal AC output voltage is not available 	Unit is in Grid Pass Through Mode but the 15A AC Input Breaker on the unit (4, Fig 3.1) has tripped due to continuous overload of > 15A or due to short circuit on the AC load side	<ul style="list-style-type: none"> Ensure that the maximum continuous load is < 15A Check and remove short circuit on the AC load side Reset the 15A breaker on the unit
Green LED "CHARGER" (7, Fig 3.1) is OFF	<ul style="list-style-type: none"> Charging has stopped Grid voltage is available at the power cord AC output is available 	<ul style="list-style-type: none"> Charging has stopped as Grid input voltage is > 143VAC Unit is still in Grid Pass Through Mode 	Charging will resume automatically when Grid AC input voltage drops to < 138VAC
		<ul style="list-style-type: none"> Charging has stopped as Grid input voltage is < 10VAC Unit is still in Grid Pass Through Mode 	Charging will resume automatically when Grid AC input voltage rises to > 75VAC

SECTION 6 | Protections, Monitoring & Troubleshooting

Table 6.2 Protections & Monitoring: Battery Charger / Grid AC Power Pass Through Mode (continued)

LED Display	Other Symptoms	Possible Cause(s)	Remedy
<ul style="list-style-type: none"> Green LED "CHARGER" (7, Fig 3.1) is OFF Green LED "INVERTER" (8, Fig 3.1) is ON 	<ul style="list-style-type: none"> Charger has stopped Grid voltage is available at the power cord AC output is available 	5A fuse (5, Fig 3.1) feeding the Charger Section has blown. As a result, Grid AC Input Detect Circuit in the Charger Section has detected Grid AC input failure resulting in transfer from Grid to Inverter	Replace 5A fuse (5, Fig 3.1). If fuse blows again, the Battery Charger Section is likely to be defective. Call Tech Support
	<ul style="list-style-type: none"> Charger has stopped Grid voltage is NOT available at the power cord AC output is available 	Grid has failed or the breaker / switch supplying input to the GFCI protected Grid AC outlet has tripped or has been switched OFF. As a result, Grid AC Input Detect Circuit in the Battery Charger Section has detected Grid AC input failure resulting in transfer from Grid to Inverter	Confirm if Grid has failed. If not, check if the breaker / switch supplying the GFCI protected Grid AC Outlet has tripped or has been switched OFF
<ul style="list-style-type: none"> Green LED "CHARGER" (7, Fig 3.1) is OFF Red LED "FAULT" (9, Fig 3.1) is ON 	<ul style="list-style-type: none"> Charger has stopped Grid voltage is NOT available at the power cord AC output is NOT available 	<p>There is leakage or Neutral to Ground bond on AC load side.</p> <ul style="list-style-type: none"> First, the GFCI protected AC outlet supplying Grid power will trip. As a result, Grid AC Input Detect Circuit in the Charger Section will detect Grid AC input failure resulting in transfer from Grid to Inverter Once the load is transferred from Grid to the Inverter, the Inverter will shut down due to leakage or Neutral to Ground bond on the load side 	<ul style="list-style-type: none"> Check for leakage / Neutral to Ground bond on the AC load side Reset the GFCI protected AC outlet supplying Grid power The Inverter Section will remain latched in OFF condition. To reset, switch OFF the Inverter ON/OFF Switch (3, Fig 3.1), wait for 3 minutes and switch ON again

SECTION 7 | Specifications

MODEL NO.	SAM-1500C-12
OUTPUT: INVERTER MODE	
CONTINUOUS ACTIVE OUTPUT POWER	1500W (Power Factor = 1)
MAXIMUM SURGE POWER	3000W (<4 millisecond; Power Factor = 1)
NOMINAL OUTPUT VOLTAGE	115 VAC, +10% / -5%
OUTPUT FREQUENCY	60 Hz ± 5%
EFFICIENCY	87% (@ 100% load)
INVERTER ON/OFF CONTROL	By front panel Switch
OUTPUT: GRID PASS THROUGH	
NOMINAL VOLTAGE, FREQUENCY OF GRID	120 VAC, 60 Hz
MAXIMUM POWER	1500W (Power Factor = 1; Battery fully charged)
INPUT: BATTERY	
BATTERY SYSTEM VOLTAGE	12V (10.5V to 15.5V ± 0.5V)
DC CURRENT DRAW FROM BATTERY AT 1500W OUTPUT POWER	150ADC at battery voltage of 12.5 VDC
DC NO LOAD CURRENT DRAW IN INVERTER MODE	0.65A to 0.85A
INPUT: GRID	
NOMINAL VOLTAGE, FREQUENCY	120 VAC, 60 Hz
MAXIMUM AC INPUT CURRENT	15A (Protected by 15A breaker supplying Grid input)
TRANSFER RELAY K1	
CURRENT RATING OF TRANSFER RELAY	30A
TRANSFER TIME FROM GRID TO INVERTER	2 to 3 seconds
TRANSFER TIME FROM INVERTER TO GRID	Up to 1 second
GROUND SWITCHING RELAY K2	
CURRENT RATING	12A
BATTERY CHARGER	
CHARGING ALGORITHM	2 Stage Charger - Bulk & Float
FLOAT VOLTAGE	13.8V ± 0.3V
BULK CHARGE/MAX. CHARGING CURRENT	15A
MAXIMUM AC INPUT CURRENT	< 5A at 120 VAC
AC INPUT POWER FACTOR	0.6
EFFICIENCY	80 ± 5%
VOLTAGE & CURRENT RATING OF FUSE	5 mm x 20 mm, Fast Acting Glass Tube Fuse 125V / 250V, 5A ; Bussman GMA-5 or equivalent
CHARGER ON/OFF CONTROL	By front panel Switch
PASS THROUGH MODE: LOAD SIDE	
OVERLOAD / SHORT CIRCUIT SHUTDOWN	Load >15A: Input Circuit Breaker on the unit will trip
PASS THROUGH MODE: CHARGER SECTION	
HIGH AC INPUT VOLTAGE SHUTDOWN	143 VAC. Auto reset at 138 VAC (No transfer to Inverter)
LOW AC INPUT VOLTAGE SHUTDOWN	< 10 VAC. Auto reset at > 75 VAC (No transfer to Inverter)
PROTECTIONS: INVERTER MODE	
OVERLOAD SHUTDOWN	> 1650 ± 10% for up to 7 sec
LOW BATTERY INPUT VOLTAGE ALARM	10.8 ± 0.3V
LOW BATTERY INPUT VOLTAGE SHUTDOWN	10.5 ± 0.3V ; Auto reset at 11.7 ± 0.3V
BATTERY (INPUT) OVER VOLTAGE SHUTDOWN	> 15.5V ; Auto reset at < 15.5V
COOLING - LOAD CONTROLLED FAN	Inverter Mode: ON at 85W ; Charging Mode: ON at charging current > 3A ± 1A
INVERTER OVER TEMPERATURE SHUTDOWN	Internal hot spot > 88° to 110°. Auto reset when hot spot cools down 10° to 15°C below the threshold
GROUND FAULT SHUTDOWN IN INVERTER MODE	Leakage > 5.8 mA. Manual reset
GROUND FAULT SHUTDOWN IN CHARGER / PASS THROUGH MODE)	GFCI of AC outlet supplying AC input will trip
DC INPUT REVERSE POLARITY	Fuse 240A (8 pcs. 30A Automotive Type ATC Fuses in parallel)
CONNECTIONS	
DC INPUT	Nut & Bolt, M9
AC INPUT / AC OUTPUT	6 foot cord with NEMA5-15P Plug / 2 x NEMA5-15R Outlets
GENERAL	
LED DISPLAY	GREEN "Inverter"; GREEN "Charger"; RED "Fault"; YELLOW "Input Fault"
OPERATING TEMPERATURE RANGE (MIN. TO MAX.)	0°C to 25°C / 32°F to 77°F at 100% loading ; 26°C to 35°C / 78.8°F to 95°F at 80% loading
OPERATING HUMIDITY	< 80% ; Non-condensing
DIMENSIONS (W X D X H)	202 x 345 x 84 mm / 7.95 x 13.58 x 3.30 in
WEIGHT	4.0 kg / 8.82 lb

NOTES:

1. All output power and efficiency specifications are at Power Factor = 1 and battery voltage = 12.5V
3. Specifications are subject to change without notice