samlexpower®

SAM Series Inverter / Charger

SAM-1500C-12

Owner's Manual

Please read this manual BEFORE installing your inverter

MANUAL | Index

SECTION 1 | Safety

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.
    - If you need to remove a battery, always remove the ground 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.

SECTION 1 | Safety

⚠ Caution!

1. Please ensure the following when using the unit as Backup AC Power Source (UPS)
   - That the Utility AC Power input is fed from 15A/20A GFCI protected outlet to provide Ground Fault Protection.
   - Do not ground using external Chassis Ground Connection (15, Fig 3.1). The unit gets grounded to the Earth Ground of the Utility Grounding System automatically through the Grounding Wire of the AC Input Power Cord (10A, B- Fig 3.1). Use of multiple Grounds is not desirable.
2. When the unit is being used as a stand-alone inverter (Utility AC Power input is not connected), 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 Terminals of the NEMA5-15R AC outlet with respect to the chassis of the inverter / 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 TERMINAL / NEUTRAL CONDUCTORS!**
4. Do not connect AC output from NEMA5-15R outlets(s) 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.
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

Info

For additional technical and operational information on Inverters, Battery Chargers and related topics, please refer to **www.samlexamerica.com/Support/Application Notes/ White Papers.**

This unit is a Modified Sine Inverter / Charger with a Transfer Relay with primary function of Backup AC Power Source or Off-Line AC UPS (Un-interruptible Power Supply). The unit consists of the following 3 component integrated into a single unit:

- Modified Sine Wave Inverter for AC back up when utility AC Power fails:
  - Input: 12V Nominal Lead Acid Battery (10.5V to 15.5V)
  - Output: 1500W (At Power Factor =1) at 115 VAC, 60Hz
- AC Battery Charger to charge batteries when Utility 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 Utility AC Power is available
  - Input: 120 VAC, 60Hz
  - Transfer Relay: 30A

The primary function of the unit is a 1500W, 120 VAC Backup AC Power Source or Off-Line AC UPS (Un-interruptible Power Supply) with combined operation of the Inverter, the Battery Charger and the Transfer Relay. Secondary functions can be a 1500W stand alone inverter OR a 15A, 12V stand alone Lead Acid Battery Charger.

Features

- Integrated 1500W Modified Sine Wave Inverter, 30A Transfer switch, and 2 Stage 12 VDC, 15A Battery Charger
- High inverter peak efficiency of 90%, 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 or UPS function
- 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
- Low Interference Technology for controlled RF noise
- Ideal for RV's, Trucks and remote housing

SECTION 2 | Features, Applications & Principle of Operation

Applications

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

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.

LOW INTERFERENCE TECHNOLOGY

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

COOL SURFACE TECHNOLOGY

Normally, heat dissipating components are mounted directly on internal metal chassis surface of the inverter and hence, the chassis surface may rise to unsafe touch-temperature. In this inverter, 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.

LOAD CONTROLLED COOLING FAN

Cooling is carried out by convection and by forced air circulation by 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) ≥ 85W
- Battery Charging/AC Pass Through Mode: When charging current ≥ 3A

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

SECTION 2 | Features, Applications & Principle of Operation

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 below).

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.

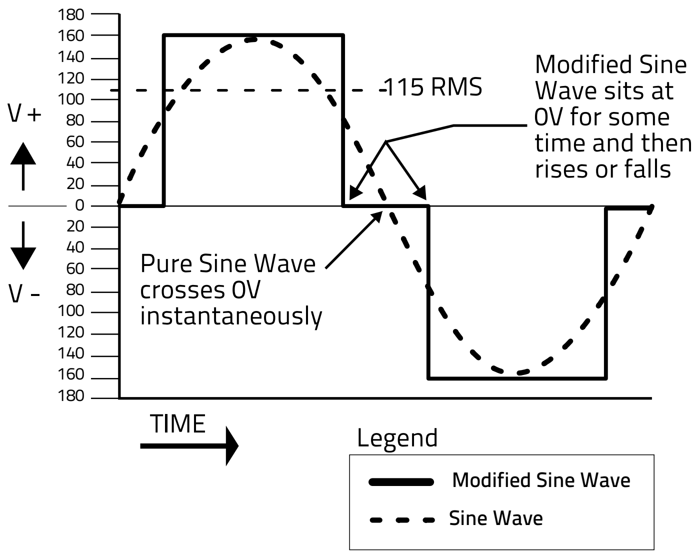


Fig 2.1 Modified Sine Wave and Pure Sine Wave - Comparison

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.**

SECTION 2 | Features, Applications & Principle of Operation

⚠ 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
- 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

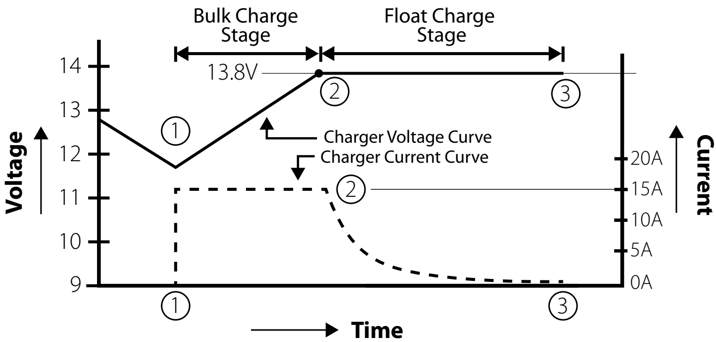
MEASURING MODIFIED SINE-WAVE VOLTAGE WITH A "TRUE RMS" VOLTMETER

As mentioned above, Modified Sine Wave voltage is a type of square wave that has an RMS (Root Mean Square) value of 115 VAC. 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.

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.

SECTION 2 | Features, Applications & Principle of Operation



LEGEND

1. Charging Starts

1 to 2. Bulk Charge Stage: Constant Current = 15A

2. Exits Bulk & Enters Float

2 to 3. Foat Stage: Constant Voltage = 13.8V
Current Tapers to 0.1% of Ah Capacity

Fig. 2.2 Battery Charger Stages and Voltage/Current Curves

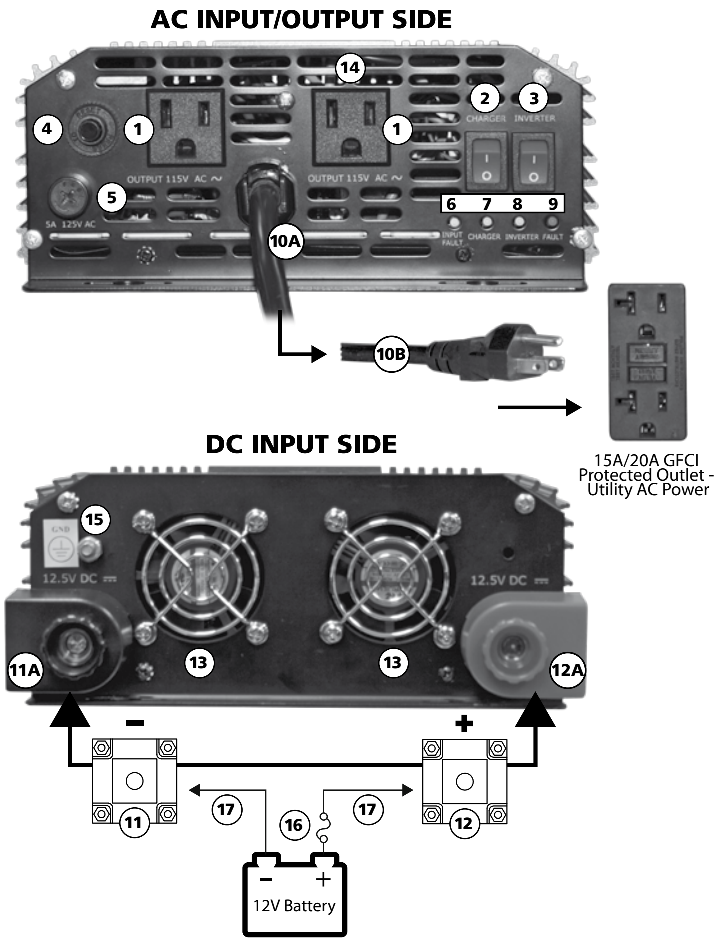
2 Stage Charging

Working of a 2 Stage Charger is explained below. Please refer to Fig 2.2.

2 Stages of Charging are Bulk and Float Stages. 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's output voltage will be 13.8V for charging current < the Bulk Charge Current of 15A.
- If the battery was discharged to a level that draws higher current > the Bulk charge Current of 15A, the charger will limit the charging current to 15A, its voltage will drop and will be clamped at the actual battery voltage when charging was started (Points 1 to 2, Fig 2.1). Charging will take place at constant current limit of 15A, the battery voltage will start rising and the current demand will start reducing. When the current reduces to less than 15A, the charger will exit current limit / Bulk Charge Stage (Point 2, Fig 2.1) and will output a fixed Float Voltage of 13.8V thereafter (Points 2 to 3 on the Voltage Curve in Fig 2.2). Battery's intrinsic voltage will continue to rise towards 13.8V and charging current will start to taper off (Points 2 to 3 on the Current Curve in Fig 2.2). When the battery voltage has reached almost 13.8V, it would have charged to around 80% capacity and the current draw will be reduced to few hundred milliamps (around 0.1% of battery Ah capacity) to compensate self discharge (Point 3 on the Current Curve in Fig 2.2).
- If the discharged level at the time of switching ON was such that the charging current drawn was < 15A, the charger will not be under current limit and will output Float Voltage of 13.8V (Points 2 to 3 on the Voltage Curve in Fig 3.2). Battery's intrinsic voltage will continue to rise towards 13.8V and charging current will start to taper off (Points 2 to 3 on the Current Curve in Fig 2.2). When the battery voltage has reached almost 13.8V, it would have charged to around 80% capacity and the current draw will be reduced to few hundred milliamps (around 0.1% of battery Ah capacity) to compensate self discharge (Point 3 on the Current Curve in Fig 2.2)

SECTION 3 | Layout



LEGEND

1. AC Outlet - NEMA5-15R
2. ON/OFF Switch - Charger
3. ON/OFF Switch - Inverter
4. Breaker for AC Input - 15A
5. Fuse for Charger Section - 5A, 125V / 250V
6. YELLOW LED for Input Fault
7. GREEN LED for Charger ON
8. GREEN LED for Inverter ON
9. RED LED for Fault

10A. & 10B. AC Input Cord - 6 ft. 10A with NEMA5-15P Plug (10B)

11. Negative Input Terminal (M9) for 12V Battery Negative

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)

* Not Supplied.

Fig 3.1 Layout and Input/Output Connections

SECTION 3 | Layout

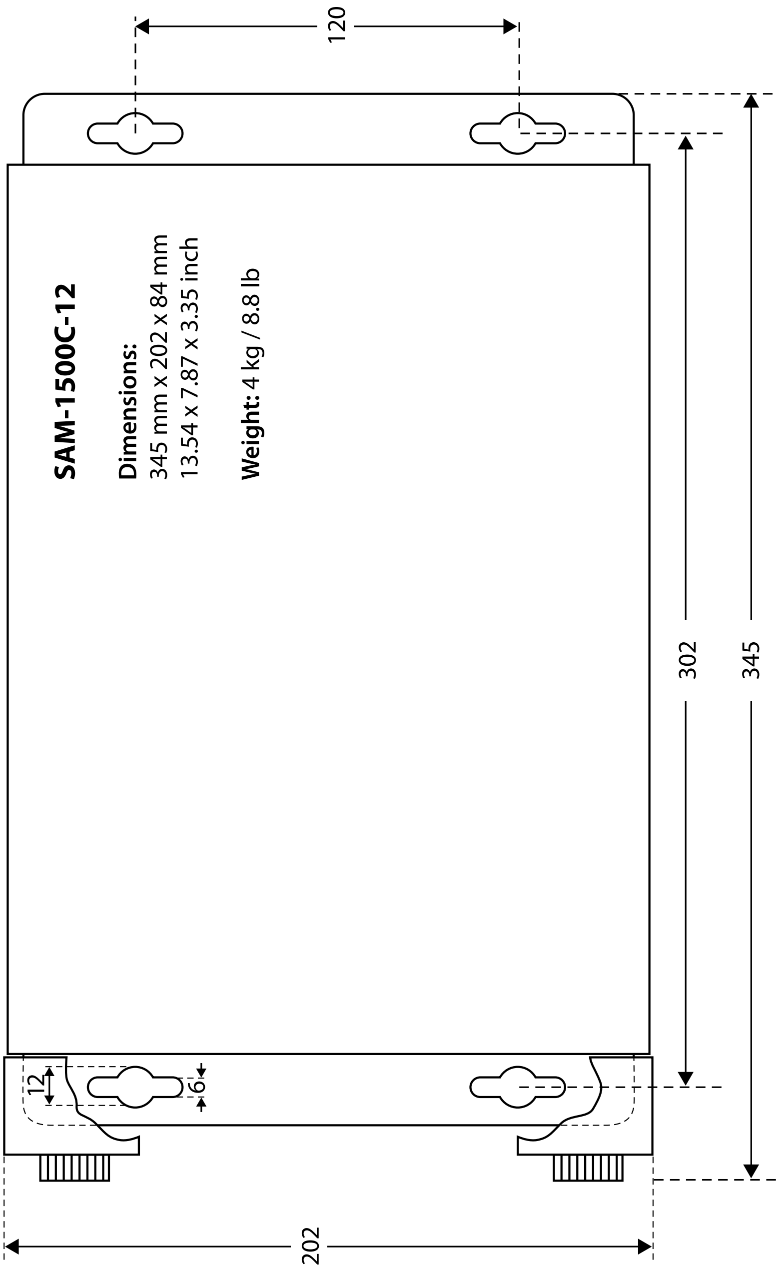


Fig 3.2 Dimensions & Mounting Arrangement

SECTION 4 | Installation

Safety of Installation

Warning!

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

Installation Environment

For best operating results, the inverter should be placed on flat surface, such as the ground, car floor, or other solid surface. The power cord allows easy positioning of the inverter. The inverter 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 power inverter. 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 load-controlled fan. The fan will switch ON automatically at load ≥ 85W when the inverter is supplying power, and at 3A charging current when in Battery Charging/AC Pass Through Mode. The fan sucks cool air from the air intake ventilation slots on the AC outlet side (14, Fig 3.1) and discharges hot air out of the fan opening (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 items on or over the unit during operation.

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 inverter 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

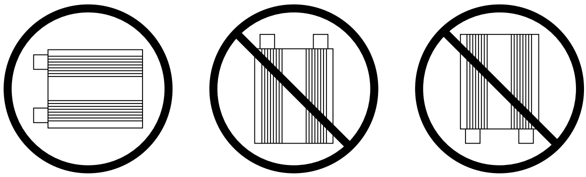


Fig 4.1
Mounting Orientation
on Wall

Grounding Arrangement

⚠ Caution!

1. For grounding requirements, the METAL CHASSIS of the unit is connected as follows:
   - To the Grounding Nut and Bolt (15, Fig, 3.1) for external Earth Ground connection, when required.
   - To the Grounding Pin of NEMA5-15P plug of the AC Input Power Cord (10A, B- Fig 3.1). When the AC Input Power Cord is plugged into 15A/20A GFCI protected outlet being fed with Utility AC Power, the metal chassis of the inverter automatically gets bonded to the Earth Ground of the Utility Distribution System.
   - To the Grounding Terminal of the 2 x NEMA5-15R outlet(s) (1, Fig 3.2) through internal Normally Closed (NC) Contact of Relay R2.
2. Following conditions will be applicable when the unit is used as a Backup AC Power Source and is connected to the Utility AC Power through AC Input Power Cord (10A, B – Fig 3.1):
   - **Utility AC Power is available:** The metal chassis of the unit gets bonded to Earth Ground of the Utility Distribution System. Internal Relay R2 will energize and will disconnect the Grounding Terminals of the AC Outlets from the metal chassis of the unit. IN THIS CASE, THE METAL CHASSIS OF THE CONNECTED AC LOADS WILL BE FLOATING. PLEASE ENSURE THAT WHEN USING THE UNIT AS BACKUP AC POWER SOURCE, THE UTILITY AC INPUT IS FED FROM 15A/20A GFCI PROTECTED OUTLET TO PROVIDE GROUND FAULT PROTECTION.
   - **Utility AC Power is NOT available:** The metal chassis of the unit is connected to Earth Ground of the Utility Distribution System. Relay R2 is de-energized and the metal chassis of the unit gets connected to the Grounding Terminals of the two NEMA5-15R outlet(s). Thus, the metal chassis of the loads also gets bonded to the Earth Ground of the Utility Distribution System.
   - **Grounding using Grounding Nut and Bolt (15, Fig, 3.1):** DO NOT GROUND USING THIS NUT AND BOLT. THE UNIT GETS GROUNDED TO THE EARTH GROUND OF THE UTILITY GROUNDING SYSTEM AUTOMATICALLY THROUGH THE GROUNDING WIRE OF THE AC INPUT POWER CORD (10A, B- Fig 3.1). USE OF MULTIPLE GROUNDS IS NOT DESIRABLE.
3. When the unit is being used as a stand-alone inverter (Utility AC Power input is not connected), Relay R2 remains de-energized and the metal chassis of the unit remains connected to the Grounding Terminals of the two NEMA5-15R outlet(s). **In this application, connect the Grounding Nut and Bolt (15, Fig, 3.1) to Earth Ground using at least AWG #8 wire.**
4. Following operating conditions will be applicable when the unit is being used as (i) A Stand-alone Inverter (Utility AC Power input is NOT connected) or (ii) as a Backup AC Power Source when Utility AC Power is OFF:
   - **The Line and Neutral Terminals of the NEMA5-15R AC outlets will be isolated from its Grounding Terminal. Thus, the metal chassis of the AC loads and the metal chassis of the inverter will also be isolated from the Line and Neutral of the NEMA5-15R AC outlets.**

The Grounding Terminal of the NEMA5-15R AC outlet will be connected to the input section of the Electronic Ground Fault Protection Circuit on the Power Circuit Board.

- **Due to the above implementation, the voltage on the Neutral and Line Terminals of the NEMA5-15R AC outlet with respect to the chassis of the inverter / 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 TERMINAL / NEUTRAL CONDUCTORS!**

5. **Do not connect AC output from the NEMA5-15 outlets 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.**

DC Side Connections

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 connector 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.**

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 inverter 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" at www.samlexamerica.com under Support/White Papers.**

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.

SECTION 4 | Installation

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 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 ± 0.5V). DC cables should be sized to ensure maximum voltage drop is limited to less than 5%.

Effects of low voltage on common electrical loads are given below:

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.

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 inverter, 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 ≥ the maximum continuous current drawn by the inverter but ≤ the Ampacity of the connecting cable should be used in the 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 inverter against short circuit. The inverter has its own internal DC side fuse(s) for internal DC side protection.

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

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 x 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.**

AC Side Connections

Feeding Utility 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).

SECTION 4 | Installation

⚠ 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!**

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.
- 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.

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.

SECTION 4 | Installation

Connecting Batteries

Series Connection

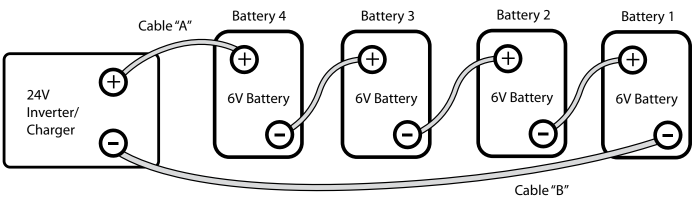


Fig. 4.2 Series Connection

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 4 pieces of 6V, 200 Ah batteries connected in series to form a battery bank of 24V with a capacity of 200 Ah. The Positive terminal of Battery 4 becomes the Positive terminal of the 24V bank. The Negative terminal of Battery 4 is connected to the Positive terminal of Battery 3. The Negative terminal of Battery 3 is connected to the Positive terminal of Battery 2. 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 24V battery bank.

Parallel Connection

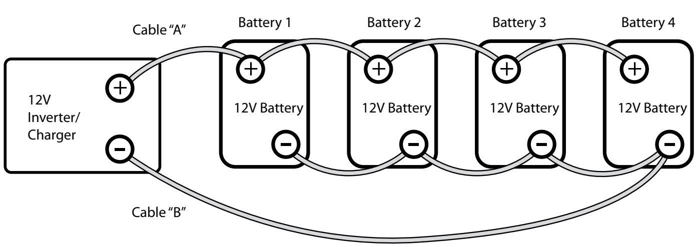


Fig. 4.3 Parallel Connection

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

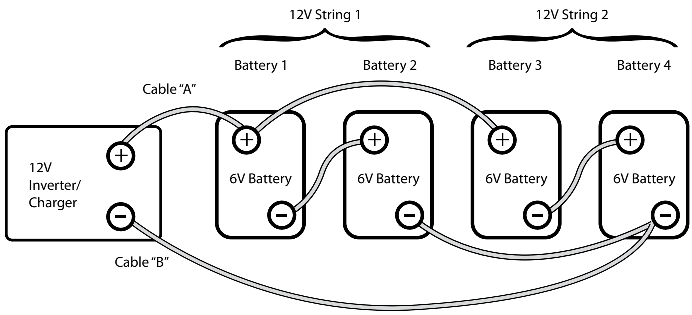


Fig. 4.4 Series-Parallel Connection

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 connected 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.

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**

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 ÷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 × 3 Hours = 450 Ampere Hours (Ah).

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 x 2 = 900 Ah.

SECTION 5 | Operation

Sizing Chart for Typical Loads That Require High Starting Surge

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
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 Lights2	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

Switching ON/OFF Inverter

The Inverter is switched ON/OFF using Inverter ON / OFF Switch (3, Fig 3.1).

When the Inverter is switched ON, Green LED "Inverter" (8, Fig 3.1) is lighted.

Switching ON /OFF Battery Charger

The Charger is switched ON/OFF using Charger ON / OFF Switch (2, Fig 3.1).

SECTION 5 | Operation

When the Charger is switched ON, Green LED “Charger” (7, Fig 3.1) is lighted.

Please note that the Charger is powered from the Utility AC Power. Hence, the charger will switch OFF when Utility AC Power fails even if the charger ON/OFF Switch is in ON Condition.

Operation as Backup AC Power Source - Switching ON

1. Make sure that the maximum single / combined load is less than 1500W. Please refer to Sizing Chart at Table 5.1 for guidance.
2. Switch OFF the Inverter and the Charger.
3. Switch OFF the load(s).
4. Connect the load(s) to the AC outlet(s) of the inverter (1, Fig 3.1) .
5. Switch ON the Inverter. Green LED “Inverter” (8, Fig 3.1) will be lighted.
6. Wait for a few minutes and then Switch ON the 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
7. Under normal operation, the load(s) will be powered from the inverter. Refer to Trouble-shooting Guide in case abnormal operation is observed.
8. Plug the NEMA5-15P plug of the AC Input Cord (10B, Fig 3.1) into 120 VAC, 15A/ 20A GFCI protected AC outlet. The Transfer Relay will operate and transfer the load to the Utility AC. Inverter will be in standby condition.
9. Switch ON the Battery Charger. Green LED “Charger” (7, Fig 3.1) will be lighted. The battery will start getting charged as described under “2 Stage Charging” in Section 2, page 7.
10. If the Utility AC power fails, the Transfer Relay will transfer the load(s) to the Inverter in around 2 to 3 sec. Battery Charger will switch OFF. The battery will start discharging at current = Power of AC load(s) in Watts ÷ 10.

Operation as Backup AC Power Source - Switching OFF

1. Switch OFF the Charger
2. Switch OFF the load(s)
3. Switch OFF the Inverter
4. Disconnect AC input Power Cord

Operation as Stand-alone Inverter - Switching ON

1. Make sure that the maximum single / combined load is less than 1500W. Please refer to Sizing Chart at Table 5.1 for guidance.
2. Switch OFF the Inverter and the Charger.
3. Switch OFF the load(s).
4. Connect the load(s) to the AC outlet(s) of the inverter (1, Fig 3.1) .
5. Switch ON the Inverter. Green LED “Inverter” (8, Fig 3.1) will be lighted.
6. Wait for a few minutes and then Switch ON the 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.

7. Under normal operation, the load(s) will be powered from the inverter. Refer to Troubleshooting Guide in case abnormal operation is observed.

Operation as Stand-alone Inverter - Switching OFF

1. Switch OFF the load(s)
2. Switch OFF the Inverter

Operation as Stand-alone Charger - Switching ON

1. Switch OFF the Inverter ON/OFF Switch (3, Fig 3.1). As only battery charging is required, the inverter should be OFF.
2. Plug the NEMA5-15P plug of the AC Input Cord (10B, Fig 3.1) into 120 VAC, 15A/ 20A GFCI protected AC outlet.
3. Switch ON the Battery Charger. Green LED "Charger" (7, Fig 3.1) will be lighted. The battery will start getting charged as described under "2 Stage Charging" in Section 2, page 7.

Operation as Stand-alone Battery Charger - Switching OFF

1. Switch OFF the Charger
2. Remove AC input Power Cord

SECTION 6 | Protections Monitoring & Troubleshooting

Protections & Monitoring when Inverter is Supplying Power & is Operating as Backup AC Power Source

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

Over Temperature Protection

The unit is cooled by load-controlled fan. In case the fan fails or if the cooling is inadequate due to higher ambient temperature or restricted airflow, the temperature inside the inverter will exceed the safe temperature threshold and the unit will automatically shut down. The unit will reset automatically on cooling down.

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 ± 0.3V.

Over Voltage Protection

The inverter will automatically shut down when the input voltage exceeds 15.5 V± 0.2V. Input voltage exceeding 16 volts could damage the inverter.

Overload / Short Circuit Protection

The inverter will automatically shut down under short circuit conditions and when the continuous / surge power exceeds rated watts. The unit will latch in shut down condition. To reset, switch OFF the ON/OFF switch, 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 and prevent overloading.

Low Input Voltage Alarm

An alarm will sound when the voltage at the input terminals of the inverter drops to 10.8V ± 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 wires connecting the inverter to the battery (due to use of thinner and longer length of wires 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 ± 0.3V.

SECTION 6 | Protections Monitoring & Troubleshooting

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.

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 get connected to its metal chassis. If the energized metal chassis is touched by a person standing on Earth Ground (considered 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". 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 kΩ when dry and 1 kΩ when wet). Human body can tolerate leakage current of up to 5ma for 15 to 30 msec.

Ground fault protection in this unit is provided as follows (Inverter is supplying power):

- The Line and Neutral terminals of the AC outlet are isolated from its grounding terminal. Thus, the metal chassis of the AC loads will also be isolated from the Line and Neutral.
- The grounding terminal of the AC outlet is connected to the input section of the Electronic Ground Fault Protection Circuit on the power circuit board.
- **Due to the above implementation, the Neutral voltage will be pulsing DC voltage with average DC value of up to 50 VDC with respect to the metal chassis of the AC loads / metal chassis of the inverter (will read 75 VAC on the AC scale of the Voltmeter because of pulsing nature of DC Voltage). Similarly, the Line voltage will also be up to 75V with respect to the metal chassis of the AC loads / metal chassis of the inverter . DO NOT touch the Line / Neutral!**
- If the metal chassis of the load develops a Ground Fault condition, up to 75V 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 AC output 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 utility 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.

SECTION 6 | Protections Monitoring & Troubleshooting

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.

Monitoring of Operational Status & Protections

Normal / abnormal behavior can be monitored by observing Green LED (8, Inverter), Yellow LED (6, Input Fault), Red LED (9, Fault) 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 (8, Inverter)	YELLOW LED (6, Input Fault)	RED LED (9, Fault)	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	15.5 ± 0.2V	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.

SECTION 6 | Protections Monitoring & Troubleshooting

Operating Condition/ Protection	Threshold/ Reason	GREEN LED (8, Inverter)	YELLOW LED (6, Input Fault)	RED LED (9, Fault)	Buzzer	Remedy/Reset
No output due to Over Load Shut Down	Output power is > Continuous / Surge Rating	ON	OFF	ON	OFF	Check starting surge rating of load. If happens with low power CFL or SMPS, try adding small resistive load. 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. Manual Reset. Unit will latch in shut down condition. To reset, switch OFF the ON/OFF Switch, wait for 3 minutes and switch ON again.
No output due to Ground Fault Shut Down	Neutral or Line connected to Ground	ON	OFF	ON	OFF	Check if there is Neutral to Ground bond or Ground Fault. Manual Reset. Unit will latch in shut down condition. To reset, switch OFF the ON/OFF Switch, wait for 3 minutes and switch ON again.
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

Protections and Monitoring

When Utility AC Power is Available, is Being Passed Through to the Load(s) and Battery Charger is Charging the Batteries:

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 Utility AC Power Pass Through Mode.

NOTE: This breaker carries combined AC input current for the Battery Charger (around 4A when delivering full 15A charging current when the batteries are deeply discharged) and the AC Loads.

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.

Protection Against Ground Fault in AC Loads

AC input to the unit is required to be fed from 15A/20A GFCI protected AC outlet of Utility AC Power. In case of Ground fault in the AC load(s), the GFCI in the 15A/20A GFCI protected AC outlet of Utility AC Power will trip.

Table 6.2 Protections & Monitoring: Utility AC Power Pass Through Mode

LED Display	Other Symptoms	Possible Cause(s)	Remedy
Green LED "Charger" (7, Fig 3.1) is OFF.	AC is available at the output of 15A / 20A GFCI protected outlet feeding AC input to the unit. 15A AC Input Breaker (4, Fig 3.1) is tripped.	Overload / short circuit in the AC load(s).	Reduce load / check for shorting. Reset the Circuit Breaker.
	AC is NOT available at the output of 15A / 20A GFCI protected outlet of Utility AC Power feed-ing AC input to the unit 15A AC Input Breaker (4, Fig 3.1) is NOT tripped.	GFCI in the 15A/20A GFCI protected outlet of Utility AC Power feeding the AC input to the unit has tripped due to Ground fault in AC load(s.)	Check for Ground Fault in the AC load(s). Reset the GFCI.
	5A Fuse (5, Fig 3.1) in the Battery Charger Circuit is blown.	Internal overload / short circuit in the Battery Charger Circuit.	Call Tech Support.

SECTION 7 | Specifications

PARAMETER	MODEL NO.SAM-1500C -12	
OUTPUT - INVERTER MODE	CONTINUOUS ACTIVE OUTPUT POWER	1500W (Power Factor = 1)
	MAXIMUM SURGE POWER	3000W (<1 sec; Power Factor = 1)
	NOMINAL OUTPUT VOLTAGE	115 VAC, +10% / -5%
	OUTPUT FREQUENCY	60 Hz ± 5%
	PEAK EFFICIENCY	90% (@ 50% 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 RATED OUTPUT POWER	150A
	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 - GRID PASS THROUGH	15A (Protected by 15A breaker)
TRANSFER SPECIFICATIONS	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
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
	AC INPUT POWER FACTOR	0.6
	VOLTAGE & CURRENT RATING OF FUSE/BREAKER	125V / 250V, 5A
	CHARGER ON/OFF CONTROL	By front panel Switch
PROTECTIONS	OVERLOAD SHUTDOWN	Yes. Manual reset.
	LOW BATTERY INPUT (VOLTAGE) ALARM	10.8 ± 0.3V
	LOW BATTERY (INPUT) VOLTAGE SHUTDOWN	10.5 ± 0.3V
	BATTERY (INPUT) OVER VOLTAGE SHUTDOWN	> 15.5V
	COOLING - LOAD CONTROLLED FAN	Inverter Mode: ON at 85W Charging Mode: ON at charging current > 3A ± 1A
	OVER TEMPERATURE SHUTDOWN	Yes. Auto reset
	GROUND FAULT SHUTDOWN	Yes. Manual Reset.
	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

Specifications are subject to change without notice.

SECTION 8 | Warranty

2 YEAR LIMITED WARRANTY

SAM-1500C-12 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 2 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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Notes

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