samlexpower®

DC-AC Power Inverter
Pure Sine Wave

PST-3000-12
PST-3000-24
PST-3000-48

Owner's Manual

Please read this manual BEFORE installing your device

OWNER'S MANUAL | Index

SECTION 1 | Safety Instructions

1.1 IMPORTANT SAFETY INSTRUCTIONS AND SYMBOLS

SAVE THESE INSTRUCTIONS. This manual contains important instructions for models PST-3000-12, PST-3000-24 and PST-3000-48 that shall be followed during installation, operation and maintenance.

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

WARNING!

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

MISE EN GARDE !

L’utilisateur pourrait se blesser lorsque les consignes de sécurité ne sont pas suivies.

CAUTION!

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

ATTENTION !

Il y a un risque d’endommager l’équipement lorsque l'utilisateur ne suit pas les instructions.

INFO

Indicates useful supplemental information.

Please read these instructions before installing or operating the unit to prevent personal injury or damage to the unit.

1.2 SAFETY INSTRUCTIONS - GENERAL

Installation and wiring compliance

- Installation and wiring must comply with the Local and National Electrical Codes and must be done by a certified electrician.

Preventing electrical shock

- Always connect the grounding connection on the unit to the appropriate grounding system.

- Disassembly/repair should be carried out by qualified personnel only.
- Disconnect all AC and DC side connections before working on any circuits associated with the unit. Turning the ON/OFF switch on the unit to OFF position may not entirely remove dangerous voltages.
- Be careful when touching bare terminals of capacitors. Capacitors may retain high lethal voltages even after the power has been removed. Discharge the capacitors before working on the circuits.

Installation environment

- The inverter should be installed indoor only in a well ventilated, cool, dry environment.
- Do not expose to moisture, rain, snow or liquids of any type.
- To reduce the risk of overheating and fire, do not obstruct the suction and discharge openings of the cooling fan.
- To ensure proper ventilation, do not install in a low clearance compartment.

Preventing fire and explosion hazards

- Working with the unit may produce arcs or sparks. Thus, the unit should not be used in areas where there are flammable materials or gases requiring ignition protected equipment. These areas may include spaces containing gasoline-powered machinery, fuel tanks, and battery compartments.

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. The batteries can produce a short circuit current high enough to weld a ring or the like to metal and, thus, cause a severe burn.
- 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.

1.3 SAFETY INSTRUCTIONS - INVERTER RELATED

Preventing Paralleling of the AC Output

The AC output of the unit should never be connected directly to an Electrical Breaker Panel/Load Centre which is also fed from the utility power/generator. Such a direct connection may result in parallel operation of the different power sources and AC power from the utility/generator will be fed back into the unit which will instantly damage the output section of the unit and may also pose a fire and safety hazard. If an Electrical Breaker Panel/Load Center is fed from this unit and this panel is also required to be fed from additional alternate AC sources, the AC power from all the AC sources (like the utility/generator/this inverter) should first be fed to an Automatic/Manual Selector Switch and the output of the Selector Switch should be connected to the Electrical Breaker Panel/Load Center. Samlex America, Inc. Automatic Transfer Switch Model No. STS-30 is recommended for this application.

CAUTION!

To prevent possibility of paralleling and severe damage to the unit, never use a simple jumper cable with a male plug on both ends to connect the AC output of the unit to a handy wall receptacle in the home/RV.

ATTENTION !

Afin d'éviter tout risque de mise en parallèle et de graves dommages à l'unité, n'utilisez jamais un simple câble de raccordement muni d'une fiche mâle aux deux extrémités pour raccorder la sortie CA de l'unité à une prise murale pratique dans une habitation ou un VR.

Preventing DC Input Over Voltage

It is to be ensured that the DC input voltage of this unit does not exceed 16.5 VDC for the PST-3000-12, 33.0 VDC for the PST-3000-24, or 60 VDC for PST-3000-48, to prevent permanent damage to the unit. Please observe the following precautions:

- Ensure that the maximum charging voltage of the external battery charger/alternator/solar charge controller does not exceed 16.5 VDC for PST-3000-12, 33.0 for PST-3000-24 or 60.0 VDC for PST-3000-48.
- Do not use solar panel/array to directly charge the battery bank connected to the inverter. Use appropriate Charge Controller between the solar panel/array and the battery bank. Using solar panel/array to directly charge the battery will lead to over voltage shutdown of the inverter and the possible damage due to battery voltage rising close to the level of the open circuit voltage of the solar panel(s) when the battery is fully charged and is in Float stage (under this condition, the battery will be drawing very low trickle charge current & the voltage of the unregulated solar panel/array will rise close to its Open Circuit Voltage).
- Do not connect this unit to a battery system with a voltage higher than the rated nominal battery input voltage of the unit.

Preventing Reverse Polarity on the Input Side

When making battery connections on the input side, make sure that the polarity of battery connections is correct (Connect the Positive of the battery to the Positive terminal of the unit and the Negative of the battery to the Negative terminal of the unit). If the input is connected in reverse polarity, the external DC fuse and the DC fuses inside the inverter will blow and may also cause permanent damage to the inverter.

SECTION 1 | Safety Instructions

CAUTION!
Damage caused by reverse polarity is not covered by warranty.

ATTENTION !
Des dommages causés par un inversement des polarités ne sont pas couverts par la garantie.

Use of External Fuse in DC Input Circuit

Use Class-T or equivalent fuse of appropriate capacity within 7" of the battery Positive terminal. This fuse is required to protect DC input cable run from damage due to short circuit along the length of the cable. Please read instructions under Section 8 - Installation.

Hard Wiring of AC Output to AC Panelboards in RVs/Motor Homes/Trailers/Campers

WARNING!
RISK OF ELECTRIC SHOCK
When this unit is installed in RV/Motor Homes/Trailers/Campers and hard-wiring connection is used to feed the AC output of the inverter to the AC Distribution Panelboard/Load Center in the vehicle, it is to be ensured that Ground Fault Circuit Interrupter(s) [GFCI]are installed in the vehicle wiring system to protect branch circuits.

The following GFCIs have been tested to operate satisfactorily and are acceptable. Other types may fail to operate properly when connected to this inverter:

Manufacturer of GFCI	Manufacturer's Model No.	Description
Pass & Seymour	2095 Series	NEMA5-20 Duplex, 20 A
Leviton	N7899 Series	NEMA5-20 Duplex, 20 A
Zhejiang Trimone	TGM20 Series	NEMA5-20 Duplex, 20 A

MISE EN GARDE ! RISQUE DE DÉCHARGE ÉLECTRIQUE !
Si l'appareil est installé dans les véhicules récréatifs/camping-cars/caravanes/remorques et est une connexion de cablâge est utilisée pour alimenter la puissance CA de l'onduleur au tableau électrique CA du véhicule, il faut assurer qu'un(s) dispositif(s) différentiel(s) à courant résiduel soit installé dans le système de cablâge pour protèger les circuits de dérivation.

Les DDR ci-dessous ont été tester, fonctionnent dans une manière satisfaisante. Des autres modèles pourraient échouer s'ils sont branchés à l'onduleur:

Fabricant du DDR	Fabricant's No. de Modèle	Description
Pass & Seymour	Série 2095	NEMA5-20 Duplex de 20 A
Leviton	Série N7899	NEMA5-20 Duplex de 20 A
Zhejiang Trimone	Série TGM20	NEMA5-20 Duplex de 20 A

2.1. DEFINITIONS

The following definitions are used in this manual for explaining various electrical concepts, specifications and operations:

Active Power (P), Watts: It is denoted as "**P**" and the unit is "**Watt**". It is the power that is consumed in the resistive elements of the load. A load will require additional Reactive Power for powering the inductive and capacitive elements. The effective power required would be the Apparent Power that is a vectorial sum of the Active and Reactive Powers.

Apparent (S) Power, VA: This power, denoted by "S", is the vectorial sum of the Active Power in Watts and the Reactive Power in "VAR". In magnitude, it is equal to the RMS value of voltage "V" X the RMS value of current "A". The Unit is VA. Please note that Apparent Power VA is more than the Active Power in Watts. Hence, the inverter, AC wiring and over current protection devices have to be sized based on the Apparent Power.

Current (I), Amps, A: It is denoted by "I" and the unit is Amperes – shown as "A". It is the flow of electrons through a conductor when a voltage (V) is applied across it.

Efficiency, (η): This is the ratio of Power Output ÷ Power Input.

Frequency (F), Hz: It is a measure of the number of occurrences of a repeating event per unit time. For example, cycles per second (or Hertz) in a sinusoidal voltage.

Impedance, Z: It is the vectorial sum of Resistance and Reactance vectors in a circuit.

Inductive Reactance (X_L), Capacitive Reactance (X_C) and Reactance (X): Reactance is the opposition of a circuit element to a change of electric current or voltage due to that element's inductance or capacitance. Inductive Reactance (X_L) is the property of a coil of wire in resisting any change of electric current through the coil. It is proportional to frequency and inductance and causes the current vector to lag the voltage vector by Phase Angle (φ) = 90°. Capacitive reactance (X_C) is the property of capacitive elements to oppose changes in voltage. X_C is inversely proportional to the frequency and capacitance and causes the current vector to lead the voltage vector by Phase Angle (φ) = 90 °. The unit of both X_L and X_C is "Ohm" - also denoted as "Ω". The effects of inductive reactance X_L to cause the current to lag the voltage by 90 ° and that of the capacitive reactance X_C to cause the current to lead the voltage by 90 ° are exactly opposite and the net effect is a tendency to cancel each other. Hence, in a circuit containing both inductances and capacitances, the net **Reactance (X)** will be equal to the difference between the values of the inductive and capacitive reactances. The net **Reactance (X)** will be inductive if $X_L > X_C$ and capacitive if $X_C > X_L$.

Peak Value: It is the maximum value of electrical parameter like voltage/current.

Phase Angle, (φ): It is denoted by "φ" and specifies the angle in degrees by which the current vector leads or lags the voltage vector in a sinusoidal voltage. In a purely inductive load, the current vector lags the voltage vector by Phase Angle (φ) = 90 °. In a purely capacitive load, the current vector leads the voltage vector by Phase Angle, (φ) = 90°. In a purely resistive load, the current vector is in phase with the voltage vector and hence, the Phase Angle, (φ) = 0°. In a load consisting of a combination of resistances, inductances and capacitances, the Phase Angle (φ) of the net current vector will be

> 0° < 90° and may lag or lead the voltage vector.

Load: Electrical appliance or device to which an electrical voltage is fed.

Linear Load: A load that draws sinusoidal current when a sinusoidal voltage is fed to it. Examples are, incandescent lamp, heater, electric motor, etc.
Non-Linear Load: A load that does not draw a sinusoidal current when a sinusoidal voltage is fed to it. For example, non-power factor corrected Switched Mode Power Supplies (SMPS) used in computers, audio video equipment, battery chargers, etc.

Reactive Load: A device or appliance that consists of a combination of resistive, inductive and capacitive elements (like motor driven tools, refrigeration compressors, microwaves, computers, audio/video etc.). The Power Factor of this type of load is <1 e.g. AC motors (PF=0.4 to 0.8), Transformers (PF=0.8), AC to DC Switch Mode Power Supplies (PF=0.5 to 0.6) etc. These devices require Apparent Power (VA) from the AC power source. The Apparent Power is a vectorial sum of Active Power (Watts) and Reactive Power (VAR). The AC power source has to be sized based on the higher Apparent Power (VA) and also based on the Starting Surge Power.

Reactive Load: A device or appliance that consists of a combination of resistive, inductive and capacitive elements (like motor driven tools, refrigeration compressors, microwaves, computers, audio/video etc.). The Power Factor of this type of load is <1 e.g. AC motors (PF=0.4 to 0.8), Transformers (PF=0.8), AC to DC Switch Mode Power Supplies (PF=0.5 to 0.6) etc. These devices require Apparent Power (VA) from the AC power source. The Apparent Power is a vectorial sum of Active Power (Watts) and Reactive Power (VAR). The AC power source has to be sized based on the higher Apparent Power (VA) and also based on the Starting Surge Power.

Resistive Load: A device or appliance that consists of pure resistance (like filament lamps, cook tops, toaster, coffee maker etc.) and draws only Active Power (Watts) from the inverter. The inverter can be sized based on the Active Power rating (Watts) of resistive type of loads without creating overload (except for resistive type of loads with Tungsten based heating element like in Incandescent Light Bulbs, Quartz Halogen Lights and Quartz Halogen Infrared Heaters. These require higher starting surge power due to lower resistance value when the heating element is cold).

Maximum Continuous Running AC Power Rating: This rating may be specified as "Active Power" in Watts (W) or "Apparent Power" in Volt Amps (VA). It is normally specified in "Active Power (P)" in Watts for Resistive type of loads that have Power Factor =1. Reactive types of loads will draw higher value of "Apparent Power" that is the sum of "Active and Reactive Powers". Thus, AC power source should be sized based on the higher "Apparent Power" Rating in (VA) for all Reactive Types of AC loads. If the AC power source is sized based on the lower "Active Power" Rating in Watts (W), the AC power source may be subjected to overload conditions when powering Reactive Type of loads.

Power Factor, (PF): It is denoted by "PF" and is equal to the ratio of the Active Power (P) in Watts to the Apparent Power (S) in VA. The maximum value is 1 for resistive types of loads where the Active Power (P) in Watts = the Apparent Power (S) in VA. It is 0 for purely inductive or purely capacitive loads. Practically, the loads will be a combination of resistive, inductive and capacitive elements and hence, its value will be > 0 <1. Normally it ranges from 0.5 to 0.8 e.g. (i) AC motors (0.4 to 0.8), (ii) Transformers (0.8) (iii) AC to DC Switch Mode Power Supplies (0.5 to 0.6) etc.

Reactive Power (Q), VAR: Is denoted as "**Q**" and the unit is **VAR**. Over a cycle, this power is alternatively stored and returned by the inductive and capacitive elements of the load. It is not consumed by the inductive and capacitive elements in the load but a certain value travels from the AC source to these elements in the (+) half cycle of the sinusoidal voltage (Positive value) and the same value is returned back to the AC source in the (-) half cycle of the sinusoidal voltage (Negative value). Hence, when averaged over a span of one cycle, the net value of this power is 0. However, on an instantaneous basis, this power has to be provided by the AC source. Hence, the inverter, AC wiring and over current protection devices have to be sized based on the combined effect of the Active and Reactive Powers that is called the Apparent Power.

Resistance (R), Ohm, Ω: It is the property of a conductor that opposes the flow of current when a voltage is applied across it. In a resistance, the current is in phase with the voltage. It is denoted by "R" and its unit is "Ohm" - also denoted as "Ω".

RMS (Root Mean Square) Value: It is a statistical average value of a quantity that varies in value with respect to time. For example, a pure sine wave that alternates between peak values of Positive 169.68 V and Negative 169.68 V has an RMS value of 120 VAC. Also, for a pure sine wave, the RMS value = Peak value ÷ 1.414.

Starting Surge Power Rating: During start up, certain loads require considerably higher surge of power for short duration (lasting from tens of millisecs to few seconds) as compared to their Maximum Continuous Running Power Rating. Some examples of such loads are given below:

- **Electric Motors:** At the moment when an electric motor is powered ON, the rotor is stationary (equivalent to being "Locked"), there is no "Back EMF" and the windings draw a very heavy surge of starting current (Amperes) called "Locked Rotor Amperes" (LRA) due to low DC resistance of the windings. For example, in motor driven loads like Air-conditioning and Refrigeration Compressors and in Well Pumps (using Pressure Tank), the Starting Surge Current/LRA may be as high as 10 times its rated Full Load Amps (FLA)/Maximum Continuous Running Power Rating. The value and duration of the Starting Surge Current/LRA of the motor depends upon the winding design of the motor and the inertia/resistance to movement of mechanical load being driven by the motor. As the motor speed rises to its rated RPM, "Back EMF" proportional to the RPM is generated in the windings and the current draw reduces proportionately till it draws the running FLA/Maximum Continuous Running Power Rating at the rated RPM.

- **Transformers** (e.g. Isolation Transformers, Step-up/Step-down Transformers, Power Transformer in Microwave Oven etc.): At the moment when AC power is supplied to a transformer, the transformer draws very heavy surge of "Magnetization Inrush Current" for a few millisecs that can reach up to 10 times the Maximum Continuous Rating of the

Transformer.

- **Devices like Infrared Quartz Halogen Heaters** (also used in Laser Printers)**/Quartz Halogen Lights/Incandescent Light Bulbs using Tungsten heating elements:** Tungsten has a very high Positive Temperature Coefficient of Resistance i.e. it has lower resistance when cold and higher resistance when hot. As Tungsten heating element will be cold at the time of powering ON, its resistance will be low and hence, the device will draw very heavy surge of current with consequent very heavy surge of power with a value of up to 8 times the Maximum Continuous Running AC Power.

- **AC to DC Switched Mode Power Supplies (SMPS):** This type of power supply is used as stand-alone power supply or as front end in all electronic devices powered from Utility/Grid e.g. in audio/video/computing devices and battery chargers (Please see Section 4 for more details on SMPS). When this power supply is switched ON, its internal input side capacitors start charging resulting in very high surge of Inrush Current for a few millisecs (Please see Fig 4.1). This surge of inrush current/power may reach up to 15 times the Continuous Maximum Running Power Rating. The surge of inrush current/power will, however, be limited by the Surge Power Rating of the AC source.

Voltage (V), Volts: It is denoted by "V" and the unit is "Volts". It is the electrical force that drives electrical current (I) when connected to a load. It can be DC (Direct Current – flow in one direction only) or AC (Alternating Current – direction of flow changes periodically). The AC value shown in the specifications is the RMS (Root Mean Square) value.

2.2 OUTPUT VOLTAGE WAVEFORMS

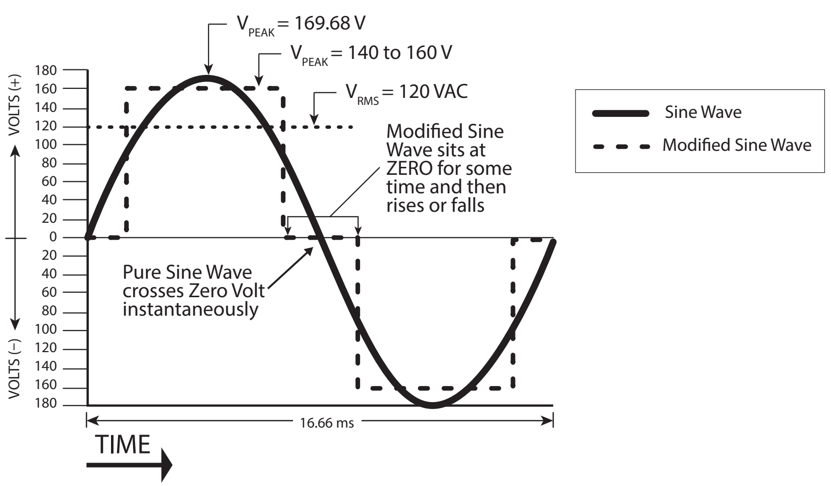


Fig. 2.1: Pure and Modified Sine Waveforms for 120 VAC, 60 Hz

The output waveform of the Samlex PST series inverters is a Pure Sine Wave like the waveform of Utility/Grid Power. Please see Sine Wave represented in the Fig. 2.1 that also shows Modified Sine Waveform for comparison.

In a Sine Wave, the voltage rises and falls smoothly with a smoothly changing phase angle and also changes its polarity instantly when it crosses 0 Volts. In a Modified Sine Wave, the voltage rises and falls abruptly, the phase angle also changes abruptly and it sits at zero V for some time before changing its polarity. Thus, any device that uses a control circuitry that senses the phase (for voltage/speed control) or instantaneous zero voltage crossing (for timing control) will not work properly from a voltage that has a Modified Sine Waveform.

Also, as the Modified Sine Wave is a form of Square Wave, it is comprised of multiple Sine Waves of odd harmonics (multiples) of the fundamental frequency of the Modified Sine Wave. For example, a 60 Hz Modified Sine Wave will consist of Sine Waves with odd harmonic frequencies of 3rd (180 Hz), 5th (300 Hz), 7th (420 Hz) and so on. The high frequency harmonic content in a Modified Sine Wave produces enhanced radio interference, higher heating effect in inductive loads like microwaves and motor driven devices like hand tools, refrigeration/air-conditioning compressors, pumps etc. The higher frequency harmonics also produce overloading effect in low frequency capacitors due to lowering of their capacitive reactance by the higher harmonic frequencies. These capacitors are used in ballasts for fluorescent lighting for Power Factor improvement and in single-phase induction motors as Start and Run Capacitors. Thus, Modified and Square Wave inverters may shut down due to overload when powering these devices.

2.3 ADVANTAGES OF PURE SINE WAVE INVERTERS

- The output waveform is a Sine Wave with very low harmonic distortion and cleaner power like Utility/Grid supplied electricity.
- Inductive loads like microwaves, motors, transformers etc. run faster, quieter and cooler.
- More suitable for powering fluorescent lighting fixtures containing Power Factor Improvement Capacitors and single phase motors containing Start and Run Capacitors
- Reduces audible and electrical noise in fans, fluorescent lights, audio amplifiers, TV, fax and answering machines, etc.
- Does not contribute to the possibility of crashes in computers, weird print outs and glitches in monitors.

2.4 SOME EXAMPLES OF DEVICES THAT MAY NOT WORK PROPERLY WITH MODIFIED SINE WAVE AND MAY ALSO GET DAMAGED ARE GIVEN BELOW:

- Laser printers, photocopiers, and magneto-optical hard drives.
- Built-in clocks in devices such as clock radios, alarm clocks, coffee makers, bread-makers, VCR, microwave ovens etc. may not keep time correctly.
- Output voltage control devices like dimmers, ceiling fan/motor speed control may not work properly (dimming/speed control may not function).
- Sewing machines with speed/microprocessor control.

- Transformer-less capacitive input powered devices like (i) Razors, flashlights, night-lights, smoke detectors etc. (ii) Some re-chargers for battery packs used in hand power tools. *These may get damaged. Please check with the manufacturer of these types of devices for suitability.*
- Devices that use radio frequency signals carried by the AC distribution wiring.
- Some new furnaces with microprocessor control/Oil burner primary controls.
- High intensity discharge (HID) lamps like Metal Halide Lamps. *These may get damaged. Please check with the manufacturer of these types of devices for suitability.*
- Some fluorescent lamps/light fixtures that have Power Factor Correction Capacitors. *The inverter may shut down indicating overload.*
- Induction Cooktops.

2.5 POWER RATING OF INVERTERS

INFO

For proper understanding of explanations given below, please refer to definitions of Active/Reactive/Apparent/Continuous/Surge Powers, Power Factor, and Resistive/Reactive Loads at Section 2.1 under "DEFINITIONS".

The power rating of inverters is specified as follows:
- Maximum Continuous Running Power Rating.
- Surge Power Rating to accommodate high, short duration surge of power required during start up of certain AC appliances and devices.

Please read details of the above two types of power ratings in Section 2.1 under "DEFINITIONS"

INFO

The manufacturers' specification for power rating of AC appliances and devices indicates only the Maximum Continuous Running Power Rating. The high, short duration surge of power required during start up of some specific types of devices 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 2.1 provides a list of some common AC appliances/devices that require high, short duration surge of power during start up. An "Inverter Sizing Factor" has been recommended against each which is a Multiplication Factor to be applied to the Maximum Continuous Running Power Rating (Active Power Rating in Watts) of the AC appliance/device to arrive at the Maximum Continuous Running Power Rating of the inverter (Multiply the Maximum Continuous Running Power Rating (Active Power

Rating in Watts) of the appliance/device by recommended Sizing Factor to arrive at the Maximum Continuous Running Power Rating of the inverter.

TABLE 2.1: INVERTER SIZING FACTOR Type Of Device Or Appliance	INVERTER SIZING FACTOR (SEE NOTE 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 Infrared Quartz Halogen Heaters	4
Switch Mode Power Supplies (SMPS): no Power Factor correction	2
Photographic Strobe/Flash Lights	4 (See Note 2)

NOTES FOR TABLE 2.1

1. Multiply the Maximum Continuous Running Power Rating (Active Power Rating in Watts) of the appliance/device by the recommended Sizing Factor to arrive at the Maximum Continuous Running Power Rating of the inverter.
2. For photographic strobe/flash unit, the Surge Power Rating of the inverter should be > 4 times the Watt Sec rating of photographic strobe/flash unit.

3.1 EMI AND FCC COMPLIANCE

SECTION 3 | Limiting Electro-Magnetic Interference (EMI)

These inverters contain 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 as per limits laid down in North American FCC Standard FCC Part 15(B), Class A. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated *in business, commercial and industrial environments*. These inverters 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.

3.2 REDUCING EMI THROUGH PROPER INSTALLATION

The effects of EMI will also depend upon a number of factors external to the inverter like proximity of the inverter to the EMI receptors, types and quality of connecting wires and cables etc. EMI due to factors external to the inverter may be reduced as follows:

- Ensure that the inverter is firmly grounded to the ground system of the building or the vehicle.
- Locate the inverter 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 inverter 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.

4.1 CHARACTERISTICS OF SWITCHED MODE POWER SUPPLIES (SMPS)

SECTION 4 | Powering Direct/Embedded Switch Mode Power Supplies (SMPS)

Switch Mode Power Supplies (SMPS) are extensively used to convert the incoming AC power into various voltages like 3.3 V, 5 V, 12 V, 24 V etc. that are used to power various devices and circuits used in electronic equipment like battery chargers, computers, audio and video devices, radios etc. SMPS use large capacitors in their input section for filtration. When the power supply is first turned on, there is a very large inrush current drawn by the power supply as the input capacitors are charged (The capacitors act almost like a short circuit at the instant the power is turned on). The inrush current at turn-on is several to tens of times larger than the rated RMS input current and lasts for a few milliseconds. An example of the input voltage versus input current waveforms is given in Fig. 4.1. It will be seen that the initial input current pulse just after turn-on is > 15 times larger than the steady state RMS current. The inrush dissipates in around 2 or 3 cycles i.e. in around 33 to 50 milliseconds for 60 Hz sine wave.

Further, due to the presence of high value of input filter capacitors, the current drawn by an SMPS (With no Power Factor correction) is not sinusoidal but non-linear as shown in Fig 4.2. The steady state input current of SMPS is a train of non-linear pulses instead of a sinusoidal wave. These pulses are two to four milliseconds duration each with a very high Crest Factor of around 3 (Crest Factor = Peak value ÷ RMS value).

Many SMPS units incorporate "Inrush Current Limiting". The most common method is the NTC (Negative Temperature Coefficient) resistor. The NTC resistor has a high resistance when cold and a low resistance when hot. The NTC resistor is placed in series with the input to the power supply. The cold resistance limits the input current as the input capacitors charge up. The input current heats up the NTC and the resistance drops during normal operation. However, if the power supply is quickly turned off and back on, the NTC resistor will be hot so its low resistance state will not prevent an inrush current event.

The inverter should, therefore, be sized adequately to withstand the high inrush current and the high Crest Factor of the current drawn by the SMPS. Normally, inverters have short duration Surge Power Rating of 2 times their Maximum Continuous Power Rating. Hence, it is recommended that for purposes of sizing the inverter to accommodate Crest Factor of 3, the Maximum Continuous Power Rating of the inverter should be > 2 times the Maximum Continuous Power Rating of the SMPS. For example, an SMPS rated at 100 Watts should be powered from an inverter that has Maximum Continuous Power Rating of > 200 Watts.

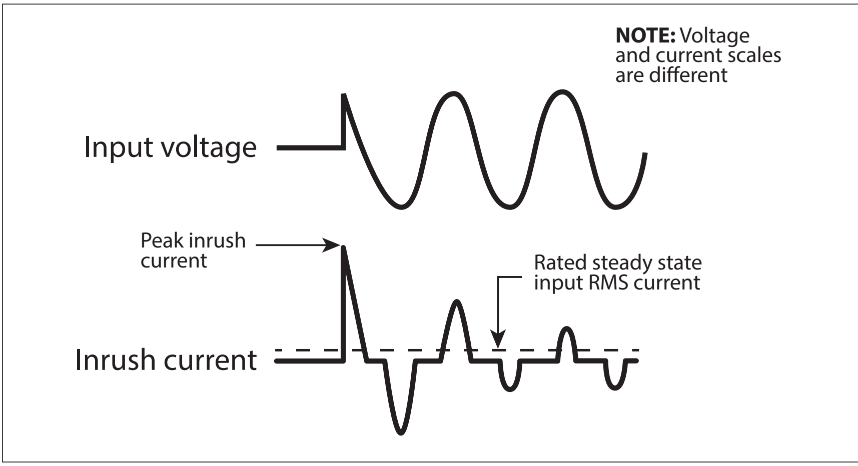


Fig 4.1: Inrush current in an SMPS

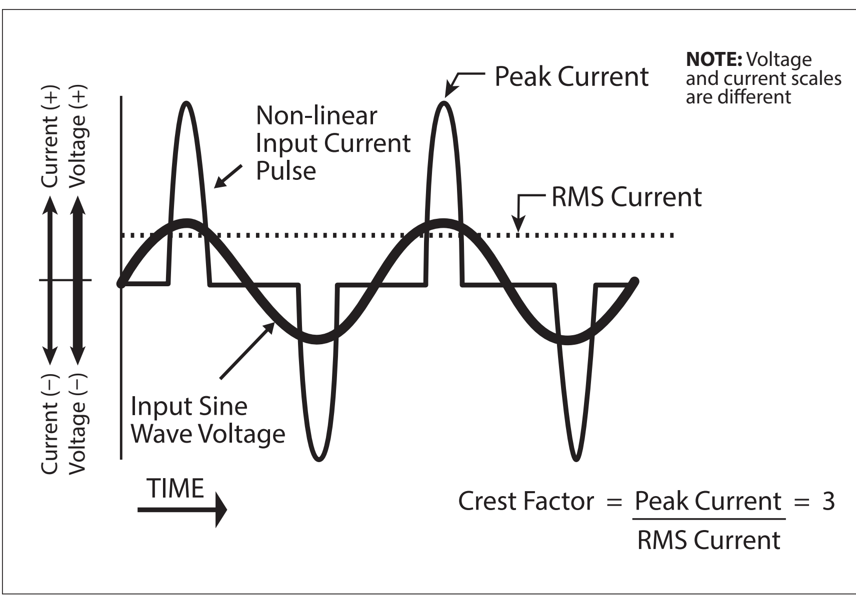


Fig. 4.2: High Crest Factor of current drawn by SMPS

SECTION 5 | Principle of Operation

5.1 GENERAL

These inverters convert DC battery voltage to AC voltage with an RMS (Root Mean Square) value of 120 VAC, 60 Hz RMS.

5.2 PURE SINE WAVE OUTPUT WAVEFORM

The waveform of the AC voltage is a pure Sine Waveform that is same as the waveform of Grid/Utility power *(Supplementary information on pure Sine Waveform and its advantages are discussed in Sections 2.2 to 2.4).*

Fig. 5.1 below specifies the characteristics of 120 VAC, 60 Hz pure Sine Waveform. The instantaneous value and polarity of the voltage varies cyclically with respect to time. For example, in one cycle in a 120 VAC, 60 Hz system, it slowly rises in the Positive direction from 0 V to a peak Positive value "Vpeak" = + 169.68 V, slowly drops to 0V, changes the polarity to Negative direction and slowly increases in the Negative direction to a peak Negative value "Vpeak" = - 169.68 V and then slowly drops back to 0 V. There are 60 such cycles in 1 sec. Cycles per second is called the "Frequency" and is also termed "Hertz (Hz)". The Time Period of 1 Cycle is 16.66 ms.

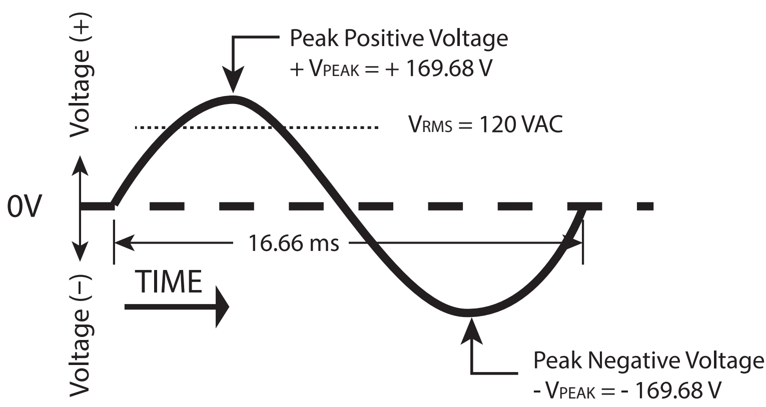
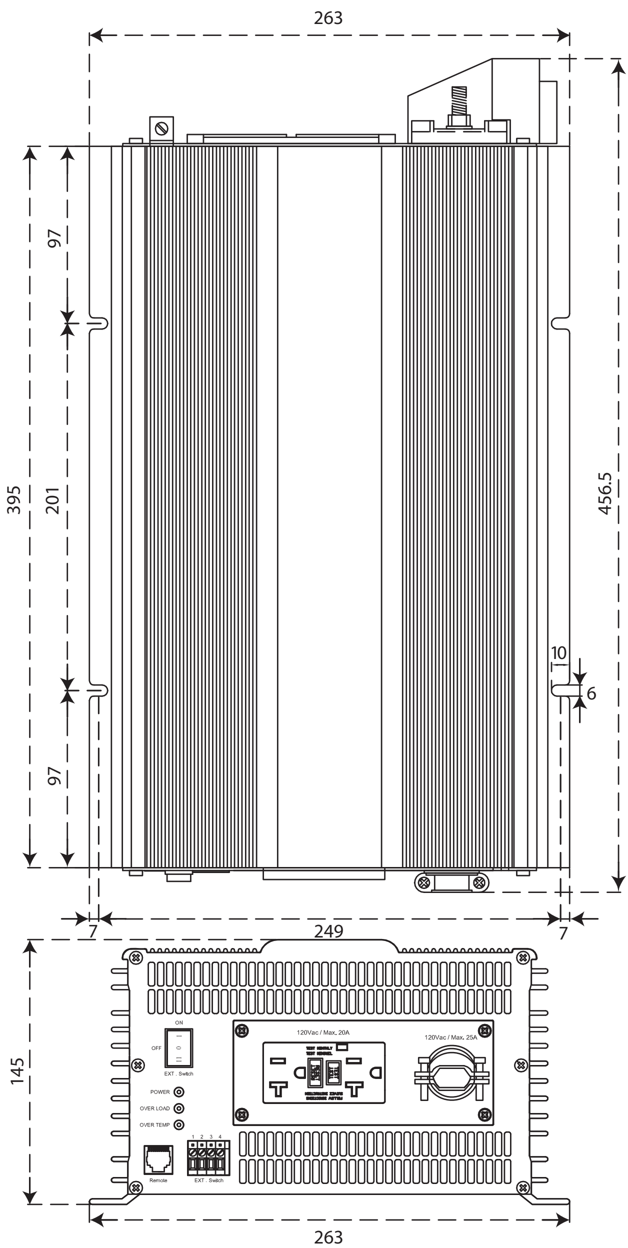


Fig. 5.1: 120 VAC, 60 Hz Pure Sine Waveform

5.3 PRINCIPLE OF OPERATION

The voltage conversion takes place in two stages. In the first stage, the DC voltage of the battery is converted to a high voltage DC using high frequency switching and Pulse Width Modulation (PWM) technique. In the second stage, the high voltage DC is converted to 120 VAC, 60 Hz sine wave AC again using PWM technique. This is done by using a special wave shaping technique where the high voltage DC is switched at a high frequency and the pulse width of this switching is modulated with respect to a reference sine wave.



NOTE: Dimensions are in mm

Fig. 8.1: PST-3000 Overall Dimensions & Mounting Slots

SECTION 6 | Layout

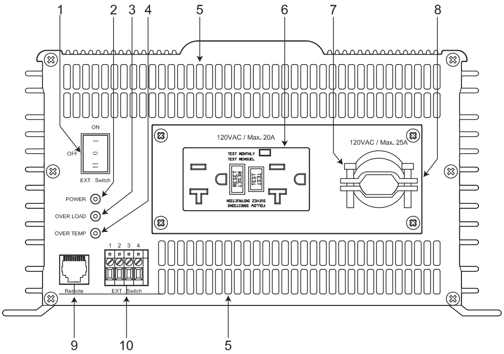


Fig 6.1 (a) PST-3000, Front

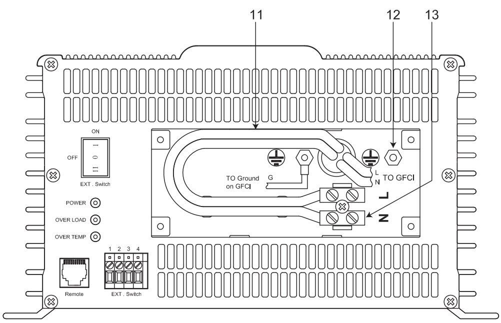


Fig 6.1 (b) PST-3000, Front - Showing compartment with terminals for hardwiring

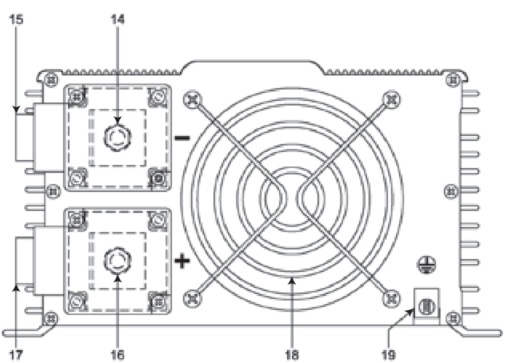
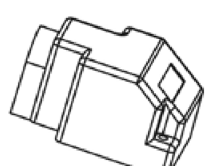


Fig 6.1 (c) PST-3000, Back

Fig. 6.1: Layout of PST-3000

1. Three Position Rocker Switch
   - – ON - Push top end to switch ON locally
   - 0 OFF – Centered to switch OFF locally
   - = EXT Switch - Push bottom end to enable switching ON and OFF by external switching control. (See section 8.8 of this user manual for details)
2. Green LED marked "POWER"
3. Red LED marked "OVER LOAD"
4. RED LED marked "OVER TEMP"
5. Air inlet slots for cooling fan
6. NEMA5-20R GFCI Duplex AC Outlet, 20 A maximum
7. Metal strain relief clamp for AC output cable (for hardwiring)
   - Size: Trade Size: ¾"
   - Wire size accommodated: 3- Conductor "Loomex" cable - AWG #14/3 to AWG #8/3
8. Cover plate for compartment containing L, N and G terminals for hardwiring of AC output to 120 VAC Panelboard
9. Modular Jack RJ-50 (10P10C) marked "Remote" for connecting optional wired Remote Control Model RC-300
10. Terminal Block marked "EXT Switch" with 4 terminals for ON/OFF switching using external control signals
11. Compartment containing L, N and G terminals for hardwiring of AC output to 120 VAC Panelboard
12. Nut and bolt terminal (size 6x32) for Ground "G" for hardwiring of AC output to 120 VAC Panelboard
13. Terminal Block for Line "L" and Neutral "N" terminals for hardwiring of AC output to 120 VAC Panelboard
    - Terminal hole diameter: 4.15 mm
    - Terminal set screw size: M3.5
14. Black Negative (-) DC input terminal – Nut and bolt: 5/16 in, 18 TPI
15. Black removable plastic cover for Negative (-) DC input terminal
16. Red Positive (+) DC input terminal – Nut and bolt: 5/16 in, 18 TPI
17. Red removable plastic cover for Positive (+) DC input terminal
18. Opening for air outlet from internal fan (fan is located behind the opening)
19. Chassis Grounding Terminal
    - Hole Diameter: 5/16"
    - Set screw size: 5/16 x 24TPI



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SECTION 7 | General Information - Battery Related

7.1 LEAD ACID BATTERY – BASIC DESCRIPTION AND ELECTRO-CHEMICAL REACTIONS

INFO

For complete information on Lead Acid Batteries and Charging Process, please visit www.samlexamerica.com > Support > White Papers > White Paper - Batteries, Chargers and Alternators.

7.1.1 A Lead Acid battery consists of a number of 2 V nominal cells (actual voltage of the cell is around 2.105 V) that are connected in series e.g. a 12 V nominal battery will have six, 2 V nominal cells in series (actual approximate voltage of the 6 cells will be 2.105 x 6 = 12.63 V). Each 2 V nominal cell in this battery consists of an independent enclosed compartment that has Positive and Negative Plates (also called Electrodes) dipped in electrolyte that is composed of diluted Sulphuric Acid.

7.1.2 A fully charged Lead Acid Battery comprises of (i) **Positive Plates**: Lead Dioxide, (ii) **Negative Plates**: Sponge Lead and (iii) Electrolyte: Mixture of 65% water and 35% Sulfuric Acid with Specific Gravity = 1.265 at Standard Room Temperature of 25 °C / 77 °F (Fully charged condition). During discharging, electro-chemical reactions lead to: (i) At Positive Plates: Conversion of Lead Dioxide to soft Lead Sulfate crystals, (ii) At Negative Plates: Conversion of Sponge Lead to soft Lead Sulfate crystals and (iii) In Electrolyte: Conversion of portion of Sulfuric Acid to water leading to reduction in Specific Gravity (1.120 for fully discharged condition).

7.2 TYPES OF LEAD ACID BATTERIES

7.2.1 Sealed Lead Acid (SLA) **Or Valve Regulated Lead Acid** (VRLA) **Batteries**: These can either be Gel Cell or AGM (Absorbed Glass Mat). In a Gel Cell battery, the electrolyte is in the form of a gel. In AGM (Absorbed Glass Mat) battery, the electrolyte is soaked in Glass Mat. In both these types, the electrolyte is immobile. There are no refill caps and the battery is totally sealed. Hydrogen and Oxygen released during the charging process is not allowed to escape and is recombined inside the battery through use of Recombinant Catalyst (s). Hence, there is no water loss and the batteries are maintenance free. These batteries have safety valves on each cell to release excessive pressure that may be built up inside the cell. The Gel Cell is the least affected by temperature extremes, storage at low state of charge and has a low rate of self-discharge. An AGM battery will handle overcharging slightly better than the Gel Cell.

7.2.2 Non Sealed (Vented/Flooded/Wet Cell) **Lead acid Batteries**: In these batteries, each individual cell compartment has a refill cap that is used to top up the cell with distilled water and to measure the specific gravity of the electrolyte using a hydrometer. When fully charged, each individual cell has a voltage of approximately 2.105 V and electrolyte specific gravity of 1.265. As the cell discharges, its voltage and specific gravity drop. Thus, a healthy, fully charged, 12 V nominal battery with each of the 6 cells fully charged to

2.105 V will measure a standing voltage of 12.63 V at Standard Room Temperature of 25 °C / 77 °F. Also, in a healthy battery, all the individual cells will have the same voltage and same specific gravity. If there is a substantial difference in the voltages (0.2 V or higher) and specific gravities of the individual cells (0.015 or more), the cells will have to be “equalized".

7.2.3 SLI (Starting, Lighting, and Ignition) **Batteries:** Everybody is familiar with the SLI batteries that are used for automotive starting, lighting, ignition and powering vehicular accessories. SLI batteries are designed to produce high current in short bursts for cranking. This current is also called also called “Cranking Amps”. SLI batteries use lots of thin plates to maximize the surface area of the plates for providing very large Cranking Amps. This allows very high starting current but causes the plates to warp when the battery is cycled. Vehicle starting typically discharges 1%-3% of a healthy SLI battery’s capacity. The automotive SLI battery is not designed for repeated deep discharge where up to 80% of the battery capacity is discharged and then recharged. If an SLI battery is used for this type of deep discharge application, its useful service life will be drastically reduced. This type of battery is not recommended for the storage of energy for inverter backup applications.

7.2.4 Deep Cycle Lead Acid Batteries: These batteries are designed with thick-plate electrodes to serve as primary power sources, to have a constant discharge rate, to have the capability to be deeply discharged up to 80% capacity and to repeatedly accept recharging. They are marketed for use in recreation vehicles (RV), boats and electric golf carts – so they may be referred to as RV batteries, marine batteries or golf cart batteries.

7.3 RATED CAPACITY SPECIFIED IN AMPERE-HOUR (Ah)

Battery capacity “C” is specified in Ampere-hours (Ah). An Ampere is the unit of measurement for electrical current and is defined as a Coulomb of charge passing through an electrical conductor in one second. The Capacity “C” in Ah relates to the ability of the battery to provide a constant specified value of discharge current (also called “C-rate” - see Section 7.6) over a specified time in hours before the battery reaches a specified discharged terminal voltage (Also called “End Point Voltage”) at a specified temperature of the electrolyte. As a benchmark, the automotive battery industry rates batteries at a discharge current or C-rate of C/20 Amperes corresponding to 20 Hour discharge period. The rated capacity “C” in Ah in this case will be the number of Amperes of current the battery can deliver for 20 Hours at 26.7 ºC / 80 ºF till the voltage drops to 1.75 V / Cell. i.e. 10.5 V for 12 V battery, 21 V for 24 V battery or 42 V for 48 V battery. For example, a 100 Ah battery will deliver 5 A for 20 Hours.

7.4 RATED CAPACITY SPECIFIED IN RESERVE CAPACITY (RC)

Battery capacity may also be expressed as Reserve Capacity (RC) in minutes typically for automotive SLI (Starting, Lighting and Ignition) batteries. It is the time in minutes a vehicle can be driven after the charging system fails. This is roughly equivalent to the conditions after the alternator fails while the vehicle is being driven at night with the headlights on. The battery alone must supply current to the headlights and the computer/ignition system. The assumed battery load is a constant discharge current of 25 A. Reserve capacity is the time in minutes for which the battery can deliver 25 Amperes at 26.7 °C / 80 °F till the voltage drops to 1.75 V / Cell i.e. 10.5 V for 12 V battery, 21 V for 24 V battery or 42 V for 48 V battery.

Approximate relationship between the two units is: **Capacity "C" in Ah = Reserve Capacity in RC minutes x 0.6**

7.5 TYPICAL BATTERY SIZES

The Table 7.1 shows details of some popular battery sizes:

TABLE 7.1: POPULAR BATTERY SIZES		
BCI* Group	**Battery Voltage, V**	**Battery Capacity, Ah**
27 / 31	12	105
4D	12	160
8D	12	225
GC2**	6	220
* Battery Council International; ** Golf Cart		

7.6 C-RATE OF CHARGE/DISCHARGE

7.6.1 The rate of charge/discharge of a battery is normally expressed in "C-rate" which is a multiple of the numerical value of the battery's Ampere Hour (Ah) Capacity (C) (See Section 7.3 for information on Ampere Hour Capacity). Few examples of C-rates (2C, 1C, 0.2C etc.) for 100 Ah capacity battery (C=100 Ah) are given below:

- 2C = (2x100) A = 200 A (As the battery capacity is 100 Ah, the battery will be completely discharged in 0.5 Hrs.)
- 1C = (1x 100) A = 100A (As the battery capacity is 100 Ah, the battery will be completely discharged in 1 Hr.)
- 0.2C (or C/5) = (0.2 x 100) A = 20 A (As the battery capacity is 100 Ah, the battery will be completely discharged in 5 Hrs.)

7.6.2 Example for Determining C-rate of Charge for Particular Value of Charge Current:

- Determine the Ah capacity (C) of the battery – say 100 Ah (C=100 Ah)
- Determine the value of charge current – say 10 Amperes
- C-rate of charge at 10A = Multiple of numerical value Ampere Hour Capacity (C) = (10 ÷ 100) C = 1/10 C or 0.1C

7.6.3 Example for Determining C-rate of Discharge for Particular Value of Discharge Current:

- Determine the Ah capacity (C) of the battery – say 100 Ah (C=100)
- Determine the value of discharge current – say 20 Amperes
- C-rate of discharge at 20 A = Multiple of numerical value of Ah Capacity (C) = (20 ÷ 100) C = 1/5 C

7.6.4 Table 7.2 gives some examples of typical C-rates of Discharge and applications:

TABLE 7.2: TYPICAL "C-rates" OF DISCHARGE	
C-rate of Discharge **(Column 1)**	**Examples of C-rate of Discharge for 100 Ah capacity battery (Column 2)**
2C	200 A
1C	100 A
C/5 or 0.2C (Inverter application)	20 A
C/8 or 0.125C (UPS application)	12.5 A
C/10 or 0.1C (Telecom application)	10 A
C/20 or 0.05C (Automotive application)	5 A
C/100 or 0.01C	1 A

7.7 CHARGE/DISCHARGE CURVES TO DETERMINE STATE OF CHARGE OF LEAD ACID BATTERY BASED ON ITS TERMINAL VOLTAGE AND C-RATES OF CHARGE/DISCHARGE

7.7.1 Fig 7.1 shows examples of State of Charge/Discharge Curves for different C-rates for typical 12 V / 24 V Lead Acid Battery at 26.7 °C / 80 °F. These curves are used to determine the State of Charge/Discharge of the battery based on its terminal voltage.

The Y-Axis shows the terminal voltage of the battery. The X-Axis shows % State of Charge. % State of Discharge can be converted to % State of Charge using formula:

- % State of Charge = (100% - % State of Discharge) e.g. 80% State of Discharge = 100%-80% = 20% State of Charge

7.7.2 Example of Determining State of Charge (using Fig 7.1) **when Charging 12 V, 100 Ah Battery at C-rate of 0.1C or C/10 or 10 A:** Refer to Charge Curve marked C\10 of the upper 4 curves marked "CHARGE". States of Charge at different battery terminal voltages will be: (a) At 15.3 V = 100% charged; (b) At 14.3 V = 90% charged; (c) At 13.5 V = 70% charged; (d) At 12.5 V = 15% charged

7.7.3 Example of Determining State of Discharge (using Fig 7.1) **when Discharging 12 V, 100 Ah Battery at C-rate of 0.33 C or C/3 or 33.3 A:** Refer to Charge Curve marked C\3 of the lower 4 curves marked "DISCHARGE". States of Discharge at different battery terminal voltages will be: [a] At 9.5 V = 100% discharged (0% charged); [b] At 10.4 V = 80% discharged (20% charged): [c] At 11.5 V = 28% discharged (72% charged) and [d] 11.75 V = 0% discharged (100% charged)

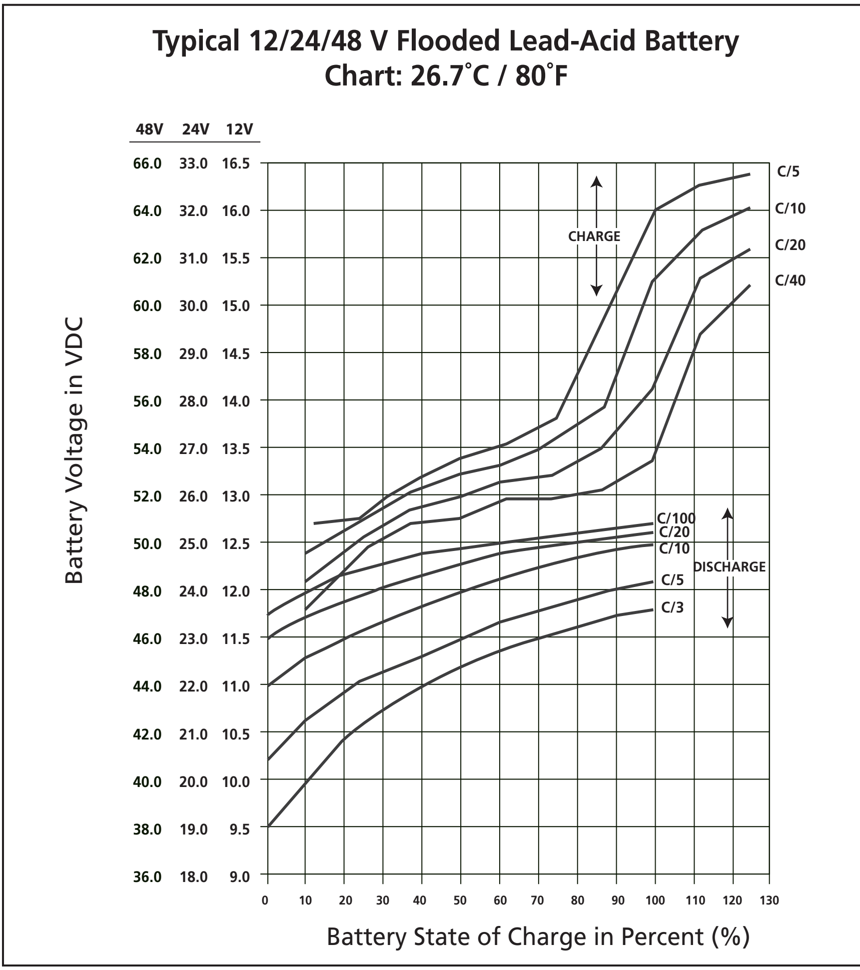

Fig 7.1 Charging/Discharging Curves for Typical 12V/24V/48 Flooded Lead Acid Battery

7.8 REDUCTION IN USABLE CAPACITY AT HIGHER DISCHARGE RATES – TYPICAL IN INVERTER APPLICATION

As stated earlier, the Ah capacity of automotive battery is normally applicable at C-rate of C/20 (or, 0.05C). As the discharge rate is increased as in cases where the inverters are driving higher capacity loads, the usable Ah capacity reduces due to “Peukert Effect”. This relationship is not linear but is more or less according to the Table 7.3.

TABLE 7.3: BATTERY CAPACITY VERSUS RATE OF DISCHARGE – C-RATE	
C-rate Discharge Current	Usable Capacity (%)
C/20 or, 0.05C	100%
C/10 or, 0.10C	87%
C/8 or, 0.125C	83%
C/6 or, 0.17C	75%
C/5 or, 0.20C	70%
C/3 or, 0.34C	60%
C/2 or, 0.50C	50%
1C	40%

Table 7.3 shows that a 100 Ah capacity battery will deliver 100% (i.e. full 100 Ah) capacity if it is slowly discharged over 20 Hours at the rate of 5 Amperes (50 W output for a 12 V inverter and 100 W output for a 24 V inverter). However, if it is discharged at a rate of 50 Amperes (500 W output for a 12 V inverter and 1000 W output for a 24 V inverter) then theoretically, it should provide 100 Ah ÷ 50 = 2 Hours. However, Table 7.3 shows that for 2 Hours discharge rate, the capacity is reduced to 50% i.e. 50 Ah. Therefore, at 50 Ampere discharge rate (500 W output for a 12 V inverter and 1000 W output for a 24 V inverter) the battery will actually last for 50 Ah ÷ 50 Amperes = 1 Hour.

7.9 STATE OF CHARGE (SOC) OF A BATTERY – BASED ON "STANDING VOLTAGE"

The "Standing Voltage" of a battery under open circuit conditions (no charger or load connected to it) can approximately indicate the State of Charge (SOC) of the battery. The "Standing Voltage" is measured after disconnecting any charging device(s) and the battery load(s) and letting the battery "stand" idle for 3 to 8 hours before the voltage measurement is taken. Table 7.4 shows the State of Charge versus Standing Voltage for a typical 12 V / 24 V / 48 V battery system at 26.7 °C / 80 °F.

TABLE 7.4: SOC VERSUS STANDING VOLTAGE (Typical Flooded Battery)				
Percentage of Full Charge	Standing Voltage of Individual Cells	Standing Voltage of 12 V Battery	Standing Voltage of 24 V Battery	Standing voltage of 48 V battery
100%	2.105 V	12.63 V	25.26 V	50.52 V
90%	2.10 V	12.6 V	25.20 V	50.40 V
80%	2.08 V	12.5 V	25.00 V	50.00 V
70%	2.05 V	12.3 V	24.60 V	49.20 V
60%	2.03 V	12.2 V	24.40 V	48.80 V
50%	2.02 V	12.1 V	24.20 V	48.40 V
40%	2.00 V	12.0 V	24.00 V	48.00 V
30%	1.97 V	11.8 V	23.60 V	47.20 V
20%	1.95 V	11.7 V	23.40 V	46.80 V
10%	1.93 V	11.6 V	23.20 V	46.40 V
0%	= / < 1.93 V	= / < 11.6 V	= / < 23.20 V	= / < 46.40 V

Check the individual cell voltages/specific gravity. If the inter cell voltage difference is more than a 0.2 V, or the specific gravity difference is 0.015 or more, the cells will require equalization. Please note that only non-sealed/vented/flooded/wet cell batteries are equalized. Do not equalize sealed/VRLA type of AGM or Gel Cell Batteries.

7.10 STATE OF DISCHARGE OF A LOADED BATTERY – LOW BATTERY/ DC INPUT VOLTAGE ALARM AND SHUTDOWN IN INVERTERS

Most inverter hardware estimates the State of Discharge of the loaded battery by measuring the voltage at the inverter's DC input terminals (considering that the DC input cables are thick enough to allow a negligible voltage drop between the battery and the inverter).

Inverters are provided with a buzzer alarm to warn that the loaded battery has been deeply discharged to around 80% of the rated capacity. Normally, the buzzer alarm is triggered when the voltage at the DC input terminals of the inverter has dropped to around 10.7 V for a 12 V battery, 21.4 V for 24 V, or 42 V for 48 V battery at C-rate discharge current of C/5 Amps and electrolyte temp. of 26 °C / 80 °F. The inverter is shut down if the terminal voltage at C/5 discharge current falls further to 10V for 12 V battery, 20 V for a 24 V battery, or 40 V for a 48 V battery.

The State of Discharge of a battery is estimated based on the measured terminal voltage of the battery. The terminal voltage of the battery is dependent upon the following:

- **Temperature of the battery electrolyte:** Temperature of the electrolyte affects the electrochemical reactions inside the battery and produces a Negative Voltage Coefficient – during charging/discharging, the terminal voltage drops with rise in temperature and rises with drop in temperature

- Battery terminal voltage under load is dependent on discharge current (C-rate). At higher discharge currents, voltage drops more rapidly. Therefore, the inverter's fixed low voltage alarm and shutdown thresholds provide only an approximate indication of State of Charge.

The discharge curves in Fig. 7.1 show the % State of Charge versus the terminal voltage of typical Flooded Lead Acid Battery under different charge/discharge currents, i.e. "C-rates" and fixed temperature of 26 °C / 80 °F. (Please note that the X-Axis of the curves shows the % of State of Charge. The % of State of Discharge will be 100% - % State of Charge).

7.11 LOW DC INPUT VOLTAGE ALARM IN INVERTERS

As stated earlier at Section 7.10, the buzzer alarm is triggered when the voltage at the DC input terminals of the inverter has dropped to around 10.7 V for a 12 V battery, 21.4 V for a 24 V or 42 V for 48.0 V battery at C-rate discharge current of C/5 Amps. Please note that the terminal voltage relative to a particular of State Discharge decreases with the rise in the value of the discharge current. For example, terminal voltages for a State of Discharge of 80% (State of Charge of 20%) for various discharge currents will be as given at: Table 7.5 (Refer to Fig 7.1 for parameters and values shown in Table 7.5):

TABLE 7.5: TERMINAL VOLTAGE AND SOC OF LOADED BATTERY						
Discharge Current: C-rate	Terminal Voltage at 80% State of Discharge (20% SOC)			Terminal Voltage When Completely Discharged (0% SOC)		
	12 V	24 V	48 V	12 V	24 V	48 V
C/3 A	10.45 V	20.9 V	41.8 V	09.50 V	19.0 V	38.0 V
C/5 A	10.90 V	21.8 V	43.6 V	10.30 V	20.6 V	41.2 V
C/10 A	11.50 V	23.0 V	46.0 V	11.00 V	22.0 V	44.0 V
C/20 A	11.85 V	23.7 V	47.4 V	11.50 V	23.0 V	46.0 V
C/100 A	12.15 V	24.3 V	48.6 V	11.75 V	23.5 V	47.0 V

In the example given above, the 10.7 V / 21.4 V / 42.0 V Low/DC Input Alarm would trigger at around 80% discharged state (20% SOC) when the C-rate discharge current is C/5 Amps. However, for lower C-rate discharge current of C/10 Amps and lower, the battery will be almost completely discharged when the alarm is sounded. Hence, if the C-rate discharge current is lower than C/5 Amps, the battery may have completely discharged by the time the Low DC Input Alarm is sounded.

In view of the above, it may be seen that a fixed Low DC Input Voltage Alarm is not useful. Temperature of the battery further complicates the situation. All the above analysis is based on battery electrolyte temperature of 26°C / 80°F. The battery capacity varies with temperature. Battery capacity is also a function of age and charging history. Older batteries have lower capacity because of shedding of active materials, sulfation, corrosion, increasing number of charge/discharge cycles etc. Hence, the State of Discharge of a battery under load cannot be estimated accurately. However, the low DC input voltage alarm function is designed to protect the inverter from excessive current drawn at the lower voltage.

7.12 LOW DC INPUT VOLTAGE SHUT-DOWN IN INVERTERS

As explained above at Section 7.10, at around 80% State of Discharge of the battery at C-rate discharge current of around C/5 Amps, the Low DC Input Voltage Alarm is sounded at around 10.7 V for a 12 V battery, at around 21.4 V for 24 V, or 42 V for 48 V battery to warn the user to disconnect the battery to prevent further draining of the battery. If the load is not disconnected at this stage, the batteries will be drained further to a lower voltage and to a completely discharged condition that is harmful for the battery and for the inverter.

Inverters are normally provided with a protection to shut down the output of the inverter if the DC voltage at the input terminals of the inverter drops below a threshold of around 10 V for a 12 V battery, 20 V for 24 V, or 40 V for 48 V battery. Referring to the Discharge Curves given in Fig 7.1, the State of Discharge for various C-rate discharge currents for battery voltage of 10 V / 20 V /40 V is as follows: (Please note that the X-Axis of the curves shows the % of State of Charge. The % of State of Discharge will be 100% - % State of Charge):

- 85% State of Discharge (15% State of Charge) at very high C-rate discharge current of C/3 Amps.
- 100% State of Discharge (0% State of Charge) at high C-rate discharge current of C/5 Amps.

- 100% discharged (0% State of charge) at lower C-rate Discharge current of C/10 Amps

It is seen that at DC input voltage of 10 V / 20 V / 40 V, the battery is completely discharged for C-rate discharge current of C/5 and lower.

In view of the above, it may be seen that a fixed Low DC Input Voltage Shutdown is not useful. Temperature of the battery further complicates the situation. All the above analysis is based on battery electrolyte temperature of 26°C / 80 °F. The battery capacity varies with temperature. Battery capacity is also a function of age and charging history. Older batteries have lower capacity because of shedding of active materials, sulfation, corrosion, increasing number of charge/discharge cycles etc. Hence, the State of Discharge of a battery under load cannot be estimated accurately. However, the low DC input voltage alarm and shut-down function is designed to protect the inverter from excessive current drawn at the lower voltage.

7.13 USE OF EXTERNAL PROGRAMMABLE LOW VOLTAGE DISCONNECTS

The above ambiguity can be removed by using an external, programmable Low Voltage Disconnect where more exact voltage threshold can be set to disconnect the battery based on the actual application requirements. We do recommend adding to your system one of the Battery Voltage Protectors, manufactured by Samlex America, Inc. For more information, visit our website www.samlexamerica.com.

- BGW-40 (40 A) – For up to 400 W, 12 V inverter or 800 W, 24 V Inverter, or 1600 W, 48 V Inverter
- BGW-60 (60 A) - For up to 600 W, 12 V inverter or 1200 W, 24 V Inverter, or 2400 W, 48 V Inverter
- BGW-200 (200 A) - For up to 2000 W, 12 V inverter or 4000 W, 24 V Inverter, or 5000 W, 48 V inverter

7.14 DEPTH OF DISCHARGE OF BATTERY AND BATTERY LIFE

The more deeply a battery is discharged on each cycle, the shorter the battery life. Using more batteries than the minimum required will result in longer life for the battery bank. A typical cycle life chart is given in the Table 7.6:

TABLE 7.6: TYPICAL CYCLE LIFE CHART

Depth of Discharge % of Ah Capacity	Cycle Life of Group 27 /31	Cycle Life of Group 8D	Cycle Life of Group GC2
10	1000	1500	3800
50	320	480	1100
80	200	300	675
100	150	225	550
NOTE: It is recommended that the depth of discharge should be limited to 50%.			

7.15 INSTALLING BATTERIES - SERIES AND PARALLEL CONNECTION

Batteries are normally available in voltages of 2 V, 6 V and 12 V and with different Ah capacities. A number of individual batteries can be connected in series and in parallel to form a bank of batteries with the desired increased voltage and capacity.

7.15.1 Series Connection

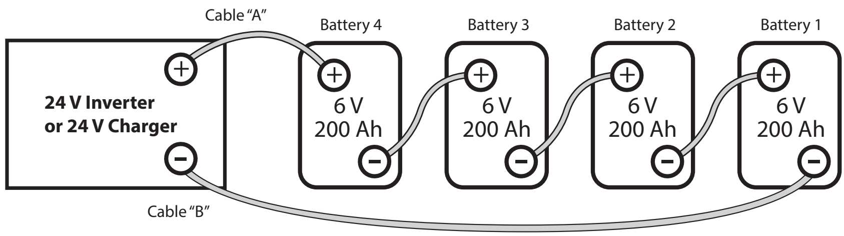

Fig 7.2 Series Connection

When two or more batteries are connected in series, their voltages add up but their Ah capacity remains the same. Fig. 7.2 shows 4 pieces of 6 V, 200 Ah batteries connected in series to form a battery bank of 24 V with a capacity of 200 Ah. The Positive terminal of battery 4 becomes the Positive terminal of the 24 V 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 24 V battery bank.

7.15.2 Parallel Connection

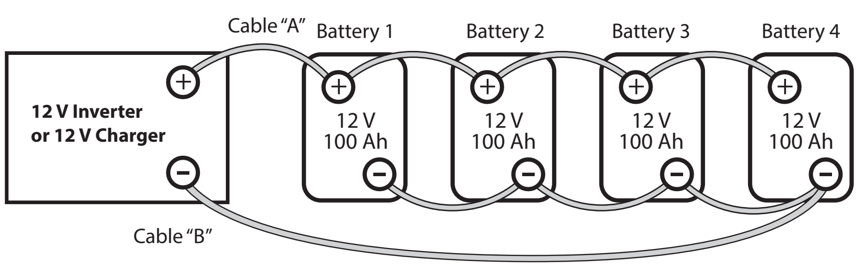

Fig 7.3 Parallel Connection

When two or more batteries are connected in parallel, their voltage remains the same but their Ah capacities add up. Fig. 7.3 shows 4 pieces of 12 V, 100 Ah batteries connected in parallel to form a battery bank of 12 V 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 12 V 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 12 V battery bank.

7.15.3 Series – Parallel Connection

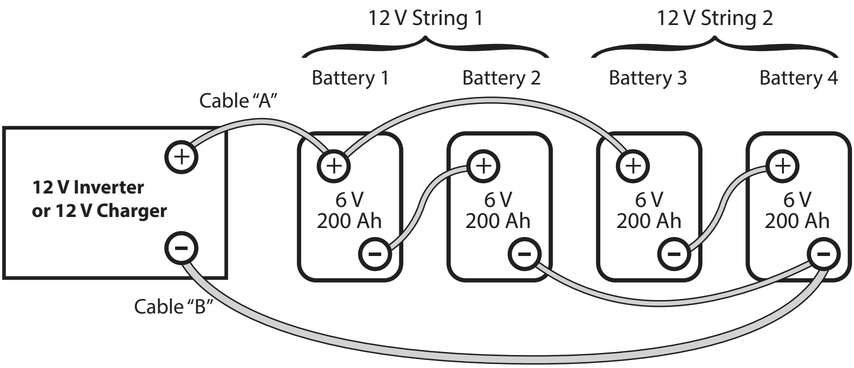

Fig. 7.4 Series-Parallel Connection

Figure 7.4 shows a series – parallel connection consisting of four 6 V, 200 AH batteries to form a 12 V, 400 Ah battery bank. Two 6 V, 200 Ah batteries, batteries 1 and 2 are connected in series to form a 12 V, 200 Ah battery (String 1). Similarly, two 6 V, 200 Ah batteries, batteries 3 and 4 are connected in series to form a 12 V, 200 Ah battery (String 2). These two 12 V, 200 Ah Strings 1 and 2 are connected in parallel to form a 12 V, 400 Ah bank.

7.15.4 Wiring Order in Parallel Connection of Batteries

CAUTION!

When 2 or more batteries/battery strings are connected in parallel and are then connected to inverter/charger (See Figs 7.3 and 7.4), 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 7.3) or to the Positive battery post of the first battery string (Battery 1 of String 1 in Fig. 7.4), 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. 7.3) or to the Negative Post of the last battery string (Battery 4 of Battery String 2 as in Fig. 7.4). 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/discharge at the same charging/discharging current and thus, will be charged/discharged to the same state at the same time.
- None of the batteries will see an overcharge/overdischarge 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. 7.3) or to the Positive battery post of the first battery string (Battery 1 of String 1 in Fig. 7.4), 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. 7.3) or to the Negative Post of the first battery string (Battery 1 of Battery String 1 as in Fig 7.4), 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/discharged at different charging discharging current and thus, will reach fully charged/ discharged state at different times.
- The battery with lower series resistance will take shorter time to charge/discharge as compared to the battery which sees higher series resistance and hence, will experience over charging/over discharging and its life will be reduced.

ATTENTION !

Quand il y a 2 batteries/fils de batterie ou plus qui sont liés en parallèle et branché à la fois, à un chargeur (voir Figs. 7.3 et 7.4), il faut faire attention à la manière dont le chargeur est branché à la banque de batterie. Veuillez assurer que le câble positif de sortie du chargeur de batterie (câble A) est lié à la borne positive de la première batterie (la batterie 1 dans la Fig. 7.3) ou à la borne positive de batterie qui est liée au premier fil (le fil 1 et la batterie 1, Fig 7.4), et puis le câble négatif de sortie du chargeur de batterie (câble B) est lié à la borne négative de la dernière batterie (la batterie 4 dans la Fig. 7.3) ou à la borne négative de batterie qui est liée au dernier fil (le fil 2 et la batterie 4 dans la Fig. 7.4). Cette connexion assure la suivante:

- Les résistances des câbles d’interconnexion seront équilibrées. Toutes les batteries/chaînes de batteries présenteront la même résistance en série.
- Toutes les batteries se chargeront et se déchargeront avec le même courant de charge/décharge et atteindront ainsi le même état de charge ou de décharge au même moment.
- Aucune des batteries ne sera soumise à une condition de surcharge ou de décharge excessive.

Si le câble positif de sortie du chargeur de batterie (câble A) est lié à la borne positive de la première batterie (la batterie 1 dans la Fig. 7.3) ou à la borne positive de batterie qui est liée au premier fil (le fil 1 et la Batterie 1, Fig 7.4), et puis le câble négatif de sortie du chargeur de batterie (câble B) est lié à la borne négative de la première batterie (la batterie 1 dans la Fig. 7.3) ou à la borne négative de batterie qui est liée au premier fil (le fil 1 de la batterie 1 dans la Fig. 7.4), les conditions :

- Les résistances des câbles de raccordement ne seront pas équilibrées.
- Les différentes batteries présenteront des résistances en série différentes.
- Toutes les batteries individuelles seront chargées/déchargées avec des courants de charge/décharge différents et atteindront donc leur état de pleine charge ou de décharge complète à des moments différents.
- La batterie présentant une résistance en série plus faible se chargera/ se déchargera plus rapidement que la batterie présentant une résistance en série plus élevée et sera donc soumise à une surcharge ou à une décharge excessive, ce qui réduira sa durée de vie.

7.16 SIZING THE INVERTER BATTERY BANK

One of the most frequently asked questions is, "how long will the batteries last?" This question cannot be answered without knowing the size of the battery system and the load on the inverter. Usually this question is turned around to ask “How long do you want your load to run?”, and then specific calculation can be done to determine the proper battery bank size. There are a few basic formulae and estimation rules that are used:

1. Active Power in Watts (W) = Voltage in Volts (V) x Current in Amperes (A) x Power Factor.
2. For an inverter running from a 12 V battery system, the approximate DC current required from the 12 V batteries is the AC power delivered by the inverter to the load in Watts (W) divided by 10 & for an inverter running from a 24 V battery system, the approximate DC current required from the 24 V batteries is the AC power delivered by the inverter to the load in Watts (W) divided by 20. It will be loads in Watts divided by 40 for a 48 V battery system.
3. Energy required from the battery = DC current to be delivered (A) x Time in Hours (H).

The first step is to estimate the total AC watts (W) of load(s) and for how long the load(s) will operate in hours (H). The AC watts are normally indicated in the electrical nameplate for each appliance or equipment. In case AC watts (W) are not indicated, Formula 1 given above may be used to calculate the AC watts. The next step is to estimate the DC current in Amperes (A) from the AC watts as per Formula 2 above. An example of this calculation for a 12 V inverter is given below:

Let us say that the total AC Watts delivered by the inverter = 1000 W.

Then, using Formula 2 above, the approximate DC current to be delivered by the 12 V batteries = 1000 W ÷10 = 100 Amperes, by 24 V batteries = 1000 W ÷ 20 = 50 A, or by 48 V batteries = 25 A.

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 12 V batteries = 100 Amperes × 3 Hours = 300 Ampere Hours (Ah), by the 24 V batteries = 50 A x 3 Hrs = 150 Ah, or by the 48 V batteries = 25 A x 3 Hrs = 75 Ah.

Now, the capacity of the batteries is determined based on the run time and the usable capacity. From Table 7.3 "Battery Capacity versus Rate of Discharge", the usable capacity at 3 Hour discharge rate (C/3) is 60%. Hence, the actual capacity of the 12 V batteries to deliver 300 Ah will be equal to: 300 Ah ÷ 0.6 = 500 Ah, and the actual capacity of the 24 V battery to deliver 150 Ah will be equal to 150 Ah ÷ 0.6 = 250 Ah, or 75 Ah/0.6 = 125 Ah.

And finally, the actual desired rated capacity of the batteries is determined based on the fact that normally only 80% of the capacity will be available with respect to the rated capacity due to non availability of ideal and optimum operating and charging conditions. So the final requirements will be equal to:

FOR 12 V BATTERY:
500 Ah ÷ 0.8 = 625 Ah (note that the actual energy required by the load was 300 Ah).

FOR 24 V BATTERY:
250 Ah ÷ 0.8 = 312.5 Ah (note that the actual energy required was 150 Ah).

FOR 48 V BATTERY:
125 Ah/0.8 = 156.25 Ah (note the actual energy required was 75 Ah).

It will be seen from the above that the final rated capacity of the batteries is almost 2 times the energy required by the load in Ah. Thus, as a rule of thumb, the Ah capacity of the batteries should be twice the energy required by the load in Ah.

7.17 CHARGING BATTERIES

Batteries can be charged by using good quality AC powered battery charger or from alternative energy sources like solar panels, wind or hydro systems. Make sure an appropriate Battery Charge Controller is used. It is recommended that batteries may be charged at 10% to 20% of their Ah capacity (Ah capacity based on 20 Hr Discharge Rate). Based on the application, batteries may be charged using 2-Stage/3-Stage/4-Stage Charging Profiles as follows:

- **Float Application Charging (2-Stage)**
  Stage 1 (Bulk Stage at constant current) → Stage 2 (Absorption Stage at constant voltage. May also be called Float Stage in some applications).
- **Normal Charging (3-Stages)**
  Stage 1 (Bulk Stage at constant current) → Stage 2 (Absorption Stage at constant voltage) → Stage 3 (Float Stage at constant voltage)
- **Equalization Charging (4-Stages)**
  Stage 1 (Bulk Stage at constant current) → Stage 2 (Absorption Stage at constant voltage) → Stage 3 (Equalization Stage at constant voltage) → Stage 4 (Float Stage at constant voltage)

SECTION 8 | Installation

WARNING!

1. Before commencing installation, please read the safety instructions explained in Section 1 titled “Safety Instructions” on page 3.

2. It is recommended that the installation should be undertaken by a qualified, licensed/certified electrician.

3. Various recommendations made in this manual on installation will be superseded by the National/Local Electrical Codes related to the location of the unit and the specific application.

AVERTISSEMENT !

1. Avant de commencer l’installation, veuillez lire les consignes de sécurité expliquées à la section intitulée « Instructions de sécurité » à la page 3.

2. Il est recommandé que l’installation soit effectuée par un électricien qualifié, agréé/certifié.

3. Les diverses recommandations d’installation formulées dans ce manuel seront supplantées par les codes électriques nationaux/locaux applicables à l’emplacement de l’unité et à l’application spécifique.

8.1 LOCATION OF INSTALLATION

Please ensure that the following requirements are met:

Working Environment: Indoor use.

Cool: Heat is the worst enemy of electronic equipment. Hence, please ensure that the unit is installed in a cool area that is also protected against heating effects of direct exposure to the sun or to the heat generated by other adjacent heat generating devices.

Well Ventilated: The unit is cooled by convection and by forced air-cooling by temperature controlled fan. The fan draws cool air from air intake openings on the front (5, Fig 6.1a) and expels hot air through the exhaust openings next to the fan (18, Fig 6.1c). To avoid shut down of the inverter due to over temperature, do not cover or block these intake/exhaust openings or install the unit in an area with limited airflow. Keep a minimum clearance of 10” around the unit to provide adequate ventilation. If installed in an enclosure, openings must be provided in the enclosure, directly opposite to the air intake and exhaust openings of the inverter.

Dry: There should be no risk of condensation, water or any other liquid that can enter or fall on the unit.

Clean: The area should be free of dust and fumes. Ensure that there are no insects or rodents. They may enter the unit and block the ventilation openings or short circuit electrical circuits inside the unit.

Protection Against Fire Hazard: The unit is not ignition protected and should not be located under any circumstance in an area that contains highly flammable liquids like gasoline or propane as in an engine compartment with gasoline-fueled engines. Do not keep any flammable/combustible material (i.e., paper, cloth, plastic, etc.) near the unit that may be ignited by heat, sparks or flames.

Closeness to the Battery Bank: Locate the unit as close to the battery bank as possible to prevent excessive voltage drop in the battery cables and consequent power loss and reduced efficiency. However, the unit should not be installed in the same compartment as the batteries (flooded or wet cell) or mounted where it will be exposed to corrosive acid fumes and flammable Oxygen and Hydrogen gases produced when the batteries are charged. The corrosive fumes will corrode and damage the unit and if the gases are not ventilated but allowed to collect, they could ignite and cause an explosion.

Accessibility: Do not block access to the front panel. Also, allow enough room to access the AC receptacles and DC wiring terminals and connections, as they will need to be checked and tightened periodically.

Preventing Radio Frequency Interference (RFI): The unit uses high power switching circuits that generate RFI. This RFI is limited to the required standards. Locate any electronic equipment susceptible to radio frequency and electromagnetic interference as far away from the inverter as possible. *Read Section 3 "Limiting Electromagnetic Interference (EMI)" for additional information.*

8.2 MOUNTING ORIENTATION

The unit has air intake and exhaust openings for the cooling fan. It has to be mounted in such a manner so that small objects should not be able to fall easily into the unit from these openings and cause electrical/mechanical damage. Also, the mounting orientation should be such that if the internal components overheat and melt/dislodge due to a catastrophic failure, the melted/hot dislodged portions should not be able to fall out of the unit on to a combustible material and cause a fire hazard. The size of openings has been limited as per the safety requirements to prevent the above possibilities when the unit is mounted in the recommended orientations. In order to meet the regulatory safety requirements, the mounting has to satisfy the following requirements:

- Mount on a non-combustible material.
- The mounting surface should be able to support the weight of the unit.
- Mount horizontally on a horizontal surface - above a horizontal surface (e.g. table top or a shelf).
- Mount horizontally on a vertical surface – The unit can be mounted on a vertical surface (like a wall) with the fan axis horizontal (fan opening facing left or right).

WARNING!

Mounting the unit vertically on a vertical surface is NOT recommended (fan opening facing up or down). As explained above, this is to prevent falling of objects into the unit through the fan opening when the fan opening faces up. If fan opening faces down, hot damaged component may fall out.

The surface of the unit is likely to be at an elevated temperature in conditions of higher load and higher ambient temperature. Hence, the unit should be installed in a mannerere it is not likely to come in contact with any person.

AVERTISSEMENT !

Le montage de l'unité verticalement sur une surface verticale n'est PAS recommandé (ouverture du ventilateur orientée vers le haut ou vers le bas). Comme expliqué ci-dessus, cela vise à empêcher la chute d'objets dans l'unité par l'ouverture du ventilateur lorsque celle-ci est orientée vers le haut. Si l'ouverture du ventilateur est orientée vers le bas, un composant endommagé et chaud peut tomber hors de l'unité.

La surface de l'unité est susceptible d'atteindre une température élevée dans des conditions de charge élevée et de température ambiante élevée. Par conséquent, l'unité doit être installée de manière à ne pas entrer en contact avec une personne.

8.3 DC SIDE CONNECTIONS

8.3.1 Preventing DC Input Over Voltage

It is to be ensured that the DC input voltage of this unit does not exceed 16.5 VDC for PST-3000-12, 33.0 VDC for PST-3000-24, and 60 VDC for PST-3000-48 to prevent permanent damage to the unit. Please observe the following precautions:

- Ensure that the maximum charging voltage of the external battery charger/ alternator/solar charge controller does not exceed 16.5 VDC for PST-3000-12, 33.0 VDC for PST-3000-24, and 60 VDC for PST-3000-48.

- Do not use solar panel/array to directly charge the battery bank connected to the inverter. Use appropriate Charge Controller between the solar panel/array and the battery bank. Using solar panel/array to directly charge the battery will lead to over voltage shutdown of the inverter and possible damage due to battery voltage rising close to the level of the open circuit voltage of the solar panel(s) when the battery is fully charged and is in Float Stage (under this condition, the battery will be drawing very low trickle charge current & voltage of the unregulated solar panel(s) will rise close to its Open Circuit Voltage).

- When using Diversion Charge Control Mode in a charge controller, the solar/wind/hydro source is directly connected to the battery bank. In this case, the controller will divert excess current to an external load. As the battery charges, the diversion duty cycle will increase. When the battery is fully charged, all the source energy will flow into the diversion load if there are no other loads. The charge controller will disconnect the diversion load if the current rating of the controller is exceeded. Disconnection of the diversion load may damage the battery as well as the inverter or other DC loads connected to the battery due to high voltages generated during conditions of high winds (for wind generators), high water flow rates (for hydro generators). It is, therefore, to be ensured that the diversion load is sized correctly to prevent the above over voltage conditions.

- Do not connect this unit to a battery system with a voltage higher than the rated battery input voltage of the unit.

8.3.2 Preventing Reverse Polarity on the DC Input Side

CAUTION!

Damage caused by reverse polarity is not covered by warranty! When making battery connections on the input side, make sure that the polarity of battery connections is correct (Connect the positive of the battery to the positive terminal of the unit and the Negative of the battery to the negative terminal of the unit). If the input is connected in reverse polarity, DC fuse(s) inside the inverter will blow and may also cause permanent damage to the inverter.

ATTENTION !

Des dégats causés par un inversement des polarités ne sont pas couverts par la garantie! Quand vous faites des connexions à la batterie du côté d'entrée, veuillez assurer que les polarités sont mises du bon côté (liez le positif de la batterie à la borne positive de l'appareil et le négatif de la batterie à la borne Négative de l'appareil). Si les polarités de l'entrée sont mises à l'envers, le(s) fusible(s) CC dans l'onduleur va/vont s'exploser et pourrait causer des dégats permanents à l'onduleur.

8.3.3 Connection from Batteries to the DC Input Side – Sizing of Cables and Fuses

CAUTION!

The input section of the inverter has large value capacitors connected across the input terminals. As soon as the DC input connection loop (Battery (+) terminal → External Fuse → Positive input terminal of the PST unit → Negative input terminal of the PST unit → Battery (–) terminal) is completed, these capacitors will start charging and the unit will **momentarily** draw very heavy current to charge these capacitors that will produce sparking on the last contact in the input loop even when the unit is in powered down condition. Ensure that the fuse is inserted only after all the connections in the loop have been completed so that sparking is limited to the fuse area.

In addition, the DC input cables shall be sized with adequate ampacity to safely carry the maximum input current without conductor temperature limits, in accordance with applicable standards (e.g. latest standard of National Electrical Code (NEC), UL 458 and ISO10133). Undersized conductors may result in excessive heating, insulation damage, or fire hazard.

ATTENTION !

La section d'entrée de l'onduleur comporte des condensateurs de grande capacité connectés aux bornes d'entrée. Dès que la boucle de connexion d'entrée CC (borne Batterie (+) « fusible externe » borne d'entrée positive de l'unité PST « borne d'entrée négative de l'unité PST » borne Batterie (–)) est complétée, ces condensateurs commenceront à se charger et l'unité tirera momentanément un courant très élevé pour charger ces condensateurs, ce qui produira des étincelles au dernier point de contact de la boucle d'entrée, même lorsque l'unité est hors tension. Assurez-vous que le fusible est inséré uniquement après que toutes les connexions de la boucle ont été complétées afin que les étincelles soient limitées à la zone du fusible.

De plus, les câbles d'entrée CC doivent être dimensionnés avec une ampacité suffisante pour transporter en toute sécurité le courant d'entrée maximal sans dépasser les limites de température des conducteurs, conformément aux normes applicables (p. ex., la version la plus récente du National Electrical Code (NEC), de la norme UL 458 et de la norme ISO 10133). Des conducteurs sous-dimensionnés peuvent entraîner un échauffement excessif, des dommages à l'isolation ou un risque d'incendie.

Flow of electric current in a conductor is opposed by the resistance of the conductor. The resistance of the conductor is directly proportional to the length of the conductor and inversely proportional to its cross-section (thickness). The resistance in the conductor produces undesirable effects of voltage drop and heating. The size (thickness/cross-section) of the conductors is designated by AWG (American Wire Gauge). Conductors thicker than AWG #4/0 are sized in kcmil. Table 8.1 below gives resistance in Ohm (Ω) per Foot at 25 °C / 77 °F for the wire sizing recommended for use with this inverter.

TABLE 8.1: WIRING RESISTANCE PER FOOT	
WIRE SIZE, AWG	**RESISTANCE IN OHM (Ω) PER FOOT AT 25°C / 77°F**
AWG#2	0.000159 Ω per Foot
AWG#1/0	0.000096 Ω per Foot
AWG#2/0	0.000077 Ω per Foot
AWG#4/0	0.000050 Ω per Foot

Conductors are protected with insulating materials rated for specific temperatures (e.g., 105 °C / 221 °F). As current flows through a conductor, heat is generated, and each conductor size is therefore limited to a maximum permissible current, referred to as its "ampacity," based on insulation rating and installation conditions.

Conductor ampacity shall comply with applicable standards, including the latest editions of the National Electrical Code (NEC) and UL458, which generally require conductors to be rated for not less than 125% of the continuous DC input current, which depends on the set up of the inverter and loads.

In DC input circuits for inverters, very high currents may be present, particularly at lower system voltages. While ampacity ensures that conductors can safely carry current without overheating, it does not by itself ensure proper system performance.

In practice, conductor sizing for inverter DC input wiring is typically governed by voltage drop rather than ampacity, especially in low-voltage, high-power systems. Resistance in the conductors causes voltage drop, which reduces the voltage available at the inverter terminals, leading to reduced efficiency, increased losses, and possible improper operation or shutdown.

Accordingly, conductor sizing should be primarily based on limiting voltage drop to an acceptable level (typically 2–3% for inverter DC circuits), while ensuring that the selected conductor also meets applicable ampacity requirements per code.

Thinner cables and loose connections will result in excessive voltage drop performance and additional heating, leading to poor inverter performance, reduced efficiency, and potential risk of insulation damage or fire. Normally, the thickness of the cable should be such that the voltage drop due to the current & the resistance of the length of the cable should be less than 2% to 5%. Use oil resistant, multi-stranded copper wire cables rated at 105 °C / 221 °F minimum. Do not use aluminum cable as it has higher resistance per unit length. Cables can be bought at a marine/welding supply store. Effects of low voltage on common electrical loads are given below:

- **Lighting circuits** - incandescent and Quartz Halogen: A 5% voltage drop causes an approximate 10% loss in light output. This is 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 a nearly proportional drop in light output.
- **AC induction motors** - These are commonly found in power tools, appliances, well pumps etc. They exhibit very high surge demands when starting. Significant voltage drop in these circuits may cause failure to start and possible motor damage.
- **PV battery charging circuits** - These are critical because voltage drop can cause a disproportionate loss of charge current to charge a battery. A voltage drop greater than 5% can reduce charge current to the battery by a much greater percentage.

To determine the cable size for each model to be used, electrician should take into consideration the kind of cable, cable length, voltage drop and type of connection.

Circular Mils (CM) or required conductor size defines the size of the cable. The formula below is generally adopted for CM calculation and the calculated value (CM) will be used to look up the closest cable size without going over (Table 8.2):

$$CM = \frac{2 \times K \times I_{MAX} \times L}{V_D}$$

Where:

1. K = 12.9 (copper conductors with insulated rating of 105 °C / 221 °F and ambient temperature 30 °C / 86 °F.

2. Calculate the continuous DC input current (at capacity) for the inverter using:

$$I_{MAX} = \frac{\text{Inverter Maximum Power}}{(\text{DC system voltage x Efficiency})}$$

- I_{MAX} (12 V) = 3000 / (12 x 0.85) =294.1 A
- I_{MAX} (24 V) = 3000 / (24 x 0.88) = 142.05 A
- I_{MAX} (48 V) = 3000 / (48 x 0.9) = 69.44 A

3. Calculate the allowable voltage drop using:

V_D = Battery Voltage x Allowable drop %

Example: 12 V system with 2% drop is equivalent to 0.24 V

- V_D for 2% of 12, 24, 48 V are 0.24, 0.48, 0.96 V
- V_D for 3% of 12, 24, 48 V are 0.36, 0.72, 1.44 V

4. L = one-way length of cable, assuming use of common cable length

- 3 ft (0.9 m), 6 ft (1.8 m), and 10 ft (3 m)

5. Below is the reference table for looking up for the closest cable size based on the caculated CM Values:

TABLE 8.2: REFERENCE AWG - CM VALUES	
AWG	**CM**
#10	10,380
#8	16,510
#6	26,240
#4	41,740
#2	66,360
#1	83,690
1/0	105,600
2/0	133,100
4/0	211,600

Below table 8.3 summarizes the minimum cable size subject to a 2% or 3% voltage drop; total conductor length using twice the one-way distance that is based on copper conductors with insulated rating of 105 °C / 221 °F; and ambient temperature of 30 °C / 86 °F, is compared to minimum size selected based on ampacity.

TABLE 8.3: MINIMUM CABLE SIZE			
Model No.	**Length**	**2% Voltage Drop (Conservative)**	**3% Voltage Drop (Acceptable)**
PST-3000-12	3 ft	AWG 1/0	AWG 2
	6 ft	AWG 4/0	AWG 2/0
	10 ft	2 × AWG 2/0	AWG 4/0
PST-3000-24	3 ft	AWG 6	AWG 8
	6 ft	AWG 3	AWG 5
	10 ft	AWG 1	AWG 3
PST-3000-48	3 ft	AWG 12	AWG 11
	6 ft	AWG 9	AWG 8
	10 ft	AWG 7	AWG 9

Due to the high current levels and associated voltage drop constraints, the resulting conductor sizes—particularly for low-voltage, high-power systems—may be large and potentially impractical for certain installations. Final cable sizing and routing shall be determined by a qualified electrician based on actual installation conditions, applicable codes, and practical considerations.

Samlex provides standardized DC installation kits as universal solutions to support installations. These kits are designed to meet installation requirements of a wide power range from 600 to 3000 W for all inverter models; installers may select and apply these kits based on their specific application requirements. Further details on available kits and configurations can be found on the Samlex website.

8.3.4 Fuse Protection in the Battery Circuit

A battery is an **unlimited** source of current. Under short circuit conditions, a battery can supply thousands of Amperes of current. If there is a short circuit along the length of the cables that connects 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 become red-hot, the insulation will melt and the cable will ultimately break. This interruption of very high current will generate a hazardous, high temperature, high-energy arc with accompanying high-pressure wave that may cause fire, damage nearby objects and cause injury.

To prevent occurrence of hazardous conditions under short circuit conditions, the fuse used in the battery circuit should limit the current (should be "Current Limiting Type"), blow in a very short time (should be Fast Blow Type) and at the same time, quench the arc in a safe manner. For this purpose, **UL Class T Fuse** or equivalent should be used (As per UL Standard 248-15). This special purpose current limiting, very fast acting fuse will blow in less than 8 ms under short circuit conditions. **Appropriate capacity of the above Class T fuse or equivalent should be installed within 7” of the battery Plus (+) Terminal** (Please see Table 8.2 for fuse sizing). Marine Rated Battery Fuses, (MRBF) may also be used. These fuses comply with ISO 8820-6 for road vehicles.

WARNING!

Use of an appropriately sized external fuse as described above is **mandatory** to provide safety against fire hazard due to accidental short circuit in the battery cables. Please note that the internal DC side fuses are designed to protect ther internal components of the inverter against DC side overloading. These fuses will **NOT** blow if there is a short circuit along the length of wires connecting the battery and the inverter.

AVERTISSEMENT !

Il est obligatoire d'utiliser un fusible de la bonne taille (comme décris audessus), afin de réduire la risque d'incendie à cause d'un court-circuit accidentale des fils de batterie.Veuillez noter que des fusibles de côté CC dans l'unité sont conçus pour protèger les composants internes de l'onduleur. Ces fusibles vont pas s'exploser s'il y a un court-circuit sur la longueur des câbles connectant la batterie à l'onduleur.

8.3.5 DC Input Connection

The DC input terminals for battery connection (14 & 16 in Fig. 6.1c) have nut and bolt connection - bolt size is 5/16" (18 Threads per Inch). Crimp correctly sized ring terminals onto the DC wires to ensure a secure installation.

8.3.6 Reducing RF Interference

Please comply with recommendations given in Section 3 - "Limiting Electromagnetic Interference".

8.4 AC SIDE CONNECTIONS

WARNING! Preventing Paralleling of the AC Output

1. The AC output of the inverter cannot be synchronized with another AC source and hence, it is not suitable for paralleling. The AC output of the inverter should never be connected directly to an electrical Panelboard/Load Center which is also fed from the utility power/generator. Such a connection will result in parallel operation and AC power from the utility/generator will be fed back into the inverter which will instantly damage the output section of the inverter and may also pose a fire and safety hazard. If an electrical Panelboard/Load Center is being fed from the utility power/generator and the inverter is required to feed this panel as backup power source, the AC power from the utility power/generator and the inverter should first be fed to a manual selector switch/Automatic Transfer Switch and the output of the manual selector switch/Automatic Transfer Switch should be connected to the electrical Panelboard/Load Center.
2. To prevent possibility of paralleling and severe damage to the inverter, never use a simple jumper cable with a male plug on both ends to connect the AC output of the inverter to a handy wall receptacle in the home/RV.

AVERTISSEMENT ! Prévention de la mise en parallèle de la sortie CA

1. La sortie CA de l'onduleur ne peut pas être synchronisée avec une autre source CA et n'est donc pas adaptée au fonctionnement en parallèle. La sortie CA de l'onduleur ne doit jamais être connectée directement à un panneau de distribution/centre de distribution électrique également alimenté par le réseau public/générateur. Une telle connexion entraînera un fonctionnement en parallèle et la puissance CA du réseau public/générateur sera renvoyée vers l'onduleur, ce qui endommagera instantanément la section de sortie de l'onduleur et peut également présenter un risque d'incendie et de sécurité. Si un panneau de distribution/centre de distribution est alimenté par le réseau public/générateur et que l'onduleur doit alimenter ce panneau comme source d'alimentation de secours, la puissance CA du réseau public/générateur et de l'onduleur doit d'abord être acheminée vers un commutateur sélecteur manuel/commutateur de transfert automatique, et la sortie de ce commutateur doit être connectée au panneau de distribution/centre de distribution électrique.
2. Afin d'éviter tout fonctionnement en parallèle et des dommages graves à l'onduleur, ne jamais utiliser un cordon muni de fiches mâles aux deux extrémités pour connecter la sortie CA de l'onduleur à une prise murale dans une maison/VR (véhicule récréatif).

8.4.1 Neutral to Chassis Ground Bond

The Neutral slots of the NEMA5-20R GFCI Duplex Receptacles (6, Fig 6.1a) and the Neutral Terminal for hardwiring (13, Fig 6.1b) are internally bonded to the metal chassis of the inverter.

8.4.2 AC Output Connection Through Ground Fault Circuit Interrupter (GFCI)

An un-intentional electric path between a source of current and a grounded surface is referred to as a "Ground Fault". Ground faults occur when current is leaking somewhere. In effect, electricity is escaping to the ground. How it leaks is very important. If your body provides a path to the ground for this leakage (dry human body has a low resistance of only around 1 K Ohm), you could be injured, burned, severely shocked or electrocuted. A Ground Fault Circuit Interrupter (GFCI) protects people from electric shock by detecting leakage and cutting off the AC source. The AC output of this inverter is available through a NEMA5-20R GFCI Duplex Receptacle (6, Fig 6.1a) and also through hardwiring terminal connections located in a compartment (13, Fig 6.1a) behind the GFCI receptacle. The Neutral slot of this receptacle (longer rectangular slot) and the Neutral Terminal "N" of the Terminal Block for AC output hardwiring (13, Fig 6.1b) are internally bonded to the metal chassis of the inverter.

There is a Green indicator light on the GFCI outlet that will be on when the GFCI is operating normally. The light will switch OFF if the GFCI is tripped.
The GFCI is provided with the following buttons:

- **Reset Button:** In case the GFCI is tripped, it can be reset by pressing the "Reset Button".

  NOTE: For the Reset Button to operate, the inverter has to be in ON condition and should be outputting AC power to the internal Line Side of the GFCI (no Fault/ shutdown condition).
- **Test Button:** This button is used to test if the GFCI is operating normally. Test the GFCI periodically to ensure that it is operating normally.

The GFCI will trip due to the following conditions:

- Leakage or Ground Fault (Leakage of 5 to 6 mA)
- Neutral to Ground bonding (connection) on the load side of the GFCI

CAUTION!

1. Each of the NEMA5-20R outlets is rated for 16 A continuous and 20 A intermittent. Do not draw more than this rating from each outlet. For drawing the full rated output capacity of 25 A of the inverter, use AC output connections for hardwiring (13, Fig 6.1b) as described at Section 8.5.2 below.
2. Do not feed the output from the GFCI receptacle to a Panelboard/Load Center where the Neutral is bonded to the Earth Ground. This will trip the GFCI. If the AC output is required to be fed to a Panelboard/Load Center, use hardwiring connections (please see details given at Section 8.5.2 below).

3. If an extension cord is used from the GFCI outlet, please ensure that the cord is 2-Pole Grounding Type with NEMA5-15P/NEMA5-20P plug.

MISE EN GARDE !

1. Chacune des prises NEMA 5-20R est prévue pour 16 A en continu et 20 A en service intermittent. Ne pas dépasser ces valeurs pour chaque prise. Pour tirer la pleine capacité nominale de sortie de 25 A de l'onduleur, utiliser les connexions de sortie CA pour câblage fixe (13, Figure 6.1b), tel que décrit à la section 8.5.2 ci-dessous.
2. Ne pas alimenter la sortie de la prise DDFT vers un panneau de distribution/centre de distribution où le neutre est relié à la terre. Cela déclenchera le DDFT. Si la sortie CA doit être raccordée à un panneau de distribution/centre de distribution, utiliser des connexions par câblage fixe (voir les détails à la section 8.5.2 ci-dessous).
3. Si une rallonge est utilisée à partir de la prise DDFT, s'assurer que le cordon est de type mise à la terre à 2 pôles avec fiche NEMA 5-15P / NEMA 5-20P.

8.4.3 AC Output Connections for Hardwiring

For connecting the AC output of the inverter to an AC Panelboard / Load Center, separate connections are available for hard wiring. Please refer to Fig 6.1. Compartment (11, Fig 6.1b) contains terminals for AC output. The compartment is covered by a Cover Plate (8, Fig 6.1a) with the help of 4 screws. The AC wiring enters through the metal Strain Relief Clamp (7, Fig 6.1a). After the connections have been made, tighten the clamp. AC output connections are as follows:

Terminal Block (13, Fig 6.1b) with Line "L" and Neutral "N" Terminals.
Please note that Line terminal "L" of the AC Terminal Block (13, Fig 6.1b) and the Line terminal on the Line side of the GFCI (6, Fig 6.1a) are internally connected together at the PCB. Similarly, Neutral terminal "N" on the AC Terminal Block (13, fig 6.1b) and the Neutral terminal on the Line side of the GFCI (6, Fig 6.1a) are internally connected together at the PCB.

- Hole diameter: 4.15 mm / 0.16"
- Set screw: #6 (UNF, 40 Threads per Inch) or M3.5 (Coarse Pitch 0.6 mm) **AC Ground Terminal (12, Fig 6.1b)**
- Stud: #6 (UNC, 32 Threads Per Inch)

Neutral to Chassis Ground Bonding

- Neutral "N" is bonded to the metal chassis of the inverter through a loop of wire connecting the "N" terminal on the Line side of the GFCI to the chassis of the inverter.

SECTION 8 | Installation

WARNING!

RISK OF ELECTRIC SHOCK. When this unit is installed in vehicles and hard-wiring connection is used to feed the AC output of the inverter to the AC Panelboard/Load Center in the vehicle, it is to be ensured that Ground Fault Circuit Interrupter(s) [GFCI] are installed in the vehicle wiring system to protect all Branch Circuits.

The GFCIs in Table 8.4 have been tested to operate satisfactorily and are acceptable. Other types may fail to operate properly when connected to this inverter:

AVERTISSEMENT !

RISQUE DE CHOC ÉLECTRIQUE. Lorsque cet appareil est installé dans des véhicules et qu'un raccordement par câblage fixe est utilisé pour alimenter la sortie CA de l'onduleur vers le panneau de distribution / centre de distribution CA du véhicule, il doit être assuré que des disjoncteurs différentiels de fuite à la terre [DDFT] sont installés dans le système de câblage du véhicule afin de protéger tous les circuits de dérivation.

Les DDFT indiqués au tableau 8.4 ont été testés et fonctionnent de manière satisfaisante et sont acceptables. D'autres types peuvent ne pas fonctionner correctement lorsqu'ils sont connectés à cet onduleur.

TABLE 8.4: GFCI INFORMATION

Mfr. of GFCI	Mfr.'s Model No.	Description
Pass & Seymour	2095 Series	NEMA5-20 Duplex 20 A
Leviton	N7899 Series	NEMA5-20 Duplex 20 A
Zhejiang Trimone	TGM20 Series	NEMA5-20 Duplex 20 A

8.4.4 Hard Wiring of AC Output – Sizing of Wiring and Breaker

Sizes of Line and Neutral conductors and breaker are shown in Table 8.5. Sizing is based on safety considerations specified in UL-458 and NEC-2014. Please refer to "Notes for Table 8.5" for details.

Example of AC cable types: (a) 12/3, Loomex/Romex (NMD-90) - **N**on **M**etallic sheathed; **D**ry: 90 °C / 194 °F. This is a 3-conductor (Insulated Line, Neutral and bare Ground), AWG #12 cable used for residential wiring (b) AC cord types: SE, SEOO, ST, STO, SJ, SJEOO, SJT or SJTO

For firm connection when using set screw type of terminals for connecting stranded wire, use "Cord End Terminals" for termination of the bare Line and Neutral ends of the conductors and "Ring Type of Terminal" for termination of the bare end of Grounding Conductor. For convenience, the following terminals have been provided:

For Line and Neutral conductors: 2 pieces of Cord End Terminals for conductor size AWG#12
For Neutral conductor: 1 piece of Ring Terminal for #6 stud and for conductor size AWG#12

CAUTION!

(a) Use proper Crimping Tool to crimp the terminals to the bare ends of the conductors.

(b) Make sure that the AC cable is adequately clamped by the metal Strain Relief Clamp (7, Fig 6.1a)

MISE EN GARDE !

(a) Utiliser un outil de sertissage approprié pour sertir les bornes aux extrémités dénudées des conducteurs.
(b) S'assurer que le câble CA est correctement fixé par le serre-câble métallique de retenue (7, Figure 6.1a).

TABLE 8.5: RECOMMENDED SIZING OF AC OUTPUT WIRING AND BREAKER

Model No. (1)	Maximum continuous AC output current (2)	Minimum Ampacity of AC output Line and Neutral conductors as per NEC (125% times Column 2) (3)	Maximum size of external AC output Breaker (Based on Column 3) (4)	Minimum size of Line and Neutral conductors based on Ampacity at Column 3 (Ampacity based on conductor temperature of 90°C) (5)
PST-3000-12 24, 48	25 A	31.25	30 A	AWG#12

NOTES FOR TABLE 8.5

1) Column 2 indicates the rated continuous AC output current
2) Column 3 indicates NEC Ampacity based on which cable conductor size (Column 5) is determined. NEC Ampacity is not less than 125% of the rated continuous AC output current (Column 2) - Refer to NEC-2014 (National Electrical Code) - Section 215.2(A)(1)(a) for Feeder Circuits.
3) Columns 5 indicates conductor size for the Line and Neutral conductors based on guidelines in NEC-2014 Table 310.15(B)(16) for conductors running in conduit/raceway.
   (a) NEC Ampacity specified at Column 3 but limited to Breaker size of 30 A (Column 4).
   (b) Copper conductor with temperature rating of minimum 90 °C / 194 °F
   (c) Ambient temperature of 30 °C / 86 °F
4) Column (4) indicates the maximum size of external AC breaker (30A) based on maximum NEC Ampacity of 30 A for AWG#12 insulated copper conductor (Column 5) rated at 90 °C / 194 °F at 30 °C / 86 °F ambient – Refer to NEC-2014 Table 310.15(B)(16) for conductors running in conduit/raceway.

8.5 GROUNDING TO EARTH OR TO OTHER DESIGNATED GROUND

For safety, ground the metal chassis of the inverter to the Earth Ground or to the other designated ground (For example, in a mobile RV, the metal frame of the RV is normally designated as the Negative DC Ground). A chassis Grounding Lug (19, Fig 6.1c) has been provided for grounding the metal chassis of the inverter to the appropriate ground.

When using the inverter in a building, connect a 10 mm^2 or AWG #8 insulated stranded copper wire from the above equipment grounding lug to the Earth Ground connection (a connection that connects to the Ground Rod or to buried metallic water pipe or to another connection that is solidly bonded to the Earth Ground). The connections must be tight against bare metal. Use star washers to penetrate paint and corrosion.

When using the inverter in a mobile RV, connect a 10 mm^2 or AWG #8 insulated stranded copper wire from the above Chassis Grounding Lug to the Main Grounding Bus Bar of the RV (bonded to the vehicle chassis). The connections must be tight against bare metal. Use star washers to penetrate paint and corrosion.

8.6 OPTIONAL WIRED REMOTE CONTROL – MODEL RC-300

CAUTION!

For the optional Remote Control RC-300 to operate, the inverter has to be **FIRST** turned **ON** using the following ON/OFF controls:

a. **<u>When NOT using external 1-Wire or 2-Wire ON/OFF Control:</u>** By pushing the top end (marked "–") of the 3-Position Rocker Switch (1, Fig 6.1a) to position marked "ON"

b. **<u>When using external 1-Wire or 2-Wire ON/OFF Controls</u>**: By **FIRST** pushing the bottom end (marked "=") of the 3-Position Rocker Switch (1, Fig 6.1a) to position marked "EXT. Switch" and **THEN** switching **ON** the inverter by (i) closing the switch or relay contact in 2-Wire ON/OFF Control (Fig 8.2a) or (ii) closing the switch or relay contact in 2-Wire ON/OFF Control using switched DC voltage (Fig 8.2b) or (iii) closing the switch or relay contact in 1-Wire ON/OFF control using switched DC voltage from battery supplying the inverter.

MISE EN GARDE !

Pour que la télécommande optionnelle RC-300 fonctionne, l'onduleur doit d'abord être mis sous tension en utilisant les commandes MARCHE/ARRÊT suivantes :

a. **Lorsqu'aucune commande MARCHE/ARRÊT externe à 1 fil ou 2 fils n'est utilisée :** en appuyant sur l'extrémité supérieure (marquée « – ») de l'interrupteur à bascule à 3 positions (1, Figure 6.1a) pour le mettre en position « ON ».

b. **Lorsqu'une commande MARCHE/ARRÊT externe à 1 fil ou 2 fils est utilisée :** en appuyant d'abord sur l'extrémité inférieure (marquée « = ») de l'interrupteur à bascule à 3 positions (1, Figure 6.1a) pour le mettre en position « EXT. Switch », puis en mettant l'onduleur sous tension en (i) fermant le contact de l'interrupteur ou du relais dans la commande MARCHE/ARRÊT à 2 fils (Figure 8.2a), ou (ii) en fermant le contact de l'interrupteur ou du relais dans la commande MARCHE/ARRÊT à 2 fils utilisant une tension CC commutée (Figure 8.2b), ou (iii) en fermant le contact de l'interrupteur ou du relais dans la commande MARCHE/ARRÊT à 1 fil utilisant une tension CC commutée provenant de la batterie alimentant l'onduleur.

An optional Wired Remote Control Model No. RC-300 (with 25 ft. / 7.62 metre cable), is available for switching ON and switching OFF and monitoring. The remote has LCD display showing AC output V, A, Hz, W, VA and Power Factor. It also has LED indications similar to the indications on the front panel (2, 3, 4 in Fig. 6.1a). The Remote Control is connected to RJ-50 Jack (9, Fig 6.1a). Read the RC-300 User Manual in the Samlex America Inc. website (www.samlexamerica.com) for more details.

8.7 ON/OFF CONTROL FROM REMOTE LOCATION USING 2-WIRE OR 1-WIRE EXTERNAL ON/OFF CONTROL

CAUTION!

For operation of this function, the 3-Position Rocker Switch on the front panel marked "ON/OFF/EXT. Switch (1, Fig 6.1a) should be **FIRST** pushed at the bottom end (marked "=") to rock it to the bottom "EXT. Switch" position.

MISE EN GARDE !

Pour le fonctionnement de cette fonction, l'interrupteur à bascule à 3 positions sur le panneau avant, identifié « ON/OFF/EXT. Switch (1, Figure 6.1a) », doit d'abord être enfoncé à l'extrémité inférieure (marquée « = ») afin de le basculer en position inférieure « EXT. Switch ».

The unit can be switched ON/OFF from a remote location using external, wired ON/OFF control arrangements as shown in Fig 8.2(a), (b) and (c). Details are given below:

- **2-Wire ON/OFF Control from Remote Location Using Switch/Relay Contact, Fig 8.2(a):** In this arrangement, external voltage source is NOT required. The inverter will switch ON when the relay contact / switch is closed and terminals 1 and 2 of the Terminal Block (10, Fig 6.1a) are shorted. The inverter will switch OFF when the relay contact / switch is opened and short is removed across terminals 1 and 2 of the Terminal Block (10, Fig 6.1a)
- **2-Wire ON/OFF Control Using Switched DC Voltage (10-60 VDC), Fig 8.2(b):**

CAUTION!

1. Please ensure correct polarity of wiring connection. Positive (+) of the external DC source should be connected to Terminal 3 of the Terminal Block (10, Fig 6.1a) and Negative (-) to Terminal 4. In case the polarity is reversed, the ON/OFF control will **NOT** operate. **The input to these terminals is protected against reverse polarity**
2. Use 1A fuse as shown as close to the DC source as possible.

MISE EN GARDE !

1. Assurez-vous que la polarité du raccordement est correcte. Le positif (+) de la source CC externe doit être raccordé à la borne 3 du bornier (10, Figure 6.1a) et le négatif (–) à la borne 4. En cas d'inversion de polarité, la commande MARCHE/ARRÊT ne fonctionnera PAS. L'entrée de ces bornes est protégée contre l'inversion de polarité.
2. Utiliser un fusible de 1 A, installé aussi près que possible de la source CC, tel qu'illustré.

INFO

The 10-60 VDC external control signal on terminals 3 and 4 of the Terminal Block (10, Fig 6.1a) feeds to an internal Opto-Isolator. Hence, the Negative Ground of the external 10-60 VDC source can be isolated from the Negative Ground of the Battery input to the inverter.

The inverter will switch ON when the external relay contact/switch is closed [External DC voltage (10-60 VDC) is fed to terminals 3 and 4 of the Terminal Block (10, Fig 6.1a)]. The inverter will switch OFF when the external relay contact / switch is opened [External DC voltage (10-60 VDC) is removed from terminals 3 and 4 of the Terminal Block (10, Fig 6.1a)].

- **1-Wire ON/OFF Control Using Switched DC Voltage from the Battery Supplying the Inverter, Fig 8.2(c) :**

CAUTION!

1. Please ensure correct polarity of wiring connection. Positive (+) of the battery voltage should be connected to Terminal 3. In case the polarity is reversed, the ON/OFF control will NOT operate. The input to this terminal is protected against reverse polarity.
2. Use 1 A fuse as shown as close to the battery input point as possible.

MISE EN GARDE !

1. Assurez-vous que la polarité du raccordement est correcte. Le positif (+) de la tension de la batterie doit être raccordé à la borne 3. En cas d'inversion de polarité, la commande MARCHE/ARRÊT ne fonctionnera PAS. L'entrée de cette borne est protégée contre l'inversion de polarité.
2. Utiliser un fusible de 1 A, installé aussi près que possible du point d'entrée de la batterie, tel qu'illustré.

The inverter will switch ON when the external relay contact / switch is closed [Voltage from the 12 V, 24 V & 48 V battery supplying the inverter is fed to terminal 3 of the Terminal Block (10, Fig 6.1a)]. The inverter will switch OFF when the external relay contact / switch is opened [Voltage from the 12 V, 24 V & 48 V battery supplying the inverter DC voltage is removed from terminal 3 of Terminal Block (10, Fig 6.1a)].

In a vehicle/RV, the control voltage may be fed directly from the Ignition Switch. This will switch ON the inverter when the Ignition is ON and switch OFF the inverter when the Ignition is switched OFF.

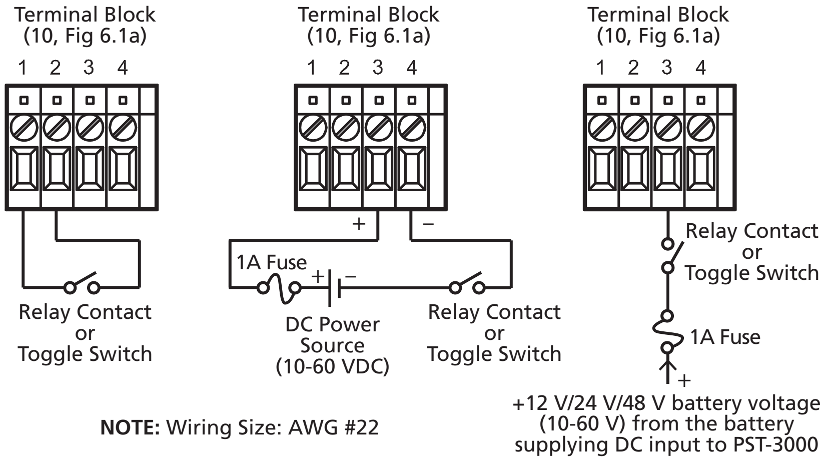

Fig 8.2(a) – 2-Wire ON/OFF control using switch/relay contact

Fig 8.2(b) – 2-Wire ON/OFF control using switched DC voltage

Fig 8.2(c) – 1-Wire ON/OF control using switched DC voltage from battery supplying the inverter

Fig. 8.2: ON/OFF Control from Remote Location using External 2-Wire or 1-Wire Control

9.1 SWITCHING THE INVERTER ON/OFF

Before switching on the inverter, check that all the AC loads have been switched off. The 3-Position Rocker Switch marked ON/OFF/EXT. Switch (1, Fig 6.1a) on the front panel of the inverter is used to manually switch ON and OFF the inverter. This switch operates a low power control circuitry, which in turn controls all the high power circuitry.

The unit can also be switched ON/OFF remotely as follows:

- Through optional Remote Control Model RC-300 connected to Modular Jack RJ-50 (9, Fig 6.1a). Read Optional Remote Control Manual for RC-300 for details.
- Using 2-wire or 1-wire External Switching Control. See details under heading "ON/OFF Control from Remote location using 2-Wire or 1-Wire External ON/OFF Control" on Section 8.7.

CAUTION!

Please note that the ON/OFF switch is not switching the high power battery input circuit. Parts of the DC side circuit will still be alive even when the switch is in the OFF position. Hence, disconnect the DC and AC sides before working on any circuits connected to the inverter.

ATTENTION !

Veuillez noter que l'interrupteur ON/OFF ne gère pas le circuit d'entrée de batterie à haute puissance. Certaines parties du circuit de côté CC seraient encores actives même si l'onduleur a été fermé. Alors, il faut déconnecter
tous les côtés CC et CA avant de travailler sur n'importe quel circuit connecté à l'onduleur.

When the inverter is switched ON, the Green LED marked "POWER" (2, Fig 6.1a) will be lighted. This LED indicates that the input section of the inverter is operating normally. Under normal operating conditions, AC output voltage will now be available at the GFCI Duplex Receptacle (6, Fig 6.1a) and at the AC output terminals for hardwiring (13, Fig 6.1b). The Green indicator light on the GFCI will be lighted.

Switch on the AC load(s). The Green LED marked "POWER" (2, Fig 6.1a) and the indication light on the GFCI should remain lighted for normal operation of the load.

9.2 POWERING ON THE LOADS

After the inverter is switched on, it takes a finite time to become ready to deliver full power. Hence, always switch on the load(s) after a few seconds of switching on the inverter. Avoid switching on the inverter with the load already switched on. This may prematurely trigger the overload protection.

CAUTION!

When a load is switched on, it may require initial higher power surge to start. Hence, if multiple loads are being powered, they should be switched on one by one so that the inverter is not overloaded by the higher starting surge if all the loads are switched on at once.

ATTENTION !

Lorsqu’une charge est mise sous tension, elle peut nécessiter une surtension de puissance initiale plus élevée pour démarrer. Par conséquent, si plusieurs charges sont alimentées, elles doivent être mises sous tension une par une afin d’éviter de surcharger l’onduleur en raison de la surtension de démarrage si toutes les charges sont mises sous tension en même temps.

9.3 TEMPERATURE CONTROLLED COOLING FAN

One thermostatically controlled cooling fan (18, Fig 6.1c) has been provided for forced air cooling. Temperature of a critical hot spot inside the inverter (Power Transformer T6) is monitored to activate the fan and the over temperature shut-down. When the temperature of this hot spot reaches 55 °C ± 3 °C / 155 °F ± 37 °F, the fan is switched ON. The fan will be automatically switched OFF once the hot spot cools down to 45 °C ± 3 °C / 113 °F ± 37 °F. Please note that the fan may not switch ON at low loads or if the ambient temperature is cooler. This is normal.

9.4 INDICATIONS FOR NORMAL OPERATION

When the inverter is operating normally and supplying AC load(s), the Green LED marked "POWER" (2, Fig 6.1a) and the Green indication light on the GFCI will be lighted. *Please see Section 10 "Protections" and Section 11 "Troubleshooting Guide" for symptoms of abnormal operation.*

9.5 NO LOAD DRAW (IDLE CURRENT)

When the unit is switched ON, all the circuitry inside the inverter becomes alive and the AC output is made available. In this condition, even when no load is being supplied (or, if a load is connected but has been switched OFF), the inverter draws a small amount of current from the batteries to keep the circuitry alive and ready to deliver the required power on demand. This is called the "Idle Current" or the "No Load Draw". Hence, when the load is not required to be operated, turn OFF the inverter to prevent unnecessary current drain from the battery.

CAUTION!

When the inverter is switched OFF using the optional external Remote Control RC-300, there will be a very minor current drain of up to 3 mA for the PST-3000-12, up to 5 mA for the PST-3000-24 and up to 7 mA for the PST-3000-48. There will be **NO** drain from the battery when the inverter is switched OFF as follows:

a. **When NOT using external 1-Wire or 2-Wire ON/OFF Control:** By switching OFF the 3-Position Rocker Switch (1, Fig 6.1a) to center position marked “ON”/“OFF”

b. **When using external 1-Wire or 2-Wire ON/OFF Control:** By Switching OFF the inverter by (i) opening the switch or the relay contact in 2-Wire ON/OFF Control (Fig 8.2a) or (ii) opening the switch or relay contact in 2-Wire ON/OFF Control using switched DC voltage (Fig 8.2b) or (iii) opening the switch or relay contact in 1-Wire ON/OFF Control using switched DC voltage from the battery supplying the inverter.

ATTENTION !

Lorsque l'onduleur est mis à l'arrêt à l'aide de la télécommande externe optionnelle RC-300, il y aura une très faible consommation de courant pouvant atteindre 3 mA pour le PST-3000-12, jusqu'à 5 mA pour le PST-3000-24 et jusqu'à 7 mA pour le PST-3000-48. Il n'y aura AUCUNE consommation de la batterie lorsque l'onduleur est mis à l'arrêt comme suit :

a. **Lorsque vous n'utilisez pas le contrôle ON/OFF du fil-1 et le fils-2 externe:** en éteignant l' interrupteur à 3 positions (1, Fig 6.1a) pour centrer la position marquée "ON"/"OFF"

b. **Lorsque vous utilisez le contrôle ON/OFF du fil-1 et le fils-2 externe:** en éteignant l'onduleur par (i) en allumant l' interrupteur ou le contact du relais en Contrôle ON/OFF 2 -fils (figure 8.2a), ou (ii) en allumant l'interrupteur ou relais Contrôle ON/OFF 2 -fils en utilisant la tension CC (figure 8.2 b) ou (iii) en allumant l'interrupteur ou le contact de relais contrôle ON/OFF 1-fil en utilisant la tension CC de la batterie qui alimente l'onduleur.

10. PROTECTIONS

The inverter has been provided with protections detailed below:

10.1 POWER SURGE/OVERLOAD/SHORT CIRCUIT SHUT DOWN

INFO

Please refer to definitions of Active Power (Watts), Apparent Power (VA) and Power Factor (PF) at Section 2.1. In the explanation below, the values of Power are expressed in Apparent Power in VA. Corresponding Active Power (Watts, W) will depend upon the type of load (Resistive or Reactive) and its Power Factor (Power Factor may range from 1 to 0.5). Please note the following:

- Active Power (Watts) = Apparent Power (VA) x Power Factor (PF).
- For resistive type of loads, the Power Factor = 1 and hence, Apparent Power (VA) = Active Power (Watts, W)
- For reactive types of loads, the Power Factor will be < 1 (up to 0.5) and hence, the Active Power (Watts, W) will be less than the Apparent Power (VA)

The AC output voltage will shut down due to overload and short circuit conditions as follows:

Power Surge Condition: When the AC output current tries to exceed around 200% of the rated value, output current limiting is carried out instantly resulting in drop in the AC output voltage (the drop is proportional to the load impedance). Surge Power of 200% will, thus, be provided for < 8 ms every half cycle. If this situation continues for 2 to 2.5 sec Overload Condition is activated.

Overload Condition: If there is a continuous overload of 110% to 115% for 2 to 2.5 sec, the output voltage will be shut down. Red LED marked “OVERLOAD” (3, Fig 6.1a) will turn ON, the Green indication light on the GFCI outlet will be OFF and buzzer alarm will sound. The Green LED marked “POWER” (2, Fig 6.1a) will continue to be lighted. The unit will be latched in this shut down condition and will require manual reset. To reset, switch OFF the unit using the 3-Postion Rocker Switch “ON/Off/EXT. Switch”, wait for 3 minutes and then switch ON the unit again. Before switching ON, determine and remove the cause of overloading.

Short Circuit Condition: Short circuit condition will be detected when the AC output voltage drops to 80 VAC or lower over a period of around 1 to 1.5 sec. The AC output voltage will be shut down thereafter.

Red LED marked “OVERLOAD” (3, Fig 6.1a) will turn ON, the Green indication light on the GFCI outlet will be OFF and buzzer alarm will sound. The Green LED marked “POWER” (2, Fig 6.1a) will continue to be lighted. The unit will be latched in this shut down condition and will require manual reset. To reset, switch OFF the unit using the 3-Postion Rocker Switch “ON/Off/EXT. Switch”, wait for 3 minutes and then switch ON the unit again. Before switching ON, determine and remove the cause of overloading.

10.2 WARNING ALARM - LOW DC INPUT VOLTAGE

The voltage at the DC input terminals will be lower than the voltage at the battery terminals due to voltage drop in the battery wires and connectors. The drop in the voltage at the DC input terminals of the inverter could be due to lower battery voltage or due to abnormally high drop in the battery wires if the wires are not correctly sized (*Please see Section 8.4.3 "Connection from Batteries to the DC Input Side-Sizing of Cables and Fuses"*). If the voltage at the DC input terminals is below its threshold (10.7 V for PST-3000-12, 21.4V for PST-3000-24 and 42 V for PST-3000-48), a buzzer alarm will be sounded. The Green LED marked "POWER" (2, Fig 6.1a) and indication light on the GFCI will continue to be lighted and the AC output voltage would continue to be available. This warning buzzer alarm indicates that the battery is running low and that the inverter will be shut down after sometime if the voltage at the inverter terminals keeps dropping.

10.3 LOW DC INPUT VOLTAGE SHUT DOWN

If the voltage at the DC input terminals drops to, or its shutdown threshold (10.0 V for PST-3000-12, 20.0 V for PST-3000-24 and 40.0 V for PST-3000-48), the AC output will shut down. Buzzer alarm is sounded. The Green LED marked "POWER" (2, Fig 6.1a) will remain lighted. The Green indication light on the GFCI will be OFF.

The unit will reset automatically when the DC input voltage rises to to the value marked as "Auto-reset" in the "Low DC input Voltage Shutdown" portion of the unit's specification sheet in Section 12.

10.4 HIGH DC INPUT VOLTAGE SHUTDOWN

If the voltage at the DC input terminals rises to above its threshold (17 V for PST-3000-12, 34 V for PST-3000-24 and 64 V for PST-3000-48), the AC output voltage will shut down temporarily. Buzzer alarm will be sounded. The Green LED marked "POWER" (2, Fig 6.1a) will remain lighted. The Green indicator light on the GFCI will be OFF. The unit will be reset automatically when the voltage drops back to below its threshold voltage (17 V for PST-3000-12, 34 V for PST-3000-24 and 64 V for PST-3000-48).

10.5 OVER-TEMPERATURE SHUT DOWN

In case of failure of the cooling fans or in the case of inadequate heat removal due to higher ambient temperatures/insufficient air exchange, the temperature inside the unit will increase. The temperature inside the inverter is monitored (Power Transformer T3), and at 90 °C ± 5 °C / 196 °F ± 41 °F, the AC output of the inverter will shut down temporarily. Buzzer alarm will be sounded. The Green LED marked "POWER" (2, Fig 6.1a) will remain on. The Green indication light on the GFCI will be OFF.

The unit will automatically reset after the internal temperature of the unit has cooled down to 65 °C ± 5 °C / 149 °F ± 41 °F.

10.6 GROUND FAULT / LEAKAGE PROTECTION FOR AC OUTPUT THROUGH NEMA5-20R GFCI DUPLEX RECEPTACLE

AC output is supplied through hardwiring connections (11, Fig 6.1b) or through NEMA5-20R GFCI Duplex Receptacle (6, Fig 6.1a). The GFCI will trip if there is 5 to 6 mA leakage/Ground fault on the load side, or if Neutral and Ground are bonded on the load side. When tripped, the Green LED indication will be switched off. Remove the cause of tripping. Switch ON the inverter if OFF and then, press the "Reset Button" on the GFCI to reset (GFCI will not reset if the inverter is OFF and there is no AC voltage on the line side of the GFCI).

CAUTION!

Please note that the NEMA5-20R GFCI Duplex Receptacle (6, Fig 6.1a) is a Ground Fault and Leakage Protection Device and NOT an Over Current Protection Device (Breaker). The current carrying capacity of each of the two receptacles is 20 A intermittent and 16 A continuous. As the maximum continuous AC output current of PST-3000 is 25 A, please ensure that the full 25 A output is NOT drawn from only one receptacle but is shared between the two receptacles so that the above current carrying capacity of each of the receptacles is not exceeded. If the full rated current of 25 A is drawn from only one receptacle, the receptacle/GFCI will be damaged. Another option for drawing the full rated AC output current of 25 A is to use hardwiring connection (11, Fig 6.1b)

ATTENTION !

Veuillez noter que la NEMA5-20R Le GFCI Récipient Duplex (6, Fig. 6.1a) est un défaut à la terre et dispositif de protection de fuite et pas un dispositif de protection contre les surintensités (disjoncteur). La capacité de transport du courant de chacune des deux récipients est 20 A : intermittent et 16 A continu. Comme le courant de sortie CA maximale continue de la PST-3000 est 25 A, veuillez vous assurer que la pleine sortie 25 A n'est pas tirée d'un seul réceptacle mais est partagée entre les deux réceptacles de sorte que la capacité de transport de courant au-dessus de chacun des récipients n'est pas dépassé. Si la totalité du courant nominal de 25 A est tirée d'un seul réceptacle, le récipient / GFCI sera endommagé. Une autre option pour le dessin du courant de sortie alternative nominale complète de 25 A est à utiliser hardwiring connection (11, Fig. 6.1b)

10.7 INTERNAL DC SIDE FUSES

The following DC side fuses have been provided for internal protection of the DC input side:

PST-3000-12: 12 pieces of 30 A , 32 V (rated) in parallel = 360 A total

PST-3000-24: 12 pieces of 15 A , 32 V (rated) (rated) in parallel = 180 A total

PST-3000-48: 12 pieces of 10 A , 58 V (rated) in parallel = 120 A total.

NOTE: Fuses are soldered to the PCB.

10.8 REVERSE POLARITY AT THE DC INPUT TERMINALS

The Positive of the battery should be connected to the Positive DC input terminal of the inverter and the Negative of the battery should be connected to the Negative DC input terminal of the inverter. A reversal of polarity (the Positive of the battery wrongly connected to the Negative DC input terminal of the inverter and the Negative of the battery wrongly connected to the Positive DC input terminal of the inverter) will blow the external/internal DC side fuses. If the DC side fuse is blown, the inverter will be dead. The Green LED marked "POWER" (2, Fig 6.1a) and the Green indication light on the GFCI will be switched OFF and there will be no AC output.

INFO

Reverse polarity connection is likely to damage the DC input circuitry. The internal fuse(s) should be replaced with the same size of fuse(s) used in the unit. If the unit does not work after replacing the fuse(s), it has been permanently damaged and will require repair / replacement (*Please read Section 11 - "Troubleshooting Guide" for more details*).

CAUTION!

Damage caused by reverse polarity is not covered by warranty! When making battery connections on the input side, make sure that the polarity of battery connections is correct (Connect the Positive of the battery to the Positive terminal of the unit and the Negative of the battery to the Negative terminal of the unit). If the input is connected in reverse polarity, DC fuse(s) inside the inverter / external fuse will blow and may also cause permanent damage to the inverter.

ATTENTION !

Des dommages causés par un inversement de polarités ne sont pas couverts par la garantie! Quand vous faites des connexions à la batterie du côté d'entrée, veuillez assurer que les polarités sont mises du bon côté (lié le positif de la batterie à la borne positive de l'appareil et le négatif de la batterie à la borne négative de l'appareil). Si les polarités de l'entrée sont mises à l'envers, le fusible CC externe du côté d'entrée va s'exploser et pourrait causer des dommages permanents à l'onduleur.

SECTION 11 | Troubleshooting Guide

ISSUE	POSSIBLE CAUSE	REMEDY
When switched ON, the Green LED marked "POWER" (2, Fig 6.1a) does not light. Buzzer is OFF. There is no AC output voltage. Green indication light on the GFCI is OFF.	There is no voltage at the DC input terminals	• Check the continuity of the battery input circuit. • Check that the internal/external battery fuses are intact. Replace if blown. • Check that all connections in the battery input circuit are tight.
	Polarity of the DC input voltage has been reversed that has blown the external/ internal DC side fuses (**Note: Reverse polarity may cause permanent damage**. Damage caused due to reverse polarity is not covered by warranty)	• Internal fuses are soldered onto circuit board and it is recommended to only replace by professional tradesperson with advanced soldering skill. If unit continue to malfunction after replacement of fuse, there are internal damage to the unit and it is recommended to stop using the inverter.
Low AC output voltage (No buzzer alarm).	• AC load is exceeding 200% Surge Overload • Load is approaching 200% Surge Overload during lower DC input voltage	• Check that the battery is fully charged. Recharge, if low. • Check that the battery cables are thick enough to carry the required current over the required length. Use thicker cables, if required. • Tighten connections of battery input circuit. • Reduce load.
AC output voltage is available. Buzzer alarm is sounded at no load when load is switched ON. The Green LED marked "POWER" (2, Fig 6.1a) is lighted. Indication light on the GFCI is Green.	• Low DC input voltage alarm • **PST-3000-12:** DC input voltage is 10.7 ± 0.1 V or lower, but higher than 10 V ± 0.1 V • **PST-3000-24:** DC input voltage is 21.4 ± 0.2 V or lower, but higher than 20 V ± 0.2 V • **PST-3000-48:** DC input voltage is 42.0 ± 0.4 V or lower but higher than 40.0 ± 0.4 V	• Check that the battery is fully charged. Recharge, if low. • Check that the battery cables are thick enough to carry the required current over the required length. Use thicker cables, if required. • Tighten connections of the battery input circuit. • Make sure there's no sign of corrosion on any of the connections.
There is no AC output voltage. Buzzer alarm is sounded at no load or when load is switched ON. The Green LED marked "POWER" (2, Fig 6.1) is lighted. GREEN indication light on the GFCI is OFF.	• AC output voltage has been shut down due to low DC input voltage • **PST-3000-12:** DC input voltage is lower than 10 V ± 0.1 V • **PST-3000-24:** DC input voltage is lower than 20 V ± 0.2 V • **PST-3000-48:** DC input voltage is lower than 40.0 ± 0.4 V	• Check that the battery is fully charged. Recharge, if low. • Check that the battery cables are thick enough to carry the required current over the required length. Use thicker cables, if required. • Tighten connections of the battery input circuit. • The AC output voltage will switch ON automatically when the DC input voltage rises to 10.7 V for PST-3000-12, 21.4 V for PST-3000-24 or 42 V for PST-3000-48.

SECTION 11 | Troubleshooting Guide

ISSUE	POSSIBLE CAUSE	REMEDY
• There is no AC output. • The Green LED marked "POWER" (2, FIG 6.1A) is lighted. • Buzzer is ON. • Green indication light on the GFCI is OFF.	Shut-down due to high input DC voltage • DC input voltage is 17.0 V or higher for PST-3000-12 • DC input voltage is 34.0 V or higher for PST-3000-24 • DC input voltage is 64 V or higher for PST-3000-48	• Check that the voltage at the DC input terminals is less than 17 V for PST-3000-12, 34 V for PST-3000-24, or 64 V for PST-3000-48. • Ensure that the maximum charging voltage of the battery charger/alternator/solar charge controller is below 17 V for PST-3000-12, 34 V for PST-3000-24, or 64 V for PST-3000-48. • Ensure that an unregulated solar panel is not used to charge a battery. Confirm that a charge controller is used between the solar panel and the battery. • The unit will reset automatically when the DC input voltage drops below 17 V for PST-3000-12, 34 V for PST-3000-24, or 64 V for PST-3000-48.
• AC output shuts down completely. • Red LED marked "OVER-LOAD" (3, Fig 6.1a) is lighted. • Buzzer is ON. • The Green LED marked "POWER" (2, Fig 6.1a) is lighted. Green indication light on the GFCI is OFF.	Permanent shut-down of the AC output due to: • Continuous overload more than 110% - 115%, OR • Short circuit on the AC load side	• Reduce the load/remove the short circuit • The load is not suitable as it may require higher power to operate. Use an inverter with higher power rating. • If the unit goes into permanent overload again after resetting and removing the load completely, the unit has become defective. Call Technical support. **NOTE:** The unit will be latched in this shut-down condition and will require manual reset. To reset, switch OFF the power ON/OFF switch (1, Fig 6.1), wait for 3 minutes and then switch ON again. Before switching on again, remove the cause of the shut-down.
• There is no AC output. Buzzer alarm is sounded. • Red LED marked "OVER TEMP" (4, Fig 6.1a) is lighted. • The Green LED marked "POWER" (2, Fig 6.1a) is lighted. Green indication light on the GFCI is OFF.	Shut-down due to over temperature because of fan failure or inadequate cooling as a result of high ambient temperature or insufficient air exchange. • Internal hot spot is at 90 ± 5 °C or higher	Check that the fans are working. If not, the fan control circuit may be defective. Call Technical Support. If the fans are working, check that the ventilation slots on the suction side and the openings on the discharge side of the fans are not obstructed. If the fans are working and the openings are not obstructed, check that enough cool replacement air is available. Also check that the ambient air temperature is less than 40 °C. Reduce the load to reduce the heating effect. After the cause of overheating is removed and the internal hot spot cools down to 65 ± 5 °C, the AC output will be restored automatically.
• There is no AC output. Green indication on the GFCI is OFF. • The Green LED marked "POWER" (2, Fig 6.1a) is lighted. • No buzzer alarm.	GFCI has tripped due to leakage or due to Neutral to Ground bond on the load side.	Check load side circuits for leakage or Neutral to Ground bonding and correct. Press "Reset Button" on the GFCI to reset. Ensure that the inverter is ON before re-setting the GFCI.

SECTION 12 | Specifications

MODEL NO.	PST-3000-12	PST-3000-24	PST-3000-48
OUTPUT			
OUTPUT VOLTAGE	120 VAC ± 3%		
MAXIMUM OUTPUT CURRENT	25 A		
OUTPUT FREQUENCY	60 Hz ± 1%		
TYPE OF OUTPUT WAVEFORM	Pure Sine Wave		
TOTAL HARMONIC DISTORTION OF OUTPUT WAVEFORM	< 3%		
CONTINUOUS OUTPUT POWER (At Power Factor = 1)	3000 Watts		
SURGE OUTPUT POWER	6000 Watts		
PEAK EFFICIENCY	> 85%	> 88%	> 90%
AC OUTPUT CONNECTIONS	(i) NEMA5-20R GFCI Duplex Receptacle (ii) Terminal block for hardwiring: Hole diameter (4 mm / 0.16") and Set Screw (#6 x 40 TPI or M3.5 x 0.6 mm Pitch)		
INPUT			
NOMINAL DC INPUT VOLTAGE	12 V	24 V	48 V
DC INPUT VOLTAGE RANGE	10.7 - 16.5 VDC	21.4 - 33 VDC	42 - 60 VDC
MAXIMUM INPUT CURRENT	360 A	180 A	120 A
DC INPUT CURRENT AT NO LOAD	< 1.6 A	< 1.0 A	< 0.7 A
DC INPUT CONNECTIONS	Bolt & Nut: 5/16” x 18 TPI		
DC INPUT FUSES (INTERNAL) (Automotive, Blade Type)	12 X 30 A = 360 A (Each 30 A, 32 V)	12 x 15 A = 180 A (Each 15 A, 32 V)	12 x 10 A = 120 A (Each 10 A, 58 V)
DISPLAY			
LED	Power, Overload, Over Temperature		
PROTECTIONS			
LOW DC INPUT VOLTAGE ALARM	10.7 V ± 0.1 V	21.4 V ± 0.2 V	42 V ± 0.4 V
LOW DC INPUT VOLTAGE SHUTDOWN	10 V ± 0.1 V; Auto-reset: 11.5 V ± 0.3 V	20 V ± 0.2 V; Auto-reset: 23 V ± 0.5 V	40 V ± 0.4 V; Auto-reset: 46 V ± 1.0 V
HIGH DC INPUT VOLTAGE SHUTDOWN	> 17 V ; Auto-reset: < 17 V	> 34 V ; Auto-reset: < 34 V	> 64 V ; Auto-reset: < 64 V
SHORT CIRCUIT SHUTDOWN	When output voltage drops to 80 VAC or lower for 1 to 1.5 sec		
OVERLOAD SHUTDOWN	At overload of 110% to 115% for 2 to 2.5 sec		
GROUND FAULT SHUTDOWN	Only on GFCI outlets (5 to 6 mA leakage)		
OVER TEMPERATURE SHUTDOWN	90 °C ± 5 °C / 194 °F ± 41 °F (Sensed at Transformer T3); Auto reset at 65 °C ± 5 °C / 149 °F ± 41 °F		
REVERSE POLARITY ON DC INPUT SIDE	External/internal DC sides fuses will blow		
REMOTE CONTROL			
WIRED REMOTE CONTROL WITH LED / LED DISPLAY WIRED ON / OFF CONTROL	RC-300 (sold separately) with 25’ cable (i) By switching external contact (ii) By switching external 12 V / 24 V /48 V signal		
COOLING			
FORCED AIR COOLING	Temperature controlled fan (Sensed at Transformer T6) Fan ON at 55 °C ± 3 °C / 131 °F ± 37.4 °F; Fan OFF at 45 °C ± 3 °C / 113 °F ± 37.4 °F		
COMPLIANCE			
SAFETY	Intertek - ETL Listed. Conforms to UL Std 458 & CSA Std C22.2 No. 107.1		
EMI / EMC	FCC Part 15(B), Class A		FCC Part 15(B), Class B
HAZARDOUS SUBSTANCE	RoHS Compliant (Lead Free)		
ENVIRONMENT			
WORKING ENVIRONMENT	Indoor use		
OPERATING TEMPERATURE RANGE	-20 to 40 °C / -4 to 104 °F		
STORAGE TEMPERATURE	-30 to 70 °C / -22 to 158 °F		
RELATIVE HUMIDITY	90%, non condensing		
GENERAL			
(W X D X H), MM	263 x 456.5 x 145		
(W X D X H), INCHES	10.35 x 17.97 x 5.71		
WEIGHT, KG	9.8		
WEIGHT, LBS	21.6		

NOTES:

1. All power ratings are specified for resistive load at Power Factor = 1.
2. All specifications given above are at ambient temperature of 25 °C / 77 °F.
3. Specifications are subject to change without notice

CAUTION! RISK OF FIRE

Do not replace any vehicle fuse with a rating higher than recommended by the vehicle manufacturer. PST-3000-12 is rated to draw 360 Amperes from 12 V vehicle outlet and PST-3000-24 is rated to draw 180 Amperes from 24 V battery vehicle outlet, and the PST-3000-48 is rated to draw 120 A from a 48 V circuit. Ensure that the electrical system in your vehicle can supply this unit without causing the vehicle fusing to open. This can be determined by making sure that the fuse in the vehicle, which protects the outlet, is rated higher than 360 Amperes for PST-3000-12 (12V battery), or higher than 180 Amperes for PST-3000-24 (24 V battery), or higher than 120 Amperes for the PST-3000-48 (48 V battery). Information on the vehicle fuse ratings is typically found in the vehicle operator's manual. If a vehicle fuse opens repeatedly, do not keep on replacing it. The cause of the overload must be found. On no account should fuses be patched up with tin foil or wire as this may cause serious damage elsewhere in the electrical circuit or cause fire.

ATTENTION! RISQUE D'INCENDIE !

Ne remplacez pas un fusible de véhicule avec une taille plus grande que celle qui est recommandée par le fabricant du véhicule. Ce produit est fabriqué pour tirer 360 Ampères d'une prise de véhicule de 12 V et 180 Ampères d'une prise de 24 V, et le PST-3000-48 est conçu pour tirer 120 A d’un circuit de 48 V. Donc, il faut s’assurer que le système électrique dans le véhicule puisse alimenter l'onduleur sans que le fusible s'ouvre. Vérifiez, en lisant le manuel du véhicule, que le fusible qui protège la prise (du véhicule) est fabriqué pour plus que 360 Amp (batterie de 12V) ou, plus que 180 Amps (Batterie de 24 V), ou supérieure à 120 A pour le PST-3000-48 (batterie de 48 V). Si le fusible s'ouvre plusieurs fois, ne continuez pas de le remplacer. Dan ce cas, il faut trouver la cause de la surcharge. Il faut jamais essayer de réparer/combler un fusible avec un fil ou papier aluminium, çà pourrait engendrer des dommages dans le circuit électrique ou même causer un incendie.

SECTION 13 | Warranty

3 YEAR LIMITED WARRANTY

The PST-3000-12, PST-3000-24 and PST-3000-48, are manufactured by Samlex America, Inc. (the "Warrantor") is warranted to be free from defects in workmanship and materials under normal use and service. The warranty period is 3 years for the United States and Canada, and is in effect from the date of purchase by the user (the "Purchaser").

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

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

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

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

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

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

Samlex America Inc. (the "Warrantor")

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NOTES:

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