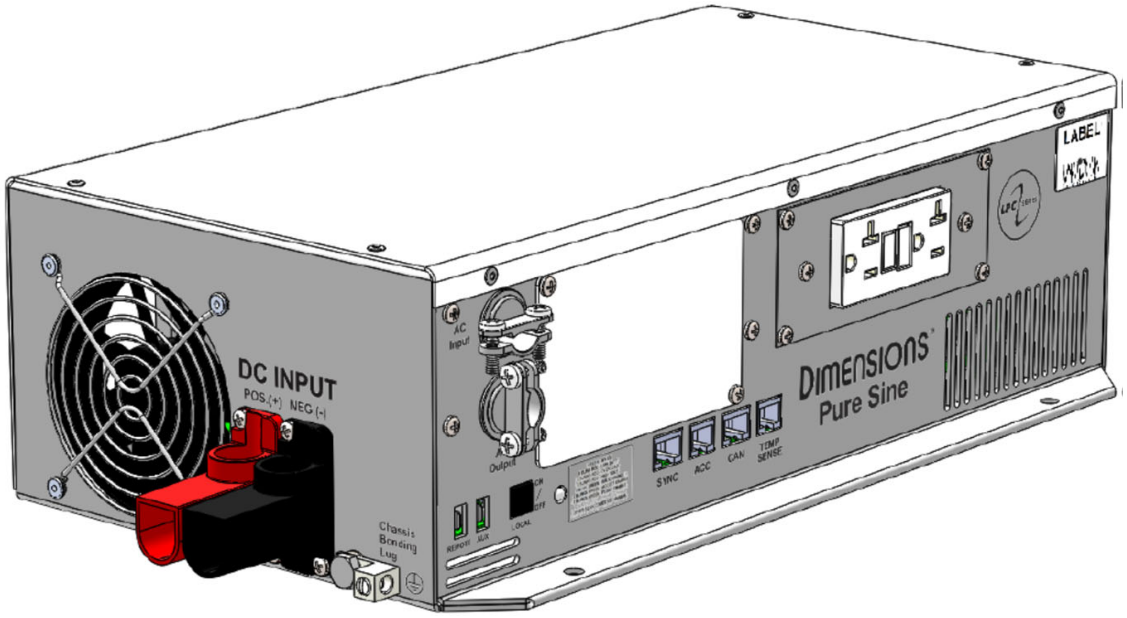
DIMENSIONS

DC to AC Power Inverter/Charger
Pure Sine Wave Output

Owner's Manual



Base Model:
12LP15/12LPC15

Sensata
Technologies

The World Depends on Sensors and Controls

INTRODUCTION

Thank you for purchasing a Dimensions Inverter/Charger from Sensata Technologies! We think that you will find this product to be extremely reliable and easy to use.

Please read this manual completely, before installation and operation.

Contact us by phone or email if you need assistance with this product.

We can be reached at: 1-800-553-6418

http://dimensions.sensata.com inverterinfo@sensata.com

Important

Read this manual before installation. This manual contains important safety, installation and operating instructions. Save this manual and keep it in a safe place.

Sensata Technologies is an ISO 9001:2015 Registered Company.

Sensata uses the following special notices to help prevent injury and/or damage to equipment.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION is used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTE is used to notify of installation, operation, or maintenance information that is important but not hazard related.

SAFETY LISTING

c UL us LISTED

Power Inverter, E100666

Inverter Safety Instructions

- ⚠ **WARNING:** Power Inverters produce hazardous voltages. To avoid risk of harm or fire, the unit must be properly installed.
- ⚠ **WARNING:** There are no user serviceable parts inside. Do not remove the cover.
- ⚠ **WARNING:** Power Inverters should not be mounted in a location that may be exposed to rain or spray.
- ⚠ **WARNING:** Power Inverters should not be installed in a zero-clearance enclosure.
- ⚠ **WARNING:** Damage to the Power Inverter will occur if correct polarity is not observed when installing the inverter's DC input cables.
- ⚠ **WARNING:** Damage to the Power Inverter will occur if an external AC power source is applied to the inverter's AC hardwire output.
- ⚠ **WARNING:** Power Inverters contain a circuit breaker and capacitor that may produce a spark upon connection or during normal operation. Do not mount in a confined battery or gas compartment
- ⚠ **WARNING:** Be sure the Power Inverter is turned OFF and AC power is disconnected when batteries are being connected, disconnected, serviced, and replaced or personal injury and/or damage to the inverter could result.
- ⚠ **WARNING:** Working near lead-acid batteries is dangerous. There is a risk of acid exposure.

Battery Safety Instructions

- ⚠ **WARNING:** Batteries generate explosive gases during operation.
- ⚠ **WARNING:** There is risk of high current discharge from shorting a battery that can cause fire and explosion. Use insulated tools during installation.
- ⚠ **WARNING:** Remove all rings, watches, jewelry or other conductive items before working near the batteries.
- ⚠ **WARNING:** Inspect the batteries at least once a year for cracks, leaks or swelling.
- ⚠ **WARNING:** Dispose of the batteries according to local regulations. Do not incinerate batteries; risk of explosion exists.
- ⚠ **WARNING:** A fuse must be installed between the battery and the inverter to protect against shorted cables.

TABLE OF CONTENTS

SPECIFICATIONS

Input Voltage: (Vdc)	10.5-15.0
DC Surge Voltage (Vdc)	Up to 24Vdc
Output Voltage (Vac)	120 +/- 5%
Output Frequency (Hz):	60 +/- .05%
THD:	< 5% at 12.6Vdc and 1500W
Output Waveform:	Pure Sine < 5% THD
Output Power (Watts Cont.)	1500
Output Current (Aac Cont.)	12.5
Input Current (Adc Cont.)	Up to 167 at 12.6Vdc
Input Current (Adc Cont.)	Up to 190 at 10.5Vdc
Peak Power (Watts)	3000
Peak Output (Aac)	25.0
Motor Starting Rating (h.p.)	1/2
Inverter Efficiency:	Up to 80%
Charger Input Voltage (Vrms)	85 – 135 (LPC only)
Max Charger Output Current (Adc)	65 at 12.6Vdc (LPC only)
Input Current Bypass (Arms)	20 (LPC only)
Weight (lbs.)	30
Dimensions in. (L x W x H)	19.0" x 9.75" x 4.8" *
Operating Temperature:	-40C to 50C (-40F to 122F) **
Agency Listings:	UL458, E100666

Table 1 – Specs

- All ratings above assume 12.6Vdc nominal voltage, 25°C ambient temperature, and the inverter is mounted in free air. 12.6Vdc is to be measured at the inverter input terminals.
- For use at ambient temperatures less than -20°C, use the hardwire connections. The GFCI may fail to operate properly at temps below -20°C.
- At temperatures greater than 25°C, the inverter output is de-rated. See graph in "Theory of Operation" section of the manual.

* Length includes DC terminals and handle.

** At ambient temperatures above 50°C, the inverter/charger may fail to restart in the event it shuts down in an overtemperature condition.

OTHER DESIGN FEATURES

- GFCI receptacle protection, Remote Switch or "On/Off" switch hookup.
- Unit Protection: Automatic inverter short circuit/overload protection, automatic over temperature shutdown, and AC output circuit breaker.
- Battery Protection: Automatic low battery shutdown with an in-rush delay. Other low battery settings may be configured with the PC CAN interface.
- Shutdown Timer: Shutdown time helps preserve battery life over long periods of time. When enabled it will shut the inverter off in 30 or 60 minutes regardless of load.
- Load Sense: Inverter output will shut off if no load is connected. The inverter will turn back on when it detects that a load has been connected.

PHYSICAL DESCRIPTION

(1) **GFCI:** Provides 120VAC output. Only replace with an approved GFCI.

(2) **Status LED:** This LED will show inverter operation mode and troubleshooting information. See the table in the troubleshooting section at the rear of the manual for further operation mode descriptions.

(3) **Local On/Off:** This switch turns the inverter on or off. **Switch inoperable for "HR" and "R" configurations.

(4) **AC Input and Output Breakers:** Input and output breakers. Protects the inverter from output short circuits and overloads. The 12LP15 (inverter only) only uses a 15A output breaker. The 12LPC15 (inverter/charger) uses 20A input and output breakers. The input breaker position for the 12LP15 is plugged.

(5) **Bonding lug:** Connects to the system ground.

(6) **DC input connections:** Connects to the battery bank.

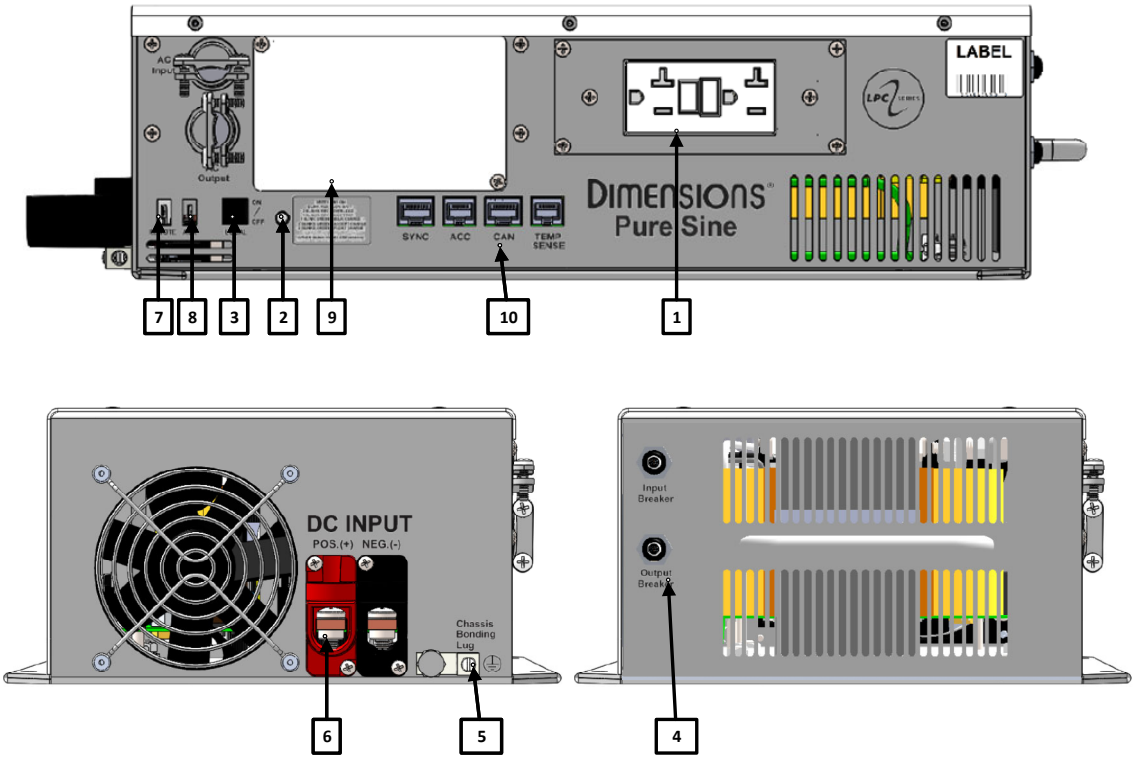
(7) **Remote On/Off Wiring Tab:** Terminal is used to wire a customer supplied remote ON/OFF switch. Apply battery voltage to tab to turn on inverter.

(8) **Aux Wiring Tab:** Terminal is used to enable internal housekeeping power only. Apply battery voltage to enable. Does not turn on inverter output.

(9) **AC Wiring Access Plate:** Provides wiring and inspection access to AC output terminals inside the AC wiring box. To be closed during operations.

(10) **Various Ports**: "CAN" is used for connection of a CAN interface. "TEMP SENSE" is used for connection a battery temperature sensor (BTS), sold separately. "ACC" is used for a remote switch (purchased separately). The Sync port may be plugged with an empty connector because it is currently not used.

Figure 1 - Features



MOUNTING THE INVERTER

Installation Tools

The following tools may be required for inverter installation: Crimper, Cable Ties, Cutter, Drill, #2 Phillips Screw Driver (with a magnetic end), Slotted Screw Driver, Tape Measure, Wire Cutters, Needle Nose Pliers, and Wire Strippers.

Inverter Mounting Recommendations

NOTE: The inverter mounting location should provide adequate ventilation and clearance to maintain room temperature during operation. At least ½" of clearance is required on all sides except the bottom.

1. Locate a suitable, secure mounting surface as close to the batteries as possible without being in the same compartment.
2. Mount the inverter using four each ¼-20 steel bolts, flat and lock washers, and nuts. The length of the bolts should be equal to the mounting material thickness plus ¾".

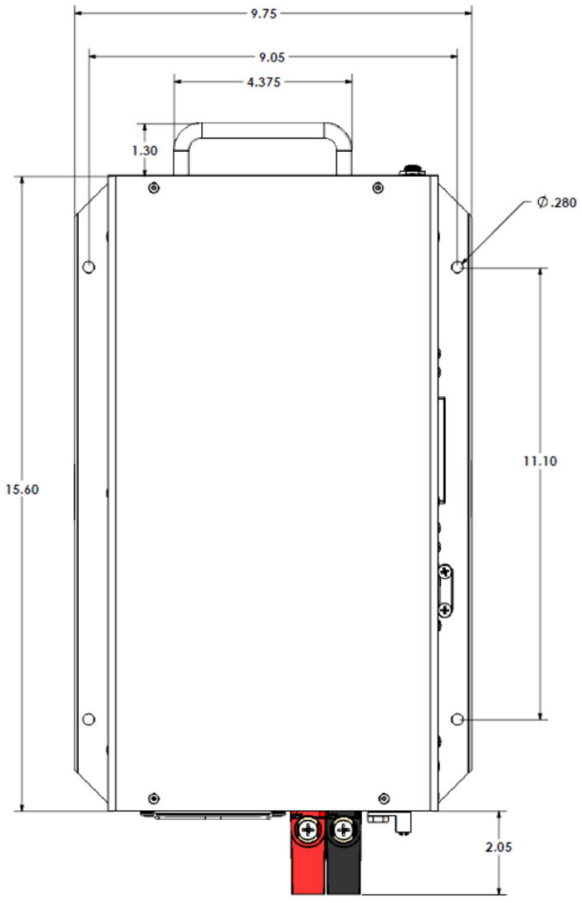


Figure 2 - Mounting for all models (units are in inches)

DC WIRE GAUGE & FUSING

Inverter Cable

An "Inverter Cable Kit" (positive cable, negative cable, and proper fuse) is needed to connect the inverter to a battery bank. An 8-gauge wire is also recommended to connect the inverter's bonding lug to system ground.

Use a 1/0 cable to connect to the inverter. The recommended maximum length of the inverter cable is 15-ft, and it must be fused within 18 inches of the positive (+) terminal of the battery.

An inverter cable kit designed to SAE guidelines can be purchased directly from Sensata – call for options.

Torque the DC connections on the inverter to 50-60 lbs.-in.

Torque the inverter bonding lug to 45 lbs.-in. for 6AWG or 40 lbs.-in. for 8AWG.

Min. Cable and Max. Fusing Guide for 3% Voltage Drop at 100% Output.		
Inverter Model	Full Load (Adc)	Inverter to Battery Est. Cable Length in Feet
		up to 15 feet @ 25°C (77°F)
12LP15/ 12LPC15	190Adc 100% Duty (at 10.5Vdc)	1/0 AWG, 350A Fuse
12LP15/ 12LPC15	190Adc 50% Duty (at 10.5Vdc)	1/0 AWG, 350A Fuse

Table 2 - Cable Sizing

NOTE: Using a smaller cable may cause the inverter to go into low battery or high temperature prematurely.

NOTE: 100% duty rating assumes the inverter is operating at its full rated output power continuously for at least an hour. The 50% duty rating assumes that the inverter is operating at its full rated output power for up to 15 minutes and then operating with a load less than 25% of its full rating for at least 15 minutes before returning to full power and repeating. Alternately it can also operate at 50% of its rated output power continuously. Table assumes operating in an ambient temperature of 25°C (77°F). For higher ambient temperatures, additional derating may be required (i.e. may need to use a larger cable size).

To make your own "Inverter Cable Kit," follow the below recommendations:

1. Use 1/0-ga stranded copper cables in all cases.
2. USE SGX cross-linked polyurethane insulation type that complies with the high temperature insulation requirements (125°C.) of SAE J-1127 and vehicle manufacturer requirements.
3. For 1/4" ring lugs, use JST 38-S6.

TIP: It is useful to use a needle nose pliers to help insert or remove the 1/4x20 screw and toothed washer.

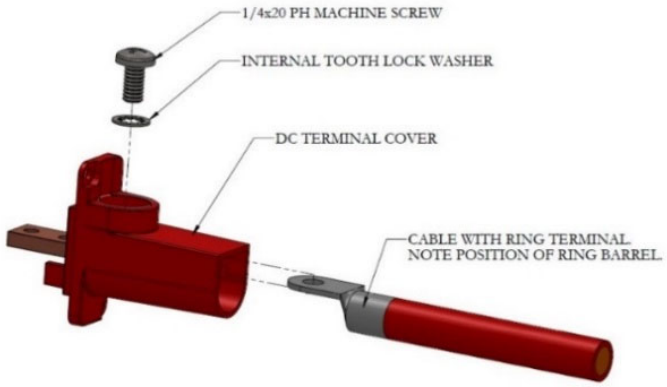
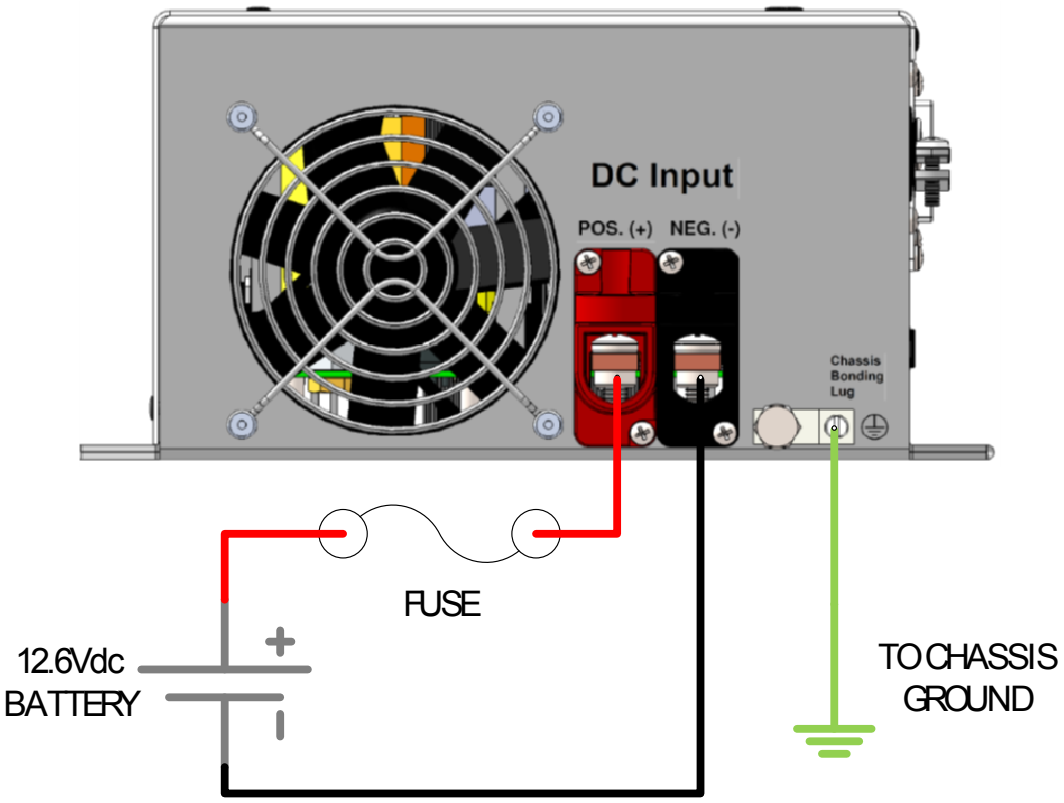


Figure 3 - Proper installation of cable into DC terminal cover

WIRING DIAGRAM

Typical DC Wiring Diagram



Cable Connection Procedure

- Remove the fuse from the fuse holder.
- Connect the inverter's bonding lug to ground of the vehicle chassis.
- Connect the ring terminated end of the black inverter cable set directly to the (-) Negative side of the battery bank at a negative battery post.
- Connect the fuse holder to the (+) Positive side of the battery bank.
- Connect the ring terminated end of the RED inverter cable set directly to the fuse holder.
- Install the fuse in the fuse holder. A typical one-time spark will occur when this final connection is made.
- Install the fuse holder cover.

Figure 4 - DC Input Wiring

AC INPUT/OUTPUT CONNECTIONS

⚠ **WARNING:** Do not connect another source of AC power directly to the AC output of the inverter. This will result in damage not covered under warranty.

GFCI:

A 20A GFCI is installed into the side of the inverter, except for "H" suffix hardwire only versions where it is omitted. The rated output of the inverter is 12.5A. If a 20A load is applied to the GFCI, the 15A AC output breaker installed on a 12LP15 inverter only will eventually trip. The 12LPC15 allows for 20A of bypass current, so a 20A breaker is used. If 20A of load is connected to the inverter or inverter/charger while in inverter mode, the inverter will shut down in overload.

Hardwire Interface:

Remove the cover for hardwire AC wiring. Insert AC input and output wiring through the AC Output cable clamps to protect the wires from the metal edge of the hole. Connect the AC wiring to the provided internal terminal blocks. Be sure to connect the AC input wiring to the AC input terminal blocks, and the AC output wiring to the AC output terminal blocks. The AC terminal block will accept 14-8 AWG wire. Proper torque for the AC terminal blocks is 10lbs.-in. The 12LP15 should use 14AWG minimum for the AC output. The 12LPC15 should use 12AWG minimum for the AC input and AC output. Connect the hot wires to the black terminal, the neutral to the white terminal, and the ground to the green terminal.

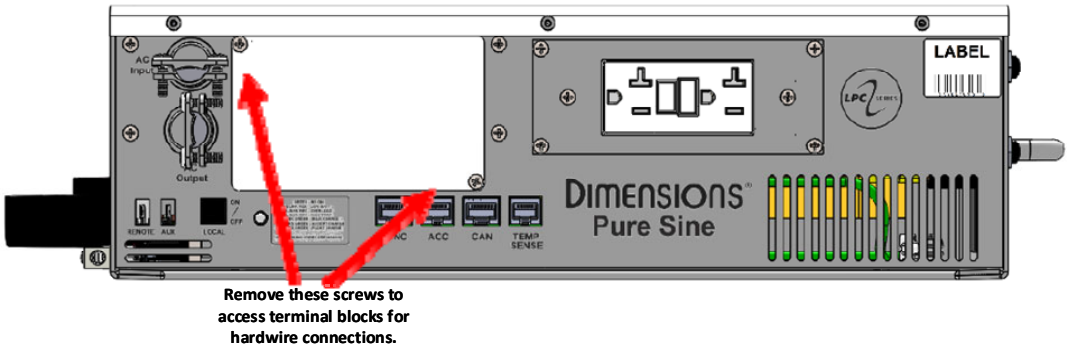
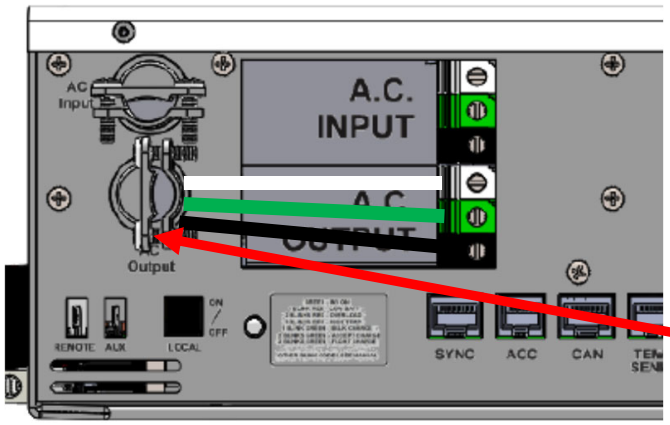
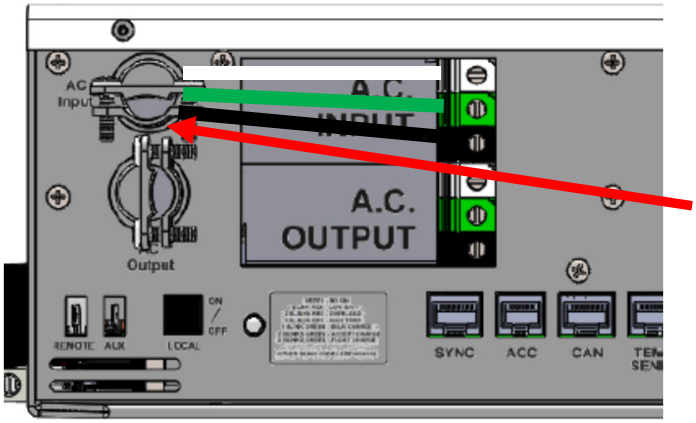


Figure 5 - Hardwire access



Connect inverter AC output wires here. Black is AC hot, white is AC neutral, and green is ground.

Figure 6 - AC Inverter Output Connections



Connect charger AC input wires here. Black is AC hot, white is AC neutral, and green is ground.

Figure 7 - AC Input for Charger/Bypass

NOTE: The AC input should be protected by a 20A branch rated breaker external to the inverter/charger.

NOTE: The AC output should be protected by a branch rated breaker external to the inverter if required to comply with the National Electric Code, NFPA 70.

NOTE: Connecting the AC inverter input to a GFCI protected outlet may cause some interference with the inverter's GFCI.

REMOTE INVERTER ON/OFF SWITCH

Remote Inverter ON/OFF Switch – Customer Supplied

Two types of remote switches may be used to control the inverter/charger. They are momentary or snap switches. However, the type of switch used can only be used in specific circumstances. For non "-R" suffix versions, a momentary switch must be used. For remote only "-R" suffix versions, a snap switch must be used. If a snap switch is used in place of a momentary switch, the inverter may not respond correctly.

In remote only mode, the snap switch will turn the inverter on and off when in inverter mode. When in charger mode, it will switch the inverter state between off and standby.

In non-remote only mode, the momentary switch will toggle the inverter state between on and off, or standby and off while in charge mode.
The remote switch may be customer supplied or ordered separately from the factory. Mount the remote switch in a convenient location. Using 18-gauge wire and an insulated ¼" female faston, wire between the "Remote ON/OFF" connection on the left side of the inverter. Wire from the remaining connection on the remote switch to the battery positive (+) terminal. Be sure to install a 5-amp in-line fuse in series within 10 inches from the positive (+) terminal of the battery.

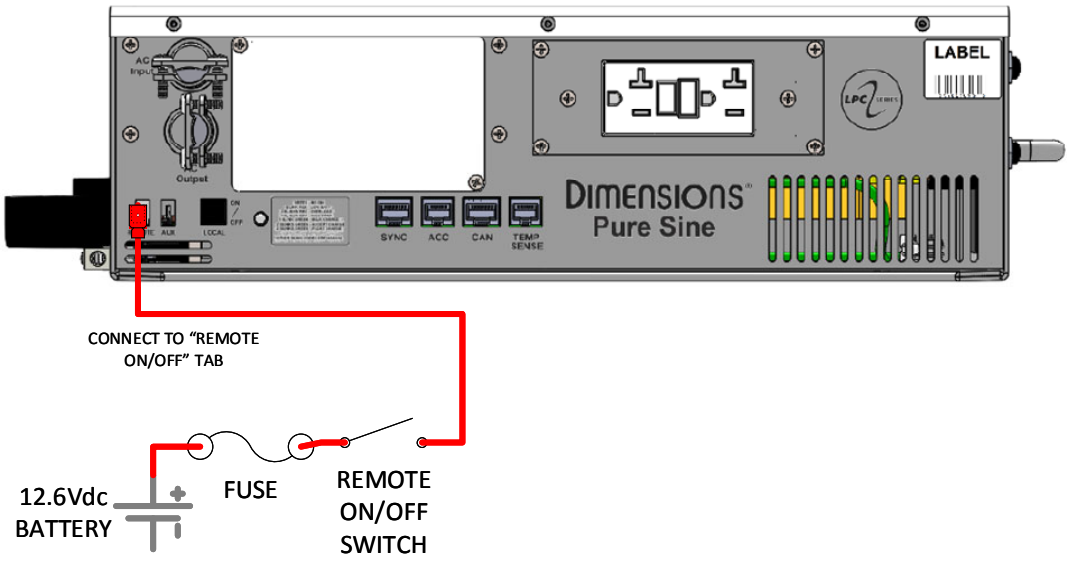


Figure 8 - 12LP15R shown with snap switch

OPERATION

Once the inverter has been fully installed and wired, and DC power has been applied, the inverter is ready to turn on. The Status LED beneath the AC wiring box on the left side of the inverter shows the current state of the inverter.

Inverter Power Mode

The inverter can now be turned on by using the local or remote switch. When the inverter is on, the local Status LED will be a constant green. When the Local On/Off switch is enabled in assemblies without the "R" suffix, any switch may turn on or off the inverter. When using the local switch, any remote switch must be a momentary type.

With the "R" suffix, only the remote switch will turn on the inverter. The remote switch must be a snap type. The Local On/Off switch will be inactive.

The function of the switch will depend on the mode the unit is running in, and if the Aux tab is enabled and being used.

Note: The LED will blink a yellow-green pattern indicating the battery type on the 12LPC15 during the first 5 minutes of operation upon initial power-up. The pattern will cease if a warning or fault occurs.

External Power Mode - Bypass

The loads attached to the inverter output will operate directly from the external AC power line independently of the inverter ON/OFF status. If the inverter is left ON (standby mode), the built-in bypass relay will automatically cycle back and forth between "Inverter Power" mode and "External Power" mode depending on the availability of the external AC power line.

External Power Mode -Battery Charger

The battery charger will engage automatically and independently of the inverter ON/OFF status. The 3-step charging process modes are: Constant Current (Bulk), Constant Voltage (Acceptance), and Float. The Battery Temperature Sensor (BTS) must be plugged into the "TEMP SENSE" connector on the inverter. If not, the charger will not operate.

Charging Status LED Normal States		
LED Color	LED State	Operating Conditions
Green	1 blink	Constant Current (Bulk) Charge
Green	2 blinks	Constant Voltage (Accept) Charge
Green	3 blinks	Float Charge
Green	4 blinks	Load Management Active

Table 3 - Charge Modes

CONFIGURATIONS

Default Configuration

	DEFAULT SETTINGS										
MODEL	**Local Switch**	**Remote Switch**	**Low Battery**	**Shut Down Timer**	**Load Sense**	**Aux Control**	**Battery Type**	**Branch Circuit Rating**	**AC Line Qualify**	**CAN Instance**	**CAN Baud Rate**
LP STANDARD	ENABLED	MOMENTARY	10.5 V	OFF	OFF	DISABLED	N/A	N/A	N/A	1	250k
LP WITH "R" SUFFIX	DISABLED	SNAP	10.5 V	OFF	OFF	DISABLED	N/A	N/A	N/A	1	250k
LPC STANDARD	ENABLED	MOMENTARY	10.5 V	OFF	OFF	DISABLED	AGM	15A	30 SECS	1	250k
LPC WITH "R" SUFFIX	DISABLED	SNAP	11.0 V	OFF	OFF	DISABLED	AGM	20A	30 SECS	1	250k
	SETTING OPTIONS (SET BY CAN PROGRAMMING TOOL OR FACTORY)										
	Local Switch	**Remote Switch**	**Low Battery**	**Shut Down Timer**	**Load Sense**	**Aux Control**	**Battery Type**	**Branch Circuit Rating**	**AC Line Qualify**	**CAN Instance**	**CAN Baud Rate**
OPTIONS	ENABLED	MOMENTARY	10.5	OFF	ON	DISABLED	WET LEAD ACID	DISABLED	5 SECS	1	250k
	DISABLED	SNAP	to	30 MINUTES	OFF	RV	AGM	5A	to	to	500k
			12.0V	60 MINUTES		UTILITY	GEL	to	30 SECS	13	
						CUSTOM		20A			
INCREMENT			0.1V STEPS					5A STEPS	5 SEC STEPS		

Table 4 - Configurations and Defaults

Switch Options

The inverter can be configured by the factory or through the CAN configuration interface to have different local and remote switch configurations. The local switch may be set to enabled or disabled. The remote switch may be set to snap or momentary. "Snap" and "momentary" describe the type of switch that is used.

There is one switch combination that isn't allowed. If the local switch is set to enabled, the remote switch must be set to momentary. If the remote is set to snap, the inverter may not respond correctly to changes in the remote switch's state. This is also true if the inverter remote switch is set to momentary, but a snap style switch is used.

ALLOWED SWITCH OPTIONS

	REMOTE SWITCH STYLE	
LOCAL	**SNAP**	**MOMENTARY**
ENABLED	**no**	**yes**
DISABLED	**yes**	**yes**

Table 5 - Switch Options

Low Battery Shutdown

Low Battery Shutdown is a protective measure to prevent deep discharge of the battery and/or to make sure that the starting batteries have enough power to start the vehicle.

NOTE: If the inverter is shutdown in low battery conditions, the unit will go into a hard shutdown for under voltage protection (UVP) if the battery is not charged up to the inverter's auto recovery voltage of 13.5V after 15 minutes. The inverter will be completely off and there will be zero current drawn in UVP. Cycling the ON/OFF switch (remote switch only for "R" suffix) will immediately restart the inverter if the voltage is above the Low Battery Threshold at the DC input terminals.

NOTE: The inverter may be de-rated when the input voltage approaches the low battery set-point. To conserve battery voltage, the internal inverter fan may turn off. This will cause the inverter to go into high temp shutdown if the load is high enough.

Shutdown Timer

As an alternative to sleep mode, a factory configured shutdown timer is available to disable the inverter after fixed periods (regardless of output load). Standard timer settings are OFF, 30 minutes and 60 minutes. Following shutdown, the DC input current will be less than 0.5mA. Cycling the ON/OFF control will restart the inverter.

Sleep Mode (Load Sense)

The inverter has a Sleep Mode feature which if enabled can significantly reduce DC power drawn over long periods of no-load operation to help preserve battery life. If Sleep Mode is enabled the inverter output will automatically turn off when AC loads greater than 20W are not present for 60 seconds. The inverter will check for the presence of a load once a second and will automatically restart on when it reappears.

NOTE: While in sleep mode it may take up to one second for the load to receive power when the load is applied.

NOTE: The LED on the GFCI will blink when the inverter has gone to sleep**.**

Auxiliary Control

The "AUX" tab on the side of the inverter allows for additional functionality of the inverter. The "AUX" tab is set to disabled by default at the factory. To change it, contact the factory or use the CAN Setup Tool. To use the AUX tab, battery voltage needs to be applied to it. The connection should be fused.

Mode	Description of Mode
Disabled	Aux tab doesn't do anything.
Utility	Aux tab required to be high to enable inverter, charger, and bypass.
RV	Aux tab required to be high to enable inverter. Charger and bypass not affected.
Control	Aux tab required to be high to enable charger mode. Inverter and bypass not affected.

Table 6 - Aux Control

The "AUX" tab has no effect on charger and bypass functions if enabled on a 12LP15 inverter only.

Note: Applying battery voltage to the "AUX" tab while the inverter is off will cause the inverter to draw about 170mA. Remove power from the "AUX" tab when not using the inverter to conserve battery power.

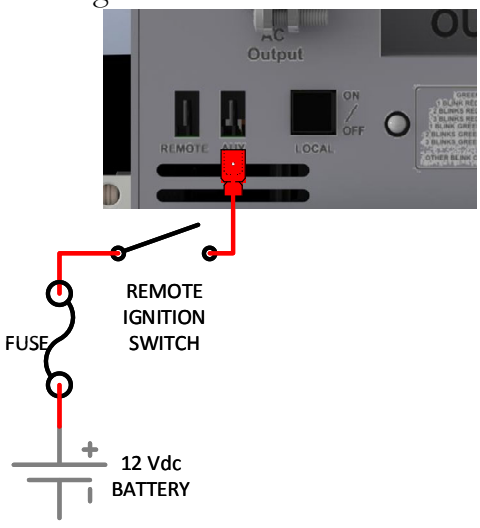


Figure 9 - Aux Connection

Battery Options

The charger can be set to charge three different types of batteries. Wet Lead Acid, AGM, or Gel. The charger is set to Wet Lead Acid by default by the factory. The battery type may be changed at the factory or by the CAN configuration interface. To determine what type of battery the inverter is configured for, monitor the LED blink code at startup. If the inverter is configured for Wet Lead Acid, the LED will blink Amber-Green. For

AGM the blink code is Amber-Green-Green. For Gel the blink code is Amber-Green-Green-Green.

Branch Circuit Rating (LPC only)

The branch circuit rating ("BCR") can be set to 0, 5, 10, 15, or 20A. If set to 0A, the charger will not enable. Bypass will still be available. The default factory setting is 15A. The BCR may be changed at the factory or by the CAN configuration interface.

AC Line Qualify Time (LPC only)

The AC line qualification time can be set to any value between 5 and 60 seconds, in 1 second increments. This default setting is 30 seconds. This setting adjusts the time that it takes for the charger and bypass to start once qualified AC power has been applied to the charger input. This setting may be changed at the factory or with the CAN configuration interface.

CAN Instance and Baud Rate

The CAN instance (address) can be changed from 1 – 13. This is useful if there are multiple inverters being used on the same CAN network. Multiple inverters should not share the same CAN instance. The Baud Rate may be changed between 250k and 500k. The default settings for the inverter are Instance 1 and Baud Rate 250k. These values may be changed at the factory or by the CAN configuration interface.

NOTE: In the highly unlikely chance that an internal error occurs to the memory of the inverter/charger, the inverter/charger configuration will reset to the 12LPC15 standard. All settings will revert to the standard default configuration, except the battery setting will be set to GEL.

INVERTER CONFIGURATION TOOL

The inverter/charger settings described in the previous section may be adjusted with a CAN interface kit, which is sold separately. The kit consists of a Kvaser CAN interface which connects to a USB port on a laptop, a DB9 to RJ45 adapter, a terminating resistor, and a Windows PC program that can be installed on a x32 or x64 machine.

After the software has been properly installed, the Kvaser device may be plugged into the computer. The first time the Kvaser is connected, the computer may need to download the appropriate Kvaser drivers from the Kvaser website. Once the Kvaser device is ready to be used, the terminating resistor and DB9 to RJ45 adapter may be connected to the inverter CAN port.

Once the inverter is turned on, the Configuration Interface may be opened on the laptop. Once open, the tool will automatically look for a CAN device on the network. Once found, it will automatically connect and display the current inverter/charger settings.

Note: Only one CAN enabled inverter can be connected at a time. To make a settings change, click on a parameter and the available options will appear in a drop-down menu. Once a setting is changed, the change is immediately set into the inverter's memory. After making all the settings changes it is prudent to turn the inverter off for 30 seconds and then turn it back on for the setting changes to take effect.

The settings may be saved to a configuration file. The configuration file maybe used to program any additional units that are to be programmed with the same settings.

THEORY OF OPERATION

Inverter

Usage: Any 120 VAC, 60 Hz single phase product within the inverter's power rating.

The inverter front "STATUS" LED will be Green while the inverter is on. The AC power produced by the inverter comes from the energy stored in the battery bank through a sophisticated electronic inversion process. A transformer, a Metal Oxide Silicon Field Effect Transistors (MOSFET), a filter capacitor, and a microprocessor are used to generate clean AC power.

The inverter will operate at DC input voltages ranging from 10.5Vdc to 16 Vdc. Above 16 Vdc the inverter may stop operating due to input voltage being out of range. The inverter can tolerate up to 24 Vdc for 5 minutes. Durations longer than 5 minutes will result in a shut down. Input voltages above 24Vdc will result in an immediate shutdown. The inverter will restart when the input voltage drops below 16 Vdc. When the input voltage drops to the low battery volts, the inverter will stop operating due to a low battery condition. When the lead acid battery bank voltage drops to 10.5 volts, the battery is fully discharged.

Note: The signal output waveform produced by the inverter when in "inverter mode" is pure sinusoidal. It has a total harmonic distortion of less than 5% at nominal input.

The inverter output needs to be de-rated as the ambient temperature surrounding it increases. See the following chart for operation at 12.6 Vdc.

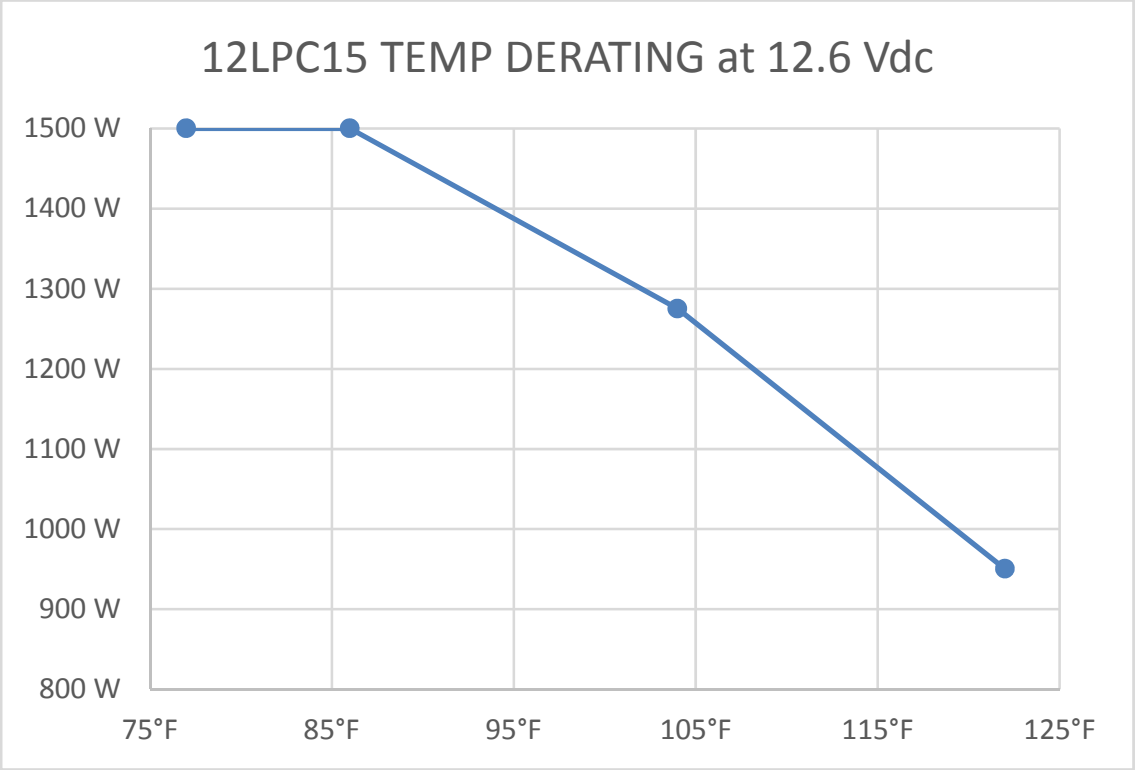


Figure 10 - Temp Derating

External Power Mode (LPC only)

Bypass Relay: The loads attached to the inverter output will operate directly from the external AC power line independently of the inverter ON/OFF status. If the inverter is left ON (standby mode), the built-in bypass relay will automatically cycle back and forth between "Inverter Power" mode and "External Power" mode depending on the availability of the external AC power line.

Note: If the AC load is short-circuited while in bypass mode, the inverter/charger may experience an internal fault.

Battery Charger: The battery charger will engage automatically and independently of the inverter ON/OFF status. The 3-step charging process modes are; Constant Current (Bulk), Constant Voltage (Acceptance), and Float. There are three additional states the charger may enter: Load Management, Equalization, and Monitor

The LED Display Panel will show charger mode and the Status LED located on the side of the inverter will blink Green to indicate the charging process mode (1 blink = Constant Current, 2 blinks = Constant Voltage, 3 blinks = Float). See the LED blink code chart for additional blink codes.

Constant Current (Bulk):
The charger will output the maximum rated current to the battery until the battery voltage (as measured at the charger DC terminals) reaches the maximum voltage threshold or the Constant Current timer expires.

Constant Voltage (Acceptance):
The charger will output at the rated voltage until the output current reaches nearly zero or the Constant Voltage time expires.

Float:
The charger will output current and voltage at the minimum duty cycle until the voltage drops below a threshold.

Load Management:
Incoming AC power is shared between the AC loads and the charger. The AC loads are given priority; this means the charger will reduce its output with large AC loads. This feature controls the total amperage draw of the system so the utility service circuit breaker is not tripped. The Load Management feature will return the charger to full output when the AC loads are removed or reduced.

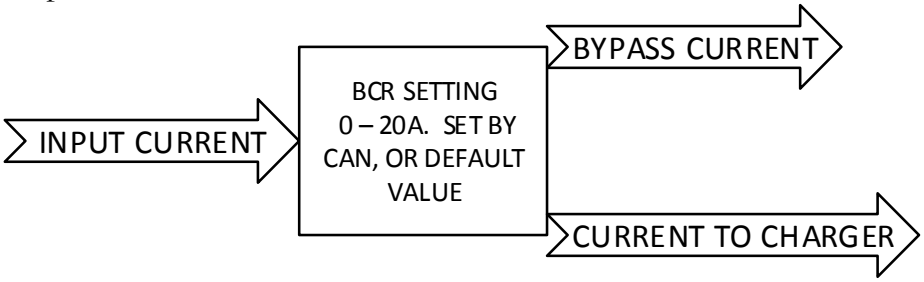


Figure 11 - Load Management

The charger splits the input current to the charger and to the AC output. The charger will limit the amount of current flowing to battery based on the AC current limit setting. If the total input current exceeds the limit setting, the charge current will be reduced until the limit is met. If the bypass current exceeds the limit setting, the charger will not output current to the battery. The default AC current limit is set by the factory to 15A.

NOTE: Dynamic external loads may cause variations in the charge rate. The charger may reset if the dynamic load causes the input AC waveform to become temporarily disqualified.

Equalization:
Available only for wet-lead-acid batteries, this function overcharges the battery in a controlled fashion to remove sulphate build up from the battery's internal plates. Consult your battery manufacturer on how frequently the equalization process should be carried out. Equalization can only be initiated with a RV-C CAN command. The process will not start until a full charge cycle has been completed.

Monitor:
In this mode, the charger stops charging at the end of a charge cycle. It keeps track of the battery voltage to decide when and if it needs to restart a charge cycle.

NOTE: When in charge mode, the charger may not be able to charge at its full capacity if AC power is being used in bypass mode.

NOTE: The charger is capable of charging AGM, GEL, or Wet Lead-Acid cell batteries. Selection of battery type must be done when ordering the inverter from the factory. The battery type may also be set with the CAN interface or via RV-C CAN. Contact factory for further details on RV-C CAN.

Charger Battery Temperature Sensor (BTS):
Charger operation with a BTS cable is REQUIRED! The BTS measures the battery temperature and automatically adjusts the charger output voltage for the fastest and safest charge.

When batteries are cold, their chemical reaction is slowed, so they will not take on a charge as easily. A charge voltage optimized for room temperature will not charge the battery at low temperatures. The temp sensor cable allows the charger to increase the charge voltage for optimum charging at low temperatures.

When batteries are hot, their chemical reaction is accelerated and they absorb energy too readily. A charge voltage optimized for room temperature will tend to overcharge the batteries and cause gassing. The BTS will cause the charger to decrease the charge voltage to a safe level.

Our charger will switch to a "warm battery" mode in which the charger will only provide a float voltage when the batteries reaches 122F/50C to 140F/60C. If the battery temperature continues to rise over 140F/60C the charger will shut off. The charger will resume charging in the "warm battery" mode when the battery cools to 131F/55C. The charger will resume normal charging when the battery cools to 113F/45C.

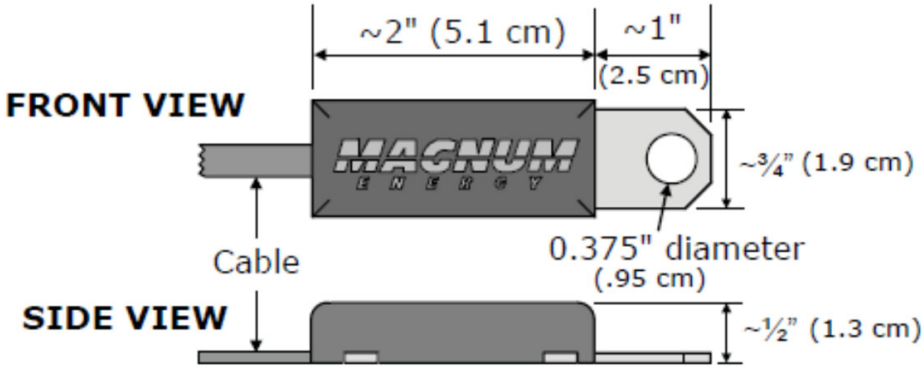


Figure 12 - BTS

Connect the lug end of the temperature compensation cable to the negative post of the battery. Connect the connector to the appropriate mating connector located at the side of the inverter labeled "Temp Sense". Temp Sensor cable is part# ME-BTS-XX

(XX=length in feet - 6, 8, 15, 25, 40)

NOTE: If the Temp. Sensor Cable is not connected; the battery charger will not function

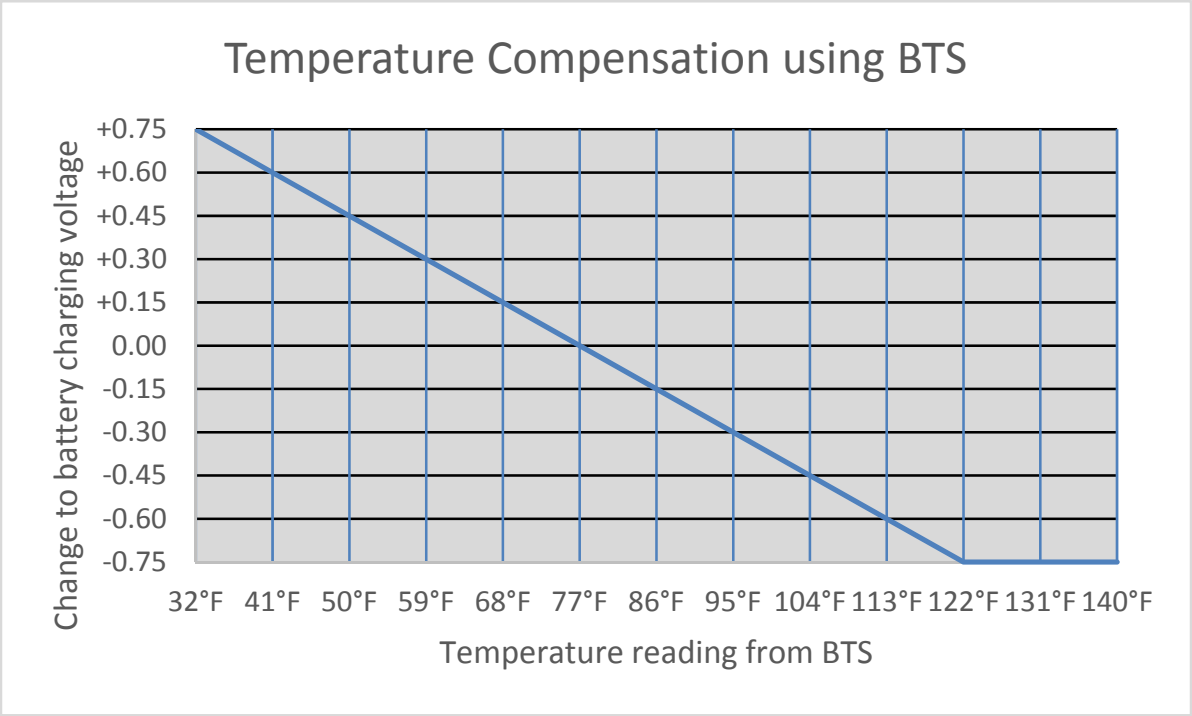


Figure 13 - Charger Voltage Adjustment

TROUBLESHOOTING GUIDE

WARNING: Do not remove chassis cover. No user-serviceable parts inside. Call or e-mail customer service for free consultation during business hours. Business hours are 7:30am-5:30pm C.S.T

Phone: 1-800-553-6418 or 1-651-653-7000
Fax: 1-888-439-3565 or 1-651-653-7600
E-mail: inverterinfo@sensata.com;
Website: http://dimensions.sensata.com

LED Status Chart

LED Color & State	Remote LED State	Operating Conditions
Status LED Normal States		
Green – 1 blink	Constant on	Bulk Charge (Constant Current)
Green – 2 blinks	Constant on	Accept Charge (Constant Voltage)
Green – 3 blinks	Constant on	Float Charge
Green – 4 blinks	Constant on	Load Management Active
Green – 5 blinks	Constant on	Equalization Mode
Green – 6 blinks	Constant on	Monitor Mode
Green - Solid	Constant on	Inverting
Inverter Status LED Fault States		
None	Off	No Power to Unit or Internal Fault
Amber - Solid	Constant on	Low Battery 0-5 seconds (warning)
Red - Solid	Constant on	Overload 0-5 seconds (warning)
Red- 1 blink	1 blink	Inverter Low Battery Shut Down**
Red – 2 blinks	2 blinks	Inverter Overload Shut Down
Red – 3 blinks	3 blinks	High Temp Heatsink*
Red – 4 blinks	4 blinks	Feedback Fault, Output Short Circuit**
Red – 5 blinks	5 blinks	High Battery 0-5 minutes
Red – 6 blinks	6 blinks	High Battery > 5 minutes
Red – 7 blinks	7 blinks	High Temp Transformer
Red – 8 blinks	8 blinks	Inverter Off by CAN
Charger Status LED Fault States		
None	Off	No Power to Unit or Internal Fault
Amber- 1 blink	Fast blink	Charger Off – Check Battery Probe
Amber – 2 blinks	Fast blink	Charger – Warm Battery*
Amber – 3 blinks	Fast blink	Charger Off – High Battery Voltage*
Amber – 4 blinks	Fast blink	Charger Off – High Batt Temp
Amber – 5 blinks	Fast blink	Charger Off – Low Battery Voltage
Amber – 6 blinks	Fast blink	Charger Off – High Temp Transformer*
Amber – 7 blinks	Fast blink	Charger Off – High Temp Heatsink*
Amber – 8 blinks	Fast blink	Charger Off – 0 Amp Limit Set
Amber – 9 blinks	Fast blink	Charger Off –Overcurrent Shutdown
Amber – 10 blinks	Fast blink	Charger Off – Disabled by CAN
Faults marked with* will self-recover when the condition returns to normal range		
Faults marked with ** may be due to a short-circuited output or a low or weak DC voltage source.		
Battery Type Local LED States at Start-up (5 Minutes)		
Amber - Green		Wet Lead-Acid
Amber – Green - Green		AGM
Amber – Green - Green - Green		GEL

Table 7 - LED Status

Note: Upon initial start-up, the inverter will blink amber and green to identify the type of battery it is configured for.

Faults and Warnings - Inverter

Low Battery – The inverter LED will switch to solid Amber when the DC voltage measured at the inverter input terminals drops below the low battery setpoint. After five seconds, the inverter will shut down if the DC voltage has not recovered above the low battery setpoint. When shut down, the inverter LED will blink Red. The inverter will automatically restart if the battery voltage rises above a preset threshold within 15 minutes. If the battery voltage does not recover within 15 minutes, the inverter will completely shut-down and the inverter will need to be turned off then on with a local or remote switch.

Overload – The inverter LED will switch to a solid red when an overload condition is detected. If the overload condition clears within 5 seconds the LED will return to the normal state. If the overload condition continues after 5 seconds, the inverter will shut down and the LED will blink red twice. The inverter power will need to be cycled to restart the inverter. If the overload condition exceeds 108% of the rated load for greater than 1.5 seconds, the inverter will shut down and the LED will blink red twice. The inverter power will need to be cycled to restart the inverter. If the overload condition exceeds 200% of rated load, the inverter will shut down immediately.

Note: The inverter will only permit an overload event to exceed 108% of rated load once every 30 seconds. For example, the inverter may go into overload when starting up a compressor. 30 seconds must pass before attempting to start the compressor again.

High Temp – If the internal inverter heatsink temperature exceeds the preset limit, the inverter will shut down in high temp, and the LED will blink red three times. If the transformer temperature exceeds its limit, the inverter will shut-down, and the LED will blink red seven times. The inverter will automatically restart once the inverter has cooled down.

Feedback Fault/Output Short Circuit – If the inverter detects that the output is short circuited, the inverter will immediately shut off and the LED will blink red four times. If the input voltage to the inverter is approaching the low battery setpoint and a heavy load is applied, the output voltage may collapse causing the inverter to fault like an output short circuit. The inverter power will need to be cycled to restart the inverter.

High Battery – If the DC voltage measured at the inverter input exceeds the maximum rating of the inverter for up to five minutes, the inverter LED will blind red 5 times. If the battery voltage drops below the high voltage threshold, the LED will return to its normal state. If the DC voltage remains above the high voltage threshold for greater than 5 minutes, the inverter will shut down and the LED will flash red 6 times. The inverter will resume normal operation when the voltage drops below the high battery threshold.

Off by CAN – If the inverter has been turned off with a CAN command, the inverter LED will blink red eight times.

Faults and Warnings - Charger

Battery Probe – If the battery temperature sensor (BTS) has been disconnected or is shorted, the charger LED will blink amber one time.

Warm Battery - If the battery temperature measured by the BTS is between 50°C and 59.9°C, the charger will reduce the charge current to the minimum. The LED will blink amber two times.

Battery High Temp – If the battery temperature exceeds 60.0°C the charger will shut down. The LED will blink amber four times. The charger will need to be restarted once the battery has cooled down.

Low Battery – If the battery voltage measured at the charger DC terminals drops below a threshold, the charger will shut down. The LED will blink amber five times. The charger will need to be restarted once the battery voltage has recovered.

Charger High Temp - If the internal heatsink temperature exceeds the preset limit, the charger will shut down in high temp, and the LED will blink amber six times. If the transformer temperature exceeds its limit, the charger will shut-down, and the LED will blink yellow seven times. The inverter will automatically restart once the inverter has cooled down.

Zero Amp Branch Setting – The charger will turn off if the branch circuit rating (BCR) setting has been set to zero. Setting this feature to zero limits the power that can be used for the charger to zero. Bypass power is still available. The LED will blink amber eight times.

Charger Short Circuit – If the charger detects that the output has short circuited, the charger will immediately shut down. The LED will blink amber nine times.

Disabled by CAN – If the charger has been turned off with a CAN command, the charger will LED will blink amber 10 times.

Troubleshooting

NOTE: If the status LED's are illuminated, refer to the "LED Status Chart" on the previous page for additional information.

1. **No AC output power during inverter mode:**
    a. Is the in-line fuse which is located within 18" from the battery's positive post installed or open?
    b. Are the DC connections tight and clean?
    c. Is the AC output circuit breaker tripped?
    d. Are the switches on? Are any of the wires connected to the remote switches loose or disconnected? (Local switches are inactive with "R" configurations.)
    e. Is the GFCI tripped? Reset if necessary.
        i. If GFCI is set, disconnect all loads and connect a test light. If the test light is off, replace GFCI or return the inverter for service.
    f. For hardwired connections, remove DC input voltage and inspect the AC hardwire connections.
2. **Low Battery:**
    a. The use of a battery isolator is not recommended due to excessive voltage drop across isolator terminals.
    b. Battery voltage must be above the low battery setpoint (measured at the inverter) for the inverter to be on.
    c. Check for proper DC wire gauge (see DC Wire Gauge & Fusing section).
3. **Overload:**
    a. Unplug all loads and reset the inverter On/Off.
        i. If the overload condition clears, check for short circuits or check load size versus inverter output wattage size.
        ii. If the overload persists, possible failed inverter.
4. **High Temperature:**
    a. Let the inverter/charger cool down.
    b. Verify that all vent openings are clear of obstruction.
    c. Reduce ambient temperature and/or load.
5. **Inverter will not turn OFF:**
    a. Verify that all remote ON/OFF switches are in the "OFF" position.
6. **The Charger or Bypass will not Enable:**
    a. Verify that the AC input voltage is between 90V and 130Vrms.
    b. Verify that the AC input breaker hasn't tripped.
7. **Cycling Power:** Whenever cycling power, wait at least 30 seconds before turning back on to allow the inverter processor to completely power down. If the processor doesn't power down, it may retain the previous fault state.

APPENDIX

Accessories & Replacement Parts

PART NUMBER	ITEM DESCRIPTION
430005	GFCI Outlet, Leviton GFNT2
431021	Fuse holder with cover
430012	Fuse 350A, ANN-350
430010	Fuse 200A, ANN-200
430011	Fuse 250A, ANN-250
430012	Fuse 300A, ANN-300
612007	**20FT LED REMOTE MOMENTARY SWITCH CABLE**
510031	Non-illuminated Momentary Switch (no cable)
612016	**20FT LED REMOTE SNAP SWITCH CABLE (OTHER LENGTHS AVAILABLE)**
ME-BTS-XX	Temperature temp sensor (-xx = 6, 8, 15, 25, or 40 for length in ft)
245052	CAN Configuration Kit (includes cable, terminating resistor gender changer, CAN interface, and software)
612015-CAN	CAN Configuration Software (provided on flash drive)

Table 8 - Accessories

GFCI Operation

The GFCI installed in this inverter is compliant with the latest requirements for GFCI's per UL 943. This includes automatic self-testing and line-load reversal. A GFCI measures the amount of AC current into the GFCI line side "hot" and "neutral" terminals. Both terminals should measure the same amount of current under normal conditions. Any difference in current is considered the leakage current. If the leakage current is greater than 5mA, the GFCI will trip. A tripped GFCI suggests that there has been a breakdown in the electrical insulation of a connected device. This can result in a safety hazard for the user. The breakdown could have been caused by broken wire insulation with the live wire contacting the ground conductor, water in contact with a live conductor, or any other inadvertent electrical path to ground.

The inverter needs to be on, or bypass power applied to be able to reset a tripped GFCI.

The GFCI has a status LED on it. When installed with a Leviton GFNT2 GFCI, the LED will operate as follows.

- LED is GREEN, the GFCI is powered from the line side and operating correctly.
- LED is solid RED. Fault was found during normal operation. Press the "TEST" button to trip the GFCI. If it fails to reset after pressing the "RESET" button, the GFCI will need to be replaced.
- LED is blinking RED. Fault was found during self-test. Press the "TEST" button to trip the GFCI. If it fails to reset after pressing the "RESET" button, the GFCI will need to be replaced.

Self-Testing – The GFCI will periodically test the ground fault detection circuit in the background. If the test determines there is a problem with the detection circuit, the GFCI will trip and/or notify the user visually with the status LED. The GFCI will perform a self-test when AC power is first applied to it. The LED will blink RED before turning GREEN.

Line-Load Reversal – If the line and load terminals are wired backwards, the GFCI will not reset and power will not be available until the wiring has been corrected.

NOTE: Depending on the GFCI model that is used, the line and load terminals on the rear may not be in the same position. The user must verify the GFCI markings to ensure proper connection.

NOTE: It is advisable when replacing a GFCI outlet to only use the exact replacement part unless instructed to do otherwise by the factory. Other types may fail to operate properly when connected to this unit.

NOTE: Ground-fault circuit-interrupters shall be installed in the recreational vehicle wiring system to protect all branch circuits.

GFCI MFG	CATALOG NO.
LEVITON	GFNT2-# (FOR #, I=IVORY, W=WHITE)
HUBBELL	GFR5362SG# (FOR #, I=IVORY, W=WHITE)
COOPER	TRSGF20# (FOR #, V=IVORY, W=WHITE)

Table 9 - GFCI Replacements.

Inverter Model Options

The following model options are available:

Table 10 - Options

OPTION	DESCRIPTION
A	AC TERMINALS PROTECTED BY GFCI
H	HARDWIRE ONLY, NO GFCI.
R	REMOTE ONLY, LOCAL SWITCH INACTIVE

Other options available, contact the factory for more information.

3 Step Battery Charger Recipes with BTS

	Battery Type	AGM	GEL	Wet
Constant Current "CC" Charge Phase				
CC	CC charge current limit	SEE SPEC		
	CC phase terminates	1. When battery voltage reaches the CV Voltage		
Constant Voltage "CV" Charge Phase				
Constant Voltage	CV charge voltage @ 77F/25C	14.3 VDC	13.7 VDC	14.6 VDC
	CV voltage temp compensated	5mv/cell/°C		
	Maximum constant voltage at low temps	15.0 VDC @ 4C	14.5 VDC @ -6C	15.0 VDC @ 10C
	CV phase terminates	1. When charge current is reduced. 2. When the CV timeout is reached.		
	CV phase timeout	6 hours (may be configured through CAN)		
Float Charge Phase				
Float	Float voltage @ 77F/25C	13.4 VDC	13.4 VDC	13.2 VDC
	Float voltage temp comp	5mv/cell/°C		
Condition (Equalization) Phase				
Condition	Condition voltage @ 77F/25C	N/A	N/A	15.5 VDC
	Condition voltage temp compensation	N/A	N/A	30.24mV/cell/°C
	Condition duration	N/A	N/A	4 hours
	Condition frequency	N/A	N/A	Manual Control
Battery Temperature				
Battery Temp	Charger Warm Battery: output switches to compensated float from CC/CV/Off(hot)	>122F/50C <140F/60C		
	Charger High Battery Temp: Output to Off	>140F/60C		
	Charger Resumes in previous mode: CC/CV/Float	<112F/45C		

Table 11 - Charger Recipe

Charger Output vs. Temperature

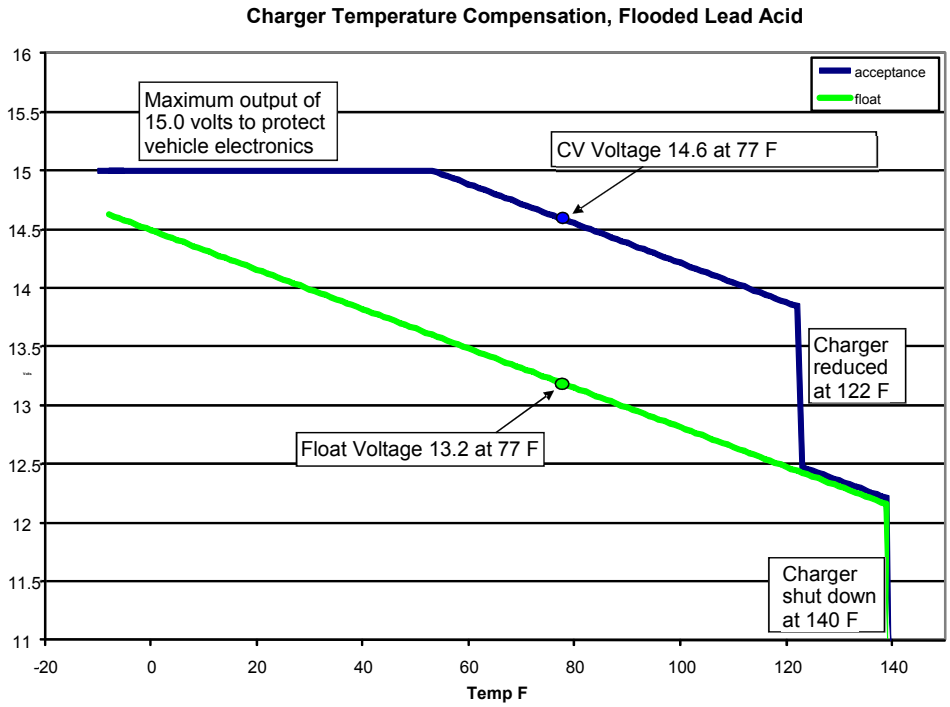


Figure 14 - Charger Output vs. Temp

CAN

The inverter is compatible with RV-C CAN, developed by the RVIA (Recreational Vehicle Industry Association). CAN allows for the inverter to communicate with other devices on the network.

For CAN to work properly, the inverter and all other devices on the CAN network must be using the same CAN protocol. If the protocols are different, the devices will not recognize each other.

The typical RV-C CAN network is operated at 250 kbit/s, although the inverter may be configured for 500 kbits/s. Up to 13 inverter/chargers can be placed on the CAN network. Each inverter/charger requires a unique instance to differentiate itself from similar devices.

The inverter/charger supports most standard RV-C instructions in additional to several custom commands for configuration changes. Contact the factory for more information.

Supported Standard RV-C instructions include (not limited to):

COMMAND	COMMAND DESCRIPTION
CHARGER COMMAND	Enable or disable the charger.
CHARGER CONFIG CMD 2	Set Branch Circuit Rating
GENERAL RESET	Reboots the inverter/charger.
INVERTER COMMAND	Enable or disable the inverter.

Table 12 - CAN Command

STATUS	STATUS DESCRIPTION
CHARGER CONFIG STATUS 1	Returns yes or no if the battery temp sensor is present, the battery type, and max charge amps for the charger.
CHARGER CONFIG STATUS 2	Returns the Branch Circuit Rating setting and the default battery temperature.
CHARGER EQUALIZATION STATUS	Returns the minutes remaining in the equalization process and the pre-charge status.
CHARGER STATUS	Returns charge voltage, charge current, the current charge mode.
CHARGER AC STATUS 1	Returns the input Vrms, Arms, and line frequency.
CHARGER AC STATUS 2	Returns the Branch Circuit Rating.
DC SOURCE STATUS 1	Returns the charger output Vdc and Adc.
DC SOURCE STATUS 2	Returns the battery temperature °C
INV AC STATUS 1	Returns the inverter output Vrms, Arms, and frequency.
INV AC STATUS 3	Returns the inverter output watts.
INVERTER DC STATUS	Returns the inverter input Vdc.
INVERTER STATUS	Returns the inverter/charger Instance ID, RVC Status, and the inverter/charger status bits.
PRODUCT ID	Returns the model number and serial number.

Table 13 - CAN Status

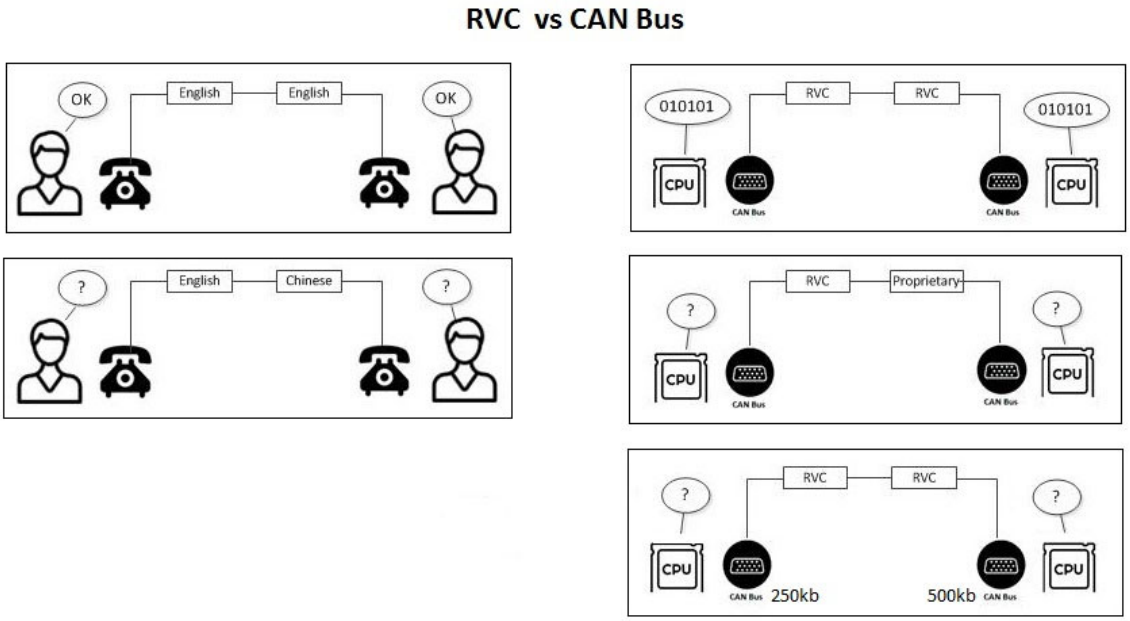


Figure 15 - Communications

NOTES

LIMITED WARRANTY TERMS & CONDITIONS

SHIPPING TERMS: F.O.B. St. Paul Minnesota. Freight prepaid and billed, subject to prior credit approval.
MINIMUM ORDER: $50.00 Net Price

LOSS OR DAMAGE: Loss or damage in transit are the responsibility of the carrier. Any claim should be filed with the delivering transport company. Invoice, Bill of Lading and Delivery receipt with damage noted therein must accompany any claims for freight damage. Claims for shortage and lost shipments must be made in writing to Sensata Technologies within 10 days of date of shipment. Claims not reported within this time frame will not be honored.

PRICES: Prices are subject to change without notice. All orders are subject to acceptance at the factory. We reserve the right to invoice prices in effect at time of shipment.

TERMS: Net 30 days with approved credit, credit card or C.O.D.

RETURN GOODS POLICY:

- No returned materials will be accepted without an accompanying Returned Materials Authorization Number (RMA) from the factory.
- Credit will be issued for returned goods to the original purchaser within 60 days of purchase, provided the inverter is returned to Sensata unused and not mounted. The amount of credit will be issued at Sensata's discretion based on the condition of the product.
- Customer must be in good standing with Sensata Technologies.
- Inverters that are discontinued, high-voltage (over 24vdc), special-order or used are excluded and will not be eligible for credit. Non-inverter items such as cable assemblies, fuses and fuse holders, will not be eligible for credit
- Support components supplied by Sensata vendors will be covered under that manufacturer's credit return policy.
- Customer pays return freight.

PLEASE SHIP AUTHORIZED RETURNS TO:
Sensata Technologies RMA#_____ | 4467 White Bear Parkway | St. Paul, MN 55110
Return Freight Prepaid

LIMITED WARRANTY:
Sensata Technologies extends the following warranty to the original purchaser of those goods subject to the qualifications indicated. Sensata warrants to the original purchaser for use that the goods or any component thereof manufactured by Sensata will be free from defects in workmanship from the date of purchase for the period listed on the product label, provided such goods are installed, maintained and used in accordance with Sensata and the original manufacturer's written instructions. Damages caused by the misuse, undue care or obvious wear through use will not be covered by this warranty.

Components not manufactured by Sensata, but used within the assembly provided by Sensata, are subject to the warranty period as specified by the individual manufacturer of said component, provided such goods are installed, maintained and used in accordance with Sensata and the manufacturer's written instructions.

Sensata's sole liability and the Purchaser's sole remedy for a failure of goods under this limited warranty and for any and all claims arising out of the purchase and use of the goods shall be limited to the repair or replacement of the goods that do not conform to this warranty.

To obtain repair or replacement service under the limited warranty, the purchaser must contact the factory for a Return Material Authorization (RMA) Number. Once obtained, send the RMA Number along with the defective part or goods to:
Sensata Technologies RMA#_____, 4467 White Bear Parkway, St. Paul, MN 55110. Return Freight Prepaid.

THERE ARE NO EXPRESS WARRANTIES COVERING THESE GOODS OTHER THAN AS SET FORTH ABOVE. THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION TO ONE YEAR FROM DATE OF PURCHASE.

SENSATA TECHNOLOGIES ASSUMES NO LIABILITY IN CONNECTION WITH THE INSTALLATION OR USE OF THE PRODUCT, EXCEPT AS STATED IN THIS LIMITED WARRANTY. SENSATA TECHNOLOGIES WILL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

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Sensata
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The World Depends on Sensors and Controls

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Form # 122221 Revision A
12LP15/12LPC15 Manual