

Auto Power Inverter Charger



Remote
Displays
Available

Compatible with
Super Auto Eject with Deluxe Covers



MODEL # : 091-263-12-1500

INPUT: 12 VDC

OUTPUT: 1500W, 120 VAC

File: IM_091-263-12-1500
Rev. A1
Revised By: PSS/JRN
Date: 06-19-19

5 Year Warranty

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Please record the unit's model and serial number in case you need to provide this information in the future. It is much easier to record this information now than try to gather it after the unit has been installed.

Model Number:

Serial Number:

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IMPORTANT SAFETY INSTRUCTIONS

Save This Manual! Read this manual before installation, it contains important safety, installation and operating instructions. Keep it in a safe place for future reference.

All wiring must follow the National Electric Code, Provincial or other codes in effect at the time of installation, regardless of suggestions in this manual. All wires should be copper conductors.

I. PERSONAL PRECAUTIONS:

1. Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
2. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
3. Wear complete eye and clothing protection. Avoid touching your eyes while working near a battery.
4. If battery acid contacts skin or clothing, wash immediately with soap and water. If battery acid enters the eye, immediately flood eye with cold running water for at least 10 minutes and get medical attention immediately.
5. **NEVER** smoke or allow a spark or flame in the vicinity of the battery or engine.
6. Be extra cautious to reduce the risk of dropping a metal tool onto the battery. It might spark or short-circuit the battery or other electrical part and cause a fire or an explosion.
7. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery, when shorted, can produce a current sufficient to weld a ring or the like metal causing a severe burn.
8. Use the battery charger for charging gel-cell, AGM and flooded lead-acid batteries only. Do not use the charger for charging dry-cell batteries that are commonly used with home applications. These batteries may burst and cause injury to persons and damage to property.
9. **WARNING – RISK OF EXPLOSIVE GASES:** Working in the vicinity of a lead-acid battery is dangerous. Batteries generate explosive gases during normal battery operation.

II. SAFETY PRECAUTIONS

1. Before installing and using the Inverter Charger, read the manual and cautionary markings on the Inverter Charger enclosure. Be sure to read all instructions and cautionary markings for any equipment attached to this unit. Installers must be certified technicians or electricians.
2. This product is designed for indoor/compartiment installation. Do not expose the inverter/charger to rain, snow, spray, bilge or dust. To reduce risk of hazard, do not cover or obstruct the ventilation openings. Do not install the Inverter Charger in a zero-clearance compartment. Overheating may result. Allow clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit. A minimum air flow of 145CFM is required.
3. To avoid a risk of fire and electronic shock. Make sure that existing wiring is in good electrical condition; and that wire size is not undersized. Do not operate the Inverter with damaged or substandard wiring.
4. This equipment contains components which can produce arcs or sparks. To prevent fire or explosion do not install in compartments containing batteries or flammable materials or in locations which require ignition protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connection between components of the fuel system. See Warranty for instructions on obtaining service.
5. Do not dis-assemble the Inverter Charger. It contains no user serviceable parts. Attempting to service the Inverter Charger yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
6. To reduce the risk of electrical shock, disconnect both AC and DC power from the Inverter Charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.
CAUTION: Equipment damage
The output side of the inverter's AC wiring should at no time be connected to public power or a generator. This condition is far worse than a short circuit. If the unit survives this condition, it will shut down until corrections are made. Installation should ensure that the inverter's AC output is, at no time, connected to its AC input.
7. The power unit is to be installed so that it prevents and discourages human contact.

WARNING: LIMITATIONS ON USE

SPECIFICALLY, PLEASE NOTE THAT THE INVERTER CHARGER SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES. WE MAKES NO WARRANTY OR REPRESENTATION IN CONNECTION WITH THEIR PRODUCTS FOR SUCH USES. USING THE INVERTER CHARGER WITH THESE PARTICULAR EQUIPMENTS IS AT YOUR OWN RISK.

IMPORTANT SAFETY INSTRUCTIONS

III . PRECAUTIONS WHEN WORKING WITH BATTERIES:

1. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 20 minutes and get medical attention immediately.
2. Never smoke or allow a spark or flame in vicinity of battery or engine.
3. Do not drop a metal tool on the battery. The resulting spark or short-circuit on the battery or other electrical part may cause an explosion.
4. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery produces a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
5. To reduce the risk of injury, charge only rechargeable batteries such as deep-cycle lead acid, lead antimony, lead calcium gel cell, absorbed mat or NiCad/NiFe. Other types of batteries may burst, causing personal injury and damage.
6. Don't install the inverter near batteries, the inverter may heat battery electrolyte and cause corrosive fumes to vent and damage/corrode nearby electronics or metals.

IV . CHARGER PRECAUTIONS:

1. **NEVER** charge a frozen battery.
2. Make sure the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
3. Do not operate the charger with a damaged cord or plug; replace them immediately.
4. Do not operate the charger if it has received a sharp blow, been dropped, or otherwise damaged.
5. Do not disassemble the charger. Incorrect reassembly may result in a risk of electric shock and fire.
6. To reduce the risk of electric shock, disconnect the charger from the AC source before attempting any maintenance or cleaning.
7. **LOCATION OF CHARGER:** The charger should be mounted on ground vehicle floor, ventilated compartment or other suitable surface as close to the batteries to be charged as possible. Do not block the charger's fan or air intakes. Do not mount the charger directly over the batteries as fumes may cause excessive corrosion. The area should be well ventilated and free from excessive moisture, exhaust manifolds, and battery fumes. For maximum performance, the charger should not be located in an area of extreme high temperature. The charger is not waterproof. Do not mount the charger where there is a possibility of water entering the unit. Evidence of water entry into the charger will void the warranty.
8. **CAUTION:** Do not attempt to increase battery bank capacity by splitting the output of one of the banks with a diode-type battery isolator. The diode isolator lowers the charger voltage and results in undercharging the batteries connected to it. If additional capacity is required it is preferable to add another isolated or parallel battery.

V. GROUND AND AC POWER CORD CONNECTION:

1. The charger should be grounded via the AC power connection to reduce the risk of electrical shock.
2. The charger must be plugged into or wired to an outlet that is an over-current protected 3 prong outlet. Alternatively, it may be routed through a separate dedicated fuse or circuit breaker on an AC distribution panel with proper earth/safety ground. All wiring shall comply with UL recommendations, NEC or NFPA standards and local ordinances. Never alter the AC cord or plug if provided. Any modification of the cord must only be done by a qualified electrician. Improper cord/outlet connection may result in a risk of electrical shock.
3. Observe color coding of the AC wiring as follows:

Black.....	AC Hot or LINE (fused)
White.....	AC Neutral
Green.....	AC Ground (safety/earth)
4. A branch rated overcurrent protection shall be provided for the AC terminal output blocks.
5. **CAUTION:** (230 VAC applications only): If AC input is provide from a source consisting of two HOT or LINE leads (phase-to-phase 230 VAC input voltage); an external fuse or circuit breaker must be used to protect both hot leads.
6. **CAUTION:** To reduce the risk of fire, connect only to an AC circuit provided with a 50A maximum branch circuit overcurrent protection in accordance with the National Electrical Code, ANSI/NFPA 70.

INTRODUCTION

1. GENERAL INFORMATION

The Kussmaul Inverter Charger is a transformer based inverter and battery charger with an unprecedented conversion efficiency of 80%.

Packed with unique features, it is one of the most technically advanced inverter/charger on the market. It features power factor corrected, sophisticated multi-stage charging control and pure sine wave output with high surge capability to meet power needs of all sorts of demanding loads without putting the equipment at risk.

The transformers of the whole line have been consistently improved for years to achieve the best balance of conversion efficiency, idle consumption and maximum THD.

The idle consumption of the Inverter Charger is ultra low, roughly 1.5% of its rated power.

Loaded with full linear loads, the maximum THD of the Inverter Charger is 3% at nominal battery voltage and 10% at low battery voltage alarm point.

These special features make this line compete very well with its high frequency counterparts.

The powerful battery charger of Auto Power Inverter Charger goes as high as 55 Amps. In response to the increasing demand of more advanced battery charging, our engineering team equipped the line with Battery Temperature Sensing for increased charging precision. The generous 300% surge capacity of 20 seconds makes it possible to support demanding inductive loads.

The AC/Battery priority and auto generator start functionality make it ideally suitable to work in either backup power or renewable energy applications. When customized to Battery priority mode via a DIP switch, the inverter will extract maximum power from external power sources in renewable energy systems and a minimal cycle of battery will be required. With the availability of auto generator start, an electrical generator can be integrated into the system and started when the battery voltage goes low. With audible buzzer, the inverter gives the users comprehensive information of the operation status, making it easier for maintenance and troubleshooting.

Thus the Auto Power Inverter Charger is suitable for a myriad of applications including renewable energy systems, utility, truck, RV and emergency vehicles etc.

To get the most out of the power inverter, it must be installed, used and maintained properly. Please read the instructions in this manual before installing and operating.

2. APPLICATION

Power tools—circular saws, drills, grinders, sanders, buffers, weed and hedge trimmers, air compressors.

Office equipment – computers, printers, monitors, facsimile machines, scanners.

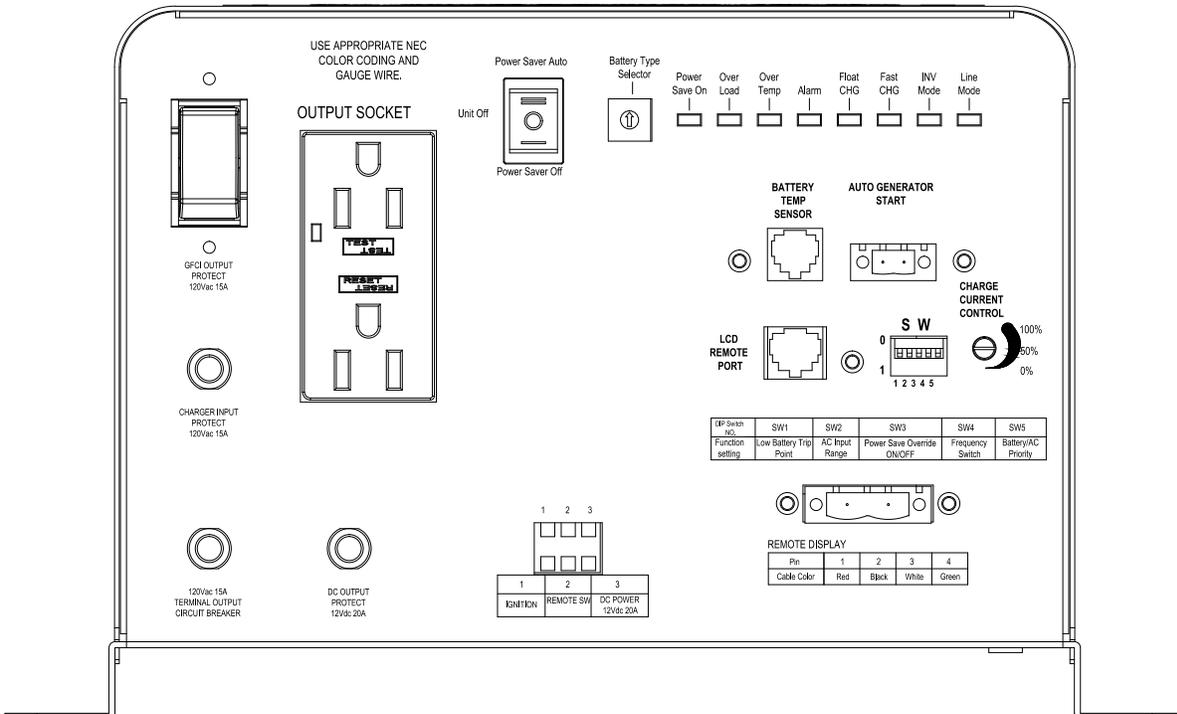
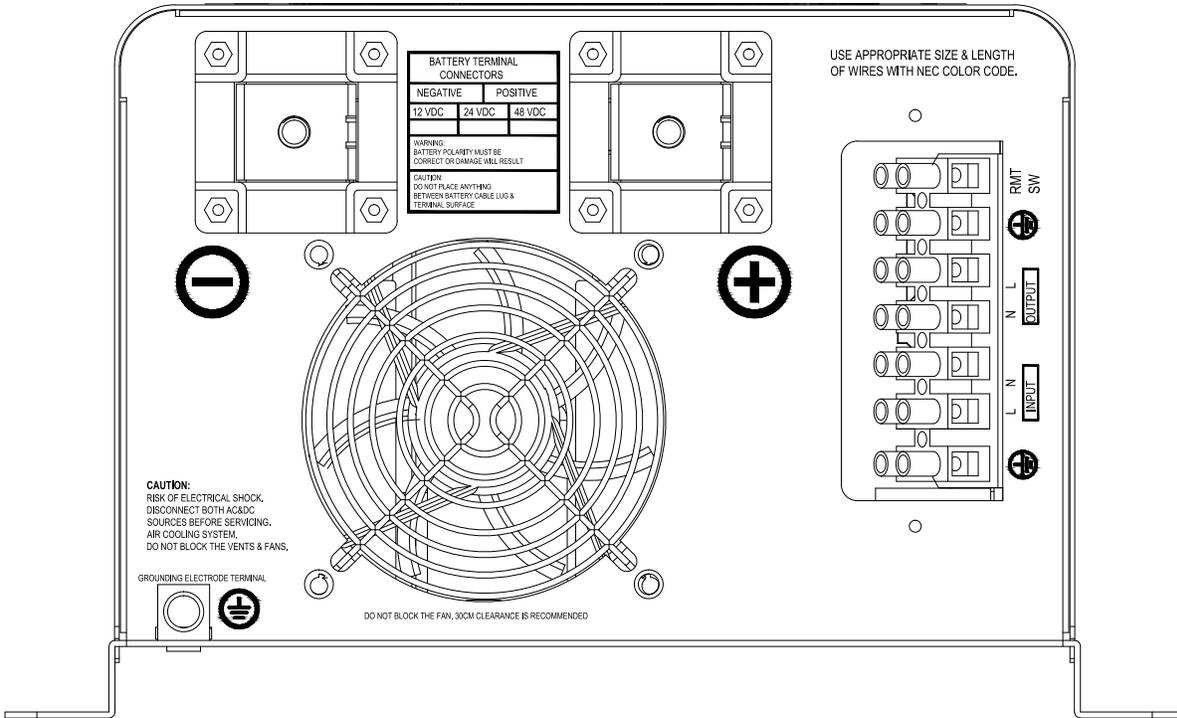
Household items – vacuum cleaners, fans, fluorescent and incandescent lights, shavers, sewing machines.

Kitchen appliances – coffee makers, blenders, ice makers, toasters.

Industrial equipment – metal halide lamp, high – pressure sodium lamp.

Home entertainment electronics – television, VCRs, video games, stereos, musical instruments

MECHANICAL DRAWING



FEATURES

- 20A DC output power
- 12Vdc remote start
- 4 pins for KECO Deluxe Auto Eject remote interface
- Auto Generator Start
- Battery Temperature Sensing for increased charging precision
- Manual 50Hz/60Hz output frequency switch for worldwide operation
- Maximum THD: 3% at nominal battery voltage
- Maximum 80% conversion efficiency
- Powerful 4-stage power factor corrected battery charger up to 55 Amps, settable from 0%-100%
- High surge output capability, 300% peak load for 20 seconds
- Fully isolated AC output from battery input
- Ultra low quiescent current, low power 'Power Saver Mode' to conserve energy
- Battery type selector for 8 type of batteries and de-sulphation for completely drained batteries
- 10 ms transfer time from AC to battery for continuous load operation
- Remote enable
- 5 sec DC to AC transfer delay, improved protection for generator driven loads
- Thermally controlled variable speed fan for more efficient cooling
- Extensive protections against various harsh situations
- New functionality (Battery priority mode and Low battery recover) developed for renewable energy systems

OPERATION

I. INVERTER:

A. Topology

The Auto Power Inverter Charger is built according to the following topology.

Invert: Full Bridge Topology.

Charge: Isolated Boost Topology

When operating in invert mode, the direct current (DC) that enters the inverter from the batteries is filtered by a large input capacitor and switched "On" and "Off" by the Metal Oxide Silicon Field Effect Transistors (MOSFET) at a rate of 50 Hz or 60Hz, and directed into the transformer which steps the voltage up to 230 or 120 volts. The unit has a 16bit, 4.9MHZ microprocessor to control the output voltage and frequency as the DC input voltage and/or output load varies.

Because of high efficiency MOSFETs and the heavy transformers, it outputs PURE SINE WAVE AC with an average THD of 7% (min 3%, max 10% under full linear loads) depending on load connected and battery voltage.

The peak invert efficiency of Inverter is 80%.

B. Overload Capacity

The Auto Power Inverter Charger has different overload capacities, making it ideal to handle demanding loads.

1. For $110% < \text{Load} < 125% (\pm 10%)$, no audible alarm in 14 minutes, beeps 0.5s every 1s in the 15th minute, and Fault(Turn off) after the 15th minute.
2. For $125% < \text{Load} < 150% (\pm 10%)$, beeps 0.5s every 1s and Fault(Turn off) after the 1 minute.
- 3 For $300% < \text{Load} > 150% (\pm 10%)$, beeps 0.5s every 1s and Fault(Turn off) after 20s.

C. Soft Start in Inverter Mode

The inverter is engineered with "Soft Start" feature.

When the inverter is turned on, the output voltage gradually ramps up from 0VAC to rated voltage in about 1.2 sec. This effectively reduces otherwise very high starting inrush current drawn by AC loads such as Switched Mode Power Supplies and inductive loads. This will result in lower motor inrush current, which means less impact on the loads and inverter.

Caution:

After the inverter is switched on, it takes a finite time for it to self diagnose and get 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. 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.

II. Charger:

The Auto Power Inverter Charger is equipped with an active PFC (Power Factor Corrected) multistage battery charger. The PFC feature is used to control the amount of power used to charge the batteries in order to obtain a power factor as close as possible to 1.

Unlike other inverters whose max charging current decreases according to the input AC voltage, Auto Power Inverter Charger is able to output max charge current as long as input AC voltage is in the range of 95-127VAC for 120V model, and AC freq is in the range of 48-54Hz(58-64Hz for 60Hz model).

The Auto Power Inverter Charger has a very rapid charge current available, and the max charge current can be adjusted from 0%-100% via a liner switch on the DC side of the inverter. This will be helpful if this powerful charger apply charging on a small capacity battery bank. Choosing "0" in the battery type selector will disable charging function.

There are three main charging stages:

Bulk Charging: This is the initial stage of charging. While Bulk Charging, the charger supplies the battery with controlled constant current. The charger will remain in Bulk charge until the Absorption charge voltage (determined by the Battery Type selection) is achieved.

Software timer will measure the time from charger start until the battery charger reaches 0.3V below the boost voltage, then take this time as T0 and $T0 \times 10 = T1$.

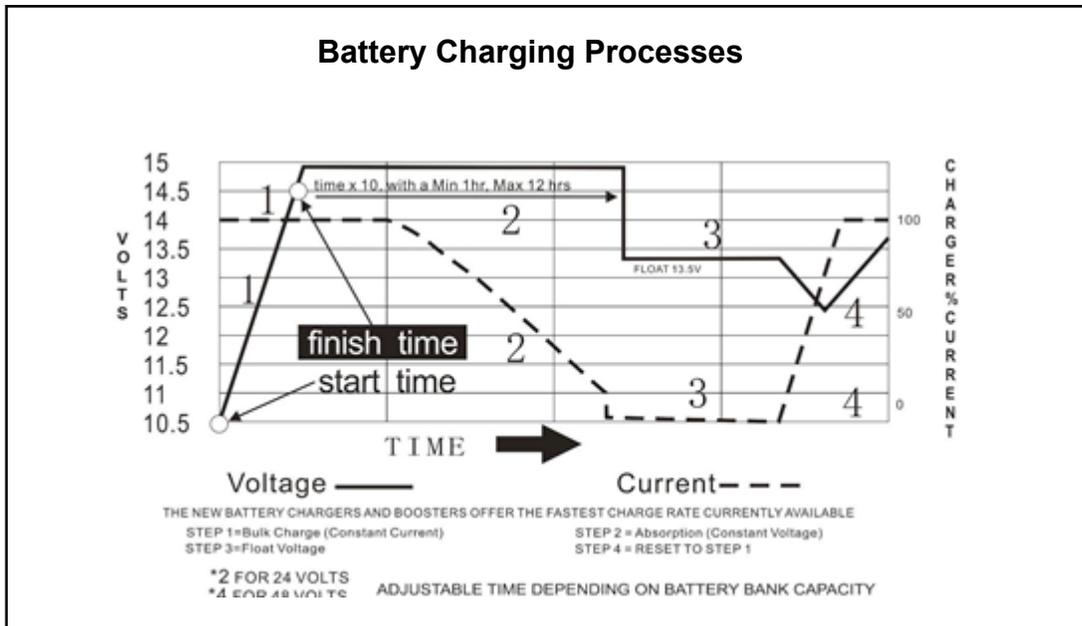
Absorb Charging: This is the second charging stage and begins after the absorb voltage has been reached. Absorb Charging provides the batteries with a constant voltage and reduces the DC charging current in order to maintain the absorb voltage setting.

In this period, the inverter will start a T1 timer; the charger will keep the boost voltage in Boost CV mode until the T1 timer has run out. Then drop the voltage down to the float voltage. The timer has a fix time of 1 hour.

Float Charging: The third charging stage occurs at the end of the Absorb Charging time. While Float charging, the charge voltage is reduced to the float charge voltage (determined by the Battery Type selection*). In this stage, the batteries are kept fully charged and ready if needed by the inverter.

If the A/C is reconnected or the battery voltage drops below 12Vdc/24Vdc/48Vdc, the charger will reset the cycle above.

If the charge maintains the float state for 10 days, the charger will deliberately reset the cycle to protect the battery.



De-sulphation

The de-sulphation cycle on switch position 8 is marked in red because this is a very dangerous setting if you do not know what you are doing. Before ever attempting to use this cycle you must clearly understand what it does and when and how you would use it.

What causes sulphation? This can occur with infrequent use of the batteries, nor if the batteries have been left discharged so low that they will not accept a charge. As the saying goes, desperate diseases must have desperate remedies. This cycle is a very high voltage charge cycle especially designed to try to break down the sulphated crust that is preventing the plates from taking a charge and thus allow the plates to clean up and accept a charge once again.



Warning!

The de-sulphation charging should not be carried out on batteries with good conditions.

Charging depleted batteries

The Auto Power Inverter Charger allows start up and through power with depleted batteries.

For 12VDC models, after the battery voltage goes below 10V, if the switch is still (and always) kept in "ON" position, the inverter is always connected with battery whose voltage doesn't drop below 2V, the inverter will be able to charge the battery once qualified AC inputs.

Before the battery voltage going below 9VDC, the charging can activated when the switch is turned to "Off", then to "ON".

When the voltage goes below 9VDC, and the power switch is turned to "OFF" or disconnect the inverter from battery, the inverter will not be able to charge the battery once again, because the CPU lose memory during this process

Battery type selector			
Switch Setting	Description	Boost/Vdc	Float /Vdc
0	Charger Off		
1	Gel USA	14.0	13.7
2	AGM 1	14.1	13.4
3	AGM2	14.6	13.7
4	Sealed Lead acid	14.4	13.6
5	Gel Euro	14.4	13.8
6	Open Lead acid	14.8	13.3
7	Calcium	15.1	13.6
8	De sulphation	15.5 (4 Hours then Off)	
9	Customized	Customized	Customized
12 Vdc Mode (* 2 for 24 Vdc ; *4 for 48 Vdc)			

Charging current for each model

Model Wattage	Battery Voltage	Charging Current
1.5KW	12Vdc	55 Amp

The charging capacity will go to peak in around 3 seconds, this may probably cause a generator to drop frequency, making inverter transfer to battery mode.

It is suggested to gradually put charging load on the generator by switching the charging switch from min to max, together with the 15s switch delay, our inverter gives the generator enough time to spin up.

Changing max charging current

The battery type selector position of "0" will disable battery charger.

The "Charge Current Control" knob will enable the user to control the max charging current from 15% to maximum.

Plug in BTS to get max charging capacity

The inverter charger will output max capacity when the BTS is plugged in. Without BTS, it will output a max of 25A.



Caution:

Please use a small jeweler's style flat-head screwdriver to turn the charge current control switch gently to avoid breakage due to over-turning.

To guarantee the best performance of AC charger when the AC input is from a generator, the standby generator should be of at least 150% higher capacity than the inverter.

Warning! Operation with an under-rated generator or generator with unqualified wave form may cause premature failure which is not under warranty.

III. Transfer:

While in the Standby Mode, the AC input of the inverter is continually monitored. Whenever AC power falls out of the trip voltages, the inverter automatically transfers back to the Invert Mode with minimum interruption to your appliances.

The transfer from Standby mode to Inverter mode occurs in approximately 6 milliseconds, with the worst case of 10 milliseconds. And it is the same time from Inverter mode to Standby mode. Though it is not designed as a computer UPS system, this transfer time is usually fast enough to hold them up as devices like computers can generally tolerate a max power loss of 20ms.

There is a 5-second delay from the time the inverter senses that continuously qualified AC is present at the input terminals to when the transfer is made. This delay is built in to provide time for a generator to spin-up to a stable voltage and avoid relay chattering. The inverter will not transfer to generator until it has locked onto the generator's output. This delay is also designed to avoid frequent switch when input utility is unstable.

IV. Power Saver

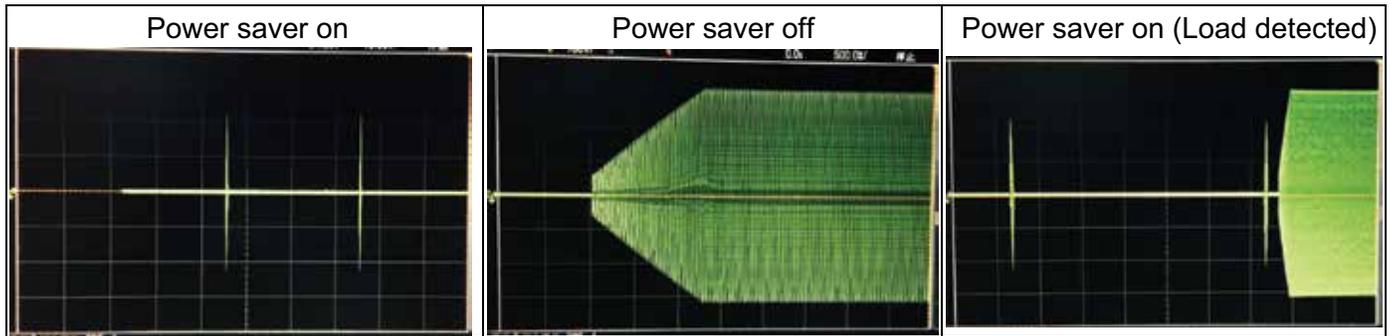
There are two different working statuses for Auto Power inverter: "Power On" and "Power Off". When power switch is in "Unit Off" position, the inverter is powered off.

When power switch is turned to either of "Power Saver Auto" or "Power Saver Off", the inverter is powered on.

Power saver function is to dedicated to conserve battery power when AC power is not or rarely required by the loads.

In this mode, the inverter pulses the AC output looking for an AC load (i.e., electrical appliance). Whenever an AC load (greater than 25 watts) is turned on, the inverter recognizes the need for power and automatically starts inverting and output goes to full voltage. When there is no load (or less than 25 watts) detected, the inverter automatically goes back into search mode to minimize energy consumption from the battery bank. In "Power saver on" mode, the inverter will draw power mainly in sensing moments, thus the idle consumption is significantly reduced.

The inverter is factory defaulted to detect load for 250ms in every 3 seconds. This power sensing can be customized to "Unit off charging" via the SW3 on DIP switch.



Note: The minimum power of a load to take inverter out of sleep mode (Power Saver On) is 50 Watts.

The whole inverter is designed with extraordinarily low idle power consumption which is approximately 1.5% of its rated power.

Auto Power inverter Charger Idle Power Consumption(in Watts)

Model	Power Save Off Idle Max	Power Saver Auto	
		3 Secs (Max)	Unit Off Charging
1.5KW	25W	9W	3W

For more detailed technical information, please contact us.

When in the search sense mode, the green power LED will blink and the inverter will make a ticking sound. At full output voltage, the green power LED will light steadily and the inverter will make a steady humming sound. When the inverter is used as an “uninterruptible” power supply the search sense mode function should be defeated.

Exceptions

Some devices when scanned by the load sensor cannot be detected. Small fluorescent lights are the most common example. (Try altering the plug polarity by turning the plug over.) Some computers and sophisticated electronics have power supplies that do not present a load until line voltage is available. When this occurs, each unit waits for the other to begin. To drive these loads either a small companion load must be used to bring the inverter out of its search mode, or the inverter may be programmed to remain at full output voltage.

V. Protections

The Auto Power Inverter Charger is equipped with extensive protections against various harsh situations/faults.

These protections include:

AC Input over voltage protection/AC Input low voltage protection

Low battery alarm/High battery alarm

Over temperature protection/Over load protection

Short Circuit protection (1s after fault)

Back feeding protection

When Over temperature /Over load occur, after the fault is cleared, the master switch has to be reset to restart the inverter.

The Low battery voltage trip point can be customized from defaulted value of 10VDC to 10.5VDC through the SW1 on the DIP switch.

The inverter will go to Over temp protection when the heat sink temp. $\geq 105^{\circ}\text{C}$ (221°F), and will go to Fault (shutdown Output) after 30 seconds. After temp drops to 90°C (194°F), the switch has to be reset to activate the inverter.

The Inverter is with back feeding protection which avoids presenting an AC voltage on the AC input terminal in Invert mode.

After the reason for fault is cleared, the inverter has to be reset to start working.

VI. Remote Enable

The Inverter can also be switch on/off through the "RMT SW" pin in the right of AC terminal.

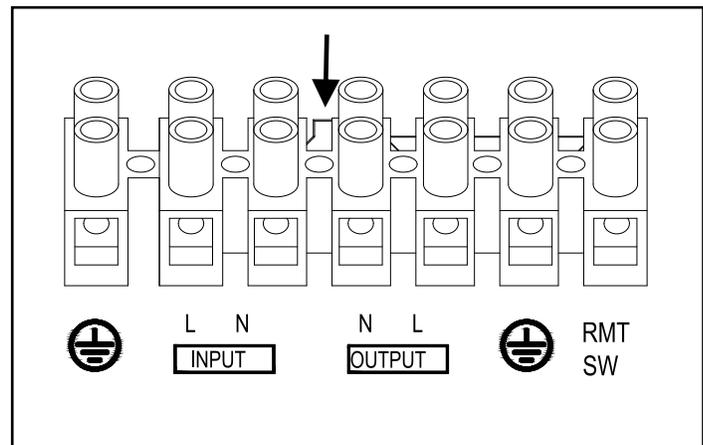
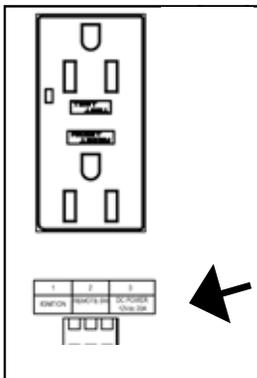
They inverter will be powered on once a +12Vdc (acceptable range 10-16Vdc) source is connected to the PIN, and powered off when the +12Vdc source is disconnected(if the switch panel is in "Unit off" position).

The 12Vdc remote start is with the same priority as "Power saver off".

Whichever first switches from "Unit Off" to "Power saver off" or "Power saver on", it will power the inverter on. If the commands from these sources conflict, the inverter will accept command according to the following priority: Power saver on > Power saver off > Power off.

Only when both panels and +12 remote control are turned to "Unit Off" position, will the inverter be powered off.

The unit can also be ground enabled by applying a ground signal to the REMOTE SW(2), located below the GFIC.



VII. 12Vdc Remote Control Wiring Diagram



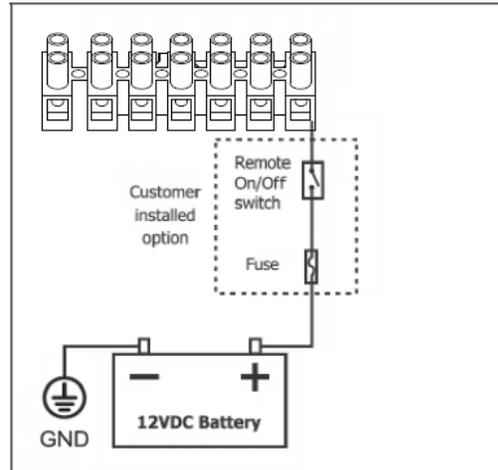
WARNING

The rated current of remote control terminal is 0.5Amp, over current may damage the inverter. Thus it must be protected with an appropriate DC fuse; the suggested value is 1 Amp.



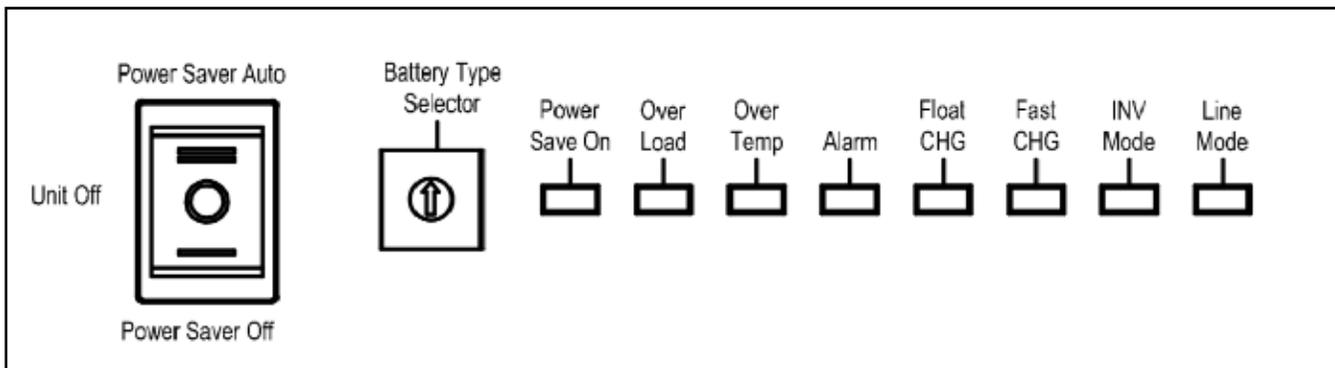
WARNING

Connecting this wire to chassis ground will cause damage not covered under warranty!



The remote switch should be single pole, single throw with at least a 1Amp rating. The wire used should be at least 18ga

VIII. LED Indicator



SHORE POWER ON	GREEN LED lighting on “Line Mode”
INVERTER ON	GREEN LED lighting on “Inv Mode”
FAST CHARGE	YELLOW LED lighting on “Fast CHG”
FLOAT CHARGE	GREEN LED lighting on “Float CHG”
OVER TEMP TRIP	RED LED lighting on “Over Temp”
OVER LOAD TRIP	RED LED lighting on “Over Load”
POWER SAVER ON	GREEN LED lighting on “Power Saver on”

Please refer to ‘Indicator and Buzzer’ for the detailed information.

Apart from the switch panel on the front of the inverter, an extra switch panel connected to the RJ45 port at the DC side of the inverter through a CAT cable can also control the operation of the inverter remotely.

If an extra switch panel is connected to the inverter via “remote control port”, together with the panel on the inverter case, the two panels will be connected and operated in parallel. Whichever first switches from “Unit Off” to “Power saver off” or “Power saver on”, it will power the inverter on.

If the commands from the two panels conflict, the inverter will accept command according to the following priority:

Power saver on > Power saver off > Power off

Only when both panels are turned to “Unit Off” position, will the inverter be powered off.

The suggested length between the switch panel and inverter is 32 feet



WARNING

Never cut the telephone cable when the cable is attached to inverter and battery is connected to the inverter. Even the inverter is turned off, this will damage the remote PCB inside if the cable is short circuited during cutting.

IX. Audible Alarm

The inverter also gives audible alarms when the following situations occur

Battery Voltage Low	Inverter green LED Lighting, and the buzzer beep 0.5s every 5s.
Battery Voltage High	Inverter green LED Lighting, and the buzzer beep 0.5s every 1s, and Fault after 60s.
Invert Mode Over-Load	(1)110%<load<125%(±10%), No audible alarm in 14 minutes, Beeps 0.5s every 1s in 15th minute and Fault after 15 minutes; (2)125% <load<150%(±10%), Beeps 0.5s every 1s and Fault after 60s; (3)Load>150%(±10%), Beeps 0.5s every 1s and Fault after 20s;
Over Temperature	Heat sink temp. ≥105°C(221°F), Over temp red LED Lighting, beeps 0.5s every 1s;

X. FAN Operation

For 1-3KW models, there is one multiple controlled DC fan.

The DC fan will work in the same way as the one on 1-3KW, while the AC fan will work once there is AC output from the inverter.

The DC fans are designed to operate according to the following logic:

Condition	Enter Condition	Leave condition	Speed
HEAT SINK TEMPERATURE	$T \leq 60^{\circ}\text{C}(140^{\circ}\text{F})$	$T > 65^{\circ}\text{C}(149^{\circ}\text{F})$	OFF
	$65^{\circ}\text{C}(149^{\circ}\text{F}) \leq T < 85^{\circ}\text{C}(185^{\circ}\text{F})$	$T \leq 60^{\circ}\text{C}(140^{\circ}\text{F})$ or $T \geq 85^{\circ}\text{C}(185^{\circ}\text{F})$	50%
	$T > 85^{\circ}\text{C}(185^{\circ}\text{F})$	$T \leq 80^{\circ}\text{C}(176^{\circ}\text{F})$	100%
CHARGER CURRENT	$I \leq 15\%$	$I \geq 20\%$	OFF
	$20\% < I \leq 50\% \text{Max}$	$I \leq 15\%$ or $I > 50\% \text{Max}$	50%
	$I > 50\% \text{Max}$	$I \leq 40\% \text{Max}$	100%
LOAD Percentage	Load < 30%	Load ≥ 30%	OFF
(INV MODE)	$30\% \leq \text{Load} < 50\%$	Load ≤ 20% or Load ≥ 50%	50%
	Load ≥ 50%	Load ≤ 40%	100%

Allow at least 30CM of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit.

Fan noise level <60db at a distance of 1m

XI. DIP Switches

On the DC end of inverter, there are five DIP switches which enable users to customize the performance of the device. *Factory Default

Switch #	Switch Function	Position: 0	Position: 1
SW1(AC Priority)	Low Battery Trip Point	10.0VDC*	10.5VDC
SW2(120Vac)	AC Input Range	100-135Vac $\pm 4\%^*$	90-135Vac (40Hz+) $\pm 4\%$
SW3	Power Save Override ON/ OFF	Inverter Off*	Power Saver On(3 sec)
SW4	Frequency Switch	50Hz	60Hz*
SW5	Battery/AC Priority	AC Priority*	Battery Priority

Low Battery Trip Point (SW1):

Deep discharge of the lead acid battery leads to high losses in capacity and early aging. In different applications a different low voltage disconnection level is preferred. For example, for applications, user may intend to have less DOD to prolong the battery life cycle. While for mobile applications users may intend to have more DOD to reduce battery capacity and on board weight.

*2 for 24VDC, *4 for 48VDC

AC Input Range (SW2):

There are different acceptable AC input ranges for different kinds of loads.

For some relatively sensitive electronic devices, a narrow input range of 100-135V is required to protect them.

While for some resistive loads which work in a wide voltage range, the input AC range can be customized to 90-135V for 120Vac models, this helps to power loads with the most AC input power without frequent switches to the battery bank.

In order to make the inverter accept dirty power from a generator, when the SW2 is switched to position "1", the inverter will bypass an AC input with a wider voltage and frequency (40Hz plus for 50Hz/60Hz). Accordingly, the AC charger will also work in a wider voltage and freq range (43Hz plus for 50Hz/60Hz).

This will avoid frequent switches between battery and generator. But some sensitive loads will suffer from the low quality power.

The pros and cons should be clearly realized.

Power Save Override ON/OFF (SW3):

Under the Battery Priority Mode (SW5 in position "1"), the inverter can be switched between two modes: Power Saver Mode (SW3 in position "1") and Unit Off Charging Mode (SW3 in position "0"). The power Switch should be in "Power saver on" position all the time for using these functions. In Power Saver Mode, the inverter is initially in standby mode and sends a pulse to detect the presence of a load every 3 seconds. Each pulse lasts for 250ms. The inverter will remain in standby mode until a load has been detected. Then it will wake up from standby mode and start to invert electricity from the battery bank to supply the load. As this function is under Battery Priority, the inverter will always prefer to invert electricity from battery first even there is a qualified AC input present. Only when the battery voltage is lower than the low voltage alarm point, will the inverter switch to AC input power to charge the battery and supply the load at the same time.

This Power Saver Mode can be changed to Unit Off Charging mode via SW3 by switching it to "0" position (SW5 still in "1"). "Unit Off Charging" will enable the inverter charger to charge batteries as much as possible while without discharging them. In "Unit Off Charging" mode, the inverter will stay in standby mode without sensing loads. It won't output any power even if a load is turned on, and only stay idle in this mode when there is no AC input. When a qualified AC input is present, it will start charging the battery and transfer power to loads. This feature is ideally suitable for applications where energy conservation for batteries is required. Charging will be activated once qualified AC exists, while discharging is disabled.

The inverter only consumes as little as 3 watts in "Unit Off Charging" mode.

Output Frequency(SW4):

The output frequency of the inverter can be set at either 50Hz or 60Hz by SW4 which make the inverter charger an international models for most electricity systems.

AC/Battery Priority (SW5):

The Auto Power Inverter Charger is designed with AC/Battery priority switch (DIP switch #5). Switch the battery priority selector to Position "0" for AC priority mode, Position "1" for battery priority mode. In AC priority mode, when AC input is present, the battery will be charged first, and the inverter will transfer the input AC to power the load. Only when the AC input is stable for a continuous period of 15 days will the inverter start a battery inverting cycle to protect the battery. After 1 normal charging cycle ac through put will be restored.

When you choose battery priority, the inverter will invert from battery despite the AC input.

When the battery voltage reaches the low voltage alarm point which is (0.5Vdc for 12V, 1Vdc for 24V, 2V for 48Vdc) higher than "Low Battery Trip Point", the inverter will transfer to AC input, charge battery, and switch back to battery when the battery is fully charged. This function is mainly for wind systems using utility power or generator as back up.

The AC/Battery Priority function can be activated by sliding the switch even when the inverter is in operation.

Note: In battery priority mode, when qualified AC inputs for the first time and the battery voltage is below 12.5Vdc, the inverter will first carry out a cycle of bulk charging and absorb charging, the inverter will not go into float charging mode.

Choosing the battery type selector to "0" will disable the built-in battery charger while still allow transfer through. When battery charger is disabled, if the battery is charged by external DC power to 13.5Vdc, the inverter will go to battery priority mode again.

XII. Auto Generator Start

The inverter can start up generator when battery voltage goes low.

When the inverter goes to low battery alarm, it can send a signal to start a generator and turn the generator off after battery charging is finished.

The auto gen start feature will only work with generators which have automatic starting capability. The generator must have start and stop controls [i.e., an electric starter and electric choke (for gasoline units)], and the safety sensors to be able to start and stop automatically.

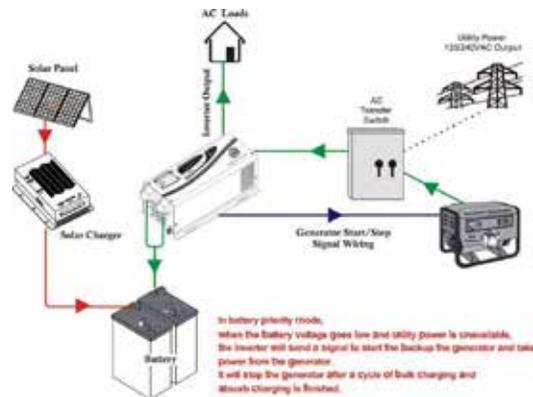
There is an open/close relay (constant open) that will close and short circuit the positive and negative cables from a generator start control. The input DC voltage can vary, but the max current the relay can carry is 16 Amp.

The Auto Generator Start terminal pins are not polarized.

In addition, these two pins can also be used as dry contacts to send out “Low Battery Voltage” signal to an external alarm device.

This AGS relay can also carry AC voltage within its capacity.

This inverter will skip the float charging when it is set at battery priority mode, so that the generator will no longer be kept running to maintain a small charge on the batteries



XIII. Battery Temperature Sensing

Applying the proper charge voltage is critical for achieving optimum battery performance and longevity. The ideal charge voltage required by batteries changes with battery temperature.

The battery temperature sensor allows the charge controller to continuously adjust charge voltage based on actual battery temperature.

Temperature compensation of charge voltage assures that the battery receives the proper charge voltage as battery temperature varies.

The entire line are equipped with Battery Temperature Sensing for increased charging precision. It sends precise information to the charger, which automatically adjusts voltage to help ensure full battery charge depending on the ambient temperature of your battery installation.

When the battery voltage is over 40°C(104°F), it will reduce the charging voltage by 0.1Vdc with every degree of temperature rise.

We recommend that you install Battery Temperature Sensors on all banks to protect your batteries and to provide optimal charging of each bank.

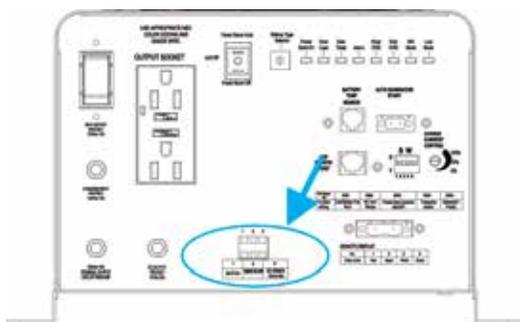
The battery temperature sensor mounts on the side of a battery or any other location where the precise temperature of battery can be detected such as battery mounting racks.

The following table describes approximately how much the voltage may vary depending on the temperature of the batteries.

Inverter Condition	Temperature on BTS	Charger Operation
Charger Mode	BTS $\geq 50^{\circ}\text{C}(122^{\circ}\text{F})$	Automatically turns off charger
	BTS $\leq 40^{\circ}\text{C}(104^{\circ}\text{F})$	Automatically turns on charger
Inverter Mode	$40^{\circ}\text{C}(104^{\circ}\text{F}) \leq \text{BTS} \leq 50^{\circ}\text{C}(122^{\circ}\text{F})$	Increases the low voltage shut down point by 0.5Vdc
	BTS $\geq 50^{\circ}\text{C}(122^{\circ}\text{F})$	Over Temp Fault
A Battery Temperature Sensor has been provided as a separate accessory. It comes with 15' / 5M cable.		

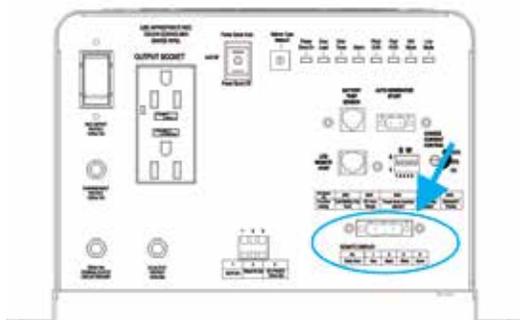
Important: If the battery temperature is allowed to fall to extremely cold temperatures, the inverter with a BTS may not be able to properly recharge cold batteries due to maximum voltage limits of the inverter. Ensure the batteries are protected from extreme temperatures. For more detailed technical information, please contact us.

XIV. Other Features



20A DC output

When there is ignition signal on Pin 1 or when the inverter transfers to qualified AC input, the Pin 3 will output 12Vdc 20A DC power



4 Pins for KECO Deluxe Auto Eject Remote Interface

Low Battery Voltage Recovery Start

After low battery voltage shut off (10V for 12V model or 20V for 24V model or 40V for 48V model), the inverter is able to restore to work after the battery voltage recovers to 13V/26V/52V (with power switch still in "On" position). This function helps to save the users extra labor to reactivate the inverter when the low battery voltage returns to acceptable range in renewable energy systems.



Warning!

Never leave the loads unattended, some loads (like a Heater) may cause accidents in such fire. Nobody wants to return home, finding house surrounded by fire trucks and naughty neighborhood kids toasting hot dogs against his house

Conformal Coating

The entire line of inverters have been processed with a conformal coating on the PCB, making it water, rust, and dust resistant.

While these units are designed to withstand corrosion from the salty air, they are not splash proof

INSTALLATION

I. Location

Follow all the local regulations to install the inverter.

Please install the equipment in a location of Dry, Clean, Cool with good ventilation.

Working temperature: -20°C to 45°C (-4°F to 113°F)

Storage temperature: - 40°C to 70°C (-40°F to 158°F)

Relative Humidity: 0% to 95% , non-condensing

Cooling: Forced air

Warning! Operation in a condensing environment will invalid warranty.

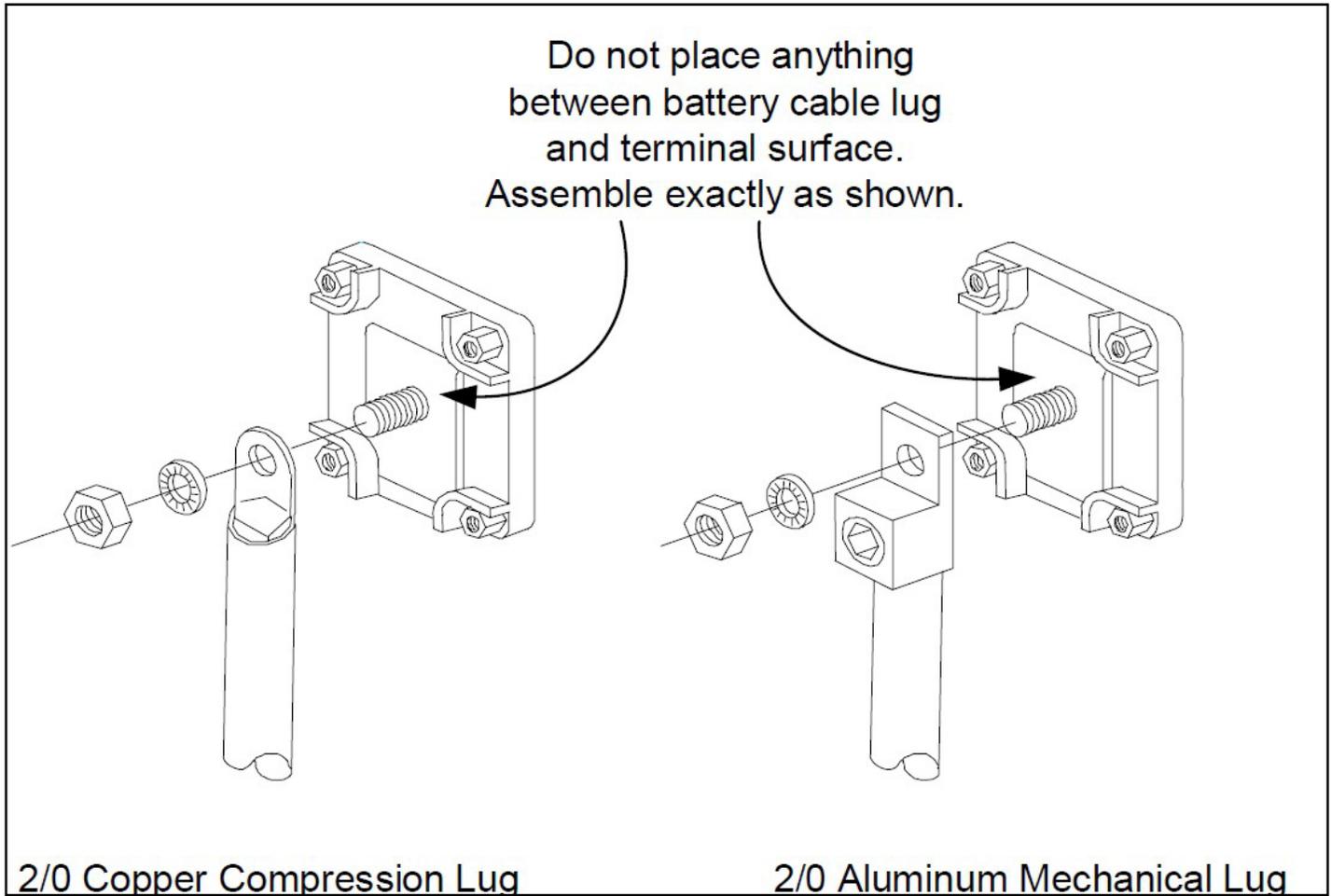
II. DC Wiring Recommendations

It is suggested the battery bank be kept as close as possible to the inverter. The following table is a suggested wiring option for DC cable with length from 1 to 15 ft.

Length of Wire to Battery (feet)	0 - 5 (5% Vdrop)			5 - 10 (5% Vdrop)			10 - 15* (5% Vdrop)		
Battery Charger Connections	V. BAT +		V. BAT -	V. BAT +		V. BAT -	V. BAT +		V. BAT -
Wire # Gauge (awg)	2		2	2		2	00		00
Fuse	200A			200A			400A		
* Consult factory if length of wire to battery is longer than 20 feet									

Battery cables must have crimped (or preferably, soldered and crimped) copper compression lugs unless aluminum mechanical lugs are used. Soldered connections alone are not acceptable. High quality, UL-listed battery cables are available. These cables are color-coded with pressure crimped, sealed ring terminals.

Battery terminal must be clean to reduce the resistance between the DC terminal and cable connection. A buildup of dirt or oxidation may eventually lead to the cable terminal overheating during periods of high current draw. Use a stiff wire brush and remove all dirt and corrosion from the battery terminals and cables.



Reducing RF interference

To reduce the effect of radiated interference, twist the DC cables. To further reduce RF interference, shield the cables with sheathing /copper foil / braiding.

Taping battery cables together to reduce inductance

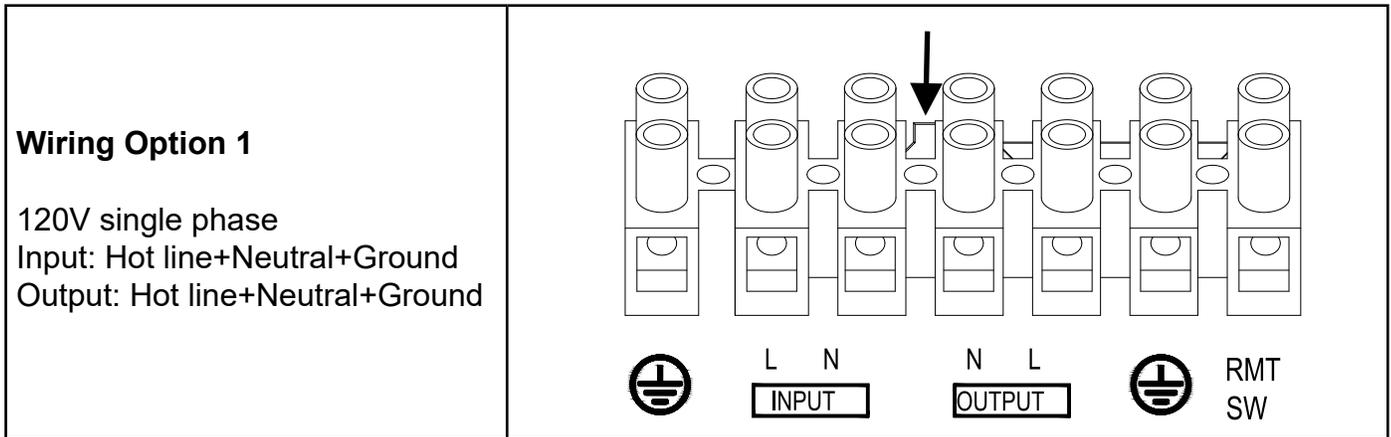
Do not keep the battery cables far apart. In case it is not convenient to twist the cables, keep them taped together to reduce their inductance. Reduced inductance of the battery cables helps to reduce induced voltages. This reduces ripple in the battery cables and improves performance and efficiency

 WARNING	<p>The torque rating range for DC terminal is 12.5NM-20.5NM(9.25-15.19 pound-foot), and the suggested torque rating is 17NM(12.6 pound-foot). Over torquing may cause the bolt to break.</p>
	<p>The inverter contains capacitors that may produce a spark when first connected to battery. Do not mount in a confined a battery or gas compartment.</p>
	<p>Ensure the inverter is off before disconnecting the battery cables, and that AC power is disconnected from the inverter input.</p>

III. AC Wiring Recommendation

We recommend using 12 Awg wire to connect to the ac terminal block.

When in AC mode the AC input power will supply both the loads and AC charger, a thicker wire gauge for AC Input is required. The wirings are UL458 compliant, please consult a qualified electrician or call our tech support if you are not sure about how to wire any part of your inverter.



WARNING

The output voltage of this unit must never be connected in its input AC terminal, overload or damage may result.
Always switch on the inverter before plugging in any appliance.
Damages caused by AC wiring mistakes are not covered under warranty.
The installer must use AC wires rated at least 75°C/167°F.

IV. Grounding: Connect an AWG 8 gauge or greater copper wire between the grounding terminal on the inverter and the earth grounding system or the vehicle chassis.

MAINTENANCE AND TROUBLESHOOTING

I. Replacement GFCI Recommendation:

Use the following GFCIs for the output circuits from AC terminal blocks:

Manufacturer	Model No.
ZHEJIANG SHOUXIN ELECTRICAL APPARATUS CO LTD	TS20

This troubleshooting guide contains information about how to troubleshoot possible error conditions while using the Inverter/Charger. The following chart is designed to help you quickly pinpoint the most common inverter failures.

II. Trouble Shooting Chart

Status	Item	Indicator on top cover					
		SHORE POWER ON	INVERTER ON	FAST CHG	FLOAT CHG	OVER TEMP TRIP	OVER LOAD TRIP
Line Mode	CC	√		√			
	CV	√		√, blink			
	Float	√			√		
	Standby	√					
Inverter Mode	Inverter On		√				
	Power Saver						
Inverter Mode	Battery Low		√				
	Battery High		√				
	Overload On Invert Mode		√				√
	Over-Temp On Invert Mode		√			√	
	Over-Temp On Line Mode	√		√		√	
	Over Charge	√		√			
Fault Mode	Fan Lock						
	Battery High		√				
	Inverter Mode Overload						√
	Output Short						√
	Over-Temp					√	
	Over Charge			√			
	Back Feed Short						

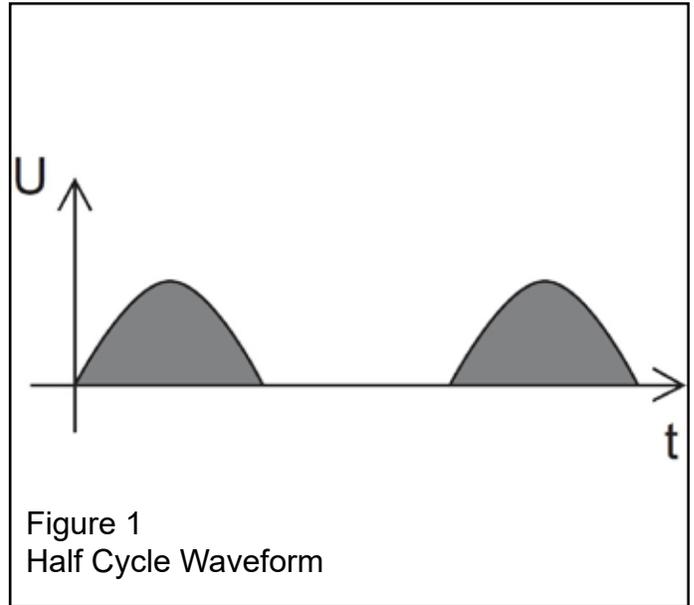
III. Trouble Shooting Chart

Symptom	Possible Cause(s)	Recommended Solution(s)
Inverter will not turn on during initial power up.	Batteries are not connected, loose battery-side connections. Low battery voltage.	Check the batteries and cable connections. Check DC fuse and breaker. Charge the battery.
No AC output voltage and no indicator lights ON.	Inverter has been manually transitioned to OFF mode.	Press the switch to Power saver on or Power saver off position.
Inverter overload indicator on	Excessive AC output load or AC output short Defective inverter	Check AC output loads and wiring
Inverter high temperature indicator on	Excessive ambient temperature or AC output load	Check AC output loads, increase ventilation, derate the inverter if ambient temperature is excessive.
AC output voltage is low and the inverter turns loads OFF in a short time.	Low battery.	Check the condition of the batteries and recharge if possible.
Charger is inoperative and unit will not accept AC.	AC voltage has dropped out-of-tolerance	Check the AC voltage for proper voltage and frequency.
Charger is supplying a lower charge rate.	Charger controls are improperly set. Low AC input voltage. Loose battery or AC input connections.	Refer to the section on adjusting the "Charger Rate". Source qualified AC power.. Check all DC /AC connections.
Charger turns OFF while charging from a generator.	High AC input voltages from the generator.	Load the generator down with a heavy load. Turn the generator output voltage down.
Sensitive loads turn off temporarily when transferring between grid and inverting.	Inverter's Low voltage trip voltage may be too low to sustain certain loads.	Choose narrow AC voltage in the DIP switch, or Install a UPS if possible.
Noise from Transformer/case*	Applying specific loads such as hair dryer	Remove the loads

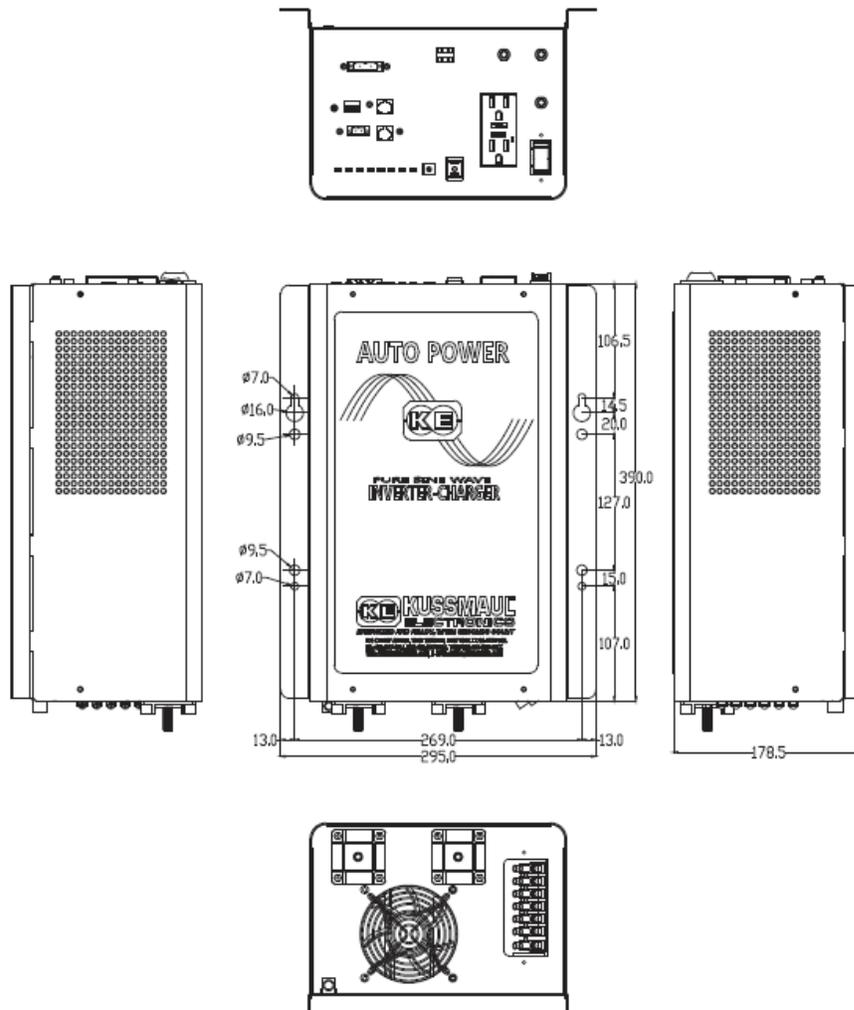
The most common load of such kind is hair dryer. If the noise comes from case. Normally when loaded with inductive loads, the magnetic field generated by transformer keeps attracting or releasing the steel case at a specific frequency, this may also cause noise.

This noise may also be generated the moment a load is detected in the power saver mode.

Reducing the load power or using an inverter with bigger capacity will normally solve this problem. The noise will not do any harm to the inverter or the loads.



OUTLINE DRAWING



SPECIFICATIONS

INVERTER OUTPUT

Model	1.5KW
Continuous Output Power	1500W
Surge Rating(20s)	4500W
Capable of Starting Electric Motor	1.5HP
Output Waveform	Pure Sine wave/Same as input(Bypass mode)
Nominal Efficiency	>88%(Peak)
Line Mode Efficiency	>95%
Power Factor	0.9-1.0

DC INPUT

Nominal Output Voltage RMS	100-110-120Vac / 220-230-240Vac
Output Voltage Regulation	±10% RMS
Output Frequency	50/60Hz ± 0.3Hz
Short Circuit Protection	Yes, Current Limit Function (Fault after 1sec)
Typical transfer Time	10ms(Max)
THD	Typically <7%, Max 10% under full linear load
Nominal Input Voltage	12.0Vdc(*2 for 24Vdc, *4 for 48Vdc)
Minimum Start Voltage	10.0Vdc
Low Battery Alarm	10.5Vdc / 11.0Vdc
Low Battery Trip	10.0Vdc / 10.5Vdc
High Voltage Alarm & Fault	16.0Vdc
High DC Input Recovery	15.5Vdc
Low Battery Voltage Recover	13.0Vdc
Idle Consumption-Search Mode	< 25 W when Power Saver On

CHARGE

Input Voltage Range	Narrow: 100~135VAC / 194~243VAC; Wide: 90~135VAC / 164~243VAC;
Input Frequency Range	Narrow: 47-55±0.3Hz for 50Hz, 57-65±0.3Hz for 60Hz Wide:43±0.3Hz plus for 50Hz/60Hz
Output Voltage	Depends on battery type
Charger Breaker Rating(230Vac)	10A
Charger Breaker Rating(120Vac)	20A
Max Charge Rate	15A to 120A +/-5A , depending on models
Over Charge Protection Shutdown	15.7V for 12Vdc (*2 for 24Vdc, *4 for 48Vdc)
Battery type	Fast Vdc
Gel U.S.A	14
A.G.M 1	14.1
A.G.M 2	14.6
Sealed Lead Acid	14.4
Gel Euro	14.4
Open Lead Acid	14.8
Calcium	15.1
De-sulphation	15.5 for 4hrs
Remote Control	Yes. Optional
Input Voltage Waveform	Sine wave (Grid or Generator)
Nominal Voltage	120Vac

BYPASS AND PROTECTION

Low Voltage Trip	80V/90V±4%
Low Voltage re engage	90V/100V±4%
High Voltage Trip	140V±4%
High Voltage re engage	135V±4%
Max Input AC Voltage	150VAC
Nominal Input Frequency	50Hz or 60Hz (Auto detect)
Low Freq Trip	Narrow: 47±0.3Hz for 50Hz, 57±0.3Hz for 60Hz
	Wide:40±0.3Hz for 50Hz/60Hz
Low Freq re engage	Narrow: 48±0.3Hz for 50Hz, 58±0.3Hz for 60Hz
	Wide:45±0.3Hz for 50Hz/60Hz
High Freq Trip	Narrow: 55±0.3Hz for 50Hz, 65±0.3Hz for 60Hz
	Wide: No up limit for 50Hz/60Hz
High Freq re engage	Narrow: 54±0.3Hz for 50Hz, 64±0.3Hz for 60Hz
	Wide: No up limit for 50Hz/60Hz
Output Short circuit protection	Circuit breaker
Bypass breaker rating(230Vac)	15A
Bypass breaker rating(120Vac)	20A

OTHER FEATURES

Auto Generator Start	Available
Battery Temp Sensing	Available

MECHANICAL SPECIFICATIONS

Mounting	Floor (horizontal) mount
Inverter Dimensions(L*W*H)	389*295*200mm
Inverter Weight	19KG
Shipping Dimensions(L*W*H)	389*295*200mm
Shipping Weight	21KG
Display	Status LEDs+LCD
Standard Warranty	5 Years

CERTIFICATIONS

UL	458
UL CANADA	C22.2 107.1
FILE #	E 503855

OPTIONAL ACCESSORIES

- I. **PIGTAIL ACCESSORY,**
18" Overall Length
MODEL #: 091-263-003-18



- II. **BTSC (Battery Temp Sensor Cable)**
Optional Sizes available: specify 20, 25 or 30 ft
when ordering
MODEL #: 091-263-005-XX



- III. **BAR GRAPH DISPLAY, MODEL #: 091-200-IND**

- 10-Segment LED display indicate the “state of charge” and the general condition of the batteries



- IV. **DELUXE STATUS CENTER, MODEL #: 091-194E-IND**

- Indicator has a digital voltage and ampere display
- 5 segment bar graph display indicates output current
- 4 LED's to show the condition of the batteries



- V. **WATERTIGHT DELUXE STATUS CENTER, MODEL #: 091-194E-IND-WT-XX**

- Indicator has digital voltage and ampere display
- 5 segment bar graph display indicates output current
- 4 LED's to show the condition of the batteries
- Indicator is housed in a watertight bezel
- Bezel is available in 6 different colors, Red, White, Blue, Yellow, Gray, and Black
- Specify color choice when ordering



ADDL. OPTIONAL ACCESSORIES

V. SUPER AUTO EJECT DELUXE COVER, BAR GRAPH DISPLAY MODEL #: 091-55-234-XXX

- Incorporates Auto Eject cover and Bar Graph Display into one product
- Lid on cover opens 180-degrees to prevent beakage
- 10-LED bar graph provides Auto Charger status
- Includes rear mounted premolded rubber gasket for extra protect from the elements
- Available in YEL, RED, BLU, WHT, GRY, and BLK



VI. SUPER AUTO EJECT DELUXE COVER, DIGITAL DISPLAY COVER MODEL #: 091-55-194E-XXX

- Incorporates Auto Eject cover and Digital Display (volts and amperes) into one product
- Lid on cover opens 180-degrees to prevent beakage
- 10-LED bar graph provides Auto Charger status
- Includes rear mounted premolded rubber gasket for extra protect from the elements
- Available in YEL, RED, BLU, WHT, GRY, and BLK



INSTALLATION RECORD

DATE INSTALLED _____

INSTALLED BY _____

VEHICLE IDENTIFICATION _____

VEHICLE OWNER _____

WARRANTY POLICY

All products of Kussmaul Electronics Company Inc. are warranted to be free of defects of material or workmanship. Liability is limited to repairing or replacing at our factory, without charge, any material or defects which become apparent in normal use within 5 years from the date the equipment was shipped. Equipment is to be returned, shipping charges prepaid and will be returned, after repair, shipping charges paid.

Kussmaul Electronics Company, Inc. shall have no liability for damages of any kind to associated equipment arising from the installation and/or use of the Kussmaul Electronics Company, Inc. products. The purchaser, by the acceptance of the equipment, assumes all liability for any damages which may result from its installation, use or misuse, by the purchaser, his or its employees or others.



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