Pure Sine Wave
Off-grid Power Inverter

INSTRUCTION MANUAL

Pure Sine Wave Off-grid Power Inverter INSTRUCTION MANUAL

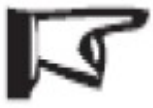
Thank you very much for selecting our product. Please read this manual carefully before installing or using the inverter and pay attention to all safety recommendations.

WARNING: Electricity is dangerous!

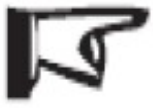
Never touch bare wires, connectors or terminals. All installation work should be carried out by an appropriately qualified person. Safety measures and precautions should be taken in all cases.

General information and suitable appliances

This inverter converts **12V/24V/48V** battery power into mains power **220V-240V 50Hz**. The inverter can power low energy appliances such as laptops, mobile phone and tablet chargers, low power LED lights, radios etc, as well as more powerful household appliances if the inverter power rating (W) is higher. Please ensure that the total continuous power consumption of all your appliances is within the maximum power limit of the inverter. Be careful of appliances with non-constant power consumption, as power spikes may cause overload and shutdown of the inverter.



Note: Do not use this inverter to run any equipment with higher power consumption than the maximum continuous power of the inverter, or appliances that have power spikes exceeding the power rating of the inverter.



Note: This inverter is not suitable for equipment with operating voltage and frequency other than 220V-240V 50Hz. For example, it cannot be used for 110V-120V/60Hz appliances.

CAUTION!

This is an <u>off-grid</u> inverter. Never connect any AC power to AC output of the inverter, otherwise you will damage it immediately.

The following table provides typical power consumption for major appliances. This table should be used for general guidance only; in all cases please refer to the appliance specifications to calculate their power consumption. If more than one device is connected to the inverter, the total power consumption should be the sum of all devices used.

Equipment	Power consumption[1]	Power rating of inverter (continuous)							
		150W	300W	600W	1000W	1500W	2000W	3000W	6000W
--- Home and kitchen appliances ---									
Table fan*	50W	-	OK	OK	OK	OK	OK	OK	OK
Sewing machine*	100W	-	OK	OK	OK	OK	OK	OK	OK
Halogen light**	100W	-	-	OK	OK	OK	OK	OK	OK
Pedestal fan*	100W	-	OK	OK	OK	OK	OK	OK	OK
Small fridge*	200W	-	-	OK	OK	OK	OK	OK	OK
Blender*	350W	-	-	-	OK	OK	OK	OK	OK
Large fridge*	500W	-	-	-	-	OK	OK	OK	OK
Washing machine* (no heating)	700W	-	-	-	-	-	OK	OK	OK
Microwave oven**	900W	-	-	-	-	OK	OK	OK	OK
Toaster	1200W	-	-	-	-	OK	OK	OK	OK
Coffee maker*	1200W	-	-	-	-	-	OK	OK	OK
Hair dryer*	1200W	-	-	-	-	-	OK	OK	OK
Iron	1500W	-	-	-	-	-	OK	OK	OK
Dishwasher*	1500W	-	-	-	-	-	OK	OK	OK
Hob	1500W	-	-	-	-	-	OK	OK	OK
Vacuum cleaner*	2000W	-	-	-	-	-	-	OK	OK
Washing machine* (with heating)	2000W	-	-	-	-	-	-	OK	OK
Air conditioner*	3000W	-	-	-	-	-	-	-	OK
Electric oven	5000W	-	-	-	-	-	-	-	OK
--- Audio and video appliances ---		**Power rating of inverter (continuous)**							
		150W	**300W**	**600W**	**1000W**	**1500W**	**2000W**	**3000W**	**6000W**
12'' colour LCD TV	20W	OK	OK	OK	OK	OK	OK	OK	OK
Satellite TV receiver	30W	OK	OK	OK	OK	OK	OK	OK	OK
HiFi stereo with CD changer **	50W	-	OK	OK	OK	OK	OK	OK	OK
DVD/Blu-ray player	50W	OK	OK	OK	OK	OK	OK	OK	OK

[1] Typical *continuous* power consumption. Note that some appliances have *peak* power several times greater than continuous power.

20" colour LCD TV	100W	OK	OK	OK	OK	OK	OK	OK	OK
42" colour LCD TV	200W	-	OK	OK	OK	OK	OK	OK	OK
100W Stereo amplifier **	200W	-	-	OK	OK	OK	OK	OK	OK
Home theatre system **	500W	-	-	-	OK	OK	OK	OK	OK
Active speakers 250W RMS**	500W	-	-	-	-	OK	OK	OK	OK
Active speakers 500W RMS**	1000W	-	-	-	-	-	-	OK	OK
--- Computers and home office ---		**Power rating of inverter (continuous)**							
		150W	**300W**	**600W**	**1000W**	**1500W**	**2000W**	**3000W**	**6000W**
Mobile phone charger	5W	OK	OK	OK	OK	OK	OK	OK	OK
Small inkjet printer	40W	OK	OK	OK	OK	OK	OK	OK	OK
Laptop	50W	OK	OK	OK	OK	OK	OK	OK	OK
Fax machine	50W	OK	OK	OK	OK	OK	OK	OK	OK
Desk lamp	50W	OK	OK	OK	OK	OK	OK	OK	OK
Desktop computer (with 17" monitor)	400W	-	-	OK	OK	OK	OK	OK	OK
Large laser printer*	800W	-	-	-	-	OK	OK	OK	OK
--- Power tools and other equipment ---		**Power rating of inverter (continuous)**							
		150W	**300W**	**600W**	**1000W**	**1500W**	**2000W**	**3000W**	**6000W**
Drill*	800W	-	-	-	-	-	OK	OK	OK
Electric Chainsaw*	1000W	-	-	-	-	-	OK	OK	OK
Electric Lawn Mower*	1000W	-	-	-	-	-	-	OK	OK
Pressure washer*	1000W	-	-	-	-	-	-	OK	OK
Grinder*	2000W	-	-	-	-	-	-	OK	OK
Air compressor*	2000W	-	-	-	-	-	-	OK	OK

*** These appliances are likely to have electric motors inside. The starting power required by most motors is several times greater than the normal working power. This should be taken into account when choosing the size of inverter. For example, even though electric lawn mowers have a normal working power of 1000W, their starting power may be higher than 4000W, so inverters with a continuous power of 2000W are not suitable because their peak power is limited by 4000W.**

Always take the starting power requirements of equipment with electric motors into account when sizing the inverter.

**** These appliances do not have an electric motor, but still have a variable power consumption with power surges. This requires a larger inverter than other appliances with a similar nominal power.**

Installation

Make sure you choose the correct battery voltage in line with the nominal input voltage of the inverter. Although this manual refers to three types of input voltages (12V, 24V and 48V), your inverter has one fixed input voltage. For example, if you purchased a 12V inverter, you should always use it with a 12V battery, and never connect it to a 24V or 48V battery.

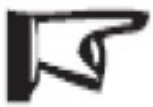
Connection / installation order:

1) If the inverter is supplied with cables, connect the red cable to the "+" battery terminal of the inverter (red or brown), and the black cable to the "-" battery terminal of the inverter (black). If two identical cables are supplied for "+" (red) and "-" (black), do not connect them in a chain. Connect cables of the same colour in parallel for an increased cross-section.

CAUTION!

Use the original cables supplied with this product. Longer cables or cables with thinner cross-sections will create resistance between the inverter and battery. Less power will reach the inverter due to cable losses and may result in "low battery condition" status, even if the battery is fully charged. Thinner cables may warm up quickly, increasing the risk of fire.

2) For vehicles, boats or other mobile systems with negative common ground, use the earth cable (yellow/green if supplied with the inverter) to connect the inverter case and the negative common ground of your system. For stationary systems, use a suitable ground connection for earthing the inverter case.



Note: this inverter cannot be used in positive common ground systems.

3) Connect the inverter cables to your battery:

   The red cable should connect the "+" battery terminal of the inverter (red / brown) and the "+" terminal of your battery; the black cable should connect the "-" battery terminal of the inverter (black) and the "-" terminal of your battery. Ensure that the connection polarity is correct. Incorrect polarity will damage the inverter.

300W / 600W inverters

If you bought a 300W or 600W inverter, it may have been supplied with cables with crocodile clips on the end. Use these for temporary connection only and replace with secure battery clamps or eyelet/ring terminals as soon as permanent connection is required. If using crocodile clips, do not leave the inverter unattended, as the connections may not be secure enough in an unstable environment.

CAUTION!

Do not use crocodile clips to connect powerful 1000W-3000W inverters to your battery. Only use battery clamps (for stud terminals) or eyelet connectors (for bolt terminals).

CAUTION!

Inverters work under extreme pressure of high voltage and high power. Take additional precautions for electrical and fire safety, for example install a fuse or resettable DC circuit breaker between the inverter and the battery bank. The current rating of such fuse / circuit breaker depends on the input voltage of your inverter and the maximum power of your load. E.g. if the inverter is running a 700W load from a 24V battery, the fuse / circuit breaker should have a current rating slightly greater than 700W/24V = 29A. Or, if the inverter is running a 1500W load from a 12V battery, the fuse / circuit breaker should have a rating slightly greater than 1500W/12V = 125A.

Picture 1:
Example of a resettable circuit breaker / isolator switch available to purchase from www.photonicuniverse.com

WARNING: FIRE HAZARD

If you choose to connect the inverter to a DC socket rather than directly to the battery, ensure that this socket and its connecting cable (between the socket and the battery) have the required power/current rating. Do not use cigarette lighter sockets as they are only suitable for low power devices. Do not use any sockets if you are not confident that the socket itself, and the wiring which connects the socket to your battery can handle the power and current drawn by the inverter.

WARNING: FIRE HAZARD

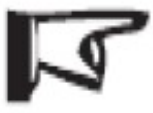
Even if the inverter is switched off, there may be a spark when connecting to a battery (powerful 1000W-3000W inverters create a strong spark). This is normal and caused by capacitors in the inverter circuit which require initial charging at connection. Once charged, reconnection of the inverter within a short time frame should not cause another spark. To avoid this spark, an external heavy duty isolator switch or suitable circuit breaker between the inverter and the battery is recommended.

WARNING: EXPLOSION HAZARD

Keep the inverter away from any flammable substance, or premises containing flammable substance. Do not use the inverter in an enclosure containing lead-acid batteries as these may vent explosive gases which can be ignited by sparks.

4) Plug your appliances into the 240V mains socket of the inverter. You can use a suitable fused mains extension lead / adaptor if you require more sockets, but you must ensure that the total power consumption of all connected appliances is within the power rating of the inverter. Use the same principle if the inverter has two built-in mains sockets – these are connected internally and should not be treated as two independent outputs.

5) Turn the inverter power switch ON (switch position I), and your appliances will start. If your inverter has a green LED power light, it should switch on.



Note: the green power LED light of the inverter may not be visible in bright conditions, and there may be a few seconds delay (possibly with a short beeping sound) before it turns on.

6) Mount the inverter only when it is fully disconnected. Choose a place on a fire-resistant surface, in a dry, dust-free environment with good airflow and ventilation, with at least 20 cm (8 inches) of air space on all sides of the inverter. Ensure there are no combustible or non-fire-resistant objects next to the inverter, particularly around the ventilation holes.

   Do not mount the inverter in cavities or places with obstructed airflow.

CAUTION!

If it is not possible to find a fire-resistant surface for mounting the inverter, install it in a metal or fire-resistant enclosure appropriate for high voltage / high power electrical equipment, with the necessary air space maintained on all sides of the inverter or additional ventilation of the enclosure. Do not keep batteries in the same enclosure as they may vent explosive gases.

Operations

1) Depending on the power rating and design of your inverter, it may feature the following LED lights:
   - **Green** is the output power indicator. This light is on whenever the inverter generates AC power to its mains socket. You can run your appliances from the inverter when the green light is on.
   - **Red** is a warning light indicating a problem (with the battery power, overload or another internal protection). Read the section below about protection and troubleshooting to find suitable solutions.
   - **Yellow/orange** is a high temperature warning light which switches on when the temperature inside the inverter is too high. Please see information on overheating protection below.

Note: if your inverter does not have a temperature warning light, it is still equipped with the automatic thermal shutdown protection to prevent overheating.

2) Your inverter is a high power device which works under extreme pressure, dissipates heat while in operation and generates high voltage. Please treat it with extreme caution as with any other high power/voltage device or appliance generating heat or electricity. Read all of the precautions and

safety measures in this manual, including the “SAFETY PRECATIONS” page at the end of this document, ensuring that you understand them all. If required, seek professional advice before installing and using the inverter.

3) When the inverter is not in use for a long time, turn it off and disconnect it from the battery completely. Disconnect the inverter cables from the battery or turn off the heavy duty switch / circuit breaker between the inverter and the battery. Remember that the inverter may draw a small amount of power from the battery even when it is switched off.

4) If the inverter is connected to the starter battery, please disconnect the inverter when starting the engine.

Note: vehicle batteries provide brief periods of very high current required for starting an engine. They are not designed for constant deep discharge. Regularly operating the inverter from a vehicle battery will rapidly shorten the life of your battery, and it will lose the ability to start the engine. For frequent, extended periods of use, connect the inverter to a special deep-cycle battery (see Appendix I for details).

5) If the inverter comes with a USB port, it is designed to power and charge USB devices. It is not designed to provide a communication link.

6) You can use the wireless remote control supplied with the inverter to turn it On/Off wirelessly. Put the inverter switch in position II to enable this feature.

Picture 2:
Wireless remote control

“I” – inverter is On **“O” – inverter is Off** **“II” – Remote mode**

Picture 3:
Master switch positions

Protection features

The inverter has four main protection functions which allow it to automatically shut down to protect itself and the battery:

- Overload protection;
- Overheating protection;
- Low battery voltage protection;
- High battery voltage protection.

1) Overload protection

If the nominal or peak power of your load is too high, the inverter will switch the red light on and start making *three consecutive beeps intermittently* - indicating that it has detected an *overload*. Disconnect your load immediately, disconnect the inverter from the battery and leave it to rest for 30 minutes before using it again. In the future, reduce the load when using the inverter, as frequent triggering of this protection may cause permanent damage to the inverter.

Note: small 300W and 600W inverters also have a red light alarm and automatic shut-down feature in case of overload, but they do not emit a beeping sound.

The inverter typically detects overload when connected to appliances with a very high starting power consumption (such as devices with electric motors). For such appliances, if their starting power is greater than the inverter's nominal power, they may shut the inverter down. For example, the following appliances may cause the inverter to shut down at start-up, even if their nominal power consumption is within the continuous power rating of the inverter:

- a 60W heating pump connected to a 300W inverter
- a 800W microwave oven connected to a 1000W inverter
- a 1500W vacuum cleaner connected to a 2000W inverter

Note: the inverter is designed to handle a small amount of peak power, but only within its maximum peak power limit and for a very short time (fraction of a second). This may not be sufficient for devices with electric motors, or appliances which have longer periods of peak power by design (e.g. active speakers).

2) Overheating protection

The inverter generates heat while in operation. This is not a malfunction. The higher the power of the load that the inverter is running, the higher the temperature inside the inverter.

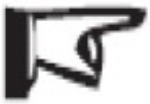
If the temperature inside the inverter reaches +50°C, the cooling fan will automatically switch on. The fan will stop working when the temperature reduces. However, if the fan is working but the temperature inside continues to rise, the yellow/orange LED will turn on (if available on the inverter) and the inverter will make *one beep* before automatically shutting itself down.

Even though the inverter can automatically restart once it has cooled down, you should disconnect all loads, disconnect the inverter from the battery and leave it to rest for a minimum of 30 minutes. To avoid overheating in the future, consider running the inverter with a smaller load or choosing a more powerful inverter.

Note: large inverters may have several fans inside; with one fan working constantly and others switching on when the temperature rises.

3) Low battery voltage protection

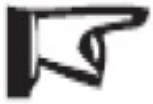
If the inverter starts *beeping once intermittently* with the green light on, this is a *low battery warning*. Turn off the inverter switch, disconnect all appliances from the inverter and disconnect it from the battery. If no action is taken, the inverter will automatically turn itself off after some time (green light will be off), and the inverter will *beep twice intermittently* indicating a *low battery automatic shutdown*.



Note: a low battery shutdown is triggered when the battery voltage drops below a low voltage threshold. With a powerful load connected to the battery, its voltage is always lower than with a small load or with no load at all. Therefore, if the inverter is running powerful appliances, the low voltage threshold will be reached sooner, with more power remaining in the battery after the shutdown. Smaller loads connected to the inverter will allow deeper discharging the battery.

Low battery warning or shutdown may be triggered by the battery becoming drained, as well as if the cables connecting the battery and the inverter are loose / too long / too thin. Check the tightness and thickness of all cables and connections, check the battery voltage with a digital multimeter and charge the battery if the voltage is below 12.0V (for a 12V inverter), 24.0V (for a 24V inverter) or 48.0V (for a 48V inverter).

Low battery automatic shutdown is designed to protect your battery from excessive discharge, which can permanently damage the battery. Fully charge your battery before using the inverter again.



Note: large inverters operating at full power can rapidly discharge your battery. For example, a 12V 100Ah battery has just enough energy to support a 2000W 12V inverter operating at full power for about 10-20 min. Not all of this energy will be used, as the low voltage threshold will be quickly reached with a 2000W load (likely within 8-10 min). Use an appropriately sized battery when running the inverter with powerful loads.

If you occasionally use the inverter and would like the battery to be fully charged by the time you need to connect the inverter, consider adding a **solar charging kit** to your system. An efficient solar charger will provide a free and constant electricity supply to top-up your battery in a place where mains electricity is not available. It is silent, clean and convenient, and you do not have to spend money on fuel to recharge the battery from an engine or generator. Modern solar chargers also have a long lifespan, typically providing stable electricity output for decades. See Appendix II for more details.

4) High battery voltage protection

High battery voltage protection is designed to protect the inverter from excessive input voltage from the battery which may result from a fault of another component or a short circuit. When the battery voltage is too high, the inverter will start *beeping constantly* and the green light will switch off. Switch the inverter off, disconnect the load and disconnect the inverter from the battery. Check the battery voltage with a digital multimeter to see if it exceeds 15V (for a 12V inverter), 30V (for a 24V inverter), 60V (for a 48V inverter). Do not use the inverter until the voltage problem has been resolved.

Note: if you have a solar charging kit connected to the same battery alongside the inverter, the solar charge controller may occasionally enter an "equalisation" charging stage charging the battery with high voltage. This will trigger an overvoltage shutdown of the inverter. This shutdown is also likely to happen in cold ambient temperatures when the solar charge controller applies temperature compensation to the charging voltage.

Troubleshooting other problems

If you have another problem with your inverter, the first thing you should do is disconnect any load, switch the inverter off and disconnect it from the battery. The summary table below should help you to find the cause of the other problem:

Problem	Possible cause	Suggested solution
No AC output - the green LED light is off	Battery is discharged	Check the battery voltage with a digital multimeter at the inverter DC terminals, recharge or replace the battery
	Battery connection or cable problem	Check all connections, cable cross-section, continuity of cables and reconnect the unit to the battery
	Inverter fuses are blown	If the fuses are located outside of the inverter case, replace them by fuses with the same current rating. If the fuses are located inside the inverter case (large inverters), seek professional advice from the supplier or manufacturer of the inverter.
The remote control is not working	Distance to the inverter is too long	The distance between the inverter and the remote control is too long, or there are obstructions on the way of the signal such as walls, doors etc.
	The control battery is discharged	Replace the battery in the remote control with the same type of battery.
Voltmeter shows low AC voltage output of the inverter	Regular type of voltmeter will not show the voltage correctly	Inverters with pure sine wave output require a certain type of voltmeter to measure the voltage correctly, which are sometimes referred to as “True RMS” multimeters.
The inverter discharges my battery too quickly	Battery capacity is not adequate	Large inverters working with powerful loads will discharge your battery very quickly. Consider increasing the capacity of your battery bank and use special deep cycle batteries (see Appendix I for more details).
	Battery is too old	If the battery is old, the capacity may be low. Consider replacing your battery (see Appendix I for more details).

Maintenance

Regularly check that the connections are clean and tight and cables are not damaged. Ensure that the ventilation holes are clear.

IMPORTANT! SAFETY PRECAUTIONS!

- ***Electricity can be very dangerous! Never touch bare wires, connectors or terminals, no matter whether they are DC or AC. Do not touch ANY exposed wires or terminals even if you think it is safe.***

- ***Do not open the inverter case, or try to repair it if broken.***
- ***Avoid any contact with water. Never operate the inverter in an environment where contact with water is possible or humidity is high.***
- ***Avoid any contact with oil or grease.***
- ***Keep the inverter, cables and other components of your system away from children.***
- ***Do not connect the inverter to any other AC power source.***
- ***Do not cover the inverter. Always place it in a well-ventilated environment and allow space around the inverter for airflow.***
- ***If you operate the inverter in a moving vehicle, you must secure the inverter to prevent any movement while the vehicle is in motion.***
- ***Do not place the inverter under direct sunlight or in a high temperature environment.***
- ***Keep the inverter away from any flammable substance.***
- ***Do not use the inverter in an enclosure containing lead-acid batteries as they may vent explosive gases which can be ignited by sparks.***

Specifications

Parameter	**Value**						
Input*	12V (10-15V) DC						
Output	220-240V AC						
Output frequency	50Hz						
Output waveform	Pure Sine Wave						
THD	Less than 3%						
Surge power	2 x continuous power for less than ½ of a second[2]						
No-load current draw	150W	300W	600W	1000W	1500W	2000W	3000W
	<0.4 A		<0.6 A	<0.8A	<1.0A	<1.5A	<1.8A
Best efficiency	Approx. 90%						
Rated USB output	2A						
Low battery shutdown*	10.5 +/- 0.5V DC						
High battery shutdown*	15.5 +/- 0.5V DC						
Thermal shutdown	60 +/-5°C						
Remote control range	50m maximum in the open space (less with obstructions)						
AC output sockets	UK socket(s)						
Operating temperature	Minimum: 0ºC Maximum: 40ºC Best 15-25ºC						

*** value for 12V inverters. If your inverter is 24V use 2x, for a 48V inverter use 4x**

[2] The higher the surge power consumption, the shorter the period for which the inverter can provide surge power.

Appendix I

Battery no longer able to run your inverter for the time you need?

Choose special deep cycle AGM or Gel batteries from **Photonic Universe** for maximum inverter performance and extended discharge time

AGM Batteries

Best for large inverters with a power rating 1500W (12V) / 3000W (24V) or above.

- ✓ Absorbed Glass Mat technology
- ✓ Completely sealed, non-spillable and maintenance free
- ✓ Low self-discharge
- ✓ 3-4 years design service life
- ✓ Better recovery from deep discharge
- ✓ Faster charging up to 25A

Gel Batteries

Best for small inverters with a power rating less than 1500W (12V) / 3000W (24V).

- ✓ Electrolyte in gel form
- ✓ Completely sealed, non-spillable and maintenance free
- ✓ Very low self-discharge
- ✓ 4-7 years design service life
- ✓ Better recovery from deep discharge
- ✓ Suitable for outdoor installations and temperatures up to -10ºC

For large inverters or powerful loads we recommend a bank consisting of several AGM or Gel deep cycle batteries.

Photonic Universe
-Bringing you the benefits of solar power-

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info@photonicuniverse.com
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Appendix II

Inverter draining your battery?

Choose a 12V/24V **solar charging kit** from **Photonic Universe** for free and constant electricity supply to charge your battery

FOLDING (PORTABLE) Solar Kits

RIGID FRAME Solar Kits

SEMI-FLEXIBLE Solar Kits

Visit our online store at

www.PhotonicUniverse.com

to find out more.

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