

Close Comfort PC9 Backup Power Principles.



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The Close Comfort PC9 air conditioner is a self-contained and extremely low power consumption air conditioner. As it consumes only 300W of power it can be used with backup power systems like household battery-inverter units. In this technical note, we explain some of the basic principles used in providing back-up power from batteries and solar panels.

TABLE OF CONTENTS

BASIC PRINCIPLES	2
Inverter	2
Waveform Pattern	2
UPS – Uninterruptible Power Supply	3
Solar Power Inverter	4

Basic Principles

First we need to explain some basic principles used for providing backup power using batteries and solar power.

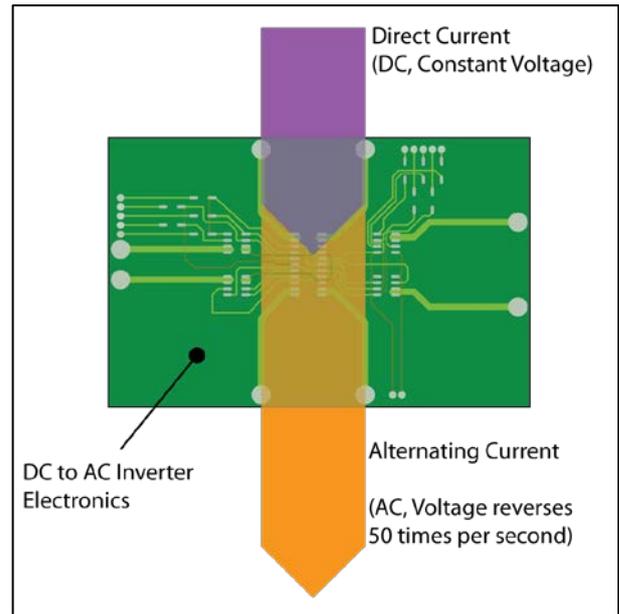
Inverter

An inverter is an electronic device that converts direct current (DC, constant voltage) electric power, such as power from a battery, into alternating current (AC, varying voltage) electric power.

Direct current (DC) is the way that electric power is provided batteries and solar panels. One wire or terminal is labelled **+** (positive, usually red wire) and the other one **-** (negative, usually black wire). Usually the battery voltage is 12 Volts or 24 Volts. Small batteries have lower voltage values, such as 1.5 Volts for common AA or AAA cells.

Alternating current (AC) is the way that mains power is provided for your home or office. One wire is labelled **A** (active, usually brown) and the second **N** (neutral, usually blue), and the third **E** (earth, usually green and yellow).

The standard AC power voltage in most countries is 230 Volts, and it alternates 50 times per second (50 Hz). However many countries have different standard voltages and frequencies. For example, in the USA, Canada, Japan and most of South America the AC standard is 115 Volts, 60 Hz.



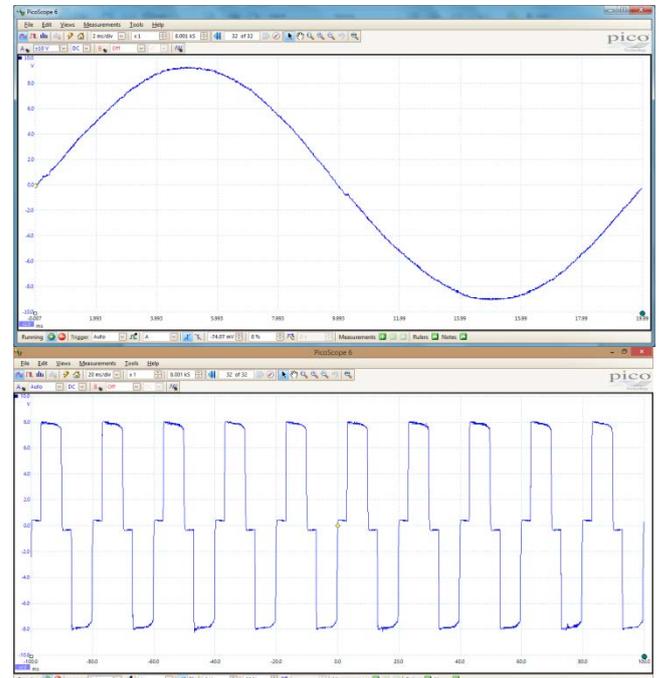
Waveform Pattern

There are different patterns of AC voltage fluctuation produced by different inverters.

Here (to the right) is a sine wave pattern of voltage fluctuation – it looks like a smooth curve. The graph shows only one cycle which is 20 milliseconds from start to finish.

The second graph (to the right) shows a square wave pattern of voltage fluctuation. The graph shows 10 cycles and is 200 milliseconds from start to finish.

Square wave inverters are cheaper and sometimes can be more energy efficient.



UPS – Uninterruptible Power Supply

A UPS is used in places where there are frequent interruptions to the main power supply.

Also known as a “UPS inverter”, this device incorporates an inverter and battery management electronics.

The diagram shows how a UPS works when the main power supply is working.

The UPS connects the main power to the air conditioner (and other household appliances not shown in the diagram such as low power lights, LED or fluorescents, and maybe a fan).

Some of the power from the main power supply is converted to direct current (DC) and charges the battery connected to the UPS.

When the main power supply is interrupted, the UPS automatically starts drawing DC power from the battery and converts it to AC power for the air conditioner using its built-in inverter, as shown in the lower diagram.

The capacity of the UPS is usually given in Watts and VA (Volt-Amps). The VA rating is always higher than the Watts rating, usually by about 40-60%. We recommend a UPS with a capacity of at least 1200 Watts (2000 VA). However, many smaller UPS models can be used.

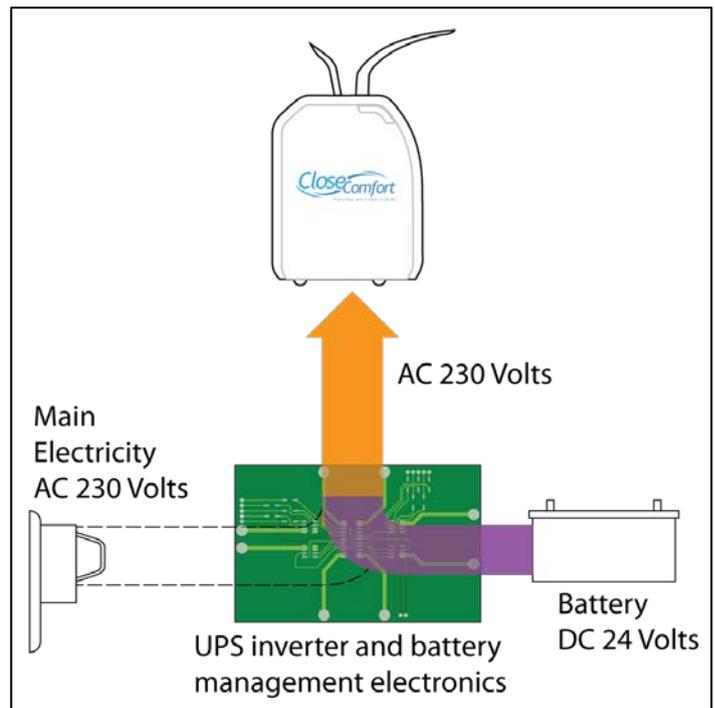
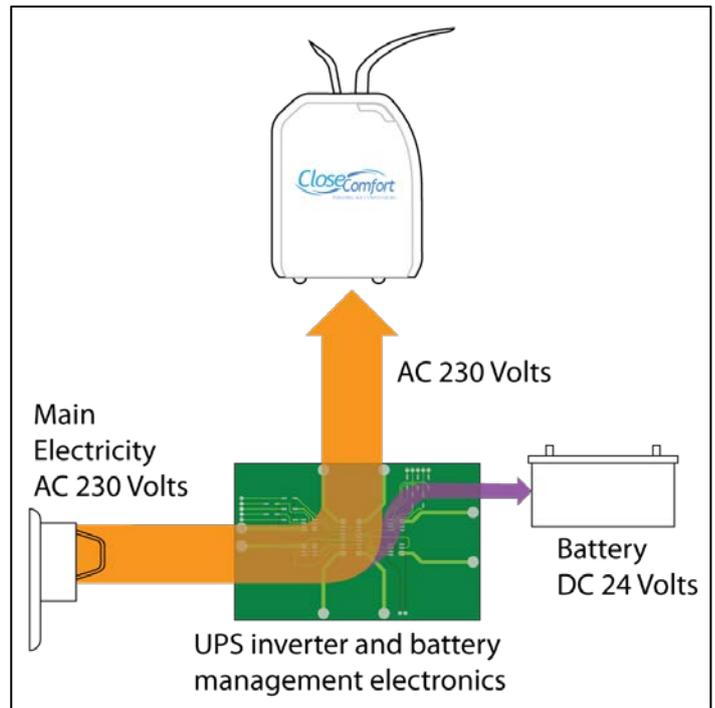
Why?

When the air conditioner compressor starts running about 90 seconds after opening the shorter cover flap, the instantaneous AC current needed to start the compressor is about 7 Amps, equivalent to an input power of 7×230 Volts or about 1600 Watts.

However, this input power is only needed for about 20-40 milliseconds.

Most UPS models will tolerate an overload for a short time. However, each model is different. We have found that some UPS models rated at 600 Watts (or 1000 VA) allow the compressor to start, whereas other models rated at 1000 Watts (or 1500 VA) trip out when starting the compressor.

Therefore you need to test your UPS unit with an air conditioner and perhaps some lights as well to make sure it will start your air conditioner satisfactorily.



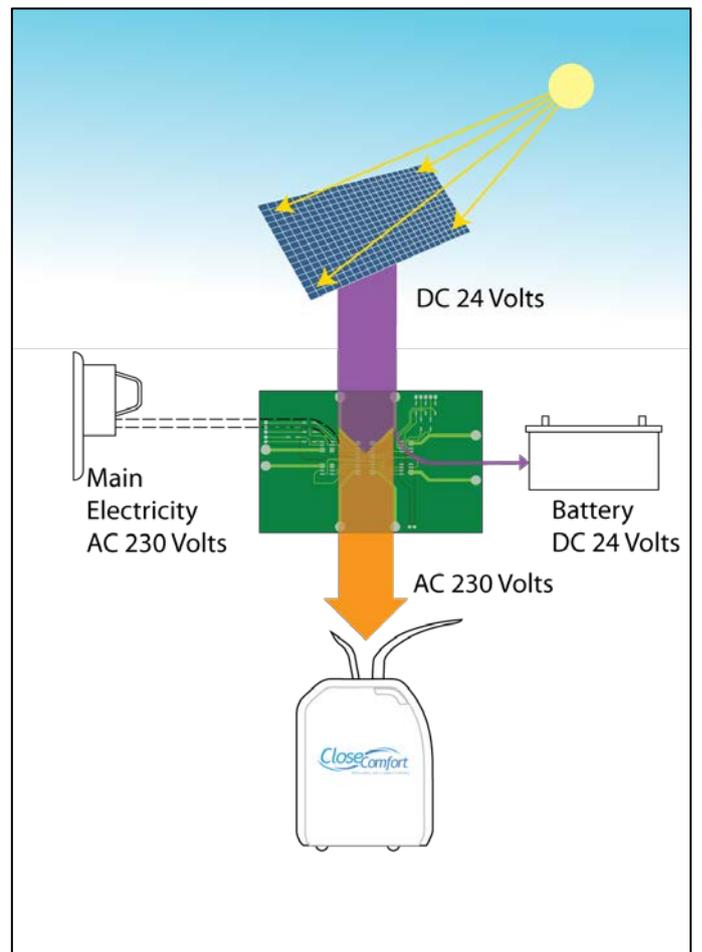
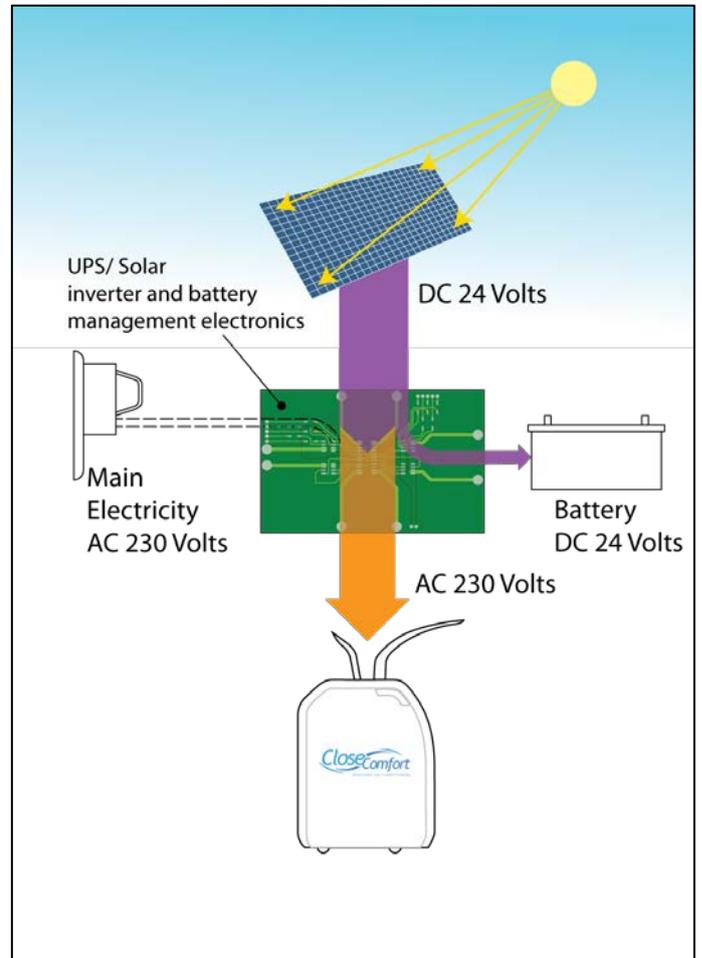
Solar Power Inverter

A solar power inverter enables the air conditioner to be run from a battery or solar panel. The inverter has a battery management system that monitors the battery charge automatically.

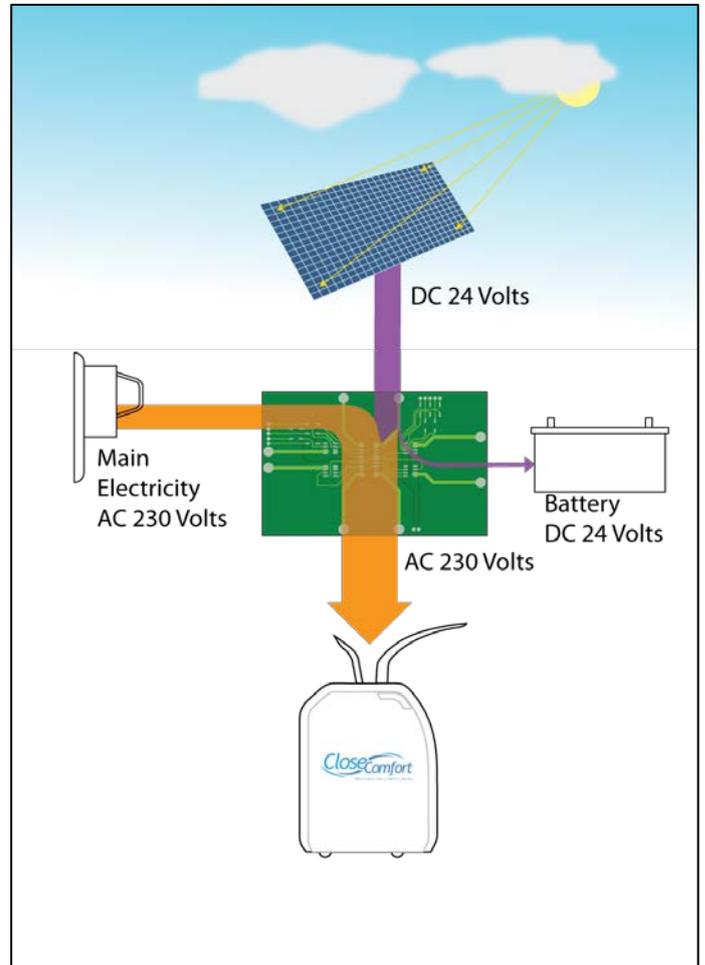
The first picture here shows how power from the solar panel operates the air conditioner and charges the battery during the day when the sun is shining.

When the battery is fully charged, the inverter reduces the current going to the battery as shown in the bottom diagram. This current is just sufficient to maintain the full charge in the battery. Most UPS models incorporate a similar feature.

Small solar systems provide 24 Volt power as shown. Medium and large scale solar systems provide much larger DC voltages, up to 600 Volts, depending on the size of the system.

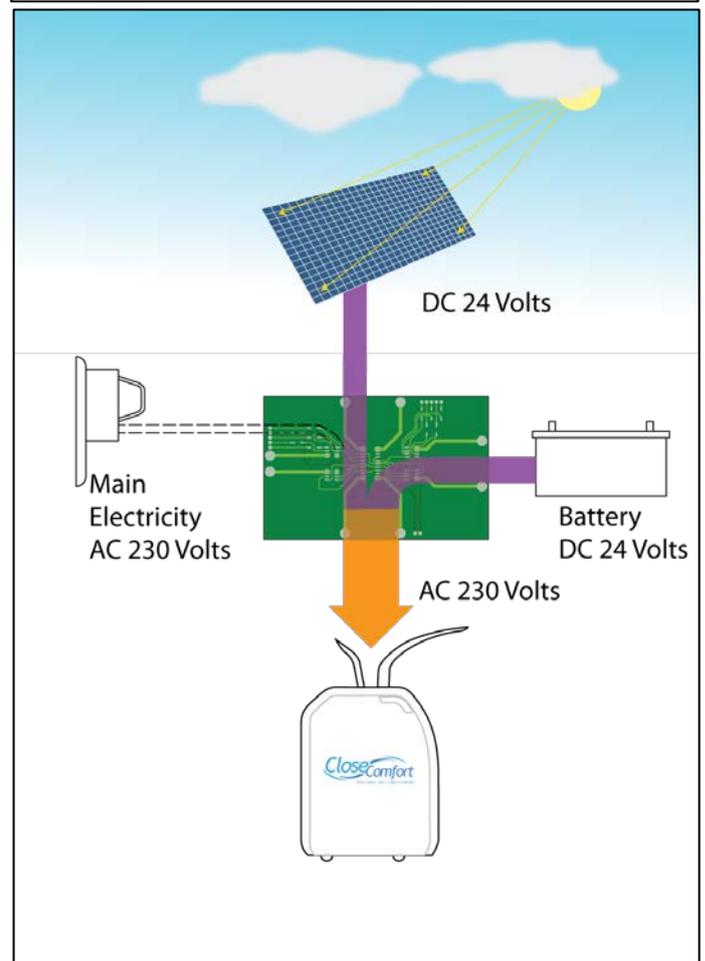


During cloudy weather or when the sun does not shine directly on the panel, less power is generated by the panel. The solar inverter automatically uses the main electricity supply to make up for the reduction in solar power.



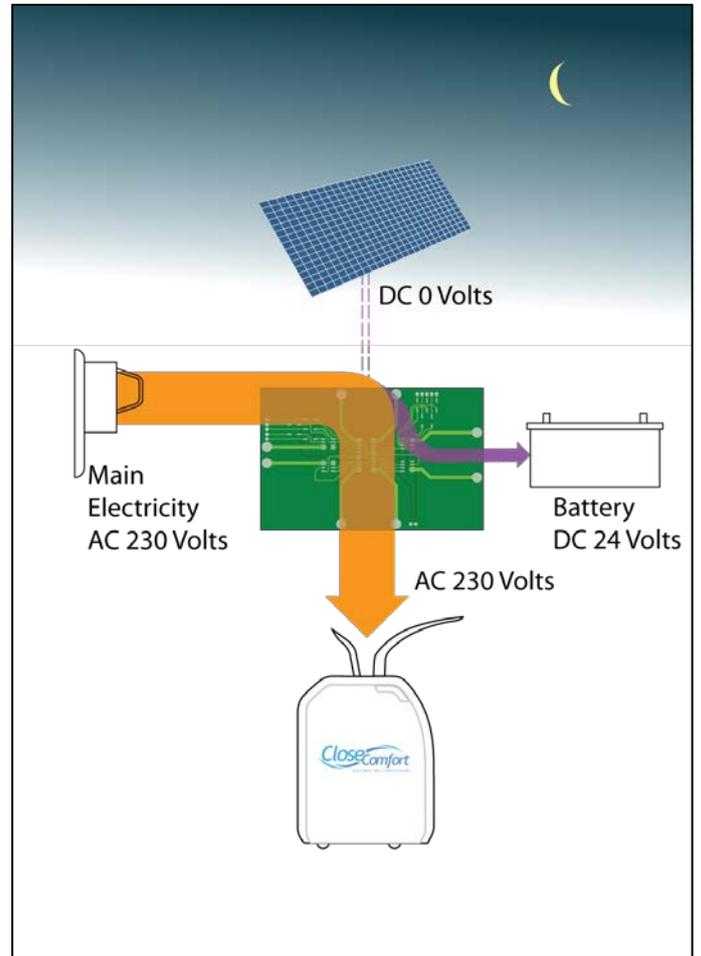
During mains power interruptions, the solar inverter automatically draws power from the battery to make up for the reduced solar power available.

Note that most inverters sold in Australia *do not* operate through mains power interruptions. However, specialist companies provide so-called "off grid" solar power supplies that do not require an active mains power connection.



At night time when there is no solar power, the solar inverter uses mains power to run the air conditioner and also to top up the battery charge when needed, like a UPS.

Some inverters can be programmed to take advantage of cheaper off-peak electricity tariffs so they charge the batteries using as much off-peak power as possible.



During mains power interruptions, the solar inverter draws power from the battery like a UPS to keep the air conditioner running.

As above, please note that most inverters sold in Australia *do not* operate through mains power interruptions. However, specialist companies provide so-called “off grid” solar power supplies that do not require an active mains power connection.

