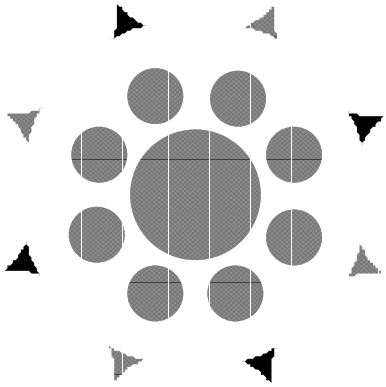

**p**ower **s**olutions **a**ustralia

# grid battery interactive sinewave inverter

# Introduction

Power Solutions Australia Grid Interactive Inverters provide a means of directly connecting dc renewable sources such as solar photovoltaic arrays and small wind turbines to the electricity grid. Grid connection ensures that all renewable energy generated can be utilised. Surplus energy not used locally is exported to the grid to other electricity users.

Systems without batteries operate only when renewable inputs and the grid supply are present but do not supply local load if the grid fails.

Systems with batteries can operate in one of several configurations:

- Without local load output, the inverter starts and synchronises to the grid when renewable input becomes available and shuts down when renewable too small to justify operation. This is useful to interface a wind turbine to the grid where the battery provides buffer storage against wind gusts and limits maximum DC input.
- With local load supplied from the grid during normal operation. If the grid fails, the inverter disconnects and local load can be supplied from the battery.
- With local load supplied from the grid and renewables during normal operation. If the renewables exceed local load excess power is exported, if they are less than local load the shortage will be supplied from the grid. If the grid fails the inverter disconnect from the grid, local load can be supplied from the battery and from renewable input. The battery will discharge if renewables are less than local load and be charged when they exceed local load.
- Reliable Power Solutions provide guaranteed supply should the grid fail, a generator is connected which automatically starts if the grid fails and the battery is discharged. It will shutdown when the battery is recharged, the grid is restored or if not required to support the load.

These modes provide flexible options to configure systems to meet differing customer requirements.

An alpha numeric LCD display allows inverter variables to be displayed and allows suitably qualified technicians to adjust operating parameters to optimise system performance.

Hardware and software provide electronic protection against most types of abuse. The inverter is fully self-resetting against all recoverable fault conditions, for example if the generator fails to start and the load persists the inverter shuts down before damage to the batteries occurs. If renewable inputs recharge the battery to a reasonable level the system will then restart automatically.

Data logging operates continuously in the inverter to record power, voltage temperature and current variables. Most variables are averaged over 15 minute periods but minimum and maximum values of selected variables during each 15 minute period are also recorded. Data covering up to 8 days of testing is stored in non-volatile memory in the inverter.

A single day of data or all stored data can be retrieved over a serial link or remotely via a modem or via sat phone. The oldest day's data is automatically cleared and overwritten as each new day of logged data is added. There is no need to clear logged data from the inverter. Remote monitoring and analysis of data allows performance to be monitored and problems anticipated. Remote diagnosis allows remote units to be fixed in a single visit and allows expert staff to assist with systems anywhere in the world.

An IBM compatible PC program is provided which converts logged data from the inverter into spreadsheet format and extracts event records. This records the times when units start, start and stop the generator or change mode as well as other events associated with inverter operation including protective actions. The data can be graphically displayed by copying it into a pre-prepared spreadsheet.

# Normal Operation: Grid Battery, no local load

## Inverter Self Test

The inverter performs a self-check as it starts up. During the self test all the LED indicators on a module flash. Only if no faults are detected will the inverter start. Normal operation is indicated by steady illumination of the top green indicator light.

A flashing green indicator at the top indicates the self-test has detected a fault and the inverter will be not able to start. If the top green indicator is flashing record the pattern of indicators that are illuminated and advise your supplier.

## Automatic Startup

The inverter is set up to start automatically when grid supply is present and when renewable inputs bring the battery voltage up to just above the charge voltage setting. The inverter will then synchronise and hold the battery at the charge voltage for the charge time before dropping the voltage to the float voltage setting. Apart from power required to hold the battery at charge voltage (or float voltage) the renewable power will be exported to the grid. Since the battery is normally in a good state of charge and losses are low at float voltage good efficiency can be achieved with appropriate voltage settings.

## Automatic Shutdown

When the renewable input falls the inverter automatically shuts down when the power exported falls to zero averaged over two minutes.

## Battery Management

The battery is held at charge voltage immediately after synchronisation for the charge time and until the charge power into the battery falls indicating a good state of charge is achieved. After this time the voltage changes to the float voltage, which is held until the inverter disconnects for an extended period. Charge and float voltages can be set through the LCD and should be set low to minimise losses. Since this voltage is held for long periods the battery can be charged at a low rate to maintain a good state of charge.

Once every two weeks (alternate times can be set through the LCD) the system will initiate a boost charge. The battery voltage will be raised to the Boost voltage. Boost voltage will be held for the Boost Time (as set on the LCD) before the voltage is reduced back to float voltage. During boost the inverter will not disconnect from the grid ensuring that if renewable input disappears during boost the boost charge will still be completed.

# Normal Operation: Grid Battery, local load

## Inverter Self Test

The inverter performs a self-check as it starts up. During the self test all the LED indicators on a module flash. Only if no faults are detected will the inverter start. Normal operation is indicated by steady illumination of the top green indicator light.

A flashing green indicator at the top indicates the self-test has detected a fault and that the inverter will not be able to start. If the top green indicator is flashing record the pattern of indicators that are illuminated and advise your supplier.

## Startup

The inverter will start provided the battery state of charge is reasonable or if grid supply is present and in tolerance. If grid supply is present. the inverter will synchronise and raise the battery to the charge voltage for the charge time before dropping the voltage to the float voltage setting. Apart from power required to hold the battery at charge voltage (or float voltage) and to meet local loads the renewable power will be exported to the grid. Since the battery is normally in a good state of charge and losses are low at float voltage good efficiency can be achieved with appropriate voltage settings.

## Mains Failure

Should the mains fail the inverter will disconnect and continue to supply the load provided the battery charge level stays above the shutdown level

## Shutdown & Restart

If the battery becomes discharged while mains power is off, the inverter will shut down until the renewable input recharges the battery or until the mains is restored

## Battery Management

The battery is held at charge voltage immediately after synchronisation for the charge time and until the charge power into the battery falls indicating a good state of charge is achieved. After this time the voltage changes to the float voltage, which is held until the inverter disconnects for an extended period. Charge and float voltages can be set through the LCD and should be set low to minimise losses. Since this voltage is held for long periods the battery can be charged at a low rate to maintain a good state of charge.

Once every two weeks (alternate times can be set through the LCD) the system will initiate a boost/equalisation charge. The battery voltage will be raised to the Boost voltage. Boost voltage will be held for the Boost Time (as set on the LCD) before the voltage is reduced back to float voltage.