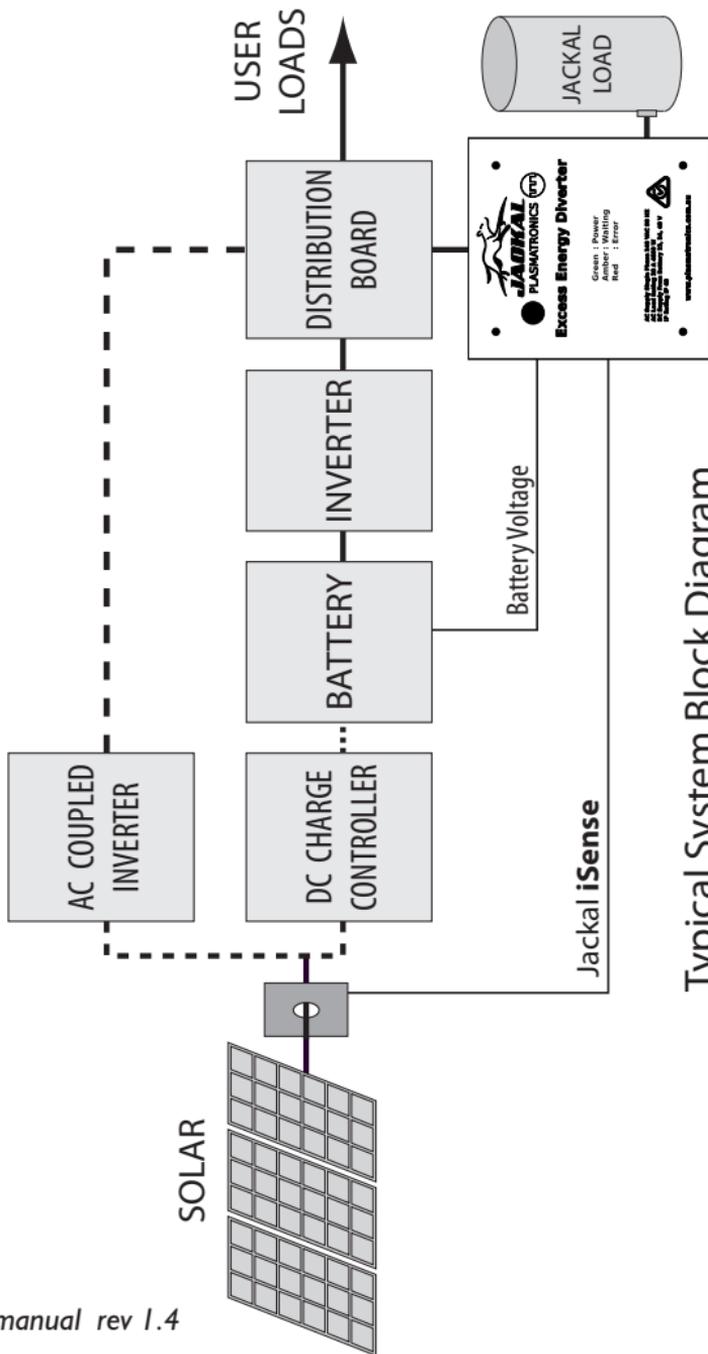




# JACKAL

## Manual





Typical System Block Diagram

## Description

The Plasmatronics Jackal is a power controller for use with battery based electrical systems that have a 12/24/48V battery and an inverter. It detects when there is excess charging energy available, not needed by the battery, and sends that energy to a resistive heating load. The Jackal is connected between the inverter and the heating load. It uses solid state switching technology to control the amount of power delivered to the load. It also has a battery connection to supply operating power and measure battery voltage. There is a Hall Effect, non contact current sensor (Jackal iSense) for sensing solar charging current(s).

## System requirements

- 12/24/48V battery with a charging system that sometimes can supply more energy than the battery needs.
- A charge control system. Can be PWM, MPPT, or AC Coupled.
- A 220-240V inverter for user loads. It must have enough spare capacity to easily drive the load. The nominal inverter power rating should be at least twice the rated power of the load. The inverter can be square wave, sine wave or modified sine wave, but must run at 50Hz nominal.
- A dedicated 220-240V resistive heating load. The power rating should be half the inverter rated power or less. It **must** have a mechanical thermostat. Nominal

power 4800W max.

## **Installation**

Caution! The Jackal can energise the load output at any time. Isolate the inverter before removing the cover or carrying out wiring work. Every time!

All wiring must be in accordance with AS/NZS 3000 wiring rules.

Installation must be carried out by a licenced electrician.

## **Mounting**

Mount the Jackal indoors on a vertical surface in free air. The fins on the heat sink must be vertical.

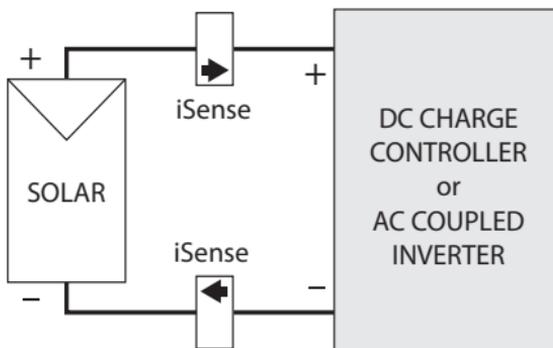
## **Wiring**

The circuit from the inverter must have a circuit breaker appropriately sized for the load and all wiring, typically in the distribution board. Select the wire size to suit the nominal load current. The battery connection must have a dc rated circuit breaker or fuse with a current rating chosen to protect the battery wiring to the Jackal. The battery current draw is 150mA max. We suggest at least 1mm<sup>2</sup> wire and a 0.5A fuse. Make the 230V connections first. The Jackal has provision for active, neutral and earth connections for both inverter (line) and load. The Jackal must be earthed even if the load has no provision for earthing. The battery connection is via a plug-in screw terminal. Unplug the terminal, wire it up, then plug it in. Replace the cover before energising. Some systems

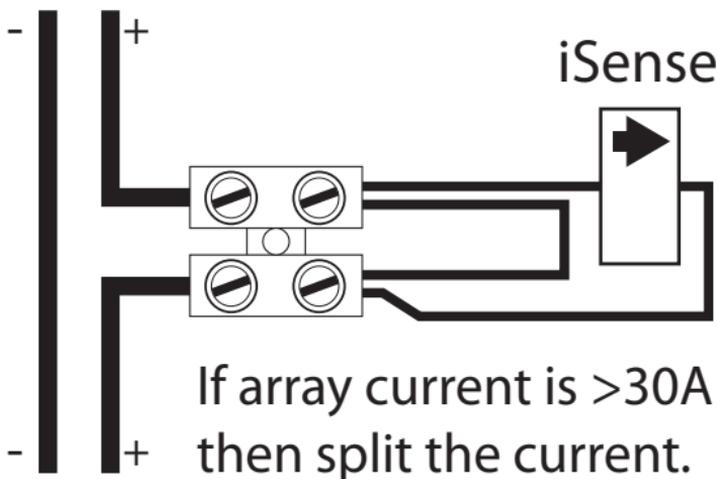
require fitting of a solar current sensor (Jackal iSense) or a cable to receive the float/ constant voltage command (see **Mode Selection**). These are fitted to the bus socket. The iSense can measure 30A max. It does not need to measure all the array current. A sample is enough.

If the array current is over 30A, wire two or more parallel paths and pass only one through the iSense.

Similarly with more

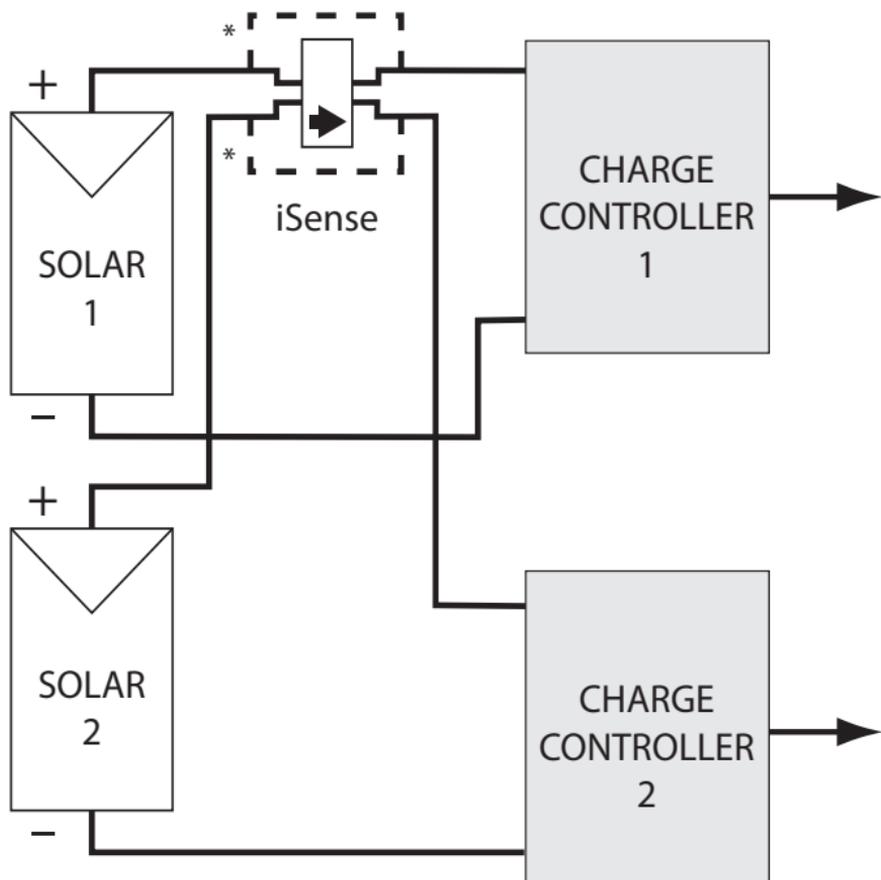


Jackal **iSense** position options



than one array, pass one wire from each array through the iSense. Again, if the total is over 30A, wire parallel runs and pass one from each array through the iSense.

\*Current split required if total current >30A



Jackal **iSense** connection for 2 arrays

## **Mode Selection**

### **1. Current sense mode.**

This senses the PV array current and uses the information to detect when there is excess PV power available (Power not needed by the battery). To use this mode, plug in the iSense and install it in the PV wiring close to the charge controller/inverter input. Pay particular attention to current flow direction. This is the mode to use if you have a PWM or MPPT DC coupled charge controller.

### **2. Frequency shift mode.**

Some AC coupled systems use frequency shift to control how much energy the array inverter delivers to the system. In this mode, the Jackal senses the frequency shift and uses it to detect when there is excess PV power available (Power not needed by the battery). To use this mode, simply do not plug anything into the bus socket. Use this mode only for AC coupled systems that use frequency shift control.

### **3. Constant voltage mode.**

This is a fall back mode for systems that are not covered by the other two modes. The Jackal functions like a diversion/shunt regulator and maintains the battery at a constant voltage of 13.7, 27.4 or 54.8 for 12, 24, or 48V systems respectively. Typically used for AC coupled systems that do not use frequency shift control. To use this mode get a Jackal CVM kit.

## **Element sizing**

The inverter must have enough power to drive both the daytime user load and the Jackal load. So a large total load power means you need a large inverter. Since the Jackal can only deliver the power that is not wanted by the battery, the maximum delivered power is set by the size of the energy source. It makes sense to choose a load power that matches the source power. This can mean the inverter doesn't need to be as large and so the Jackal can give smoother control. For example, for a 1.5kW solar array and an existing 4.8kW hot water tank element, it may make sense to change the tank element for a lower power one, say 2.4kW or even 1.2kW. The result will be smoother operation of the Jackal and a saving in inverter size without any loss of power to the load.

## **Change-over/ bypass switch**

For some loads, it may be desirable to have a bypass arrangement to turn the load on fully even when the battery does not have excess energy available. For this, wire a suitably rated switch between the inverter and load circuits (i.e. between the two active terminals of the Jackal). A change-over switch can be used to drive the load from an alternative energy source. This can be a manual switch or a suitable change-over relay arrangement. For example a generator may drive the load directly when it is running, or the load may be switched to mains supply during off peak times.

## Commissioning

When battery power is first applied to the Jackal, it runs a testing and commissioning program as an aid to installers. The sequence is as follows:

### Power ON:

#### Firmware version

The firmware version information is stored as a 2 digit number. The Jackal shows this number by giving a number of *AMBER* flashes to show the first digit followed by a number of *GREEN* flashes to show the second digit. For example, 4 *AMBER* flashes followed by 2 *GREEN* flashes shows firmware version 42.

#### Commissioning Test

The Jackal now does an output test to allow testing of the wiring to the load. It supplies about 13% of full power for 3 minutes. During this time the LED flashes rapidly (about 40mS on followed by 40mS off). The colour shown gives information about which excess energy detection mode is being used.

**Green** = iSense present. Current mode active

**Amber** = “Float” contact detected. Constant voltage mode active

**Red Fast** = No iSense or “float” contact detected. Frequency mode active

**Red Slow** = Error, see Operation (often no AC input)

## On To Normal Operation

Once the commissioning test has run for three minutes, the Jackal will start normal operation.

## Warranty

In addition to all legally required warranties. The Jackal is covered by a 5-year warranty on function for anything that was our fault, at our discretion.



## Specifications

<b>AC Supply:</b>	Off grid inverter only (not mains) permanently wired
<b>Output Power:</b>	0-100% of load rated power, variable
<b>Load:</b>	Pure resistive, with mechanical thermostat and OTP
<b>Control Method:</b>	Synchronous zero crossing burst fire
AC voltage	220-240Vac
AC frequency	50Hz nominal
Battery Nominal Voltages	12,24,48Vdc
Battery voltage allowable working range	10V-60Vdc
Maximum Power:	4800W
Load:	4.8kW max.
Battery voltage absolute max. short term	75Vdc
Maximum AC current	20A
Maximum battery draw:	150mA
Typical battery draw (no bus accessories)	12mA
AC wire entry size (Strip length 9mm)	10 mm <sup>2</sup>
DC wire entry size	0.2-2.5mm <sup>2</sup>
Wiring access: conduit holes (1- dc, 2 - ac)	3 X 20mm
Ambient operating temperature range:	-20 / +50 °C
Current sensor (Jackal iSense) range	0-30A
Dimensions: (as mounted)	176W X 150H X 93D mm

## Operation

When the battery can take all the available power, the Jackal monitors the situation and sends no energy to the load. When excess power becomes available, the Jackal detects this condition and sends only the energy that the battery can't use to the load. The source continues delivering as much energy as it can, the battery gets what it can use and whatever it can't use is delivered to the jackal load via the inverter and the Jackal.

## LED Interface Normal Operation

### AMBER - Waiting

#### Single pulses

When the battery is below the minimum Jackal start voltage, the Jackal takes no power. It gives repeated single short AMBER flashes on the LED

#### Double pulses

When the battery is above the start voltage but there is no excess energy to scavenge, the Jackal gives repeated, short, double AMBER flashes.

### GREEN - Power

#### Flashing

When the Jackal is delivering power, it flashes GREEN. The flash rate shows the power level. Faster flashing - more power

#### Nearly Constant

Maximum power is shown by nearly constant GREEN with short off pulses.

### RED - Error

**One pulse** - No AC input detected. 

**Two pulses** - Over temperature. 

**Three pulses** - System error. 