



REDBACK

TECHNOLOGIES

Installation and operators manual



Smart Hybrid Solar Inverter System

Grid-tie Solar Inverter System with utility backup
AC output and energy storage capability

Contact information: Redback Technologies

Telephone: 1300 240 182
(+61) 7 3346 0723

Address for correspondence: PO BOX 1059, Indooroopilly, QLD 4068, Australia

Address for visitors: Building 1015, 80-120 Meiers Road
Indooroopilly, QLD 4068, Australia

Email: info@redbacktech.com
warranty@redbacktech.com

Website: www.redbacktech.com

Contact information: ZEN Energy

Telephone: 1300 936 466

Address for visitors: Sustainable Industries Education Centre (SIEC)
TAFE SA
Building 5, Level 2, Suite 5.2.1
1284 South Road
CLOVELLY PARK SA 5042

Email: techsupport@zenenergy.com.au

Website: www.zenenergy.com.au

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Important safety instructions

READ AND SAVE THESE INSTRUCTIONS

This document contains important safety instructions for the products produced by Redback Technologies. Read all instructions and cautionary markings on the product and on any accessories or additional equipment included in the installation. Failure to follow these instructions could result in severe shock or possible electrocution. Use extreme caution at all times to prevent accidents.



Audience




These instructions are for use by qualified personnel who meet all local and governmental code requirements for licensing and training for the installation of electrical power systems with AC and DC voltage up to 600 volts. Installation, maintenance, and connection of inverters must be performed by qualified personnel, in compliance with local electrical standards, wiring rules, and the requirements of local power authorities and/or companies (For example: AS 4777 and AS/NZS 3000 in Australia).

The Smart Hybrid Solar Inverter System of Redback Technologies strictly conforms to related safety rules in design and test.

Safety regulations relevant to the location shall be followed during installation, operation and maintenance. Improper operation may have a risk of electric shock or damage to equipment and property.

Symbols used

Symbol	Definition
	WARNING! Hazard to human life This type of notation indicates that the hazard could be harmful to human life.
	WARNING! Burn hazard Danger of hot surface!
	CAUTION! Hazard to equipment This type of notation indicates that the hazard may cause damage to the equipment.
	Components of this product can be recycled.
	This side up. The package must always be transported, handled, and stored in such a way that the arrows always point up.
	No more than six (6) identical packages may be stacked on each other.

Symbol	Definition
	Product should not be disposed as household waste.
	The package/product should be handled carefully and never be tipped over or slung.
	Keep dry. The package/product must be protected from excessive humidity and must be stored under cover.
	CE Mark
	Signals danger due to electrical shock and indicates the time (5 minutes) to allow after the inverter has been turned off and disconnected to ensure safety in any installation operation.
	IMPORTANT This type of notation indicates that the information provided is important to the installation, operation and/or maintenance of the equipment. Failure to follow the recommendations in such a notation could result in annulment of the equipment warranty.
General safety	
	WARNING: Limitations on use This equipment is NOT intended for use with life support equipment or other medical equipment or devices.
	CAUTION: Equipment damage Only use components or accessories recommended or sold by Redback Technologies or its authorized agents.
	IMPORTANT Do not attempt to install this equipment if it appears to be damaged in any way. See the Warranty section for instructions on returning the equipment.

Personal safety

WARNING: Personal injury



- Use safe lifting techniques when lifting this equipment as recommended by the Occupational Safety and Health Association (OSHA) or other local codes.
- Use standard safety equipment when working on this equipment, such as safety glasses, ear protection, steel-toed safety boots, safety hard hats, etc.
- Use standard safety practices when working with electrical equipment. (Remove all jewelry, use insulated tools, wear cotton clothing, etc.)
- Never work alone when installing or servicing this equipment. Have someone nearby that can assist if necessary.
- Do not touch the inverter during operation. The temperature of some parts of the inverter may exceed 60°C during operation. Let it cool for at least 5 minutes after shutdown before touching it.
- Ensure that children, pets and other animals are kept away from the inverter, solar arrays, battery bank and utility grid components.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Equipment safety

WARNING: Lethal voltage



- Review the system configuration to identify all possible sources of energy. Ensure ALL sources of power are disconnected before performing any installation or maintenance on this equipment. Confirm that the terminals are de-energized using a validated voltmeter (rated for a minimum 1000 Vac and 1000 Vdc) to verify the deenergized condition.
- Do not perform any servicing other than that specified in the installation instructions unless qualified to do so, or have been instructed to do so by Redback Technologies Technical Support personnel.
- Solar arrays can be energized with minimal ambient light available. To ensure a safe disconnect from the system, install a high voltage DC rated disconnect, breaker, or accessible fuse box (depending on local code requirements).
- To avoid electric shock, disconnect the DC input and AC input of the inverter at least 5 minutes before performing any installation or maintenance.
- Completely disconnect all sources of power before proceeding with any maintenance. Do not open the upper inverter compartment of the system!
- Do not tighten the AC and DC terminals or pull on the AC and DC wiring when the inverter is running.

WARNING: Burn hazard



External and internal parts can become hot during operation. Do not remove the cover during operation or touch any internal parts. Be sure to allow sufficient time for internal parts to cool down before attempting to perform any maintenance.

WARNING: Fire hazard

- Do not keep combustible or flammable materials in the same room with the equipment. Some products contain relays with moving parts and are not ignition-protected.
- Ensure AC, DC, and ground cable sizes conform to local codes. See product manuals for minimum size requirements. Ensure all conductors are in good condition. Do not operate the unit with damaged or substandard cabling.

CAUTION: Equipment damage

- When connecting cables from the inverter to the battery terminals, ensure the proper polarity is observed. Connecting the cables incorrectly can damage or destroy the equipment and void the product warranty.
- Thoroughly inspect the equipment prior to energising. Verify that no tools or equipment have been inadvertently left behind.
- Ensure clearance requirements are strictly enforced. Keep all vents clear of obstructions that can prevent proper air flow around, or through, the unit.
- Sensitive electronics inside the equipment can be destroyed by static electricity. Be sure to discharge any static electricity before touching the equipment and wear appropriate protective gear.

CAUTION: Equipment damage

- Do not open the upper front cover of the inverter. Apart from performing work at the wiring terminals (as instructed in this manual), touching or changing components without authorisation may cause injury to people, damage to the inverter and annulment of the warranty.
 - Static electricity may damage electronic components. Take appropriate steps to prevent such damage to the inverter; otherwise the warranty may be annulled.
 - Ensure the output voltage of the proposed solar array is lower than the maximum rated input voltage of the inverter; otherwise the inverter may be damaged and the warranty annulled.
 - Solar modules should have an IEC61730 Class A rating.
-

Battery safety

WARNING: Explosion, electrocution, or fire hazard

Ensure that all cables are properly sized.

Ensure clearance requirements are strictly enforced around the batteries.



Ensure the area around the batteries is well ventilated and clean of debris.

Never smoke, or allow a spark or flame near, the batteries.

Always use insulated tools. Avoid dropping tools onto batteries or other electrical parts.

Never charge a frozen battery.

If a battery must be removed, always remove the grounded terminal from the battery first. Make sure all devices are de-energized or disconnected to avoid causing a spark.

IMPORTANT

Use the battery types recommended by Redback Technologies. Follow the battery manufacturer's recommendations for installation and maintenance.

Insulate batteries appropriately against freezing temperatures. A discharged battery will freeze more easily than a charged one.



If a remote or automatic generator control system is used, disable the starting circuit and/or disconnect the generator from its starting battery while performing maintenance to prevent accidental starting.

Wear complete eye and clothing protection when working with batteries. Avoid touching bare skin or eyes while working near batteries.

Keep plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.

If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters the eye, immediately flush it with running cold water for at least 20 minutes and get medical attention as soon as possible.

Introduction

The Redback Smart Hybrid Solar Inverter System enables the connection of two solar arrays, a battery bank, utility grid and provides backup power for AC loads in a simple, yet high performance, smart energy system. The energy produced by the solar array is automatically directed to the battery, utility grid, and/or the AC loads depending on operating conditions for the highest performance and best economic return. The system's goal is to maximise the use of the solar energy generated while minimising the amount of energy consumed from the utility. The backup / UPS functionality enables users to have continued supply of electricity in the event of a utility power outage.

The Redback Smart Hybrid Solar Inverter System includes all of the following functions, components and features in an easy-to-install single product.

Functions

- High efficiency grid-tie utility interactive inverter
- Utility grid energy metering system
- Powerful backup inverter for AC loads
- Utility powered battery charger
- Solar array Maximum Power Point Tracker (MPPT)
- Solar array charge control
- Solar array ground fault and insulation monitoring protection
- Programmable smart hybrid system controller
- Performance monitoring with wifi and web interface

Features

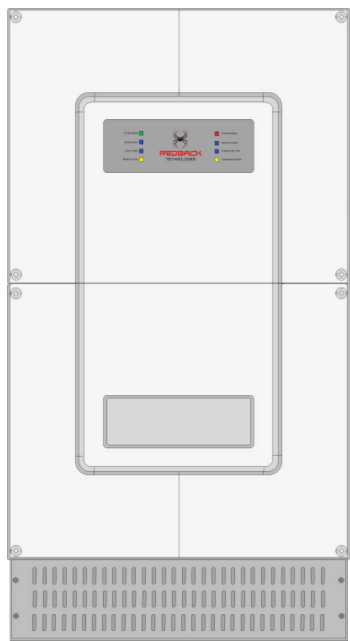
- Utility grid overcurrent protection and disconnect
- Battery overcurrent protection and disconnect
- Individual solar array disconnects
- AC backup loads overcurrent protection and disconnect
- AC backup loads residual current disconnect
- AC backup loads manual bypass switch
- Outdoor, weatherproof enclosure (IP65)

Limitations

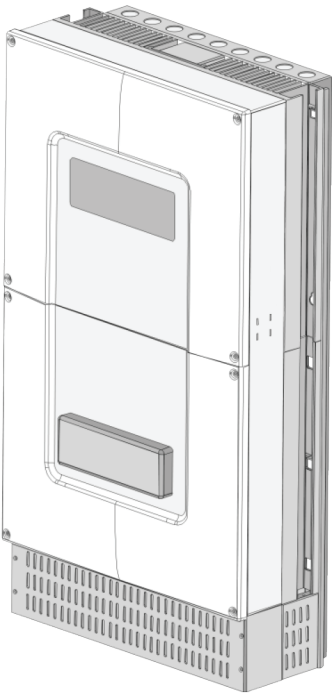
The following limitations apply to ensure the safe operation of this system.

Maximum Solar Array Voltage	550 volts DC open circuit under coldest expected conditions
Maximum Solar Array Current	11 amps DC short circuit under hottest expected conditions
Maximum Battery Voltage	60 volts DC when battery is being charged
Maximum Ambient Temperature	Keep the system below 45°C for full power rating (4600 W). At 60°C ambient temperature the inverter will shut off to self-protect.
Maximum AC Current Draw from Utility	40 amps AC at 230 Vac (protected from overloading by an included AC circuit breaker)

Figure 1 Redback Smart Hybrid Solar Inverter System



Inverter (front view)



Inverter (side view)

Planning

Backup AC loads

The Smart Hybrid Solar Inverter System is capable of providing up to 4600 watts of continuous AC power for AC loads which are connected to the backup loads AC output connections. The system can provide a maximum of 6900 watts of AC power for up to 10 seconds in order to start loads which require a higher amount of power initially. The output of the inverter is reduced if the ambient temperature exceeds 45°C and the system will shut off if the ambient temperature exceeds 60°C.

Figure 2 shows examples of AC loads that can be connected to the backup AC load circuit.

Figure 2 Examples of acceptable backup AC loads

Examples of **ACCEPTABLE** AC loads to connect to the Back-up AC load circuit:

- Small plug-in appliance such as cookers, microwaves, TV, radios, computers
- Lighting (compact fluorescent or LED recommended)
- Refrigerators and freezers



Figure 3 Examples of unacceptable backup AC loads

Examples of **UNACCEPTABLE** AC loads not to connect to the backup AC load Circuit:

- Water heaters
- Air-conditioners
- Electric cooktop ranges or oven
- Hot tubs/saunas
- Air compressors



Inverter operating modes

The Smart Hybrid Solar Inverter system automatically switches operating modes depending on the amount of solar energy produced, AC loads operating, utility grid presence, time of day, and the state-of-charge of the battery. There are six operating modes:

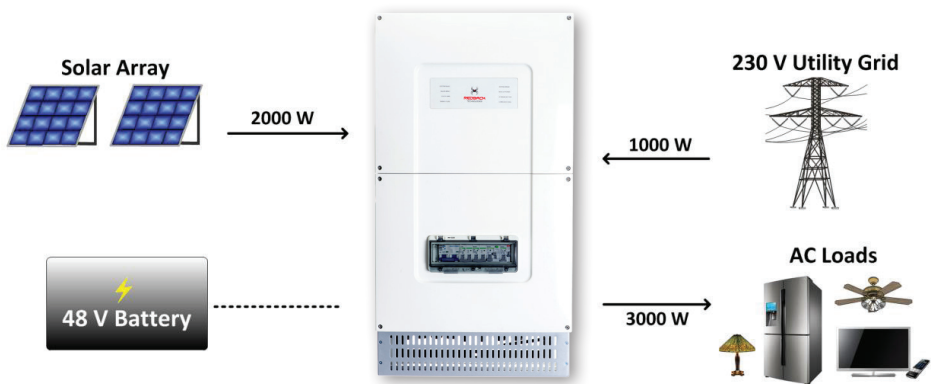
Reduce

The Smart Hybrid Solar Inverter System is able to use the solar array's energy production to reduce the amount of energy that AC loads are consuming from the utility grid. This occurs when the solar array is producing less energy than what the AC loads that are consuming.

Note

These examples of different operating modes are simplified by not including the small amount of losses involved in the energy conversion process and should not be considered as representative of real world system performance.

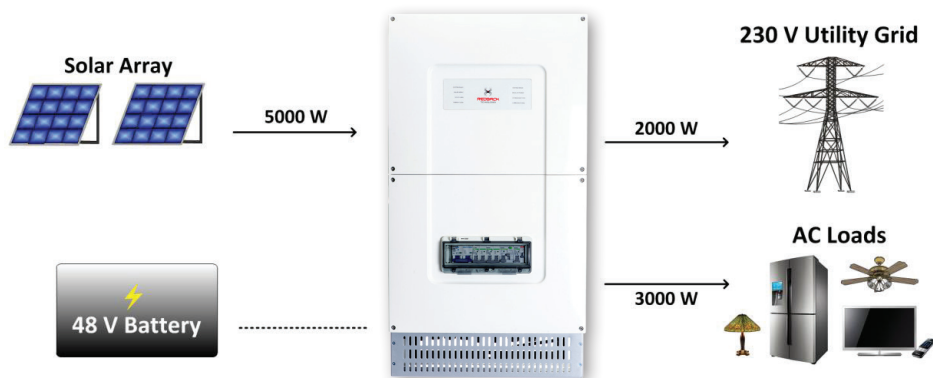
Figure 4 Reduce mode



Sell

The Smart Hybrid Solar Inverter System is able to “sell” excess power produced back to the utility grid – spinning the meter backwards where “net metering” is used. This occurs when the solar array is producing more energy than the AC loads that are consuming. This ability to sell power back to the utility grid can be enabled/disabled in the settings menu.

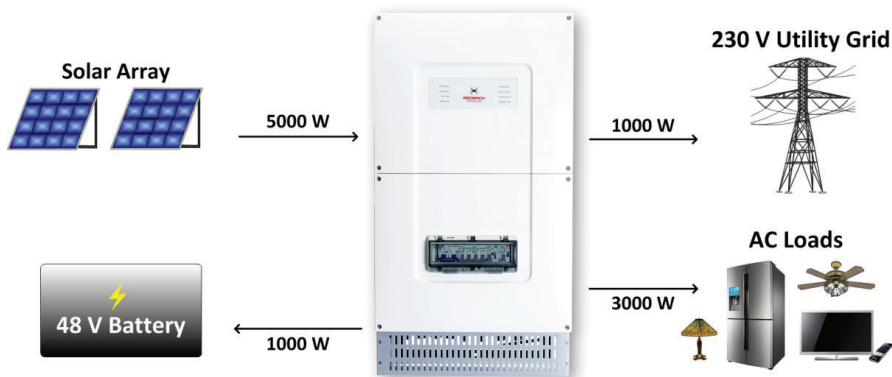
Figure 5 Sell mode



Charge

The Smart Hybrid Solar Inverter System is able to charge the battery from either the solar array or from the utility grid. The Smart Hybrid Solar Inverter System always prioritises the solar production first to power AC loads and then uses the excess solar production to recharge the battery. If there is more solar array energy being produced than can be accepted by the battery and the AC loads, the energy will flow into the utility grid (if allowed).

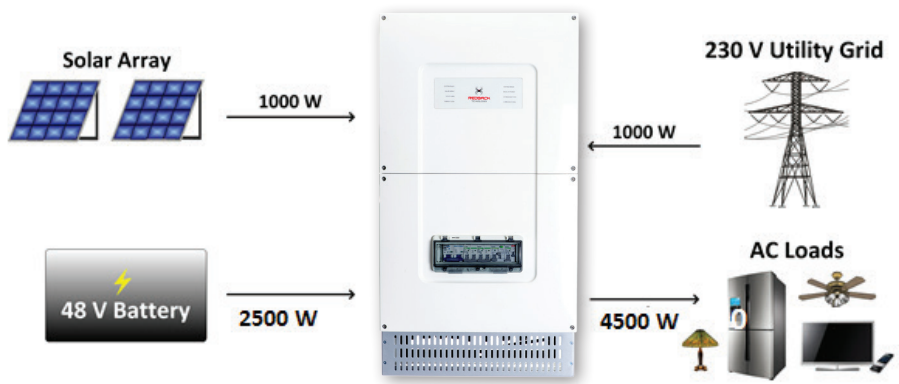
Figure 6 Charge mode



Discharge

The Smart Hybrid Solar Inverter System is able to use the battery to limit the amount of energy consumed by the AC loads from the utility grid. If the AC loads exceed the power capability of the battery, utility power can be added to the battery's output to meet the AC loads requirements.

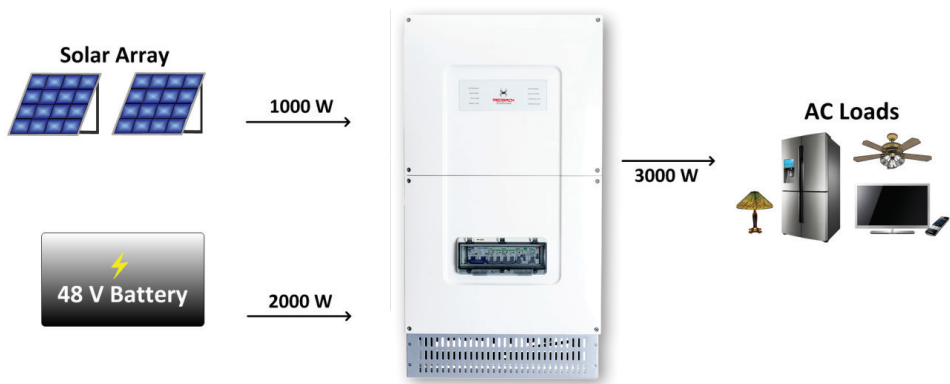
Figure 7 Discharge mode



Backup

The Smart Hybrid Solar Inverter System continues to power the AC loads which are connected to the backup AC loads output when a utility grid outage occurs. The AC loads can be powered from the solar array and/or from the battery.

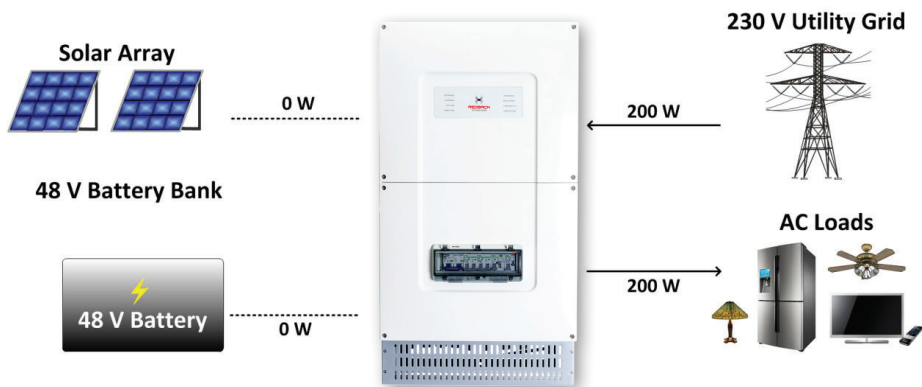
Figure 8 Backup mode



Silent

The Smart Hybrid Solar Inverter System automatically reduces its energy consumption at night when solar power is not available and the battery is not being used. This minimises energy consumption and maximises the overall system performance. While the Smart Hybrid Solar Inverter System is silent the utility grid powers all of the AC loads.

Figure 9 Silent mode



Solar array sizing

The following table provides the specifications for using solar arrays with the Smart Hybrid Solar Inverter System.

Table 1 Solar array sizing

Recommended maximum solar array DC power	6000 Watts DC
Number of solar array inputs	2 (individual MPPTs)
Maximum DC open circuit voltage	550 Volts DC (under coldest temps)
MPPT operating range	125-500 Volts DC
Starting voltage	125 Volts DC
Maximum DC input current (for each solar array input)	11 Amps DC
Overcurrent protection (for each solar array input)	20 Amps DC maximum
DC overcurrent category	Category II
Input connectors	Amphenol H4
DC disconnects	2 - Integrated (2 pole DC breakers)
Residual current monitoring	Integrated
Insulation monitoring	Integrated

Battery sizing



IMPORTANT

Battery charger settings need to be correct for any given battery type. Always follow battery manufacturer recommendations.

When planning a battery bank, consider the following:

- Inverters work best with batteries intended for deep discharge. These include lead-acid or lithium ion batteries.
- These inverters are designed to work with a nominal 48-volt battery bank. The actual voltage of the battery can vary during operation from 40 to 60 VDC depending on the battery type and number of cells in series.
- A vented enclosure for the battery bank may be required by electric code and is recommended in most cases for safety reasons and to prevent unauthorized access.



CAUTION: Hazard to equipment

Lead acid type batteries can emit hydrogen sulfide gas which is corrosive over long periods of time. Installing the inverter in the battery compartment may cause corrosion which is not covered by the product warranty. (Sealed type batteries may be an exception.)

Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Installation

Parts list

- Smart Hybrid Solar Inverter System
- Wall mounting plate with mounting hardware kit
- Wiring covers: one front cover, two side covers, one bottom cover and attachment screws
- Battery Management System (BMS) Cable with RJ45 connectors (pre-installed inside of wiring compartment)
- Energy meter with CT sensor for utility connection with communication cable with RJ45 connectors
- Amphenol H4 connectors for solar array connections: 2 positives, 2 negatives with 26 amp pins for 2.5 mm² wire
- Amphenol H4 connectors for battery connections: four positives, four negatives with 65 amp pins for 10 mm² wiring from each battery individually (paralleling of the batteries is done internally to the inverter)
- Installation and operator's manual
- Warranty card
- Inline fuse holder + glass fuse

Location and environmental requirements

- The Smart Hybrid Solar Inverter System can be installed outdoors or indoors. The inverter is rated IP65.
- The inverter must be wall mounted in a vertical position with the connections at the bottom.
- The inverter will perform more efficiently in locations offering plenty of air circulation. The recommended minimum clearance is 500 mm on the side and bottom of the inverter and 300 mm on the top.
- The inverter will function to all of its specifications if operated in a range of -25°C to 60°C (-13°F to 140°F). Note that the inverter's maximum wattage will derate in temperatures above 45°C.

Tools required

- Wire cutters/strippers
- Torque wrenches or torque screwdrivers
- Assorted insulated screwdrivers, hex drivers or wrenches
- DVM or Voltmeter
- Amphenol/MC4 crimping kit

Additional items which will be required

- Battery energy storage system
- Battery cabling - 10mm² is recommended for each individual Pylontech battery modules (up to 4 maximum)
- Battery enclosure suitable for the batteries being used and the environment they are installed in

Dimensions

Figure 10 Dimensions clearance requirements

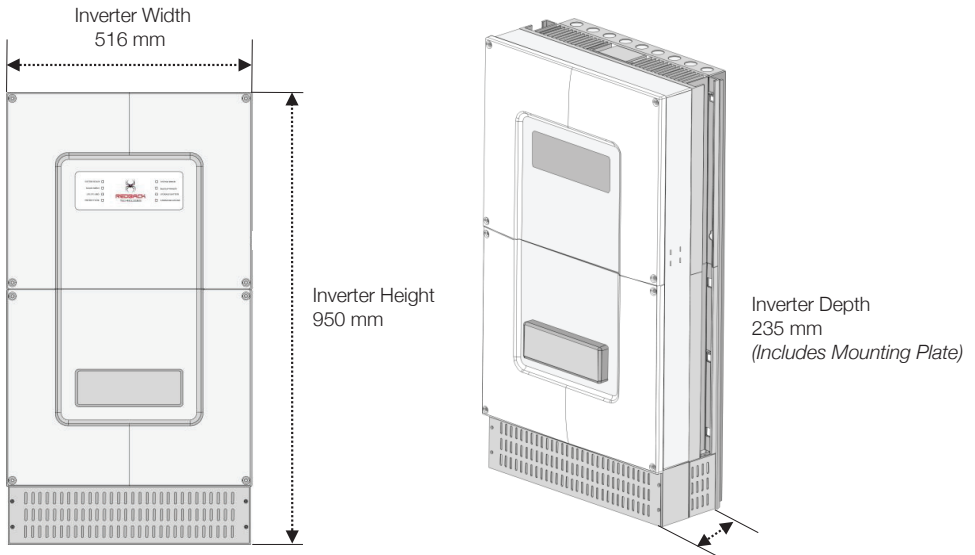
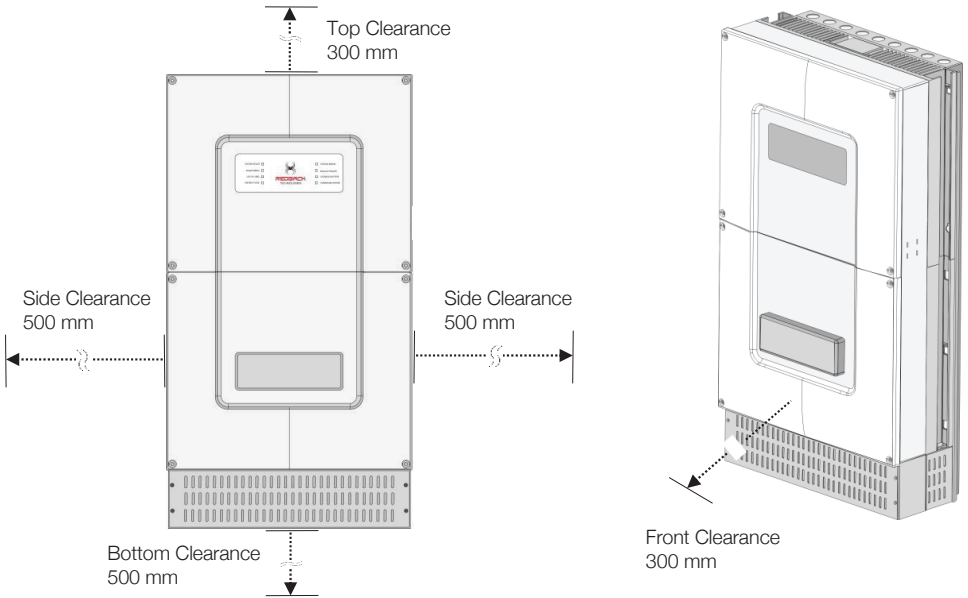


Figure 11 Minimum clearance requirements



Mounting



IMPORTANT

Use appropriate fasteners to secure the Smart Hybrid mounting plate to the mounting surface. Redback Technologies will not be responsible for damage to the product if it is attached with inadequate fasteners.

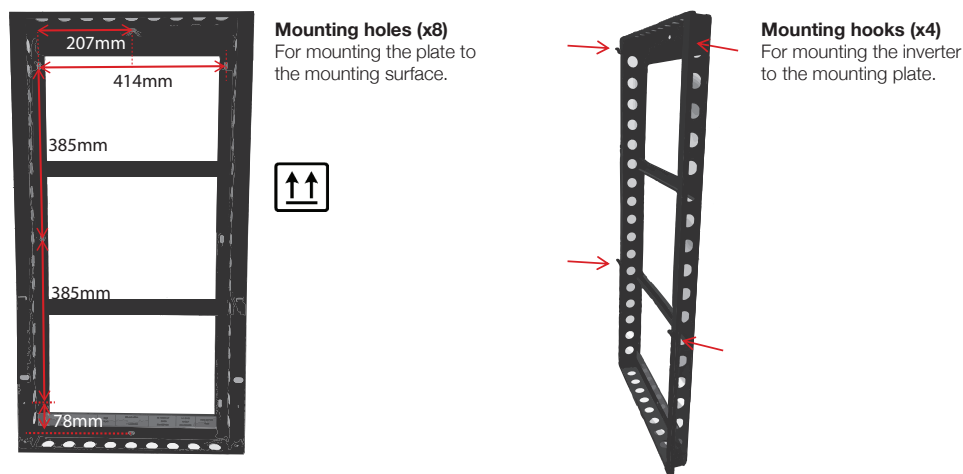
- Mount and secure the mounting plate to a solid surface before attaching any wiring. Ensure the surface is capable of holding the weight of the entire system (45kg/100lbs.). Hardware is provided but some installations may require different hardware depending on the material used for the mounting surface involved.
- Do not place the inverter in a vertical position with the weight of the inverter on the connectors at the bottom of the chassis. The connectors may be damaged and/or foreign materials may enter into them.

Wiring covers

- The Smart Hybrid Solar Inverter System includes a set of wiring covers which are installed at the end of the installation to fully enclose all of the wires and connectors on the bottom of the inverter and to restrict access, protect the wiring and improve the look of the completed installation. These covers are installed using the provided small screws using a Phillips or star type screwdriver.



Figure 12 Mounting plate



Mount the system in a vertical position only with the inverter section and heatsink at the top.

The bottom of the mounting plate can be identified by the four threaded inserts located on each of the side flanges for connection of the wiring compartment side covers.

After attaching the mounting plate to the wall, lift up the inverter and place it on the four mounting hooks. Be sure all four are engaged before releasing the inverter. Once all of the wiring has been completed, attach the two side covers for the wiring compartment to the mounting plate, then install the lower front wiring compartment covers using the supplied countersink head screws with a Phillips or star type screwdriver.

Inside the wiring compartment on the left side is a location which will allow the installation of a padlock to secure the inverter to the mounting plate to prevent unauthorised removal.

Figure 13 Mounting position

YES!

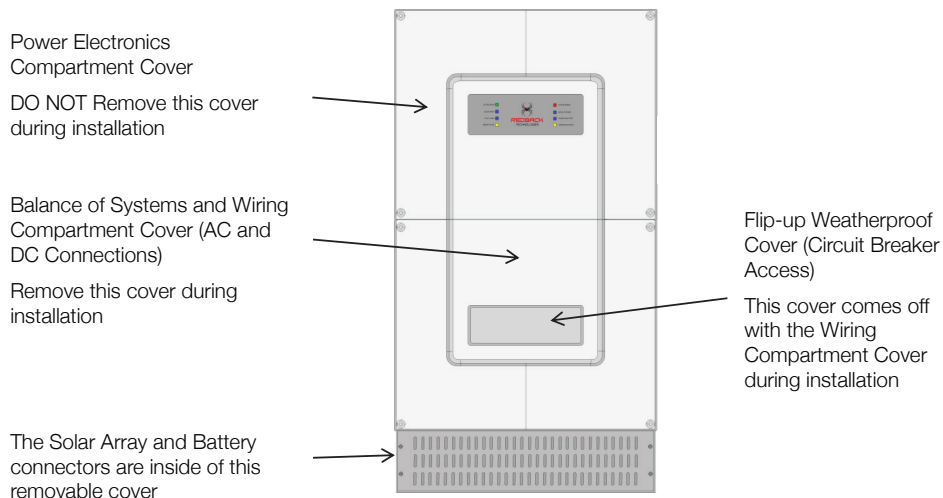


NO!



Removing the covers

Figure 14 Removing the covers

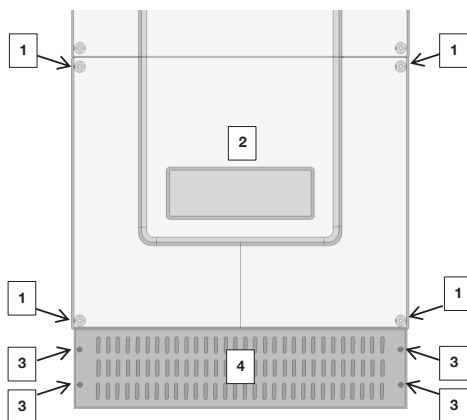


To remove the Balance of Systems Compartment Cover:

1. Remove the hex bolts (x4) from the lower half of the inverter using a 4mm hex wrench.
2. Carefully pull the cover plate away from the compartment.

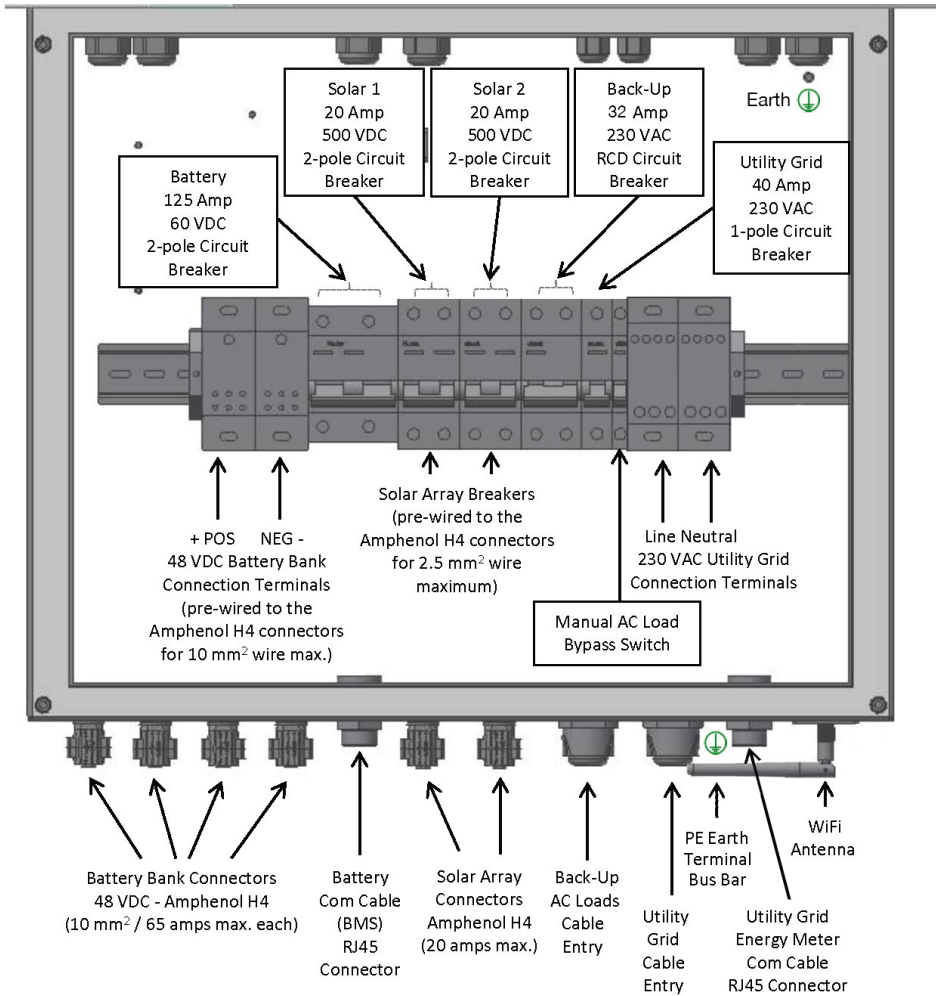
To remove the front wiring cover:

3. Remove the screws (x4) from the bottom of the inverter with a Phillips or star type screwdriver
4. Carefully lower the plate away from the solar array plug-in connectors.



Terminals and connectors

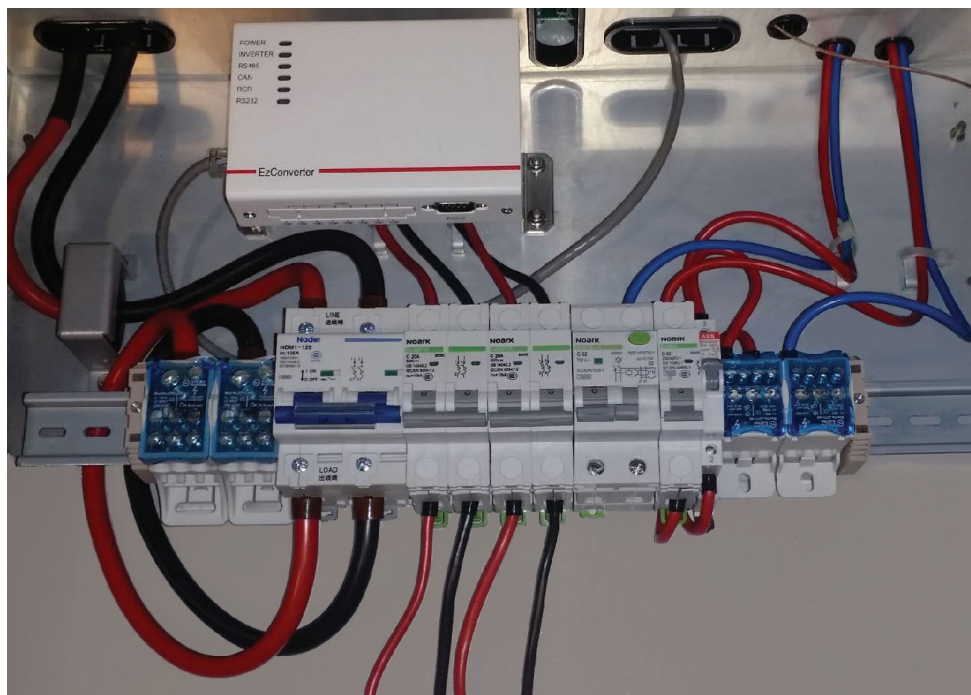
Figure 15 Terminals and connectors



WARNING: Shock hazard

The inverter's backup output is defaulted to OFF from the factory. It will deliver 230 Vac when the backup power is enabled using the Redback Technologies app.

Internal connections with the EzConverter communication device for connection to the battery BMS system.



Amphenol H4 Connectors for the solar array connections – 2.5 mm² wire.



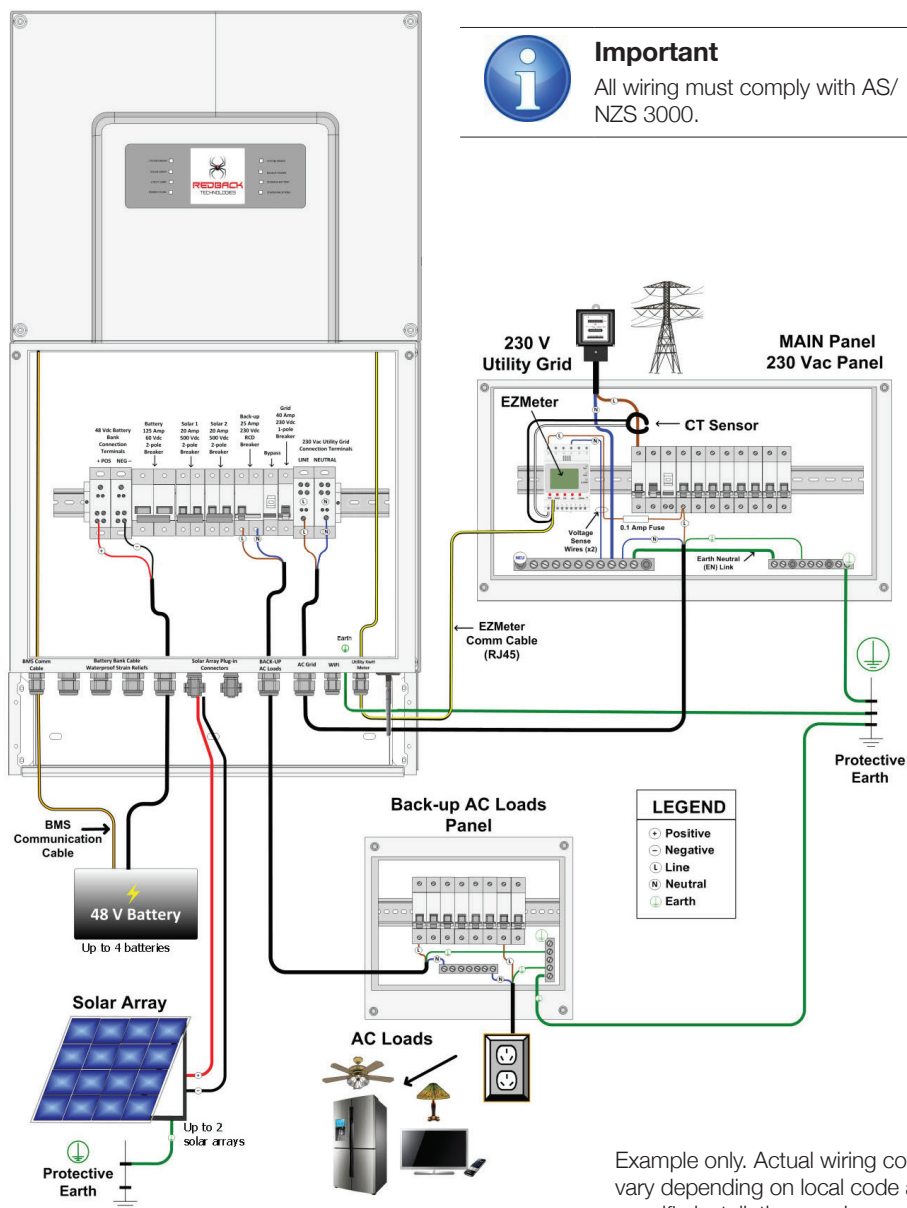
Negative solar array H4 connectors
with male pins.

Positive solar array H4 connectors
with female pins.

The pins must be properly crimped to the bare ends of the wires and then inserted into the corresponding housing – be sure to check for proper negative/positive polarity prior to making final connections.

System wiring diagram

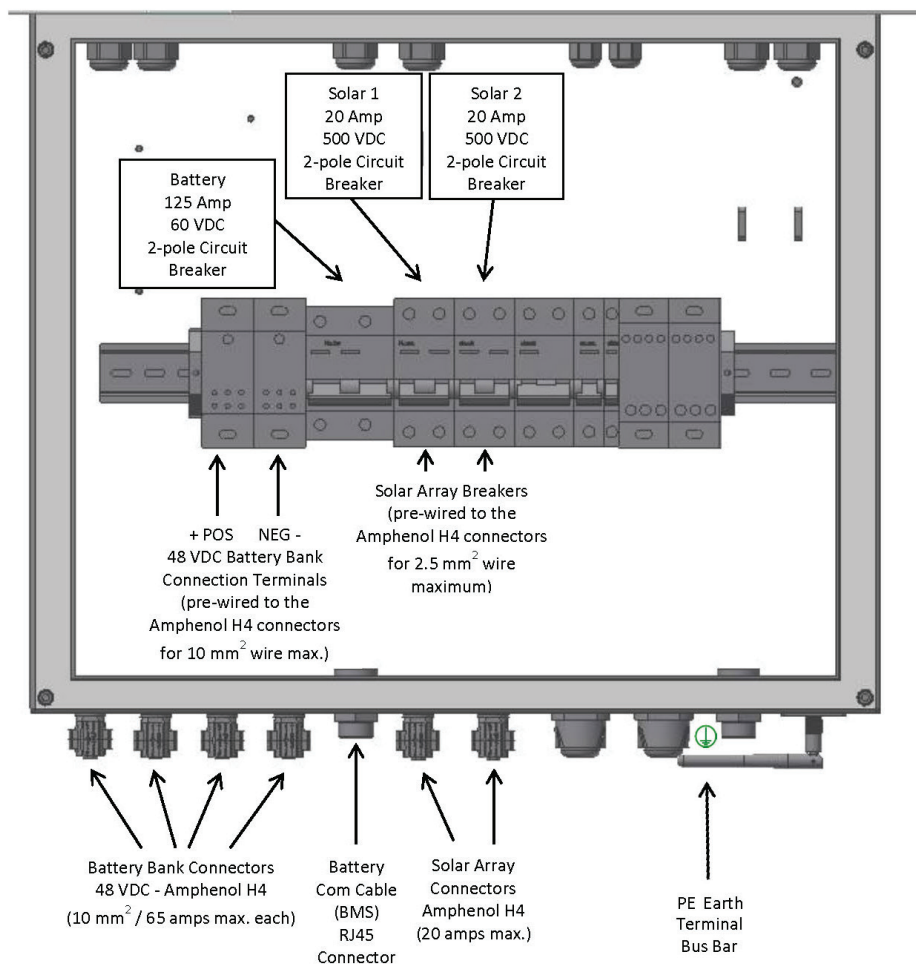
Figure 16 System wiring diagram



Example only. Actual wiring could vary depending on local code and specific installation requirements.

DC wiring connections and DC circuit breakers

Figure 17 DC terminals



All system wiring must comply with national and local codes and regulations.

Note: All Smart Hybrid Solar Inverter Systems built after November 2015 now include four battery inputs using Amphenol H4 connectors rated at 65 amps maximum per input.

Protective Earth (PE) wiring



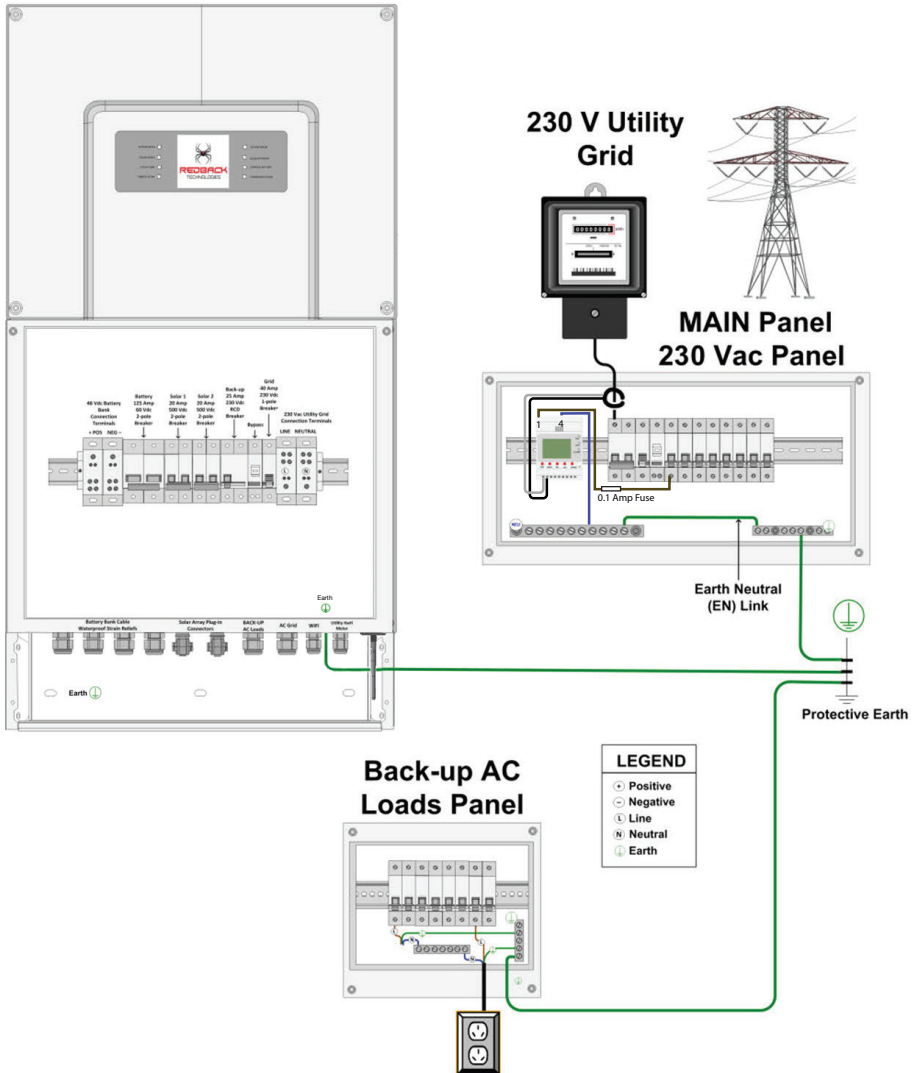
WARNING: Shock hazard

The unit must be connected to a properly earthed, permanent wiring system in compliance with AS/NZS 3000. A link is required between neutral and earth. Make sure only one link is present in the AC system at any time. Some codes require the link to be made at the main panel only.

Table 2 Earth conductor size and torque requirements

Terminal location	Maximum conductor size	Torque requirements
PE Ground	16mm ²	3.5 Nm

Figure 18 Protective Earth (PE)



Note

For further information on how to wire the energy meter please refer to the sticker on the side of the energy meter itself.

Solar array wiring



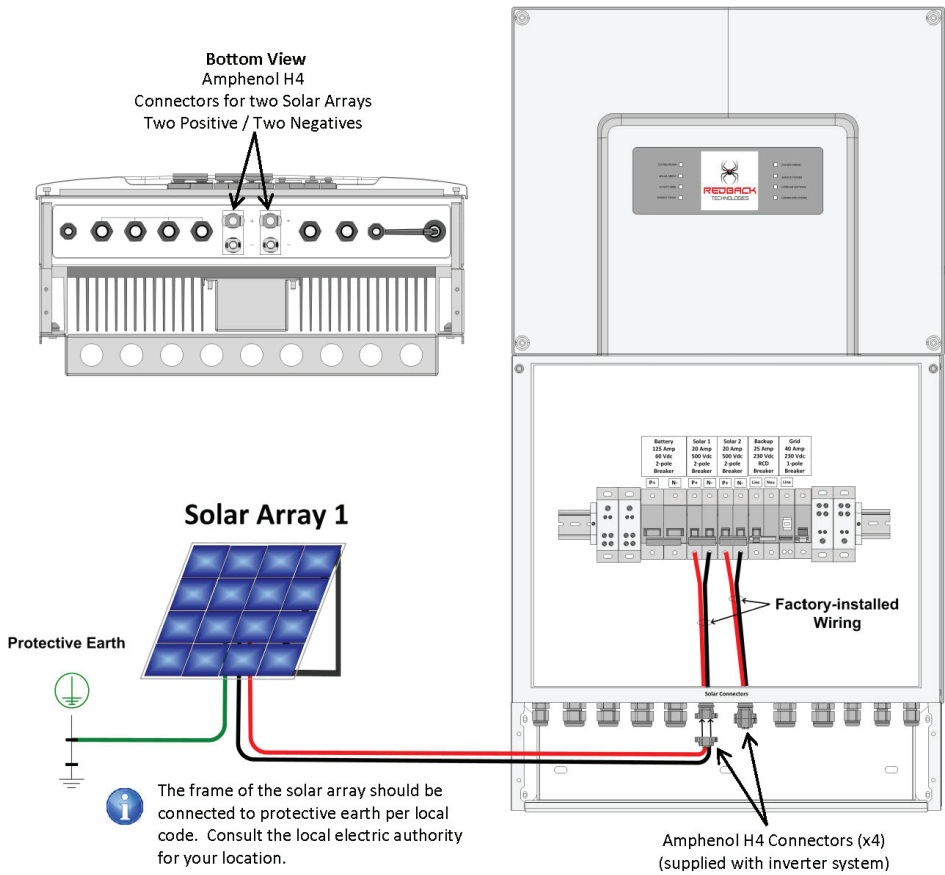
WARNING: Shock hazard

Solar arrays can be energised with minimal ambient light available. Be careful when working with the wiring and connectors to avoid shock or arcing.

Table 3 Solar array conductor size and torque requirements

Terminal location	Conductor size	Torque requirements
Solar 1	2.5 mm ²	H4 Plug-in Connectors
Solar 2	2.5 mm ²	H4 Plug-in Connectors

Figure 19 Solar array wiring



Battery wiring



CAUTION: Equipment damage

Never reverse the polarity of the battery cables. Always ensure correct polarity. Reversing the polarity of the battery cables will damage the inverter.

Table 4 Battery conductor size and torque requirements for terminal block

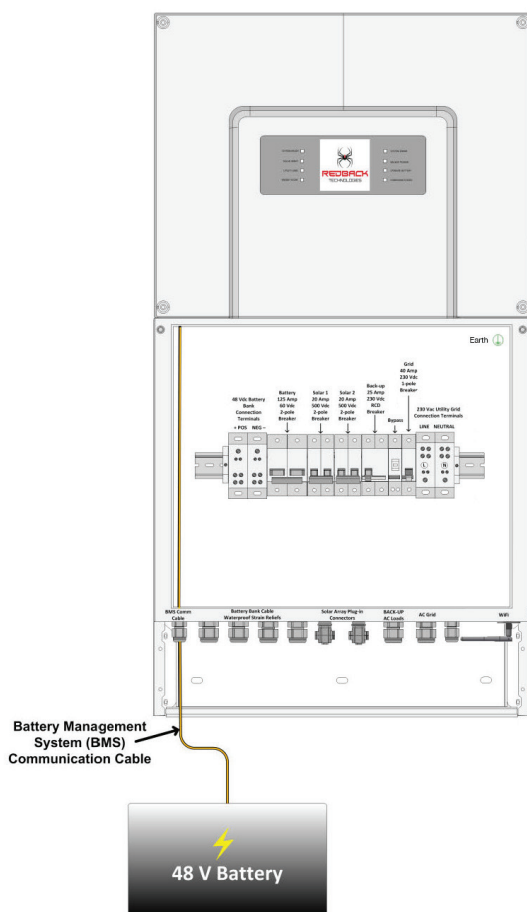
Terminal location	Maximum conductor size	Torque requirements
Each battery module's positive and negative conductors	10 mm ²	H4 plugin connectors
Battery chassis connection to protective Earth	16 mm ²	3.5 Nm - Terminal bus bar

Battery Management Systems (BMS) communications connections

The Battery Management System (BMS) communication system is used to improve the performance of the system when lithium-ion batteries are used. It is able to communicate only with models of batteries which have been tested and approved for use with the Smart Hybrid Solar Inverter System. Use of other lithium-ion batteries is not permitted.

The BMS communication cable is provided with the Smart Hybrid Solar Inverter System – the cable simply has to be uncoiled and routed to the battery system and protected from physical damage. Once in place, the cable can be connected to the battery's communication RJ15 connector and plugged into the RJ45 BMS connector on the bottom of the Smart Hybrid Solar Inverter System.

Figure 21 BMS cable installation

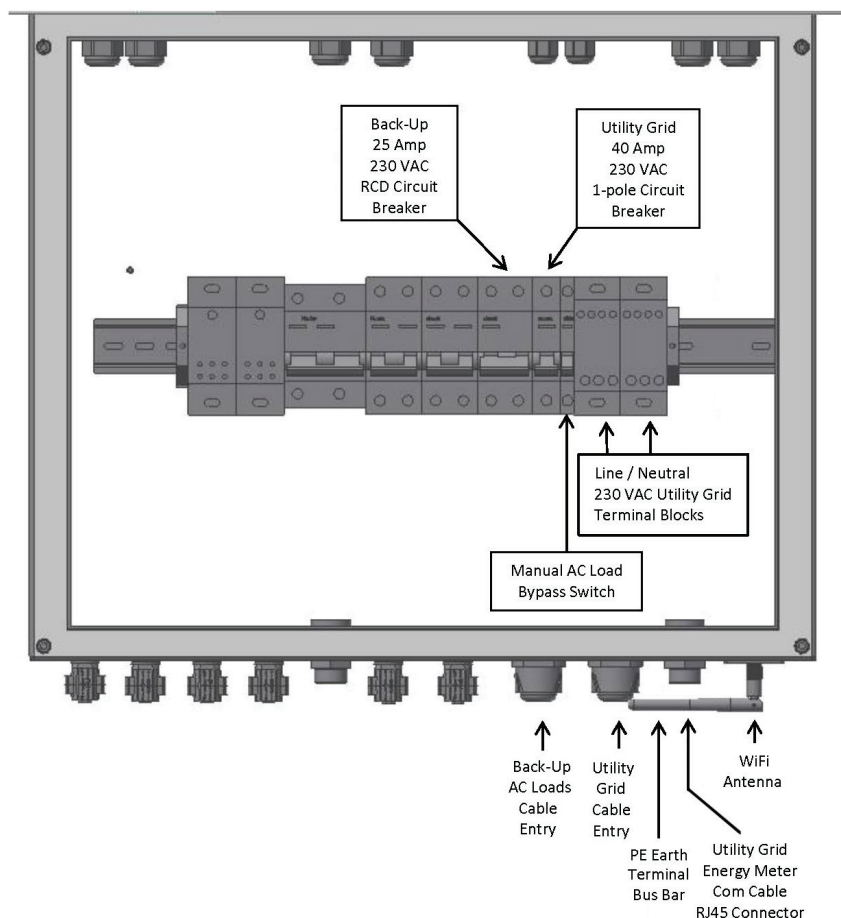


AC wiring connections and AC circuit breakers

Table 5 AC conductor size and torque requirements

Terminal location	Maximum conductor size	Torque requirements
Line and neutral	16mm ²	3.5 Nm
Earth	16mm ²	3.5 Nm

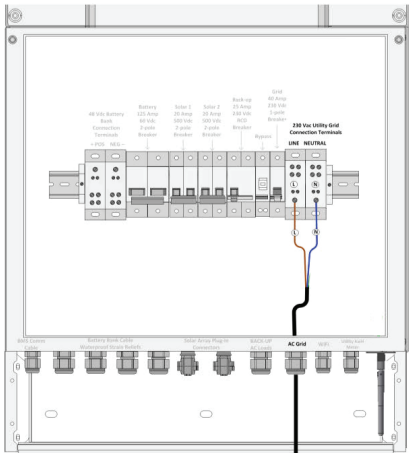
Figure 22 AC terminals



All system wiring must comply with national and local codes and regulations.

AC utility grid connections

Figure 23 AC grid connections



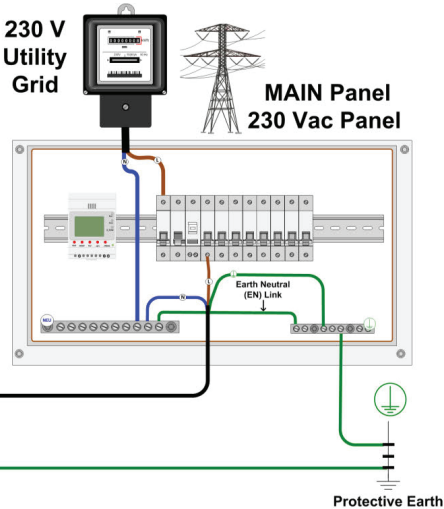
LEGEND	
+	Positive
-	Negative
L	Line
N	Neutral
⬆	Earth

To connect the inverter to the utility grid: In the main panel:

1. Ensure there is a bond between the Neutral bus bar and the EARTH bus bar. *There can only be one Earth neutral link in the system.*
2. Ensure that the main panel is connected to a primary Earth protective system.
3. Connect the inverter's EARTH wire to the EARTH bus bar.
2. Connect the inverter's LINE wire to the LINE connection terminal.
3. Connect the inverter's NEUTRAL wire to the NEUTRAL bus bar.

IN THE INVERTER:

4. Connect the EARTH wire to the EARTH connection terminal.
5. Connect the LINE wire to the LINE connection terminal.
6. Connect the NEUTRAL wire to the NEUTRAL connection terminal.



Note: Placement of the circuit breakers may vary depending on the installation.

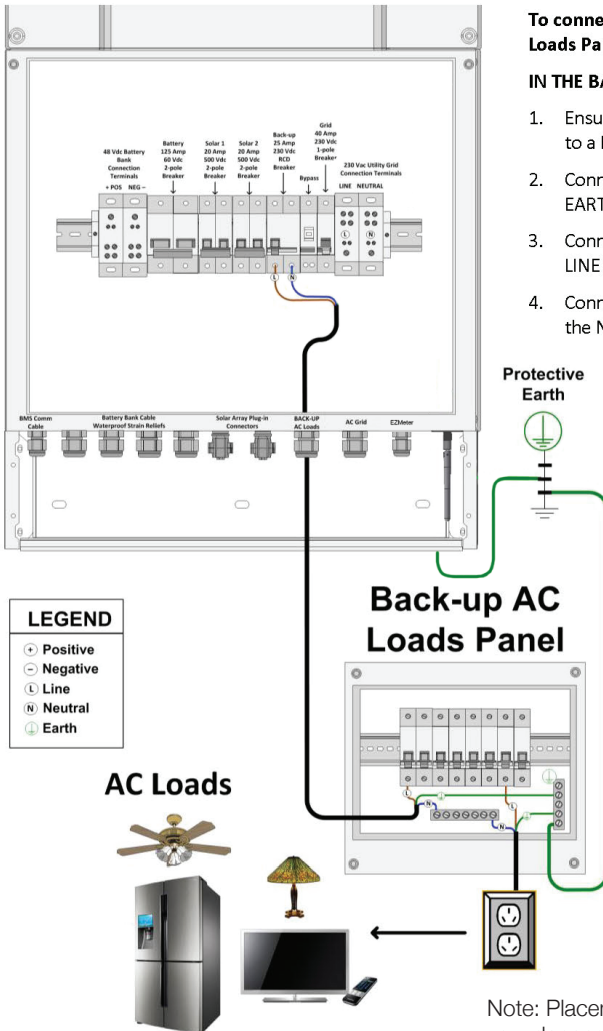
AC backup loads connections



Important:

See Page 13 for details on what AC loads are acceptable to use with the Smart Hybrid Solar Inverter System.

Figure 24 Backup AC loads wiring



To connect the inverter to the Back-Up AC Loads Panel:

IN THE BACK-UP AC LOADS PANEL:

1. Ensure the AC Load Panel is connected to a Protective Earth system.
2. Connect the Inverter's EARTH wire to the EARTH bus bar.
3. Connect the Inverter's LINE wire to the LINE connection terminal.
4. Connect the Inverter's NEUTRAL wire to the NEUTRAL bus bar.

Protective Earth

IN THE INVERTER:

5. Ensure the Inverter is connected to a Protective Earth System.
6. Connect the EARTH wire to the EARTH connection terminal.
7. Connect the LINE wire to the LINE connection terminal.
8. Connect the NEUTRAL wire to the NEUTRAL connection terminal.

Note: Placement of the circuit breakers may vary depending on the installation.

Bypass switch

The bypass switch on the Redback inverter is a three position switch which, depending on the position it is put on, determines where the power is supplied from to the loads downstream of the Backup circuit.

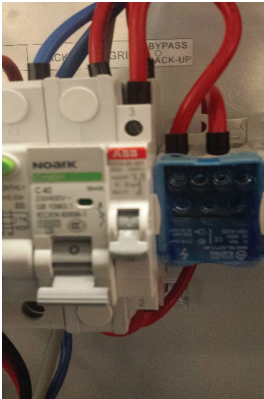


Figure 25
Bypass switch in the Backup(I) position

The default position for the bypass switch is the down(I) position. In that position, essential loads downstream of the Back Up protection device will be supplied power from the inverter's UPS circuit. In this position, all of the downstream loads will have uninterrupted power supply even during mains power outage.

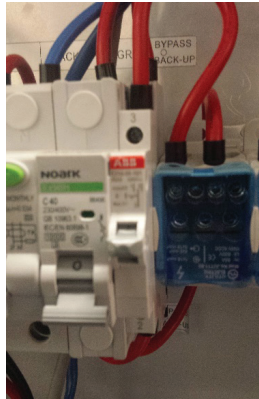


Figure 26
Bypass switch in the Isolate(O) position

When the bypass switch is in the middle position(O), the loads downstream of the backup protection device will be completely isolated.

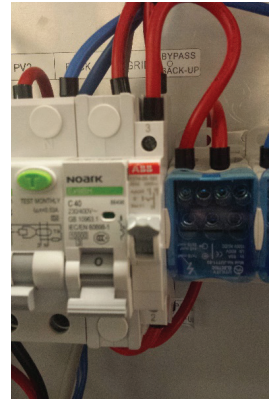


Figure 27
Bypass switch in the Bypass(II) position

When the bypass switch is in the top position(II), the inverter will be bypassed, and power will be supplied from the utility line directly. Typically, this position will be used in the rare event that the inverter is shut down for maintenance or another reason and the installation owner wants to run the backup loads from the grid until the inverter comes back online.

Energy meter connections

The utility grid energy meter is used to measure the amount of energy which is flowing from or to the utility grid, and to allow the Smart Hybrid Solar Inverter System to limit or restrict power flow back into the utility grid by adjusting the amount of power being supplied from the solar array and the battery.

The energy meter is designed to be installed inside of the main AC panel and is in addition to the utility's normal kWh meter. The energy meter uses a "split core" type current sensor which can be installed without interrupting the connection of power from the utility grid and therefore does not require the modification, rerouting or displacement of any of the utility grid wiring. An RS485 communication cable is supplied with the inverter (ethernet patch cable). The width of the energy meter is 54 mm.

Figure 28 Energy meter features

Energy Meter Display

The LCD display shows the amount of power (kW) flowing from or back into the utility grid. The value shown depends on the AC loads operating, solar production and the mode of the inverter system.


The four LED indicators show the meter's status:

Run Meter is Running
LED flashes Green

Com Meter is communicating
LED flashes RED

R_P Reverse Power Flow
Power Flowing into Grid
LED is solid on RED

— Negative Power kW
Power flowing into Grid
LED is solid on RED

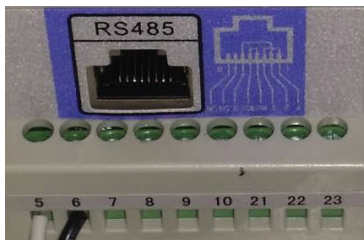


Energy meter with current transformer (CT) sensor connected

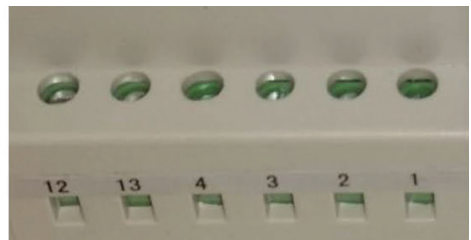
Split type
Current
Transformer
(CT) Sensor
Connected

Snaps over
existing wiring
from the utility
grid meter

120 amp /
27.6 kW AC
maximum
continuous
current rating

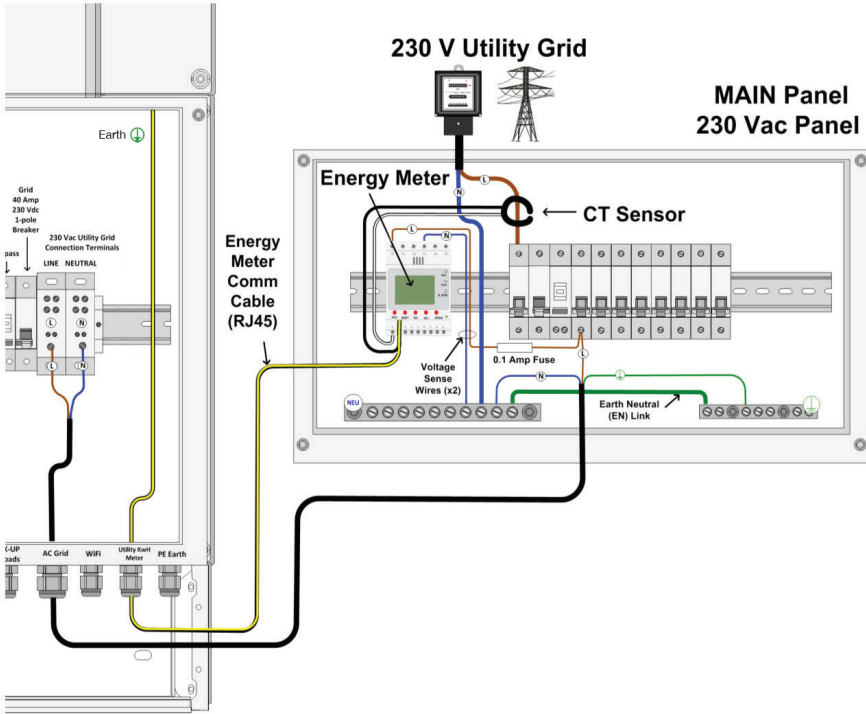


Bottom terminals



Top terminals

Figure 29 Energy meter wiring



To install the energy meter:

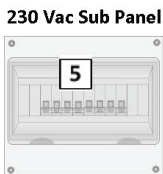
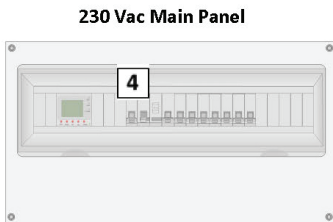
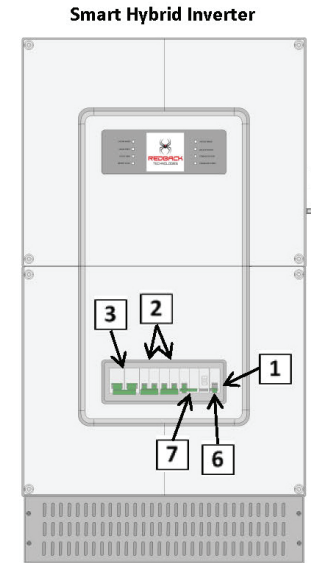
1. Install the energy meter into the main AC panel by clipping the meter onto the DIN rail. The meter requires a width of 54 mm on the rail.
2. Insert the CT current sensor around the incoming LINE wire of the utility grid inside of the main AC panel. Note the correct orientation of the CT sensor via the label provided on it.
3. The black wire from the CT Sensor is connected to the #6 terminal on the bottom of the energy meter.
4. The white wire from the CT Sensor is connected to the #5 terminal on the bottom of the energy meter.
5. Prepare two voltage sense wires for the connection of the energy meter. The recommended wire colors are BLUE for NEUTRAL and BROWN for the LINE conductor.
6. Connect the BROWN wire from terminal 1 (on the top) to the grid's LINE conductor, typically at the AC circuit breaker that supplies the inverter.
7. Connect the BLUE wire from terminal 4 (on the top) to the grid's NEUTRAL conductor, typically at the neutral bus bar.
8. Insert the communication cable into the RJ45 connector on the bottom of the energy meter.
9. Insert the other end of the communication cable into the RJ45 connector on the bottom of the Smart Hybrid Solar Inverter System enclosure that is labeled "Energy Meter" or "EZ Meter".

Operation

Start up

Perform the following steps to start up the system.

Figure 30 Starting up the system



To start up the System:



WARNING: Shock and burn hazard

Ensure the covers are replaced before proceeding.

ON THE INVERTER:

- 1** Access the circuit breaker panel on the inverter by opening the access panel on the front of the unit.
- 2** Switch the circuit breaker for the solar array(s) to the ON position.
- 3** Switch the circuit breaker for the battery to the ON position.

ON THE MAIN ELECTRICAL INPUT PANEL:

- 4** Switch the circuit breaker for the Inverter to the ON position to activate the Sub Panel input.

ON THE SUB PANEL:

- 5** Switch the circuit breaker for the Inverter to the ON position.

ON THE INVERTER:

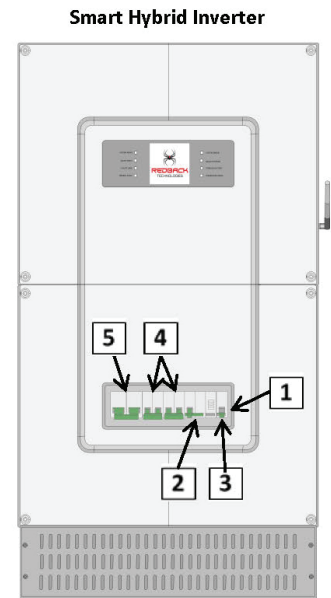
- 6** Switch the circuit breaker for the AC Grid to the ON position.
- 7** Switch the circuit breaker for the AC Loads to the ON position.

Note: Placement of the circuit breakers may vary depending on the configuration.

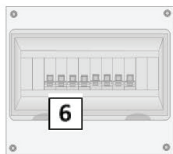
Shut down

Perform the following steps to shut down the system.

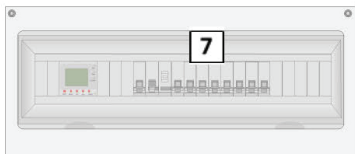
Figure 31 Shutting down the system



230 Vac Sub Panel



230 Vac Main Panel



To shut down the System:



WARNING: Shock and burn hazard

Do not remove ANY covers while the unit is active. Allow a minimum of 5 minutes for internal parts to cool down before removing any cover to perform maintenance.

ON THE INVERTER:

- 1 Access the circuit breaker panel on the inverter by opening the access panel on the front of the unit.
- 2 Switch the circuit breaker for the AC Loads to the OFF position.
- 3 Switch the circuit breaker for the AC Grid to the OFF position.
- 4 Switch the circuit breaker for the Solar Array(s) to the OFF position.
- 5 Switch the circuit breaker for the battery to the OFF position.

ON THE SUB PANEL:

- 6 Switch the circuit breaker for the Inverter to the OFF position.

ON THE MAIN ELECTRICAL INPUT PANEL:

- 7 Switch the circuit breaker for the Inverter to the OFF position.










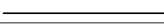







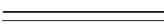








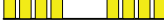
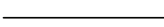


Note: Placement of the circuit breakers may vary depending on the configuration.

Inverter system LED indicators

Eight LED indicators are provided on the front panel. These LED indicators provide information about the operational status of the system.



Figure 32 LED indicators

Indicator	Status	Explanation
		ON = System is ready
		BLINK = System is starting up
		OFF = System is not operating
SYSTEM READY		ON = Solar inputs #1 and #2 are active
		BLINK 1 = Solar Input #1 is active / #2 is not active
		BLINK 2 = Solar input #2 is active / #1 is not active
SOLAR ARRAY		ON = Grid is active and connected
		BLINK = Grid is active but not connected
		OFF = Grid is not active
UTILITY GRID		ON = Consuming energy from grid / buying
		BLINK 1 = Supplying energy to grid / zeroing
		BLINK 2 = Supplying energy to grid / selling
ENERGY FLOW		ON = Fault has occurred
		BLINK = Overload of backup output / reduce load
		OFF = No fault
SYSTEM ERROR		ON = Backup is ready / power available
		OFF = Backup is off / no power available
		
BACK-UP POWER		ON = Battery is charging
		BLINK 1 = Battery is discharging
		BLINK 2 = Battery is low / SOC is low
STORAGE BATTERY		OFF = Battery is disconnected / not active
		
		
COMMUNICATIONS		ON = Wifi connected / active
		BLINK 1 = Wifi system resetting
		BLINK 2 = Wifi router problem
		BLINK 4 = Wifi server problem
		OFF = Wifi not active

Download smartphone application

The application software is available for both Android and Apple IOS systems. The name of the software is:

“Redback Tech – System Manager”

Android/Google Play Store

On your smart phone, use the Google Play Store to locate and install the software. To find the app, search for:

“Redback Tech”

Please visit the Redback Technologies webpage for the latest instructions on how to configure the Android application software.

www.redbacktech.com

iOS/Apple Store

On your smart phone, use the App Store to locate and install the software. To find the app, search for:

“Redback Tech”

Please visit the Redback Technologies webpage for the latest instructions on how to configure the Apple IOS application software.

www.redbacktech.com

Setting up your Smart Hybrid Solar Inverter System for wifi connectivity

In order that the Smart Hybrid Solar Inverter System installation meets, among others, section 3.4.3 of AS/NZS 5033:2014, the inverter needs to be continuously connected to the internet through the home wifi connection. To that end the installer needs to be configure the unit to connect to the cloud via the home wifi during commissionin.

Please note that you may need a computer with a wifi capability for the initial configuration process.

To start configuring the unit, connect to the Redback Smart Solar Inverter's built-in wifi communication system which has a factory set SSID of 'Redback' as shown below. The default password to connect to the built in wifi is **12345678**.

Figure 33 Redback's built-in wifi app

Connecting the Redback unit to the cloud

- 1. Once you are connected to the 'Redback' wifi, open a standard web browser (IE, Chrome, Firefox or Safari) and type in the factory set IP address 10.10.100.254.
- 2. Please use a username "admin" and a password of "admin" to log into the configuration portal.
- 3. Once you are logged in Step 2 above the web page would look like the figure below.

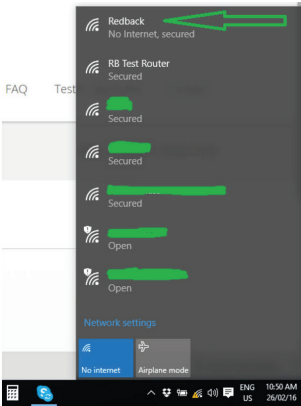
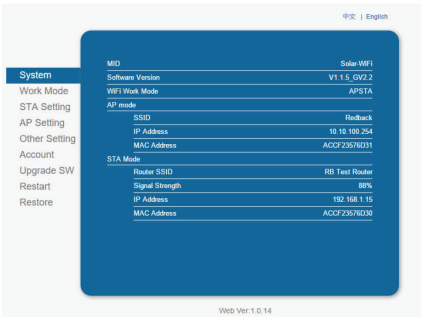
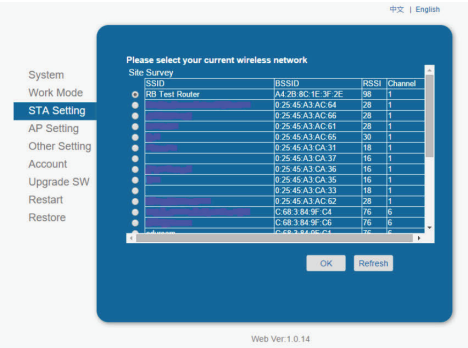


Figure 34 Redback's wifi modem configuration



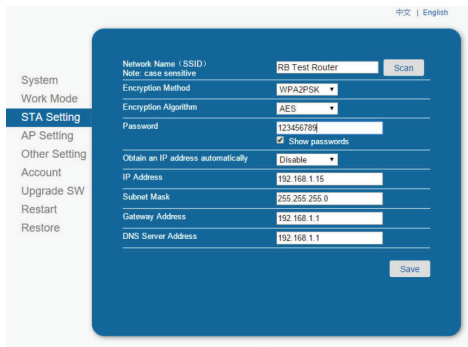
- 4. On the page explorer on the left hand side, click on 'STA setting' to configure the Redback unit to connect to the cloud.
- 5. Click on the Scan button on the first line of the page (Network Name (SSID)) to list all Wi-Fi hot spots within range, and then select your home's wifi from the list using the choice button on the left hand side, and press Ok (picture shown below) to apply the selection.

Figure 35 Lists of SSID near Redback inverter



- 6. Type in the password for your home's wifi in the fourth line, and select 'Enable' for the fifth line. You may choose the default for the other entries.
- When you click 'Save' to apply the changes, the web page might request you to restart, please select 'restart' to apply the changes.

Figure 36 Home wifi selected



- After restarting, the system should be connected to the Redback cloud Server / Portal. The yellow 'Communications' light on the front panel of your Redback Smart Hybrid Solar Inverter (bottom right yellow LED on the front door of the inverter box) will stop blinking and becomes continuously on. Your Redback unit is now connected to the cloud.

Note: Please change the inverter's default wifi password from the current 12345678 to a password with a reasonable degree of complexity consisting of a mixture of lower and upper case letters, numbers and some non-alphanumeric characters. You should also change the access password to the wifi configuration portal which is factory set to a user name of admin and a password of admin, once you are logged in.

Configuring the Redback unit via smartphone or tablet

[Note: All of the steps in these instructions apply equally to both Android and IOS devices.]

Once the Redback Smart Hybrid Solar Inverter System is connected to the cloud server through your home's wifi connection, it will start sending important measurement and monitoring data to the Redback cloud portal.

Connect your Phone/Tablet to the same home wifi connection that your Redback Smart Hybrid Solar Inverter is connected (**see the other instructions: *Setting up your Redback Smart Hybrid Solar Inverter for wifi connectivity***).

Once you are connected to your home wifi, you can run the Redback app from your phone or tablet. You now can monitor what the system status is in real time.

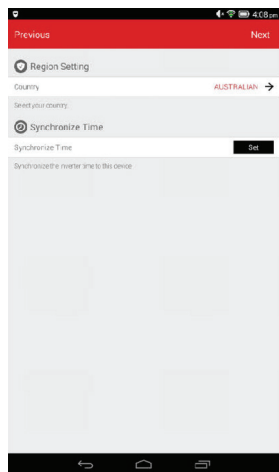
The app opens to a 'System Status' page showing the amount of solar power generated; what level your battery is at and how much electricity you are consuming currently, etc. The page should look like the sample figure below.

Figure 37 Redback's app home screen



Note: This level of access is only the 'User' level access. To configure the Redback Smart Hybrid Solar Inverter System itself, you need to have an installer password to be able to get into the **System Setup** mode. *[If you are an installer, please contact Redback Technologies via email providing your CEC Accreditation number to get your installer password.]*

Figure 38 Redback's app region and time setting



To get to the System Setup page, tap on the 'Settings' icon on the lower right hand side of the System Status page followed by System Setup. You then enter an installer password supplied to you by Redback Technologies.

In the System Setup page, you can configure several important variables and operating points of the inverter as part of the commissioning process.

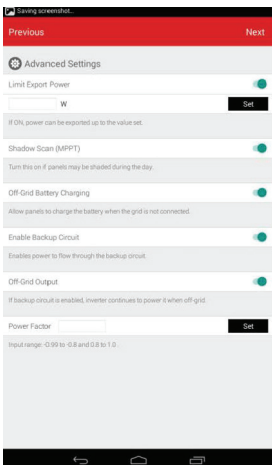
You need to set the region to 'Australia' and press the set button to synchronise the clock in the unit to the mobile/tablet device's clock (please make sure the clock and regional setting on the smart phone/tablet is accurate). Then press 'Next'.

Figure 39 Battery settings in the Redback app



In here, you will select the battery's energy storage capacity in ampere-hours (AH) from a list of preset values. You may consult the battery manufacturer's manual for the charge and discharge settings; and the depth of discharge values. Set these values and then press 'Next'.

Figure 40 Redback's App advanced settings



In this page, you can set the export power limit as determined by the utility if there is any limit on how much power your system is allowed to export. You can also enable off-grid battery charging, and the backup power function for your Smart Hybrid Solar Inverter System. The Redback inverter also has a reactive power control setting. Depending on how much your utility requires your inverter to be set to, you can set it here from 0.8 lagging to 0.8 leading power factor. Once you set the values you may press 'Next'.

Figure 41 Manual battery charging

Previous Next

Manual Battery Management

Manually define charging and discharging times instead of managing automatically. Power will be drawn from the grid if the PV power is insufficient.

Start Time 0:00 →

End Time 0:00 →

Set the start and end times for battery charging.

Power Limit 0 %

Set the percentage of the maximum charging rate at which to charge the battery.

Set

Discharge Battery

Manually define discharge times for the battery. Battery power will be allowed to feed into the grid if the discharge level is above the load's requirement.

Start Time 0:00 →

End Time 0:00 →

Set the start and end times for discharge reservation.

Power Limit 0 %

Set the percentage of the maximum discharge rate at which to discharge the battery.

Set

In this page, you can set the battery to manually charge and discharge. This is a useful feature if your electricity billing is on a Time of Use (TOU) tariff.

Figure 42 Summary page of Redback app settings

Previous Start

Settings Summary

Region Setting

Country AUSTRALIA

Battery Settings

Capacity: 100Ah

Charge Voltage: 53.8V

Charge Current: 85.0A

Discharge Voltage: 42.0V

Discharge Current: 64.5A

Discharge Depth: 80%

Manual Battery Management

Charge Time: 0:00-0:00

Power Limit: 0%

Discharge Time: 0:00-0:00

Power Limit: 0%

Advanced Settings

Export Power Limit: W

Shadow Scan: ON

PV Charge without Grid: ON

This is the summary page of parameters you entered in the previous pages. Once more confirm if the settings are correct and press 'Start' to apply the changes.

Troubleshooting

Error messages

Error message	Description
Utility Loss	Grid is disconnected or unavailable
Fac Failure	Grid frequency no longer within permissible range
PV Over Voltage	Solar array voltage is too high
Over Temperature	Over temperature on the case
Isolation Failure	Ground insulation impedance is too low
Ground I Failure	Excessive ground leakage current
Relay-Check Failure	Relay self-checking failure
DC Injection Failure	Excessive DC current in AC output
EEPROM R/W Failure	Memory chip failure
SPI Failure	Internal communication failure
DC Bus High	Excessive DC Bus voltage level
AC HCT Failure	Output current sensor failure
GFCI Failure	Detection circuit of ground leakage current failure
Vac Failure	Grid voltage no longer within permissible range
Battery Over Temperature	Battery Over Temperature
Battery Under Temperature	Battery Under Temperature
Battery Cell Voltage Differences	Li-Ion Battery Cell Voltage Differences
Battery Over Total Voltage	Li-Ion Battery Over Total Voltage
Battery Discharge Over Current	Battery Discharge Over Current
Battery Charge Over Current	Battery Charge Over Current
Battery Under SOC	Battery Capacity Low
Battery Under Total Voltage	Battery Under Total Voltage
Battery Communication Failure	Battery Communication Fail
Battery Output Short	Battery Output Short

Overvoltage category definition

Category I	Category I applies to equipment connected to a circuit where measures have been taken to reduce transient overvoltage to a low level.
Category II	Category II applies to equipment not permanently connected to the installation. Examples are appliances, portable tools and other plug-connected equipment;
Category III	Category III applies to fixed equipment downstream of and including, the main distribution board. Examples are switchgear and other equipment in an industrial installation;
Category IV	Category IV applies to equipment permanently connected at the origin of an installation (upstream of the main distribution board). Examples include electricity meters, primary overcurrent protection equipment and other equipment connected directly to outdoor open lines.

Moisture location category definition

Moisture parameters	Level		
	3K3	4K2	4K4H
Temperature range	0~+40°C	-33~+40°C	-20~ +55°C
Humidity range	5%~85%	15%~100%	4%~100%

Environmental category definition

	Ambient air temperature	Relative humidity range	
Outdoor:	-20~50°C	4 % to 100%	applied to PD3
Indoor unconditioned:	-20~50°C	5 % to 95%	applied to PD3
Indoor conditioned:	0~40°C	5 % to 85%	applied to PD2

Pollution degree definition

Pollution degree 1:	No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
Pollution degree 2:	Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
Pollution degree 3:	Conductive pollution occurs, or, dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected.
Pollution degree 4:	Persistent conductive pollution occurs, for example, the pollution cause by conductive dust, rain and snow.

Specifications

Solar array specifications

Recommended Maximum Solar Array DC Power	6000 Watts DC
Number of Solar Array Inputs	2 (individual maximum power point tracking)
Maximum DC Open Circuit Voltage	550 Volts DC
MPPT Operating Range	125-500 Volts DC
Starting Voltage	125 Volts DC
Maximum DC Input Current (for each solar array input)	11 Amps DC
Overcurrent Protection (for each solar array input)	20 Amps DC
DC Overcurrent Category	Category II
Input Connectors	Amphenol H-4
DC Disconnects	2 - Integrated (2 pole DC breakers)
Residual Current Monitoring	Integrated
Insulation monitoring	Integrated

Utility interface specifications

Nominal AC Voltage / Frequency	230 VAC, 50 Hertz, single phase
Continuous AC Power Rating	4600 Watts AC (derate over 45°C ambient)
Maximum AC Power to Utility Grid	4600 Watts AC
Maximum AC Current to Utility Grid	20 Amps AC
Maximum AC Current from Utility Grid	40 Amps AC
Nominal AC Output Range	180 to 270 Volts AC, 45 to 55 Hertz (adjustable)
Current THD	Less than 1.5%
Power Factor Adjustment Capability	0.8 leading to 0.8 lagging
AC Overvoltage Category	Category III
Utility Grid AC Disconnect	Integrated (40 Amp AC breaker)
Anti-Islanding Protection	Integrated
AC Overcurrent Protection	Integrated
Inverter Topology	Transformerless (with HF transformer for battery)
Grid Regulation Compliance	AS4777.2, AS4777.3
Safety Certification	AS/NZS3100, IEC62109-1, IEC62109-2, IEC62040-1

Backup loads output specifications

Nominal AC Voltage / Frequency	230 VAC, 50 Hertz, single phase
Continuous AC Power Rating	4600 Watts AC (up to 45°C ambient)
Maximum AC Power Rating	6900 Watts AC (10 seconds maximum)
Maximum AC Current	30 Amps AC RMS / 43 Amps peak
Voltage THD	Less than 3.0% (with resistive loads)
Back-Up Loads AC Disconnect	Integrated (32 Amp AC breaker)
Residual Current Leakage Protection	Integrated RCD disconnect
Manual Back-Up Load AC Bypass Switch	Integrated

Battery interface specifications

Nominal DC Voltage	48 Volts DC
Battery Compatibility	Lead acid or lithium ion
Battery Capacity (Adjustable)	50 to 1000 Amp-hours
Maximum Discharge Power (from battery)	4600 Watts DC
Maximum Charging Power	4600 Watts DC
Maximum Charging Current	85 amps DC
Battery Charging Method	Three stage (adaptive with maintenance charging)
Typical Charging Voltage (bulk/absorption phase)	57.0 Volts DC
Temperature Compensation	Included
Battery Voltage Sensing	Integrated
Battery Current Sensing	Integrated

Efficiency specifications

Maximum Efficiency (to utility grid)	97.6%
European Averaged Efficiency	97.0%
Maximum Power Point Tracking Efficiency	99.9%
Efficiency (powering loads from battery)	90% typical
Standby Losses	Less than 8 watts AC

Physical specifications

Dimensions (W x H x D)	516 mm x 950 mm x 278 mm
Mounting	Wall (mounting plate included)
Weight	40 kg
Ambient Temperature Range	-25 to 60°C (derate above 45°C)
Relative Humidity	0 to 95%
Moisture Location Category	4K4H
Maximum Operating Altitude	4000 m
Environmental Protection Rating	IP65
Environmental Category	Outdoor or indoor
Cooling	Natural convection
Noise Emissions	Less than 25 dB

User Interface Specifications

Front ranel display	Multi-colored LED Indicators
Communications	Integrated wifi Interface for smartphone and web monitoring
Software	Web and Android/iOS application
Utility energy metering	Included kWh metering system for utility grid connection

Certifications, standards and approvals



Checklist

Installation details	_____
Owner's name	_____
Address	_____
Phone number	_____
Mobile number	_____
Email address	_____
Inverter serial no.	_____
Date of installation	_____
Date of commissioning	_____

Have you ticked all the boxes?

- ☐ Is the installation and cabling done according to the design, and meets all the relevant electrical codes?
- ☐ Is the inverter configured using the Redback App? (please contact Redback Technologies at 1300 240 182 to get installers password)
- ☐ Is the inverter connected to the cloud using the home wifi?
- ☐ Have you created 'an installation' on the Redback portal (<https://portal.redbacktech.com>)
- ☐ Check if the inverter is online and active by logging into the web portal (<https://portal.redbacktech.com>)
- ☐ Check if you can use the phone or tablet app to communicate to the inverter
- ☐ Demonstrate to the installation owner how to use the App and the Web portal. You may also show the owner how to add other users so that they be able to see the installation on the portal.

