

Rainbow Power Victron DIY Solar Installation Manual



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Introduction

The Rainbow Power Victron DIY Solar Systems are compact, do-it-yourself power systems. These systems can energize a lot of small gear, including an efficient fridge. Suitable for low-consumption or infrequent electricity users. Ideal for remote sheds, beach huts, motor homes or weekenders.

A Victron DIY Off-Grid System consists of a prewired wall-mountable distribution board complete with MPPT solar regulator, Circuit breaker referred to as CB.

The system can be used on 12 or 24 volt battery banks up to 1000 AH, and can integrate a maximum of 4 x 260 watt solar panels (@ 12v) or 6 x 260 watt solar panels (@24v).

The board offers easy integration of a Victron Battery Voltage Monitor (BMV), battery charger and a DC/AC battery inverter (300w @ 12v, 700W @ 24V).

The distribution Board comes Prewired with a 10 amp cigarette lighter socket, 2 x USB ports 2.1 mm DC socket for lights and 40 amp Anderson Plug for Inverter.

Safety

The RPC Victron MPPT Distribution board is an electrical device with potentially dangerous equipment. Care is required to protect yourself from injury. Read this section carefully and follow all safety precautions at all times. Please Take note of ***!Warning!*** throughout this guide.

Please refer to your specified wiring diagram to ensure correct connection of all equipment.

Please Note

Rainbow Power Co. takes no responsibility for any faults that occur due to incorrect connection or use of this equipment.

If after reading this manual you have any questions relating to the installation or operation of your system please contact RPC on 02 6689 1430

Danger to life due to Spark Hazard

Operating damaged equipment can lead to hazardous situations that result in death or serious injuries due to spark hazards and resulting risk of fire.

- Only use equipment when it is technically faultless and in an operationally safe state.
- Check the equipment for visible damage.
- Make sure that all external safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.

Danger to life due to explosive gases

Explosive gases may escape from the battery and cause an explosion if ignited. This can result in death or serious injury.

- Protect the battery environment from open flames, embers or sparks. Install, operate and maintain the battery according to the manufacturer's specifications.
- Do not heat the battery above the temperature permitted.
- Ensure that the battery room or enclosure is sufficiently ventilated.

Chemical burns and poisoning due to battery electrolyte

If handled inappropriately, electrolyte from the battery can burn the eyes, respiratory system and skin, and emit toxic fumes. This may result in blindness and serious chemical burns.

- Protect the battery enclosure against destruction. Do not open or deform the battery.
- Whenever working on the battery, wear suitable personal protective equipment such as rubber gloves, apron, rubber boots and goggles.
- Rinse acid splashes thoroughly with clear water for a long time and consult a doctor.
- Install, operate, maintain and dispose of the battery according to the manufacturer's specifications.
- Spills can be neutralized with a mixture of Bi-Carbonated Soda and water

Risk of injury due to short-circuit currents

Short-circuit currents in the battery can cause heat build-up and electric arcs. Burns or eye injury due to flashes may result.

- Remove watches, rings and other metal objects.
- Use insulated tools.
- Do not place tools or metal parts on the battery.

Working at heights

Climbing up the roof exposes you to the risk of falling off. A physical barrier (scaffolding) or a correctly supported safety harness is required whenever anyone climbs onto the roof.

Lifting Injuries

The batteries are heavy and should be moved using good lifting techniques.

- Keep back straight,
- Stomach muscles should be tightened and lifting should be done with your legs.

- If they are too heavy to lift by one person then two people or mechanical lifting aids will be required

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Scope of Delivery
Your kit includes the following items

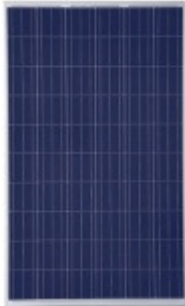
RPC Distribution Board



Battery Box



Solar Panels



Batteries



Battery Leads

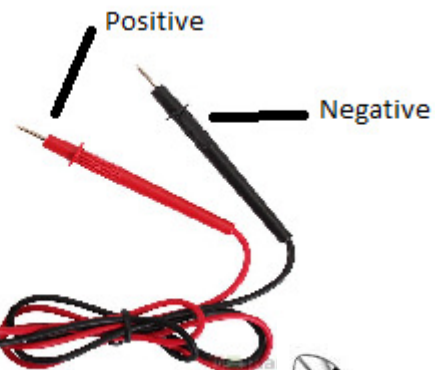


Solar Cable



Additional Tools Required

- Screw Driver
- Shifter
- Wire Cutters
- 20mm hole saw
- Multimeter



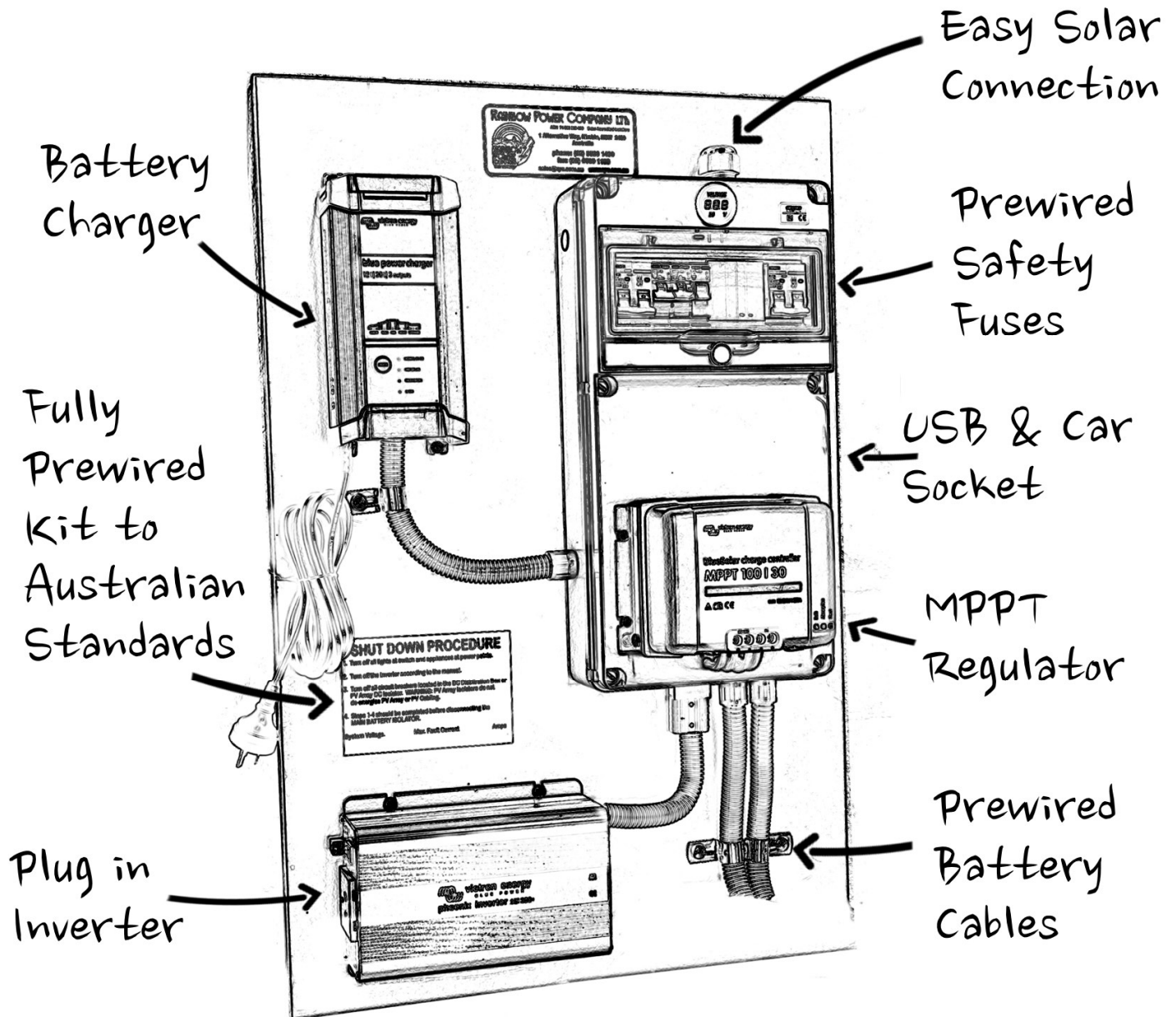
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Product Description

Rainbow Power Victron DIY Solar consists

The Rainbow Power MPPT Mini Distribution board comes with:

- Victron MPPT solar controller
- 9 pole DC Distribution box
- 1 x 63A DC CB Main battery - double pole
- 1 x 20A DC CB solar controller – double pole
- 1 x 13A CB for Cigarette socket/USB socket
- 1 x 40A CB for Pluggable Inverter.
- 1 x 6A CB for 2.1mm DC Socket for Sundaya Ulita Lighting
- 1 x inline fuse for digital LED Voltmeter
- 1 x 40A CB for Battery charger Optional



Victron MPPT Solar Regulator

The BlueSolar -MPPT charge controller is able to charge a lower nominal-voltage battery from a higher nominal voltage PV array, and is rated at max 100V open circuit voltage (on input).

Volt Meter

The Led Voltmeter provides information regarding your battery voltage. This is useful in the operation of your system. Please refer to your Operation Manual for further details.

Battery Monitor (BMV) Optional

High precision battery monitor from Victron Energy with the basic display options, such as voltage, current and ampere-hours consumed, the BMV-700 series also displays state of charge, time to go, and power consumption in watts.

Inverter

Victron Energy Phoenix Inverter 12V 300W or 24v 700W, with 230 volt AC output (standard AU/NZ outlet).

The Phoenix is built for professional duty and yet competitively priced without compromise in performance. The compact Phoenix delivers a pure sinusoidal (sine wave) output waveform and an impressive start up power (peak power). Please refer to the Victron Phoenix Series

Optional Battery Charger

Compact battery charger in a wall-mountable, compact IP22 enclosure. The Blue Power charger features a microprocessor controlled 'adaptive' battery management. The adaptive feature will automatically optimize the charging process relative to the way the battery is being used.

Note!

Please refer to supplied manufacturer's equipment manuals for detailed instructions on installation and operation of each piece of equipment.

Installation Requirements

Distribution Board

The Rainbow Power Victron MPPT Distribution Board will need to be placed in a cool, dry place, with enough room to plug your optional inverter into the Anderson plugs on the Distribution board.



Solar cells



Electronics board



Battery box

Solar Panels

Solar Panels need to be secured in a sunny position close to the RPC Distribution board. The wire size needs to be large enough to overcome the resistance in the cable which causes voltage drop. If the cable length is < 20m a pair of 4 mm² cables can be used, if cable run is between 20-30m 6mm² cable is advised. Panels should preferably face due north at an optimum sun angle of between 20 – 40 degrees from horizontal depending on your latitude. This will get the most power from your panel. Please consult your framing installation manual for detailed installation instructions.



Solar panels in 1 row



Solar panels in 2 rows



Solar panels flat mounted

PV Array Wiring

To increase safety, the PV array wiring in RPC renewable energy systems operates at less than 100 VDC. Although this increases safety, precautions against faults and fire risks should be taken. All PV array wiring should be protected from environmental damage. Protection from UV, Water and Vermin needs to also be considered. RPC recommends the use of conduit or other protective measures to alleviate these risks.



PV Panels come in a range of voltages. Your installation may require a combination of series and/or parallel connections to achieve the correct solar voltage for your system. Please consult with the PV data sheet and your *“Wiring Diagram”* for correct configuration details. We have provided a generic diagram in this manual. Make sure that the PV Panels all have the same electrical characteristics, if they are not of the same brand when connecting to your ‘RPC Mini Distribution board’.

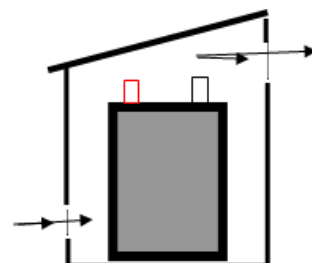
Batteries

The Batteries need to be housed in a safe place out of the sun, which allows adequate ventilation for any explosive gases to dissipate. The batteries ideally should be located in a lockable box with vermin proof ventilation holes. The Battery Box needs to ensure escaping hydrogen gas will not be exposed to sparks, naked flames or electrical equipment. Battery boxes and appropriate battery warning signs can be supplied by RPC if required.



Placement of Battery ventilation in box to stop build up of explosive gases.

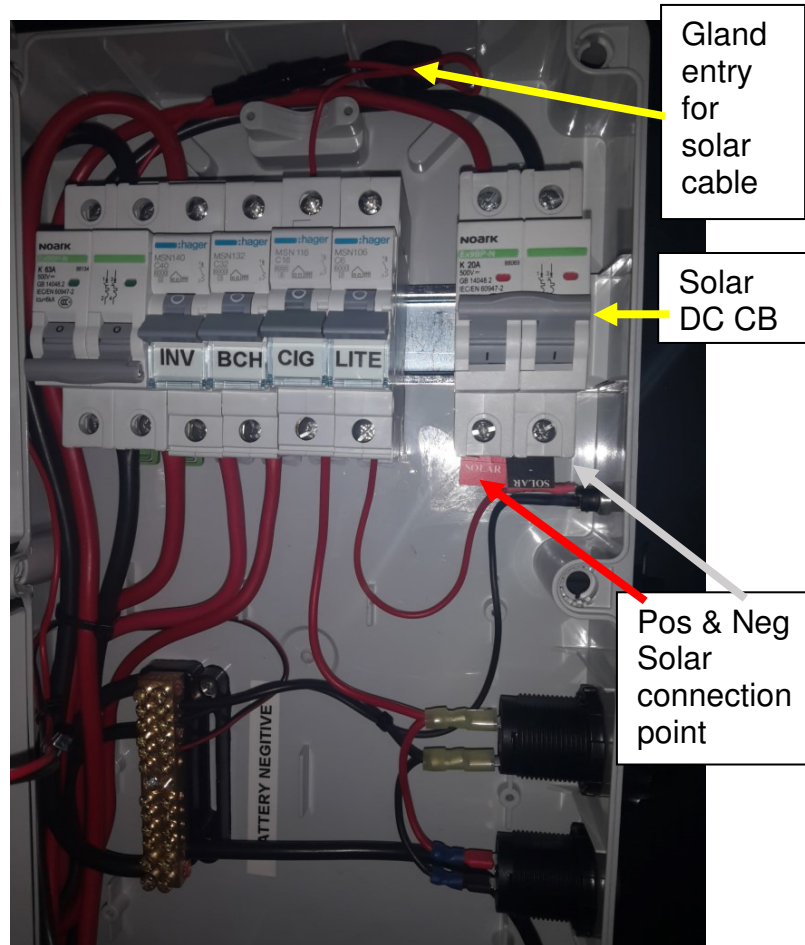
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Electrical Connections

Photo 1: Inside of box showing connection points for solar.



Connecting Solar Panels.

- 1 Make sure the MAIN BATTERY ISOLATOR is turned off and solar array cables are disconnected from the panels via the MC4 plug and socket.
- 2 Open DC distribution box and locate the double pole Solar DC CB located at the far right hand side of the din rail.
- 3 The PV array cables will feed into the distribution board through the gland at the top of the box.
- 4 Connect the **Positive +** solar cable to the bottom positive terminal **Solar +** of the Solar DC CB
- 5 Connect the **Negative -** solar cable to the bottom negative terminal **Solar -** of the Solar DC CB

Only two strings per CB, as per you wiring diagram. Solar “Strings” are panels connected in series to give a specific voltage. The string voltage must never exceed 100 OCV. Before turning on check with a Multimeter to make sure polarity is correct and voltage is <100VDC.

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Battery Configuration

Battery banks are made up of multiple 2v cells. Cells are assembled into individual batteries of 2, 6 or 12V. These units are combined in series to attain the designed system voltage of (2 x 6v = 12VDC , 4 x 6v = 24 VDC)

To make a Series connection the **+POS** from one battery will be connected to the **-NEG** of the second battery and so on until the desired voltage is achieved by adding the individual battery voltages.

Connecting 1 x 12V battery

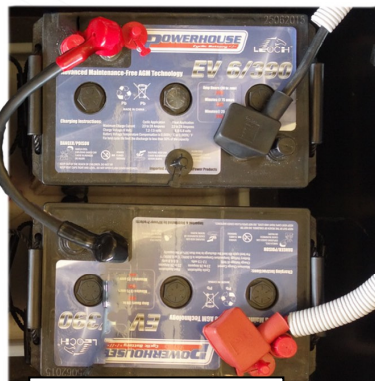
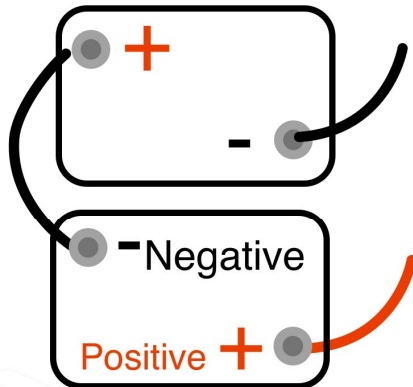
Connect the **+POS** lead from the distribution board onto the **+ POS** battery terminal. Connect the **-NEG** lead from the distribution board onto the **-NEG** pole on the battery. Make sure all connections are tight.

Connecting 2 x 6V batteries

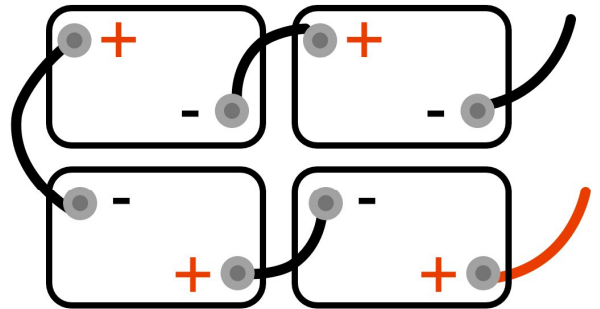
If your system is supplied with 2 x 6V batteries, you will need to connect them in series. Make sure all connections are tight.

12v & 24v Battery Bank Configuration .

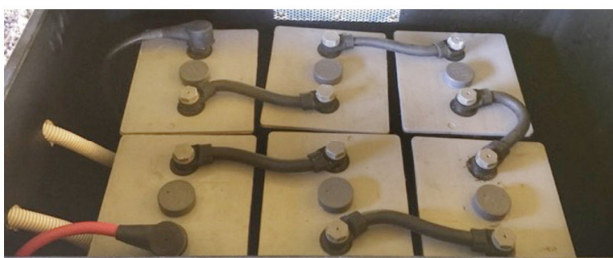
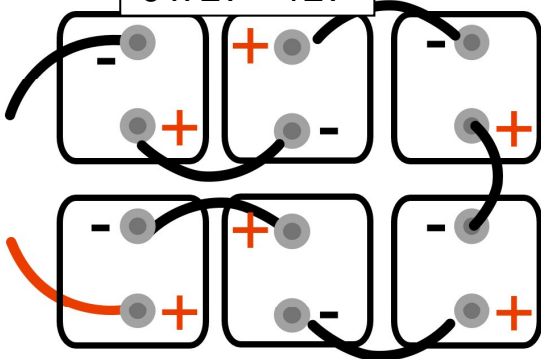
$2 \times 6v = 12v$



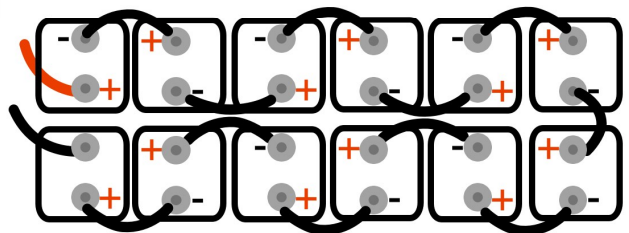
$4 \times 6v = 24v$



$6 \times 2v = 12v$



$12 \times 2v = 24v$



To Connect the Batteries,

1. Drill a hole for the positive and negative battery cables through the side of the battery box.
2. Connect the Battery **+POS** cable from you distribution board to the positive terminal on your battery and the Battery **-NEG** cable to the negative terminal on your battery.
3. Connect battery (or batteries) interconnect cables, if applicable, in the correct configuration as shown in your "Wiring Diagram". Check voltage with a Multimeter to determine battery voltage and correct polarity.
4. Make sure all connections are tight. Check that voltage and polarity are correct with a Multimeter at the 'Main Battery Isolator' terminals.
5. Smear Petroleum jelly or a similar product onto the battery terminals, this will help protect the terminals from corrosion.

!Warning!

Make sure all Circuit Breakers are in the off position before working on Batteries.

!Warning!

When connecting the batteries be careful not to connect between positive and negative on the same battery. Batteries can, under fault conditions, deliver thousands of amps and explode spraying sulphuric acid.

!Warning!

Lead Acid Batteries contain Sulphuric Acid. Care is required as well as use of appropriate Safety Equipment (Safety Glasses, Rubber gloves and a leather apron, insulated tools). If Batteries are Flooded Lead acid batteries (FLA), they require demineralized water to be added periodically. If any acid has been spilt from the batteries a Bi-carb Soda and water mixture should be used to neutralize the acid. Do not get this in the battery.

GEL or VRLA or Sealed lead acid batteries do not require anything added to them but still require care when handling.

Connecting Optional Accessories

The RPC MPPT Mini Distribution board also has the ability to connect a small inverter via an Anderson plug. A battery charger can also be installed with the inclusion of an appropriate sized CB. Always be sure to check that wire and CBs are the right size for the appliance and application. See tables 2,3 & 4 for wire size and allowable voltage drop.

Inverter

The inverter connects to the Rainbow Power Distribution board via a 50 amp Anderson plug located at the bottom of the board(Pictured below). 230 Volt AC connection is via a standard 10 amp AU/NZ Plug. Before plugging or unplugging the inverter ensure you turn off the inverter and CB before connecting into the Anderson plugs on the Rainbow Power DC Distribution box.



Battery Charger / Generator

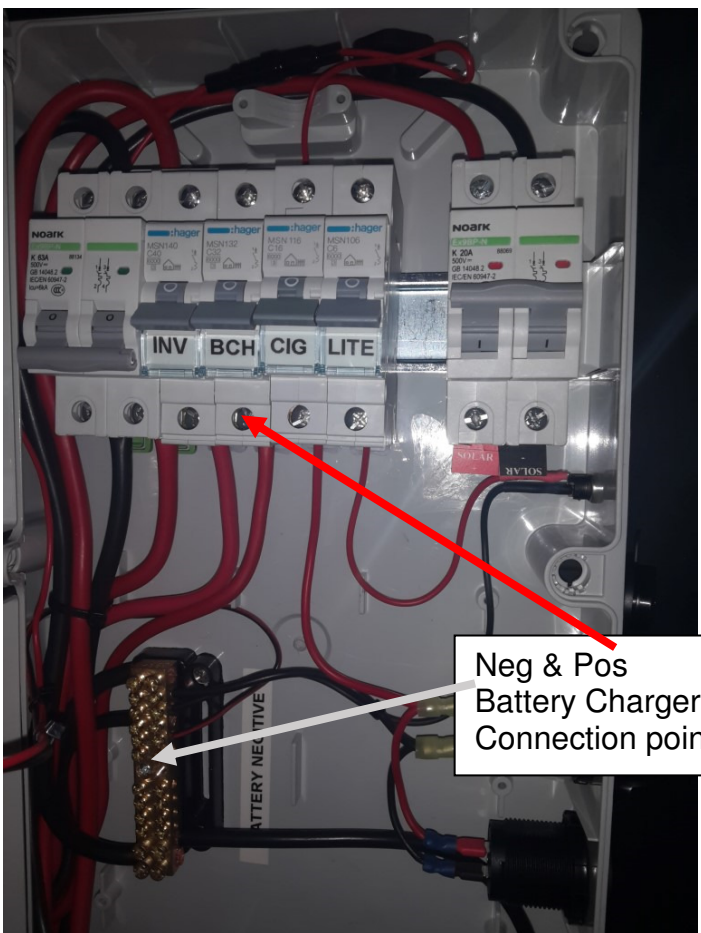
The optional Battery Charger can be hard wired via an additional CB on the din rail. The right sized CB should be selected to protect the wiring between the battery charger and the distribution box (please see wiring guide Tables 1-3)

Adding Additional CB to your system

When adding additional CB to your system you will need to energize the top of the CB by adding a short linking wire the, same size as the Batterie Charger cable, between the top of the existing CB and the top of the additional CB.

Connecting the Battery Charger

1. Shut down your system via shutdown procedure.
2. Connect Battery Charger **NEG** to Battery Negative link in Distribution Board
3. Connect Battery Charger **POS** to bottom of CB in in Distribution Board
4. Close Distribution Box.



Neg & Pos
Battery Charger
Connection point



When adding
additional CB
you may need to
install a wire to
energize the top
terminal of the
new CB.

Connecting DC Load Circuits

The RPC Distribution Board comes fitted with three sockets.
-2.1mm DC Socket for Ulitium lights (12v configuration only)
-2 x USB charge points
-1 x cigarette lighter socket

Adding additional Hard Wired Circuits

Additional Circuits can be added to the distribution board through connection to an appropriate sized CB, The **Battery Neg bus bar** is the negative connection point for 12/24V DC appliance. The Positive wire should connect into the load side of a LOAD **POS** CB. DC loads up to 10A can be used. Refer to Table 1 - 3 for appropriate wire sizes.

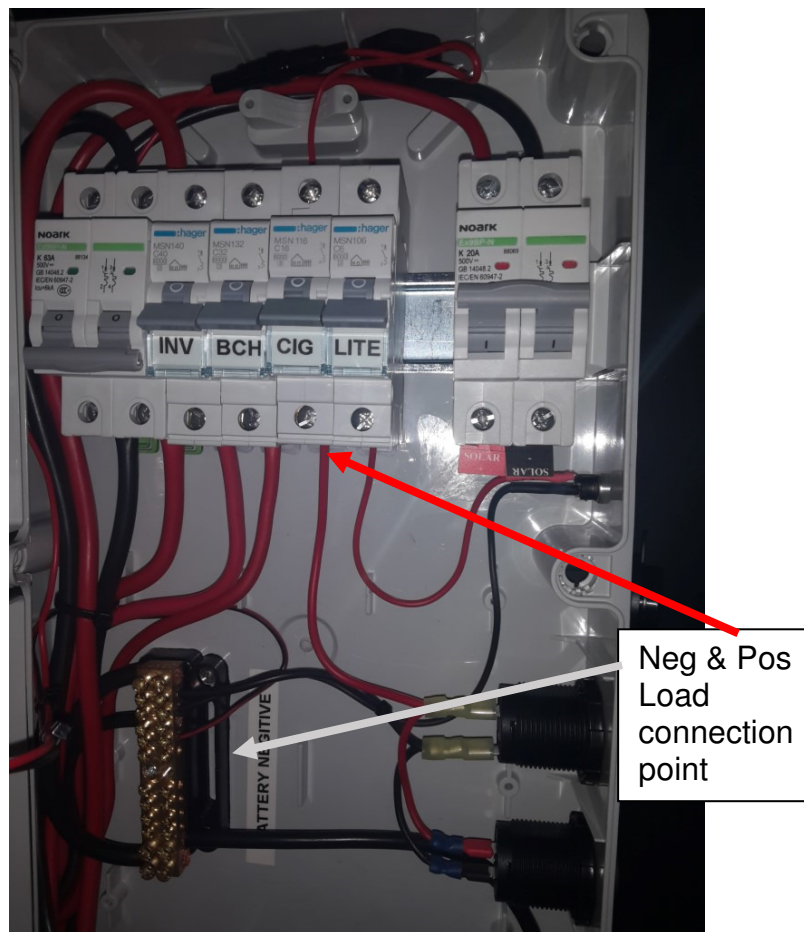


Table 1: Ampacity of cables. Maximum fuse sizes.

Cable Size	Maximum Fuse Size
49 mm ²	150 amps
32 mm ²	110 amps
21 mm ²	90 amps
13.6 mm ²	70 amps
7.9 mm ²	45 amps
4.6 mm ²	25 amps
2.9 mm ²	20 amps
1.84 mm ²	15 amps

Table 2: 12V DC Wire sizes in mm². Acceptable distances to run 12V DC cable. Length cable per ampere load. Length is from source to load.

12 Volt

Amps	acceptable cable size (mm ²)							
	Cable Length (metres)							
	1	2	5	10	15	20	25	30
0.5	0.4	0.4	0.4	0.4	1.84	1.84	1.84	1.84
1	0.4	0.4	0.4	1.84	1.84	1.84	1.84	1.84
1.5	1.84	1.84	1.84	1.84	1.84	1.84	2.9	2.9
2	1.84	1.84	1.84	1.84	1.84	2.9	4.6	4.6
3	1.84	1.84	1.84	1.84	2.9	4.6	4.6	7.9
4	1.84	1.84	1.84	2.9	4.6	7.9	7.9	7.9
5	1.84	1.84	1.84	4.6	4.6	7.9	7.9	13.6
7.5	1.84	1.84	2.9	4.6	7.9	13.6	13.6	25.7
10	1.84	1.84	4.6	7.9	13.6	13.6	13.6	25.7
15	1.84	1.84	4.6	13.6	25.7	25.7	25.7	32.2
20	2.9	2.9	7.9	13.6	25.7	25.7	32.2	49.2
25	4.6	4.6	7.9	25.7	25.7	32.2	49.2	49.2
30	4.6	4.6	13.6	25.7	32.2	49.2	49.2	
40	7.9	7.9	13.6	25.7	49.2	49.2		
60	13.6	13.6	25.7	49.2				
80	25.7	25.7	25.7	49.2				
100	32.2	32.2	32.2					
125	49.2	49.2	49.2					

Table 3: 24V DC Wire sizes in mm². Acceptable distances to run 24V DC cable. Length cable per ampere load. Length is from source to load.

24 Volt

Amps	acceptable cable size (mm ²)							
	Cable Length (metres)							
	1	2	5	10	15	20	25	30
1	0.4	0.4	0.4	1.84	1.84	1.84	1.84	1.84
2	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84
3	1.84	1.84	1.84	1.84	1.84	1.84	2.9	2.9
4	1.84	1.84	1.84	1.84	1.84	2.9	4.6	4.6
5	1.84	1.84	1.84	1.84	2.9	4.6	4.6	4.6
7.5	1.84	1.84	1.84	2.9	4.6	4.6	7.9	7.9
10	1.84	1.84	1.84	4.6	4.6	7.9	7.9	13.6
15	1.84	1.84	2.9	4.6	7.9	13.6	13.6	25.7
20	2.9	2.9	4.6	7.9	13.6	13.6	25.7	25.7
25	4.6	4.6	4.6	7.9	13.6	25.7	25.7	25.7
30	4.6	4.6	4.6	13.6	25.7	25.7	25.7	32.2
40	7.9	7.9	7.9	13.6	25.7	25.7	32.3	49.2
60	13.6	13.6	13.6	25.7	32.2	49.2	49.2	
80	25.7	25.7	25.7	25.7	49.2	49.2		
100	32.2	32.2	32.2	32.2	49.2			
125	49.2	49.2	49.2	49.2				

Commissioning

Before turning the system on

Test the polarity of all connections with a Multimeter. Check that all connections are secure and tight.

Commissioning Checklist	12v	24v	Recorded
Visual inspection of Equipment for Damage	Please notify RPC if any visual damage of equipment and wiring exists.		Y/N
Torque Test	All bolts and screws are tight Aprox 20 nm		Y/N
Polarity Test	Check correct polarity of pos and neg connections on bats and solar before turning CB on.		Y/N
Open Circuit Solar (Volts)	70-80 VDC < 100Vdc		_____ VDC ?
Battery Voltage	12.0 - 14.4 Vdc	24.0 – 28.8 Vdc	_____ VDC ?
DC Load Test	Equipment suppling dc Power		Y/N
Regulator Settings	Settings to Batterie Type		Y/N

The batteries need to be energise first for the MPPT Solar controller to recognise battery voltage. The PV should be the last item to be energised.

The Rainbow Power Distribution Board will have a ‘SHUTDOWN PROCEDURE’ showing you how to turn off the system. To energise the system the ‘SHUTDOWN PROCEDURE’ should be followed in reverse.

Turning on the system

1. Turn on **‘MAIN BATTERY ISOLATOR’** CB. The Voltage meter should now show a voltage reading.
2. Turn on **‘SOLAR’** CB. The Blue LED light on the regulator will now turn on. This will begin the charging process.
3. Turn on **‘USB’ and ‘Light’** CB.
4. Turn on **‘Inverter’** CB. Turn Inverter switch to On. Green LED on face of inverter should turn on.

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5. It is now safe to turn on devices and load test you system.

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Additional Information

Victron MPPT Manual
Inverter Manual
Battery Charge Manual
Solar Panel Data Sheet
Battery Data Sheet
PV Array Framing Guide
Commissioning Sheet

Contact

**If you have any problems or question please contact Rainbow Power Co.
on (02) 6689 1430. or Sales@rpc.com.au**

Notes.