

REhub

MPPT Eco
Solar Upgrade Made Viable

REhub-12/24-25

User Manual Ver 3.0



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Product Warranty

1. We warrant the original goods purchased for a period of 12 months after purchase.
2. Please register your device with the following Serial Number with us by sending a mail to

info@amberroot.com for validating this Warranty certificate.

3. Warranty is invalid if the device is used other than as intended by the manufacturer.
4. Within the warranty period we will repair or replace at our option all failures which are caused by material or manufacturing faults.
5. Amberroot will not be responsible for any consequential damage.
6. A warranty repair does not extend the warranty period.

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No warranty claims will be accepted for damages resulting from handling, use or treatment that are not explicitly mentioned in this manual. In particular, damages arising from the following causes are excluded from the warranty

1. Voltage higher than 90V across PV or battery terminals.
2. Battery cables connected across PV input terminals.
3. Accidental presence of liquids in the equipment or oxidation due to condensation.
4. Damage resulting from falls or mechanical shocks.
5. Opening the unit/lid or modifications carried out without the explicit authorization of Amberroot Systems.
6. Damage due to atmospheric surge voltage (lightning).
7. Damage due to inappropriate transportation or packaging.



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1 Introduction

REhub enables adding Solar PV to existing back up solutions that use UPS/Inverter and Batteries. REhub controls the charging of the batteries from from two sources – the Grid (charging by the existing UPS/Inverter) and the installed Solar PV. **REhub** provides the right combination for adding Solar PV. REhub **intelligently controls** the charging process in a way that keeps the **batteries safe** and therefore extends their life. They allow the **maximal use of Solar** power.

2 REhub MPPT Eco Operation

2.1 REhub Operation

REhub prioritizes keeping the Batteries charged for sufficient back up. There are two sources of energy to deliver power to the batteries. Solar PV panels and the Grid Mains through the back up Inverter. REhub extracts power from the Solar Panel using a **high efficiency MPPT based charger**. MPPT stands for Maximum Power Point tracking and the unit extracts power from the Solar panels at the Voltage and Current that delivers the maximum power (called the Maximum Power Point). Since this Maximum Power Voltage and Current Varies, the Unit uses sophisticated algorithms to 'Track' this maximum power point. Additionally, REhub allows the conversion of existing Inverters to Solar based systems. REhub does this by controlling the Mains Input to the Inverter. At all times, REhub ensures that the batteries are kept absolutely safe and maximum Solar power is used to power the Loads. REhub is designed to work with Inverters (12V or 24V) of any make. However it is advisable to use REhub with efficient, Pure Sine Wave output Inverters. Determine the approximate Loads (day time Load connected to the Inverters) and match the amount of Solar panels installed so that the energy generated per day is approximately equal to the energy consumed by the loads for best results with your Solar addition.

REhub functions in the following manner:

- When Batteries are discharged – the batteries are charged using both the Solar PV and Grid if Mains power is available.
- When Batteries are >90% charged (Voltage >13.5/27V for at least 5 minutes) AND Solar PV is available, the GRID based charging from UPS Inverter is cut off, Energy for the Loads and Charging the batteries is supplied from Solar PV.
- When the Battery Voltage drops below 12.3/24.6V and remains in this state for at least 5 minutes OR Solar PV is unavailable, the Mains Input to the Inverter is switched on again.

The set points can be changed using a special cable 'Amberlink'. The configuration using Amberlink is given in a separate manual available with Amberlink.

2.2 Battery charging stages

REhub follows a three stage charging from the Solar PV.

- Bulk mode : As much current as available and permissible for the batteries is delivered to the batteries
- Float mode : Only as much current as need to keep the batteries charged completely is delivered.
- Absorb Mode : The unit keeps the battery Voltage constant till the Current absorbed by the battery is lesser than 1A.

3 General information

3.1 About this User Manual



This manual contains all the necessary information and procedures to install, configure, use and troubleshoot REhub Solar MPPT chargers for use with Inverters. It does not contain information

about photovoltaic modules (PV) or batteries or Inverters of various brands that can be connected. For information of those devices, please refer to the instructions of each specific manufacturer.

3.1 Important safety information

This manual contains important safety instructions. Read carefully and follow all the safety and operation instructions before using REhub. Take into consideration all the warnings mentioned both on the equipment & in this manual. This user manual is intended to serve as a guideline for the safe and efficient use of REhub. The installation and commissioning of REhub must be entrusted to qualified personnel. The installation and use must comply with the local safety instructions and standards in force.

3.2 Symbols used in this manual

	<p>This symbol is used to indicate safety instructions which, if not followed, could result in serious personal injury or death to the operator or the user.</p>
	<p>This symbol is used to indicate a risk of material damage and/or the cancellation of the Warranty.</p>

3.3 Limitations of Liability

We disclaim all responsibility and liability for damage, costs or losses resulting from an installation that does not comply with the instructions, a faulty operation or inadequate maintenance. The use of REhub is in any case under the responsibility of the customer.

THIS EQUIPMENT IS NEITHER DESIGNED NOR GUARANTEED TO SUPPLY INSTALLATIONS USED FOR VITAL MEDICAL CARE NOR ANY OTHER CRITICAL INSTALLATION ENTAILING POTENTIAL RISKS OF DAMAGE TO PEOPLE OR TO THE ENVIRONMENT.

We assume no responsibility for the infringement of patent rights or other third parties rights resulting from the use of the Charger. Amberroot reserves the right to make any modifications to the product without prior notification.

AMBERROOT IS NOT LIABLE FOR INCIDENTAL, DIRECT OR INDIRECT DAMAGES OF ANY KIND, INCLUDING ANY PROFIT LOSS, REVENUE LOSS OR DAMAGES CAUSED TO EQUIPMENT OR GOODS DUE TO DEFECTIVE EQUIPMENT.

4 Installation

4.1 UNPACKING

When unpacking, check that the equipment has not been damaged during transportation and that all accessories listed below are present. Any fault must be immediately reported to the product distributor or to the contact mentioned in the front page of this manual.

Standard accessories:

- Installation and operation manual.

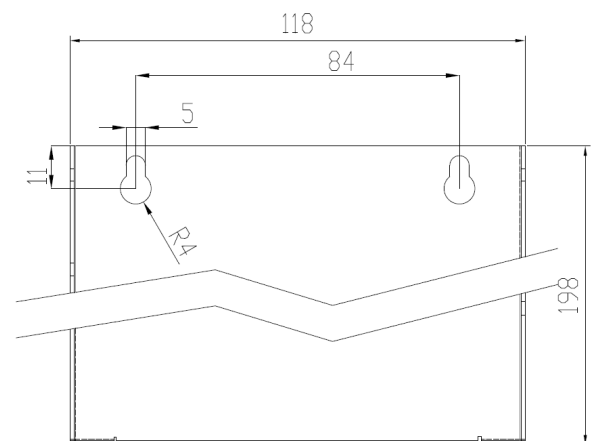
4.2 Where to Install

REhub must be installed on a flat wall vertically. Keep the air vents clear of any obstruction. Leave sufficient space around the unit for air circulation.

Install in an area which is

- Protected from any unauthorized person and children
- Protected from direct solar radiation or heat sources.





The presence of a heat source may significantly reduce its rated power. Similarly, insufficient ventilation may lead to the overheating of some internal components of the equipment. In this



Drawing 1: Dimensions for mounting on wall

case, the device will automatically limit its power as long as this abnormal situation persists. Do not expose REhub to any dripping liquids.

5 Wiring

	Wiring must be done by a professional qualified for such installations. Take extra care while connecting High voltage systems, Battery terminals.
	Take care to not connect the panels to the battery input or the connection of the batteries to the PV input.
	TAKE CARE not to connect the AC line to any of the DC (PV or Battery) connections.
	REhub is intended to be connected exclusively to Solar Photovoltaic source. It is suitable for charging any type of lead-acid batteries.

REhub is electronically protected against overloads, PV short-circuits, overheating, polarity reversal of the battery, polarity reversal of the PV.

5.1 Components of the Cable Compartment

Access the cable compartment after removing the L Plate.

Cable entry is through the slot in the L Plate. Close the L Plate after the terminals are sufficiently tightened and all the connections are checked for correctness. Refer wiring drawing in the last page.

S/no	Description	Comment
1	Terminal to connect Solar -Ve	Ensure appropriate cable size is used and ends properly crimped to avoid accidental shorts from stray strands. Ensure that the input Voltage and Current (String sizing) do not exceed name plate ratings.
2	Terminal to connect Solar +Ve	
3	Terminal to connect Battery +Ve	
4	Terminal to connect Battery -Ve	
5	3 PIN,15 A Plug to connect AC input from Mains	Connect this plug to Mains replacing the existing Inverter connection
6	Socket to connect AC input of Inverter	Connect existing Mains-in Plug of the Inverter to this socket
7	Data Port	Connect Amberlink® (available for purchase separately) to this port.
8	Mode Select Switch	Use this switch to Select the way in which Mains input to the Inverter is controlled.

Table 1: REhub Terminals

5.2 Solar PV connections

REhub accepts input voltages between 0V to 90V. It can start charging the batteries when the input voltage is above the battery voltage. Keep the connection ready. Close the connections when you are ready to POWER Up.

5.3 Serial connection of Solar PV string

REhub can operate at a much higher PV voltage compared to the Battery system Voltage. It is therefore not necessary to match the PV panel voltage to the Battery Voltage. However the name

plate limits of the PV input must be strictly followed.

To get the optimum Voltage, the solar modules shall be connected in series to form a string having the desired voltage. The optimum operating voltage of the module string (Vmpp) must always be above the battery Voltage.

To establish the **minimum number** of PV modules to be connected in series in the same string, the max voltage of the battery must be multiplied by 1.1 and divided by the modules Vmpp voltage.

For example, for a 24V system with a lead-acid battery with maximum Voltage of 30 V and using PV panels with 17V Vmpp. $30 \times 1.1 / 17 = 1.94$.

The result must be rounded up to the higher value (i.e. 2 modules - of 17 Vmpp - in series for the above example is the MINIMUM number of panels required for operation).

Maximum Panels in Series

The open-circuit voltage of the string must be lower than 90V under any temperature and irradiation conditions. To establish the **maximum numbers of the PV modules connected in series in the same string**, use the following

formula: $90V / (Voc)$. (Example: $90 / (22) = 4.09$). The result must be rounded down to the lower value (i.e. 4 modules - of 22 Voc - in series for the above example).

There can be thus 4 PV modules in series of the mentioned model for a 24V system as per this example.

Table 2 gives an idea of the possible arrangements for common panels according to the number of cells or

Solar PV panels in a string						
36 Cell Solar Panel with Voc<23V		60 Cell Solar Panel with Voc<38V		72 Cell Solar Panel with Voc<45V		
Battery Voltage	Min	Max	Min	Max	Min	Max
12V	1	4	1	2	1	2
24V	2	4	2	2	1	2

Table 2: Maximum Panels in a String

their type. Note that CIS or other forms of THIN film PV modules cannot be connected to REhub unless their Voc is <90V.

5.4 Parallel connection of Solar PV string

To get the required charging power, 2 or more strings are usually to be connected in parallel. Each string connected in parallel must be composed by the same number of modules of the same type.

The number of strings connected in parallel depends on the Isc of each string. When you need to determine the Isc of the parallel array, it is the Isc of each panel multiplied by the number of parallel strings. For example, if the Isc of the panels used in the system is 4A. And the number of Parallel strings is 4, then the Isc of the array is =16A.

The total power of the array can be slightly higher than rated power of REhub. This excess capacity is designed in to get the desired charging power under all circumstances of Solar radiation. However, the output current from REhub will be limited to the maximum rated current.(This is 25A in REhub-12/24-25 models)

5.5 Cable Size

Based on Array arrangement, calculate INPUT current. Choose the appropriate cable size for INPUT current based on the length of the cable from the PV panels to REhub. REhub must be located close to the Batteries. Connect the PV +Ve to Terminal [2] and connect PV -Ve to Terminal [1].

5.6 Battery Connection

There are two connections to the batteries from REhub. Connections [3- Battery +ve] and [4 - Battery -Ve] deliver the Solar charge to the batteries. Keep the Inverter in switched off / Away mode till you are ready with all connections. Do not close the Battery connections till you are ready

for POWER UP.

5.7 Inverter Connection

The Mains input LIVE of the Inverter is controlled by REhub. Disconnect the Mains to Inverter connection plug and connect to the REhub Socket [7]. Connect MAINS input cable [6] to Mains Live input. The rated Load current of the connected Inverter MUST be less than 60A. Keep the Inverter in Away/ Off mode till you are ready for the Final Power UP.

6 Powering Up

Connecting the battery terminals will energize and start the unit. Do this last. Before energizing the equipment, recheck the polarity and the connections. Keep the MAINS MCB switched off.

A. Connecting the battery: On the BAT+Ve and BAT-Ve terminals. Check the battery terminal Voltage. Make sure you have chosen the right Battery system Voltage for the REhub. A 12V battery system will have Voltage between 10.8V to 14V. A 24V battery is likely to have a Voltage between 22V and 28V. On first time power on REhub will go to Auto Detect Mode

B. Completing the PV+ and PV - connections.

Check the Voltage between PV+ and PV- wires before closing the PV -ve. You will get a Voltage approximately equal to the open circuit voltage of the array.

Note if the installation is being done in the night you will not get the Voc value but likely to get a Voltage which is much lesser.

C. Complete the Battery GND to Inverter connections and the AC live from Mains connection.

Switch on the AC MCB. Put the Inverter to normal mode.

Take care not to Swap Solar PV and Battery connections. **The unit is not protected for such a Swap.** The unit will not Power UP if Battery is connected in Reverse Polarity. If PV Polarity is swapped, the unit will show Solar as 'LOW'.

7 LCD Screen Indications

The Back light on the screen is ON by default when Solar is available & switches off when there is no Solar energy. To Switch on the Back light when Back light is Off, press and release the Mode Select switch for the back light to be switched on for the next 60 seconds.

7.1 Start-up screens

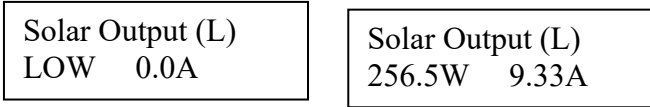
REhub MPPT Amberroot Sys	Model 0X113 12/24V – 25A	Ver:0x03b DB:22 SL # 00019	REhub MPPT Eco Detecting System
Battery System Voltage 24V			

Make sure that the correct battery system voltage is recognized.

7.2 Display screens

Solar Y Mains Y Mains to Inv: Y +	Battery 27.5V	Solar Input 73 V	Solar Output 632.5W 23 A
Solar Units 0.01Kwh	Int Temp:33°C		

The display scrolls through the screens shown above. Solar is Y if available. Mains is Y if available. Mains to Inv is Y if the Mains input to the Inverter is ON : This is controlled by Rehub based on the state of charge of the batteries and availability of Solar Power. The + / - sign indicates that a counter is running which will change the state from Y to N Or N to Y . Mains to Inv : Y means the Inverter and Solar(If Solar is Y) are charging the batteries. The Solar output screen shows the Output Amps and the instantaneous Power generated. When Solar is unavailable, it is shown as LOW.

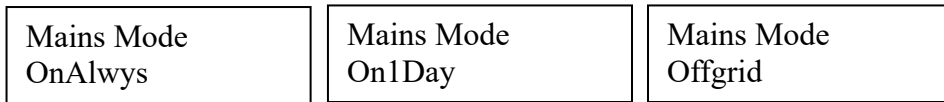


When you see L within brackets, this indicates that REhub is limiting the current output to keep batteries safe. The current limit is by default set at 10A and is triggered when Mains is available and Mains to Inverter is ON.

Both the Inverter and Solar charger are charging the batteries. The 'Energy' screen (Solar Units) shows the Cumulative energy generated by Solar PV. The screen shows the total energy generated from the Solar PV panels from the date of Installation. The value can be reset by disconnecting the batteries.

The Int Temp is the Internal temperature of the Heatsinks.

When the unit is set to a mode other than Auto, one of the following screens is additionally shown in each cycle.

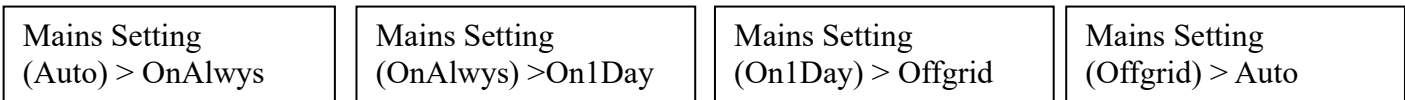


7.3 Using Auto and Override modes in REhub.

REhub by default is in **Auto** mode. REhub decides to switch off the AC Mains input to the Inverter based on the availability of Solar energy and the state of charge of the batteries. This forces the Inverter to use Solar energy to service the Loads. Similarly REhub auto restores the Mains connection when there is no Solar energy or the state of charge of the batteries is below a set value. As a user you can decide to **OVERRIDE** the decision of REhub by forcing REhub to keep the Mains switch ON. In ONAlwas (For On Always) mode, REhub keeps the Mains ON at all times. In ON1Day (for ON One Day) mode, REhub keeps REhub ON for the next 24 Hours and goes back automatically to Auto Mode at the end of 24 Hours. In OFF Grid mode, REhub continues to keep the Mains input to Inverter in forced OFF even when Solar is unavailable till the Battery reaches 12.5V/25V. These Override modes may be required in case the day is very cloudy and Inverter is toggling frequently between using Solar and using the Mains to power the load. Alternately, This may be required if heavy loads like Mixer-grinder is connected to the lighting circuit supported by the Inverter. When running a mixer, switch to ONAlwas or ON1Day mode when power is available, to ensure the Inverter is not delivering power from the batteries to the mixer. Make sure to switch back to Auto when the desired usage is completed.

7.3.1 Changing Mode using Mode Switch.

Press and hold the Mode select switch. The unit will display the mode it is in <Brackets>. By default, the unit will be in Auto Mode. If you continue HOLDING the Mode select button in pressed position, the next option moves to the bracketed position. Releasing the button now will select that option. Continue pressing the switch and the display cycles through the three options. REhub will move to the Mode that is in bracketed position when the button is released. When a Mode is selected you will get a confirmation screen indicating the mode in which REhub is functioning now.



7.3.2 Errors and resolution

The Errors indicated in screen in REhub are typically self recoverable. However if you are repeatedly getting certain errors please contact us.

Error in the system
Batt Prot Trip

Error in the system
Err 12 15.9 V

Error in the system
High Temperature

Bat Prot Trip : Sudden surge or voltage change is observed in the battery terminal. The next screen could indicate the error # and the Battery Voltage. If possible capture the details of this screen to help us zero in on the problem faster. High Temperature: Sustained Internal temperature beyond normal operating temperature. Could indicate the Fan is non functional.

Given below are some error conditions and what to do when you get them.

Error	Possible Reasons	Error Messages	Ways to eliminate
No Display	Batt Not On Or not connected	None	Turn on Battery
	Battery Reverse	None	Check and connect correctly
	Battery Over Voltage	None	Check Battery Voltage
Zero Charging Current	PV Not Connected	Solar V is Less than Bat V	Connect PV
	PV Reverse/Shorted	None / Solar Low.	Check and correct PV
	Internal Error due to PV panel Overcapacity	Error in System – Prot Trip	Reduce PV Capacity / Wait
	Internal Error due to transients arising due to long battery cables	Error in System – Prot Trip / Batt Prot Trip.	Reduce battery Cable length / Wait.
	Internal Error due to transients arising due to insufficient wire gauge	Error in System – Prot Trip	Connect proper gauge wire
	Over temperature. (The unit cycles through Charging and Tripping)	Error in System – High Temperature	Wait for temperature to reduce. Make sure there is sufficient air circulation. Also check if PV panel connected is more than what is recommended.
	PV Low/ Night time	Solar – Low	Wait for Sufficient sunlight
Unit getting stuck in System Detect	Battery Voltage Very Low	None	Check the battery health. Connect proper 12V or 24V Battery.
Not cutting off Mains	Manual Override on	Mains Setting in ' Alwas On' or 1DayOn	Change h to Auto Mode
No Mains	Mains not connected	Mains – N	Check and connect mains
	Power Cut	Mains – N	Wait for Power to be restored
	In Auto Mode	Mains – N	Switch to Manual Override Mode if Mains Power is required
	In Off Grid Mode	Mains - N	Switch to Manual or Auto mode if Mains power is required

8 Specifications

Rehub MPPT Eco-12/24-25		
Operating principle	High efficiency MPPT Based Solar Charger to enable addition of Solar PV to existing home inverters. Maximizes the usage of Solar	
Battery System Voltage	12V	24V
Recommended Solar module STC Wp	400W	800W
Output Current – Continuous, Max	25A	25A
PV Open Circuit Voltage (VOC)	90V	90V
PV MPPT Voltage range	17-65 V	30-75 V
Input Current PV (Max)	20 A	
Power Conversion Efficiency (typical)	95% typ	95% Typ
Full load output voltage	Same as battery voltage	
Float Mode Charge Voltage	13.5 V (Factory Configurable)	27V (Factory Configurable)
Bulk Mode Charge Voltage	14.4 V (Factory Configurable)	28.8V (Factory Configurable)
Ambient temperature range	-10°C to 60°C	
Ports	1PV -Ve input 1PV +Ve input 1Battery -Ve Input 1Battery +Ve 1 15A and 6A 3 Pin Socket 1 6A 1 Meter long wire with 3 Pin Plug 1 Mode Switch 1 Modbus port	
Display	16 X2 Backlit character LCD to display system state, Instantaneous Power and cumulative energy generated from Solar PV	
Dimension	200X120X95, IP20	
Weight	~ 2 Kgs	
Protections		
Battery Reverse polarity	Electronically protected	
PV Reverse and Short circuit	Electronically protected	
Over current protection	System shutdown, recovers with a timeout	
Over temperature protection	System shutdown, recovers with a timeout	
a. It is possible to add more than the recommended Wp as long as the Voc limits are taken care of. What would happen is that in periods when the Solar Panels deliver power more than REhub's rated output, the output power is limited to that of the rated power. Since a typical PV Panel delivers less than the nameplate Wp rating, installing PV more than the rated power could be beneficial because then the continuous output is as per the rated value.		

Quick reference guide for the installation of REhub MPPT

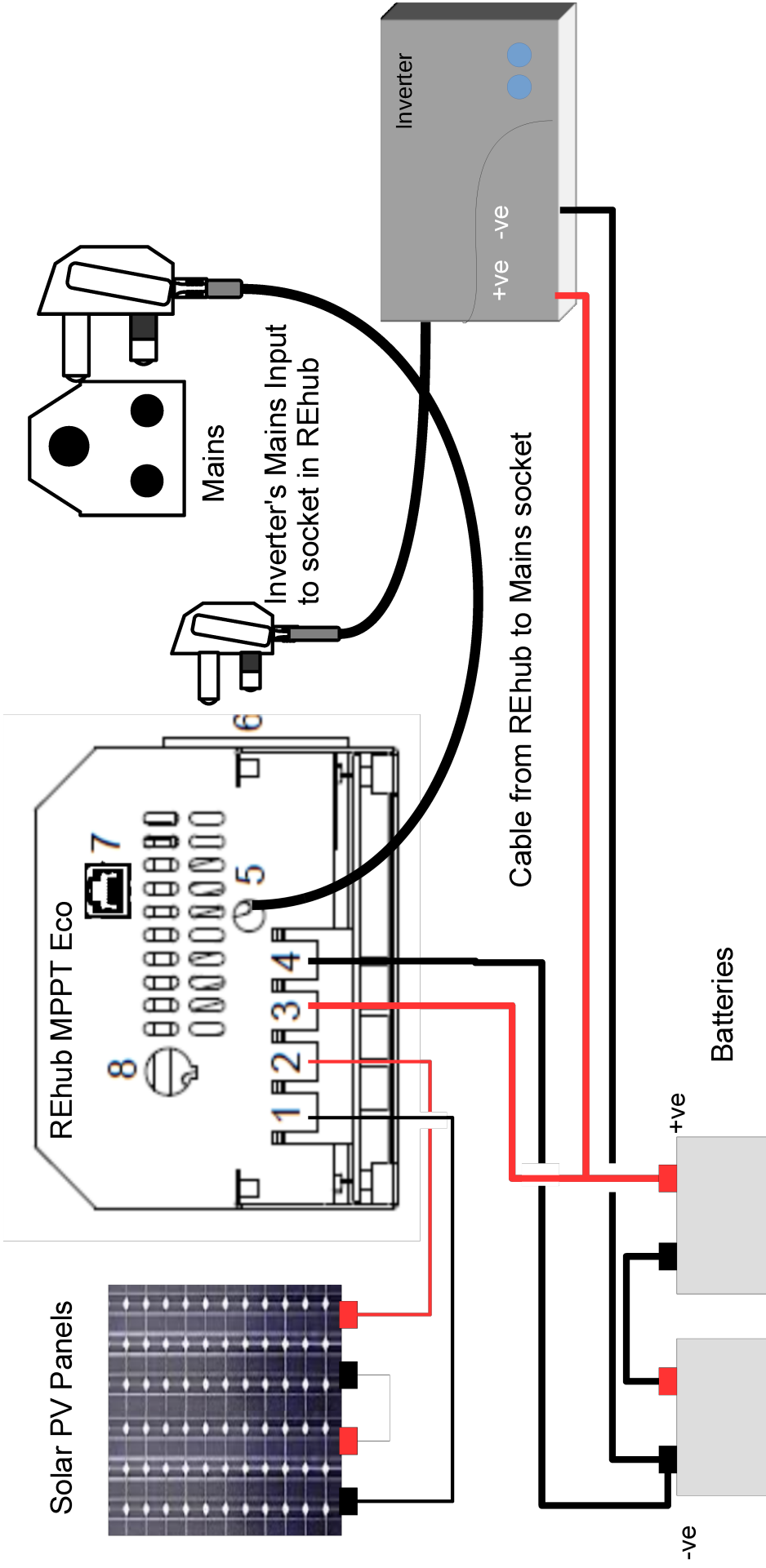
Step 1 Prepare to connect: Keep the cables ready. Draw the PV +Ve and -Ve wires to the battery room. Make provision to mount the REhub on a wall close to the batteries and the Inverter. Measure and cut a 6 Sqmm cable (RED) for connection between REhub and battery. Crimp appropriate lugs to the cable ends.

Step 2 Make the Solar connections : Measure Open Circuit voltage, ensure it is within REhub upper limit, make the PV -Ve connection to REhub. Connect the PV +Ve to the PV +Ve terminal.

Step 3 Make the battery connections : Measure the battery Voltage to make sure it is within the operating limits of 12V or 24V battery system voltage. Connect the battery +Ve cable to the battery terminal. Connect the battery -Ve cable to battery -Ve terminal.

Step 4 Make the Inverter's AC connections: Make sure there is no LIVE and Neutral Swap in the Inverter's input and output. Connect the Mains Input of the Inverter to REhub. After REhub screens shows that the battery system voltage is detected, connect the AC 3 Pin plug to Mains supply. Your REhub installation is complete. Close the L plate once the system working is verified on the display screen. WAIT till you see REhub switching off the MAINS input to the Inverter and the Inverter indicates that it is in back-up mode.

Sl no	Description	Desired Value	Measured value	Verified
01	Check PV Voc Voltage using multimeter	Less than 90V		
02	Check Battery Voltage using multimeter	12V System (11 to 14.5V)		
		24V system (22 to 29V)		
03	Check the polarity of the PV wires. Connect PV -Ve Wire to PV port and check for tightness.			
04	Connect Battery and Solar positive to respective terminals on REhub. Check for tightness.			
05	Connect Battery negative to appropriate terminal in REhub. Check for tightness			
06	REhub starts up and does System detect. Verify if correct battery Voltage is detected.	Correct battery system Voltage		
07	Make sure that LINE and Neutral wiring in existing Inverter matches the Mains / house wiring. Connect the Inverter Mains to REhub and REhub to Mains input. Wait and confirm that REhub switches off the Mains input to the Inverter			



Wiring Drawing