

documentation in progress

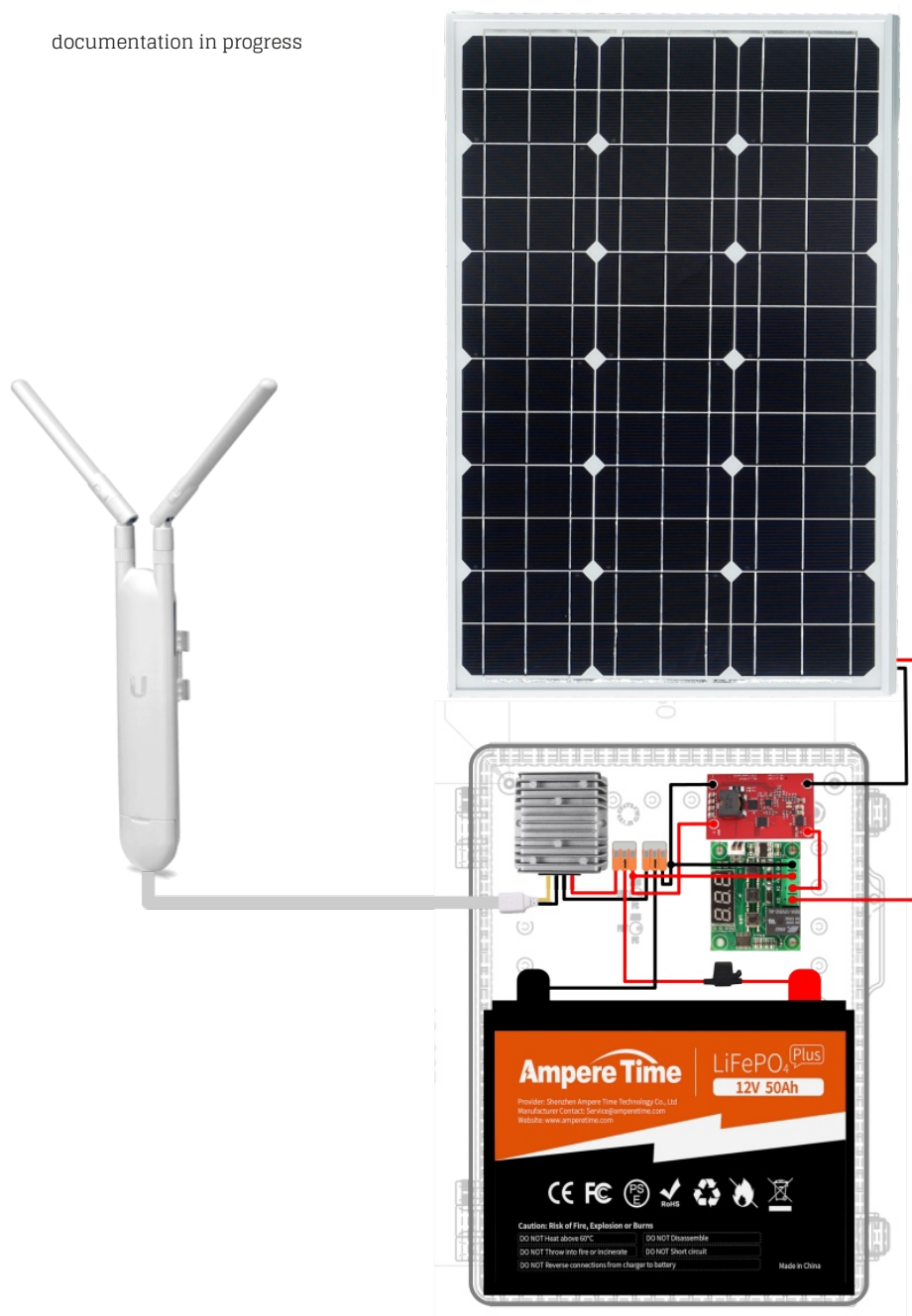
MeshBox

The MeshBox is an outdoor solar power generator for 24V ethernet powered devices. The device is designed with Ubiquiti Mesh AP devices in mind, but could power any number of small networking devices.

- An off-grid solar power source for networking equipment
- Powers 24v Power-Over-Ethernet Networking Equipment
- IP65 Weatherproof outdoor enclosure
- Includes wall or pole outdoor mounting equipment
- Safe and Long-lasting LifePO4 batteries

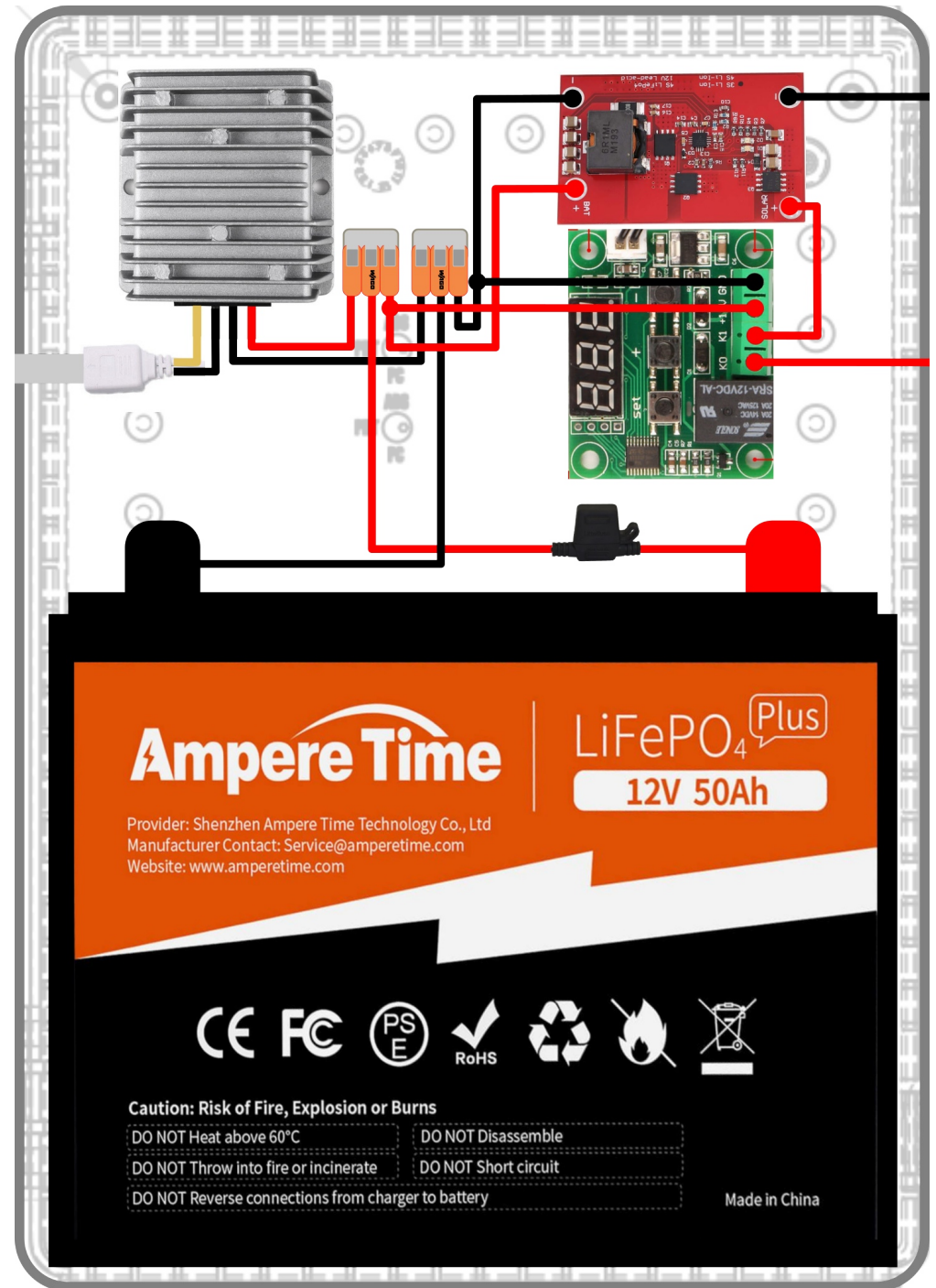
A 25-100W solar panel provides power to a small 5A Maximum Power Point Tracking (MPPT) charge controller which charges a Lithium Iron Phosphate battery. A voltage boost converter then provides the 24V necessary to run a ubiquity Mesh AP device.

The implementation documented here is a beefy version of the meshBox which theoretically provides almost 3 days of power with no sun.

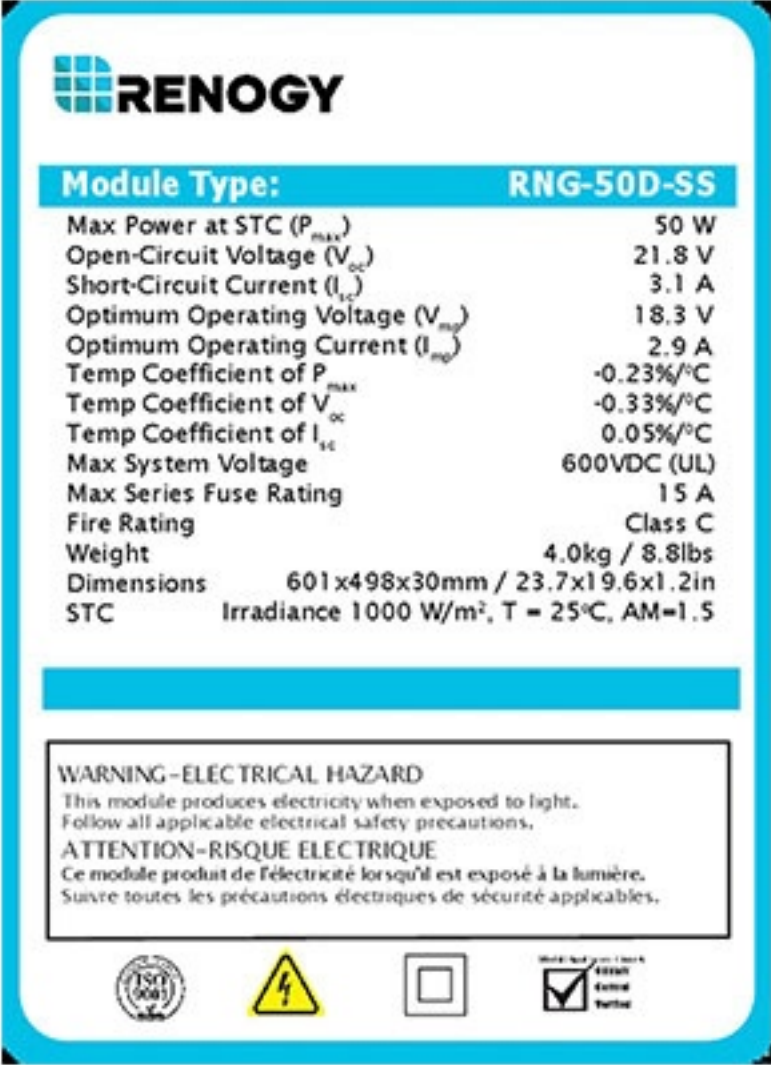


main components

- ❶ 50W PV Panel (not on this diagram)
- ❷ Low temperature disconnect
- ❸ MPPT 4A charge controller
- ❹ Inline blade fuse holder
- ❺ 4S Lithium battery
- ❻ WAGO Lever nuts
- ❼ DC 12V to DC 24V 3A Boost Converter
- ❽ Power over Ethernet Passive Injector



pv panel



RENOGY

Module Type: RNG-50D-SS

Max Power at STC (P_{max})	50 W
Open-Circuit Voltage (V_{oc})	21.8 V
Short-Circuit Current (I_{sc})	3.1 A
Optimum Operating Voltage (V_{mp})	18.3 V
Optimum Operating Current (I_{mp})	2.9 A
Temp Coefficient of P_{max}	-0.23%/°C
Temp Coefficient of V_{oc}	-0.33%/°C
Temp Coefficient of I_{sc}	0.05%/°C
Max System Voltage	600VDC (UL)
Max Series Fuse Rating	15 A
Fire Rating	Class C
Weight	4.0kg / 8.8lbs
Dimensions	601x498x30mm / 23.7x19.6x1.2in
STC	Irradiance 1000 W/m ² , T = 25°C, AM=1.5

WARNING-ELECTRICAL HAZARD
This module produces electricity when exposed to light.
Follow all applicable electrical safety precautions.

ATTENTION-RISQUE ELECTRIQUE
Ce module produit de l'électricité lorsqu'il est exposé à la lumière.
Suivre toutes les précautions électriques de sécurité applicables.

ISO 9001

Warning symbol (lightning bolt in a triangle)

RoHS symbol (circle with a slash)

Checkmark symbol (indicating compliance)



Renogy 50Watts

Nominal 12V (18.6V) - must be compatible with charge controller

PV panels always generate less than rated so increase by 40% or more

Mount built by holobiont lab from stock aluminum

enclosure



WQ-62 Hinged Weatherproof Enclosure from Polycase

13.78 x 9.84 x 7.24 in

3.70 lbs

Perfect size for a 50AH battery

Watertight

Meets IP65, IP66 & IP67 specifications

UL listed

low temperature disconnect

XH-W1209

Disconnects the power coming in from the PV panel if the temperature drops below the programmed temperature.

Goes inline between charge controller and PV panel with temperature probe taped to the battery.

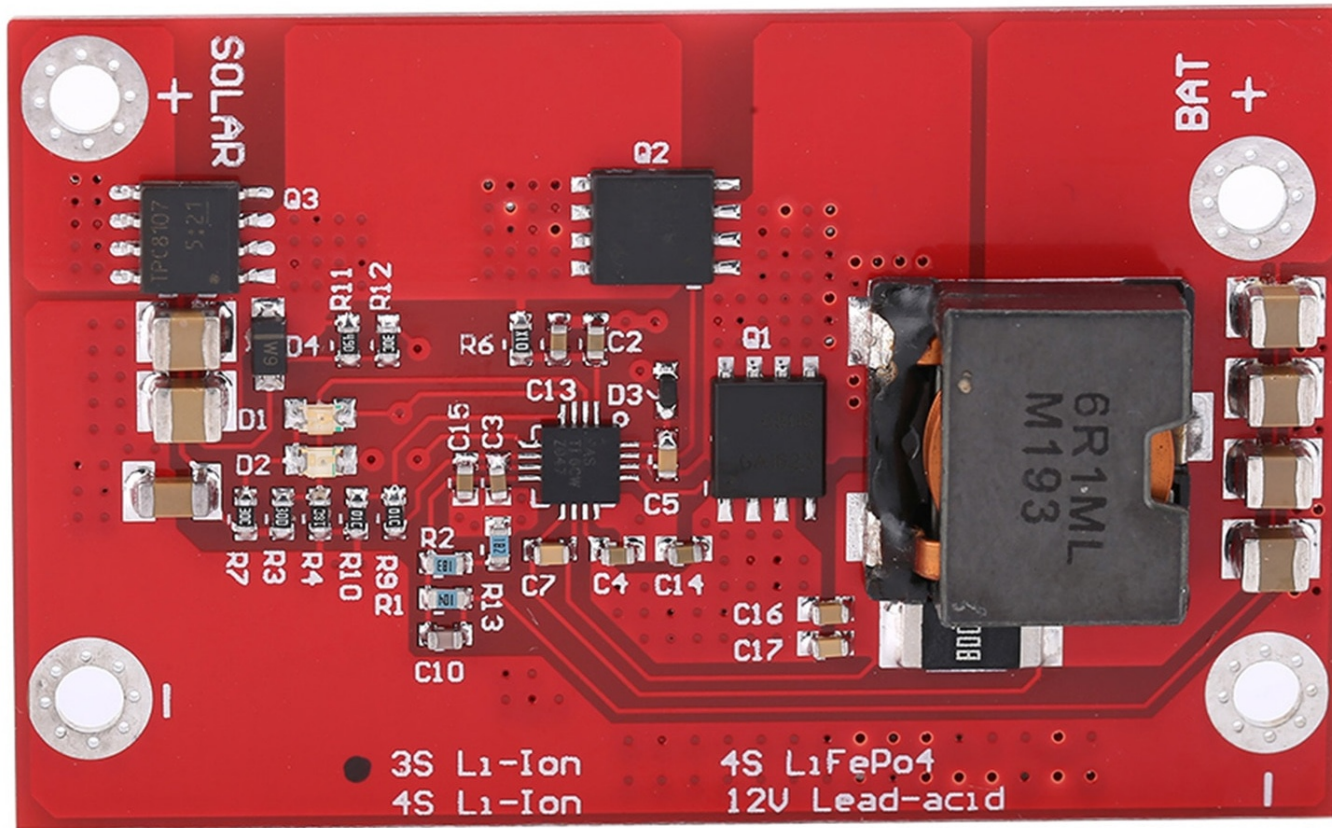
Not necessary if using a battery with built in low temp disconnect or BMS capable of low temp disconnect.

See Programming the XH-W1209 Low Temp Disconnect for more info



charge controller

MPPT 4A BQ24650



A tiny single board MPPT charge controller module.

Converts the power supplied by a PV panel into the correct voltage for charging a battery.

Must match the battery chemistry and cells. 4s LifePO4 in this case (different configurations exist)

4S means there are 4 3.2V cells in series inside the battery
(4 x 3.2 = roughly 12V)

Most cheaper lithium ion batteries do not have low temperature disconnects. LiFePO₄ chemistry can be damaged if charged below freezing, so we use the external low temp disconnect module.

It's the most expensive component of the system.

Options for recycled batteries exist from battery recyclers.

All lithium based batteries need a Battery Management System to protect against cells imbalance and over/under heating. But virtually all commercial batteries already have them installed.



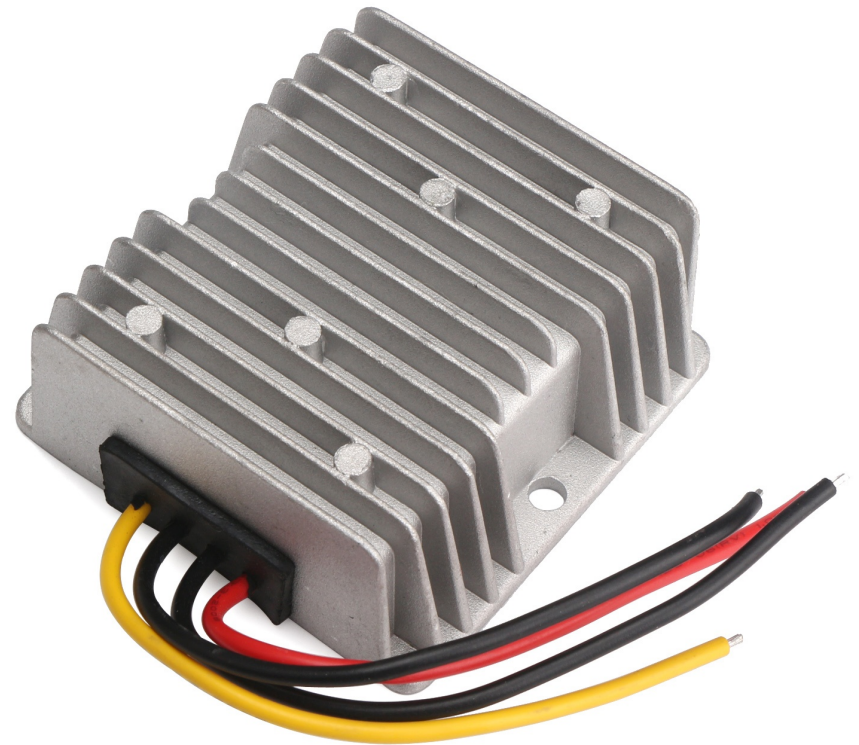
4s lithium battery

Ampere Time LiFePO₄ 12V 50Ah

dc 12V to dc 24V 3A boost converter

This converts the 12V power supplied by battery and charge controller to 24V needed by the transmitter.

Fascinating fact: Converters that increase the voltage are boost converters. Ones that decrease are called buck converters.



power over ethernet (POE) passive injector

Essentially a plug to connect POE to the device.

This can also just be a terminated regular ethernet cable.



other parts

WAGO Connectors: awesome easy to put together and pull apart
UL listed electrical connectors



Fiberglass sheet to mount components on

Stock aluminum for the panel mount.

Solder



Crimp on connectors

PV wire

MC4 connectors

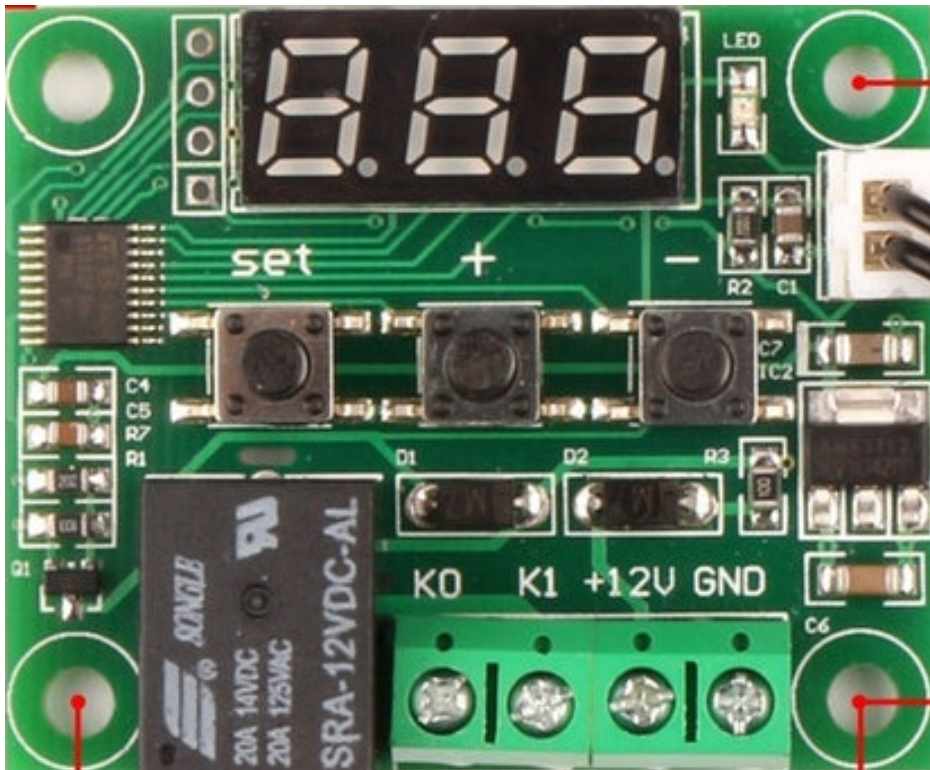


Programming the XH-W1209 Low Temperature Disconnect

Basic wiring:

First 2 terminals (labeled K0 and K1) connect to the relay. 1 of them connects to the + wire from the PV panel, the other to the + on the MPPT board.

The next 2 terminals connect to 12V power. +12V connects to positive bus bar and GND to - bus bar.



Setting the LTD:

All of the LTD modules were programmed before being delivered and should not need to be reprogrammed.

Long press the SET button (5 secs) to enter programming mode.

+ and - rotate through the settings. Set will then allow you to set that parameter.

Settings as designed are:

P0 (Mode set :Heati or Cool) :	C
P1(Hysterisis)	: 2
P2 (upper limit)	: 55c
P3 (lower limit)	: 2c
p4 (calibrate temp)	: 0
P5 (delay start time)	: 0
p6 (high temp alarm)	: off

Tape the temp sensor to the side of the battery.

Various online manuals exist for this. Eg:

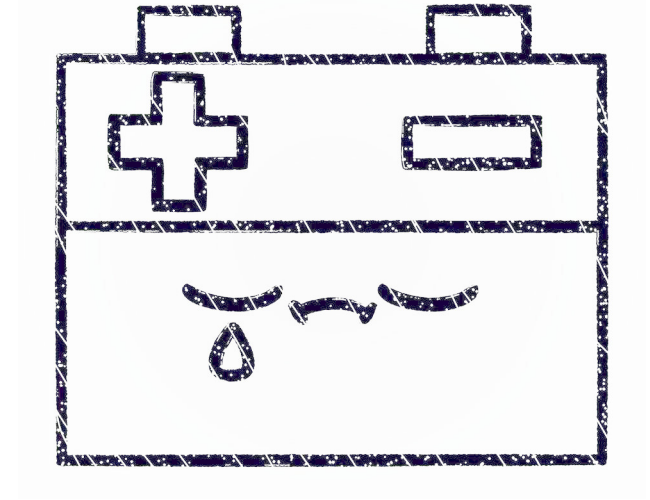
<https://directvoltage.com/wp-content/uploads/2017/03/XH-W1209-Manual-.pdf>

Troubleshooting

WARNING: when troubleshooting meshBox issues, be sure to use proper tools. The components can be easily damaged. Be very careful not to bridge connections between + and - terminals or on components.

Check these things first:

- Battery Voltage (if below 12.2V or so, the BMS has likely cut off further discharge).
- Check the fuse. Is there continuity? A blown fuse like points to a short during maintenance or miswired components.
- Is the temperature close to or below freezing? The meshBox should not be working at all if below freezing. Solution : wait for warmer moments.
- Check voltage coming out of the DC voltage converter. If you are getting around 24V the issue is likely with the AP. Try a different AP.
- Is the LTD on? Is the LED screen showing a value. See below.
- Is the LTD set up correctly? See the manual and instructions for setting it up.
- Is there V from the PV panel? If not the most likely issue would be damaged wiring.



BATTERY ISSUES

Chances are the issue will be the battery. Keep an extra one on hand to rotate out while the depleted battery is charged elsewhere.

Use a multimeter to see if the battery is at a working voltage. A 12V LiFePo4 battery should read between 12.5 and 14.6V (only that high when charging).

The battery will cut off discharging on its own in the case of low or high voltage to protect itself from damage.

In the case of the MeshBox that means power will also be cut

off to the low temperature disconnect effectively cutting off PV power and the battery will stop charging.

How to fix:

Charge up the battery.

Remove it from the enclosure and use a power supply set at 14.5V / 5-10A until the A reading on the power supply drops. Then disconnect and turn off the power supply and replace the battery in the meshBox.

Field charging.

If above freezing and you are confident it has been above freezing for long enough for the internals of the battery to rise to that point as well try the following:

Option 1:

If the battery V has dropped below the cutoff voltage and there is direct sun, one can carefully bypass the low temp disconnect with a short wire from solar panel to the MPPT + terminal until the voltage rises above its cut off. Connect the 1st two terminals of the LTD to bypass the relay (or remove and temporarily connect the 2 wires connected to the relay).

Option 2:

Connect a charged 12V lifepo4 to the terminals of the meshBox battery using short wires with an AWG of 10 or thicker. Power will quickly dump into the battery. This should be an emergency measure. Rapid charging can shorten battery life.

LOW TEMP DISCONNECT issues

Is it receiving power from the battery? With the screen at top of the

LTD, test the voltage across the 2 right most terminals. If the V is too low to power the board it will be off.

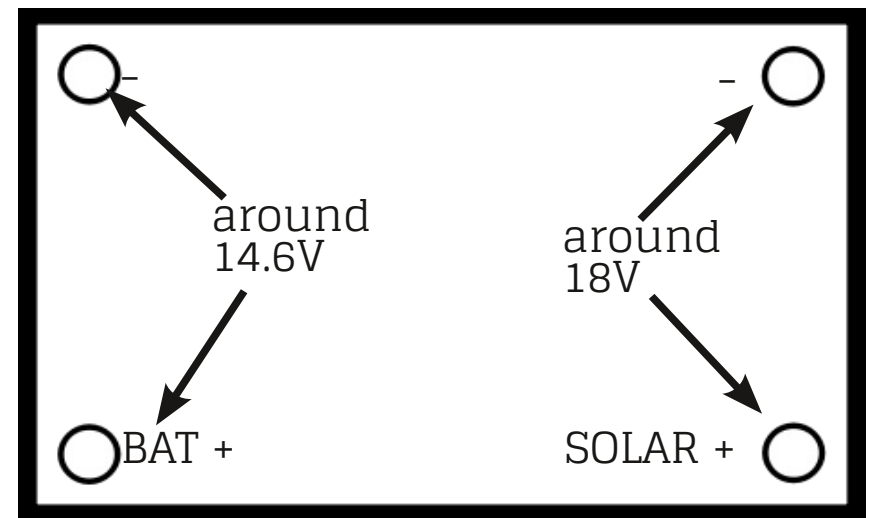
Is it wired correctly? See the manual for the LTD (xh1209). The terminals left to right should be;

PV panel in | wire to MPPT | + to battery | - to battery (or bus bar)

Is the battery charging?

Checking the MPPT board:

Check for damage. If you can see missing or damaged components, it's unlikely the meshBox will be able to charge the battery. In this case, switch out the MPPT or replace the components (some electronics knowledge and skill required here).



Use a multimeter to check terminals of the MPPT board.

Voltage going in will possibly vary, but generally around MPPT of 18V or so.

Voltage going out should be at battery charging V or 14.6V or so.

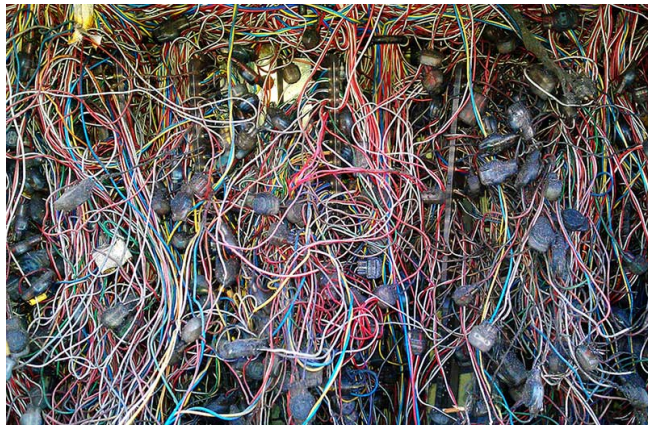
Check the wiring to ensure the wiring matches the diagram (see page 2).

Is there PV power?

If sunny the V on the PV panel should read around 18V.

The PV panel is the least likely thing to fail.

If the panel is obscured by anything it will probably not work. Anything can include buildings, trees, fences, clouds etc. The panel needs direct sunlight to function. Without direct sunlight, you may see voltage but not enough power to charge the battery or power the AP.



Check wiring

Use the wiring diagram to make sure everything is connected properly.

Use a multimeter to test for continuity between components which should connect. Bad connections could be found in badly connected wires to components or via bus bars / Wago connectors.

If you find issues with continuity, check wago connectors for solid contacts and check bolts and screws connecting different components.

Blame the System

If you've gone through all of the above and still have not solved the problem, consider blaming the system of capitalism, white supremacy and patriarchy. Most problems can be traced to that trinity.

Finally consider if anyone really needs wifi in the first place.



Holobiont Lab

Who we are:

- We are a working class, collaborative laboratory created in response to climate change and its many impacts on our communities.
- We use a combination of practical strategies, wild experimentation, affordable tools, and creative interventions to enhance community sustainability and local resilience to climate crisis.
- We understand ourselves (and others!) to be both grassroots scientists of the imagination and on-the-ground strategists for our collective survival.

HOLOBIONT LAB
holobiontlab.org
symbiont@holobiontlab.org
PO Box 23462
Philadelphia, PA 19143