Thornwave Labs Inc

PowerMon-W

WiFi / IoT

Advanced Battery Monitor / DC Power Meter

– QUICK START GUIDE –

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This document is meant to be a quick start guide for installing and configuring the PowerMon-W, WiFi / IoT Advanced Battery Monitor / DC Power Meter and does not contain in-depth details. For a complete manual please visit the product webpage at https://www.thornwave.com/products/powermon-w-wifi-iot-advanced-battery-monitor-dc-power-meter-with-data-logging

Package contents. The product has been shipped in a box containing the PowerMon-W device, an 8-pin female terminal block and a 2.4GHz WiFi antenna. From the factory, the device is configured with most disconnect features in the disabled state. No calibration has been applied to the current reading. If better accuracy is required, please read the *"Calibration"* section.

Required tools / materials. To complete the installation of the PowerMon-W device, the following tools and materials are required:

- wire cutters / wire strippers
- small flat screwdriver
- external current shunt (check our store at https://www.thornwave.com)
- 16-22 AWG wire for wiring the other signals. Different colors are recommended (red / black / yellow / green / blue)
- Terminals for connecting wires to the battery (usually 5/16" or 3/8" ring terminals)
- Crimping tool for typical automotive style terminals (ring, spade, …)
- 2 screws (for mounting the device on a flat surface). These can be metal screws, wood screws, plastic screws, or machine screws, depending on the surface the device will be mounted on. The device can also be mounted using double sticky tape or even plastic zip-ties.

SAFETY INSTRUCTIONS

Warning!

Read all the instructions and cautions before using the PowerMon-W device. Thornwave Labs Inc does not assume responsibility for any injury or property damage caused by improper installation, bad wiring, or use of PowerMon-W outside of its intended purpose. The device should be installed by a professional. Do not work on a live electrical system. Disconnect the power sources first (battery, shore power, solar panels, generator)!

Warning!

The PowerMon-W device should not be used for any medical purposes, life-sustaining equipment, safety applications, or any application where equipment failure can cause injury, death, fires, or any other hazard.

Warning!

There are no serviceable parts or fuses inside the device! Do not disassemble or attempt to repair! The unit operates with voltages up to 72V which can be lethal or cause serious and permanent injury.

Warning!

Do not submerge under water or other liquids. The device is weatherproof but not waterproof.

Warning!

The device is to be connected to DC circuits only, not exceeding 72V. Failure to do so will result in equipment damage. Confirm that all connections are tight to avoid excessive heating, sparks, or fire. Never connect the V1 terminal to a power source without using a fuse or circuit breaker. A 0.5A to 2A fuse or circuit breaker is required.

Warning!

Batteries are dangerous! Do not short-circuit a battery or the battery monitor terminals. Batteries can produce flammable and explosive gases and can generate extremely high currents that can lead to serious consequences including explosion, fire, damage to equipment, personal injury, and even death. It is the user's responsibility to operate the equipment in a safe manner. Do not charge batteries in an enclosed environment unless allowed by the manufacturer of the battery. Never connect a load to a battery without using fuses or circuit breakers, properly sized for the wires / equipment.

Warning!

Although PowerMon-W coupled with a relay can disconnect power if an over-current condition occurs, it should not be used to replace circuit-breakers. A properly rated circuit breaker or fuse should be used to protect the load and the wiring!
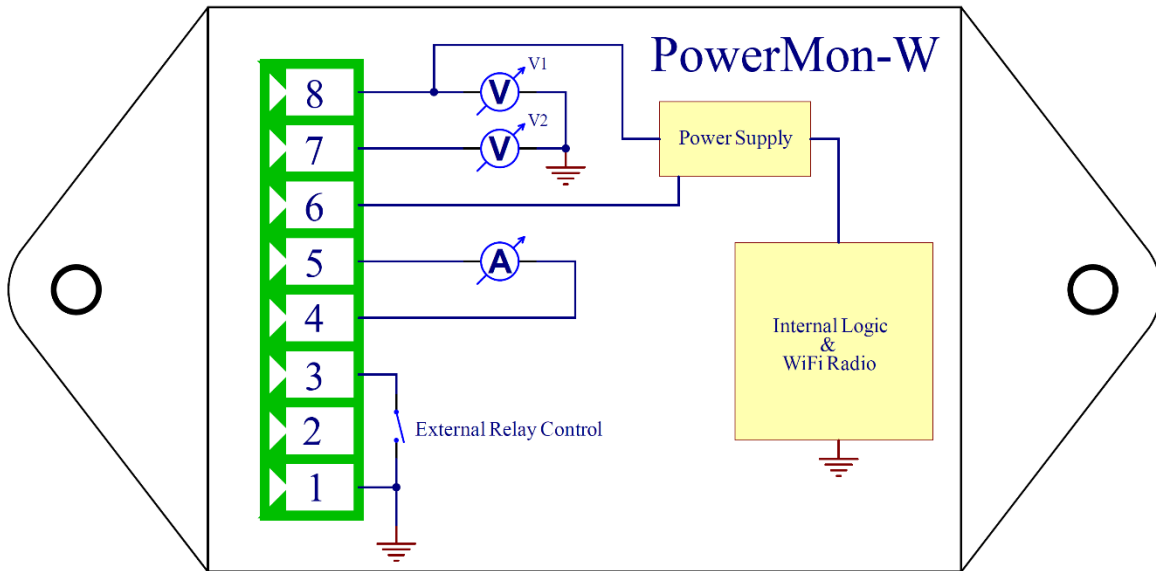
Warning!

PowerMon-W cannot be used as a charge current limiter or LiFePO cell balancer. A properly sized battery charger is required to recharge LiFePO batteries. Thornwave Labs Inc. does not assume any responsibility for expensive battery damage.

Warning!

Do not use any other WiFi antenna than the one that was provided. Using a different antenna may violate emissions standards imposed by your local EMC regulatory body (FCC for US, IC for Canada, …)

TERMINAL DESCRIPTION / INTERNAL DIAGRAM

No.	Name	Terminal Description
1	GROUND	System ground (battery negative, chassis)
2	MF	Multi-Function. Supports pushbutton input or external temperature sensor
3	RELAY	Relay output. It drives a mechanical or solid-state relay. To turn the relay on, the device is grounding this terminal internally.
4	ES1	External shunt connection
5	ES2	External shunt connection
6	+5V	5V from the internal regulator. Can be used to supply external circuits. Can also be used to supply the monitor with 5V. Do not connect to the battery!!! Should be left unconnected in most installations.
7	V2	Second monitored voltage. Can measure the voltage of a second battery.
8	V1	This is the main voltage that will be monitored. The device also draws its own power from this terminal.

INSTALLATION

Mounting the device

- Attach the device to a flat surface using two screws, double sticky tape or plastic zip-ties
- Mounting inside a metal enclosed space will substantially reduce the WiFi range. For best results mount in such a way so the radio signal will not be blocked. Keep in mind that at the WiFi frequency of 2.4GHz the radio signal travels only in a straight line and any obstacle in its path (walls, big objects) will interfere with it.
- Install the provided WiFi antenna. Do not use any other antenna. Doing so may violate emissions standards imposed by your local EMC regulatory body (FCC for US, IC for Canada)
- Mount the external shunt as close as possible to the PowerMon-W device. The longer the wires that connect the external shunt to the device the more electrical noise they will pick up.

Device power / voltage measurement

- Using a piece of 16-22AWG black wire, connect terminal 1 to the system ground (negative side of the battery / solar panels / power source / chassis)
- Using a piece of 16-22AWG red wire connect terminal 8 (V1) to the positive side of the power source using a fuse or circuit breaker in between 0.1A and 2A. This is here to protect the wiring so install it close to the battery.
- If applicable, connect terminal 7 (V2) to the second battery (or node in the system) that will be monitored. Use a similar fuse as well.

Wiring using an external shunt

- Connect ES1 / ES2 (terminals 4 and 5) to the measurement points on the shunt using 16-22AWG yellow wires. Typically, these are smaller screws positioned inside of the larger high current connections of the shunt. Keep the wires as short as possible. Twisting them will reduce the noise even further. Avoid running these wires parallel to high current carrying wires. Doing so will introduce unwanted noise into the measurements. The target is to get the current to display positive when the battery is charging and negative when discharging. If the current PowerMon-W is displaying has the wrong sign, there is no need to reverse the wires. The current sign can be flipped using the "Flip Current Sign" option in the device configuration.
- Connect the high current lugs of the external current shunt using wires of adequate size. Crimping of battery lugs may be required.

External relay (optional)

- If an external relay is used, connect one side of the coil to RELAY (terminal 3) and the other side to the load side of the shunt. Use 16-22AWG wire. Crimping a female spade connector may be required. Choose blue or green, or any color different than black, red, or yellow .
- If the Thornwave Labs SSR is used, connect RELAY (terminal 3) to the control terminal of the SSR

Check all the connections again. Verify that the high current wires are tight. Use fuses or circuit breakers where applicable. Once all these have been checked, insert the female terminal block into the PowerMon-W device and reconnect the battery or the power source. At this point a PowerMon-W with the factory settings will start operating as an access point.

Mobile application / Initial Connection

- Install the mobile application PowerMonX on your device. This is available for free on Google Play Store and Apple App Store.
- Go to the phone / tablet WiFi settings. The PowerMon-W will appear as "PMON_xxxxxxxx" where the "xxxxxxxx" is a part of the device serial number. Connect to the device. The password is "powermon"
- Once you joined the PowerMon access point, open the PowerMonX app. Tap on the top right corner menu (dots) and on "WiFi Direct Connect". This will establish a direct connection to the PowerMon-W you connected the phone/tablet to.
- If the connection is successful, you will be on the Live Data page where you can see all the live measurements the PowerMon-W is making.
- Tap on the top right corner to go to the menu. Tap on "WiFi Setup". This will allow you to configure PowerMon-W to connect to an access point. Tap on the network you wish to connect the PowerMon-W to and enter the password for your network. If the connection is successful it will be displayed on the top of the screen. The device cannot connect to captive WiFi networks (used in hotels, airports, …)
- Go back to the menu. Tap on "Device Information". Here you can change the device name, see the device's local IP address, update the device firmware and more.
- Tap on "Pair" to pair the phone to the device. This will allow you to connect to the device remotely, over the Internet. The device will appear under "Cloud Device" on the "Discover Devices" screen.
- Disconnect from the PowerMon-W by pressing the back button on the top left corner.
- Disconnect the phone / tablet WiFi from the PowerMon-W and reconnect to the network of your choice. If you are connected to the same access point as the PowerMon-W, the device will appear under "Local Devices" on the "Discover Devices" screen. If you paired with the device, you can not connect to it remotely.

Basic Configuration

- If you are not planning to connect directly to PowerMon-W (not required if you have a local access point), go to the "Device Configuration" -> "General Configuration" and disable "Keep Access Point On". This will allow the device to operate at a substantially reduced power consumption level. For initial configuration purposes, the device will keep the AP feature on for the first 2 minutes after receiving power.
- This would also be a good time to update the device firmware if an update is available. During the firmware update process, the power to the device should not be interrupted. Go to the menu and "Device Information". Scroll down and if an update is available, an "Update" button will be visible. Internet access is required for updating the device firmware.
- Configure the correct shunt you are using from "Device Configuration" -> "General Configuration"

Offset zeroing

- Because of the extremely low voltage drop across the shunt resistor that the PowerMon-W must sense, offset is inevitable. If the current measurement displayed by the app is not zero even though the actual current is, this is called an offset. It can be zeroed.
- Make sure the current that passes through the external shunt is zero (no current). The best way to make sure this happens is to disconnect the wire from the load side of the shunt.
- Tap and hold on the current measurement and select "Zero Current Offset". This will bring the measurement value to zero (zero the offset).
- WARNING: If the actual current was not zero when the "Zero Current Offset" was performed, this value will become the new zero. This is wrong since you just introduced a very large current offset.

Calibration (optional)

- The only measurement that can be calibrated by the user is the current. If a better accuracy than an uncalibrated device offers (about 1%) is required, proceed with the device calibration. The offset should be zeroed before calibrating.
- Apply a known current (accurately measured using an external amp-meter)
- Tap and hold on the current measurement and select "Calibrate Current"
- Type the actual value of the current as indicated by the amp-meter and press OK. Note that if the calibration current and the uncalibrated current reading are different by more than 10%, the calibration is not performed.
- Changing the current shunt specifications under "Device Configuration" will remove both the calibration and the zeroing of the current reading.

TROUBLESHOOTING

Symptom: The device indicates some current but there is no current flowing through the external shunt.

Possible Causes:

- If the user performed the "Zero Current" procedure, the device assumed that the external current was zero and applied an offset to the measurement in order to bring the indicated value to zero. If the actual device current was not zero at the time the "Zero Current Offset" was performed, the offset applied will not be correct which leads to the wrong reading. To fix this, make sure the actual current is zero (disconnect the load side of the shunt if required) and execute the "Zero Current Offset" procedure again.

Symptom: The PowerMonX app is not finding any device

Possible Causes:

- The PowerMon-W device is not powered. Check if power is available at the green connector terminals 8 and 1 (8 is positive, 1 is negative).
- The phone app does not have the permissions it requested when it was installed or on the first start

Symptom: The current reading is wrong

Possible Causes:

- The external shunt has not been configured properly. Go to "Device Configuration" -> "General Configuration" to fix that.
- The shunt is not connected properly to the PowerMon-W device. Check the shunt wires connect to terminals 4 and 5.