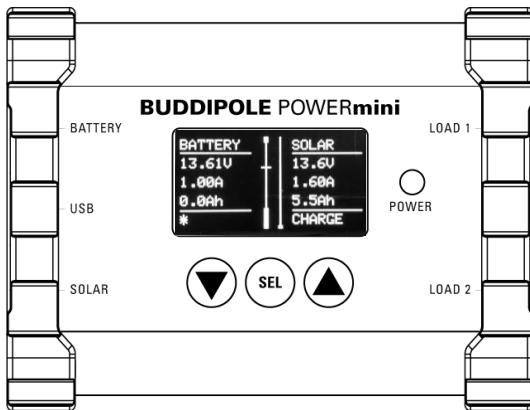


# BUDDIPOLE

## POWERmini USB

COMPACT PORTABLE DC POWER MANAGEMENT SYSTEM  
WITH BUILT IN SOLAR CONTROLLER

### USER GUIDE



The Buddipole POWER mini USB is a unique, 12 V DC pocket sized power control system particularly suited for portable operations.

This highly integrated device incorporates the functions of a solar charge controller, battery management system, power monitoring device and power distribution in a small, robust and weather resistant package.

Despite its small size the unit handles a load current of up to 35A and solar panels up to 150W output.

Built in monitoring provides you an instant view of how well your battery is keeping up with the demands of your radio as well as the performance of your solar panel.

A USB charger port is also provided to charge devices such as cell phones or tablets.

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# GETTING STARTED

## Product Overview

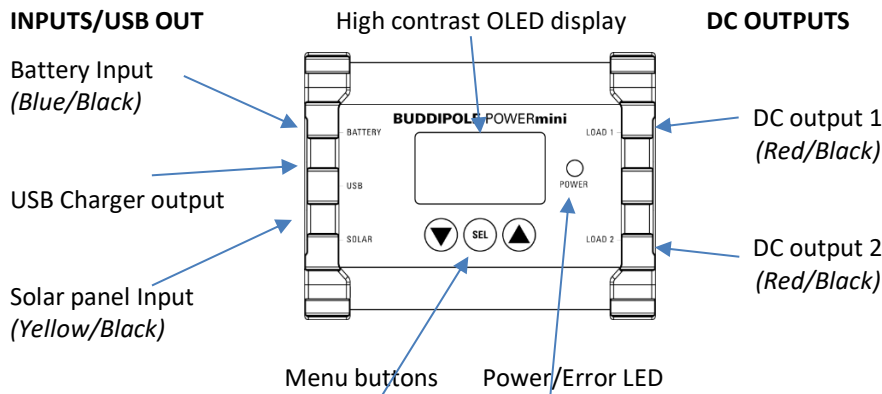


Figure 1 POWERmini USB controls and power connections

The front panel contains an OLED graphical display providing a comprehensive view of the 12 VDC power system.

Three menu buttons are provided to navigate through the display screens and make user settings.

Power inputs are located on the left side of the unit together with the USB charger output.

The DC power outputs are on the right side of the unit.

All power connections use the popular Anderson Powerpole® family of low voltage high current connectors which are popular in amateur radio particularly with emergency communications (EMCOMM).

## Power System Connections

The battery that is used to power your radio is used by POWERmini USB to power the device. POWERmini USB will turn on as soon as power is connected to the battery input. DC power is transferred to the outputs if the battery voltages are in the normal range. This provides protection for both the radio and the battery.

Battery charging is provided by connecting an external solar panel.

Figure 2 POWERmini USB power connections

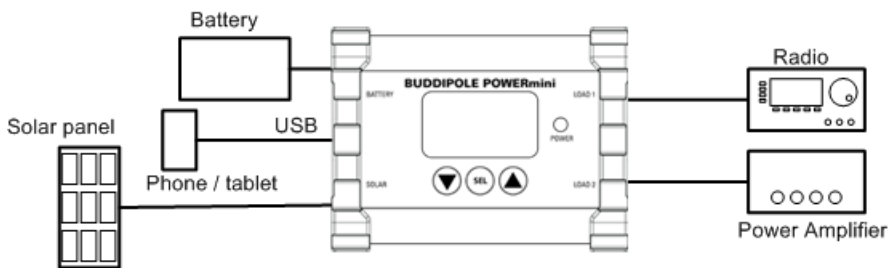


Figure 3 POWERmini USB power connections

Any device that uses USB charging can be connected to the USB connector.

## Quick Start Guide

POWERmini USB can be used with a wide variety of battery types and radios. Please read the following section before using POWERmini.

- Check battery voltage polarity.  
The BLUE Powerpole connector should be connected to the positive terminal of the battery  
The BLACK Powerpole connector should be connected to the negative terminal.

Confirm the connections are correct using a DC voltmeter (DMM).before connecting to POWERmini.

- Connect the radio and accessories to the output connectors  
The RED Powerpole connector should be connected to the positive connection of the radio  
The BLACK Powerpole connector should be connected to the negative connection of the radio

Before connecting to the radio confirm the connections are correct using a DC voltmeter (DMM).

- Press the SEL button briefly twice to view the Battery Setting page  
Select the battery type that matches your battery (See page 4, Changing User Setting)

IMPORTANT: The factor settings are generic. Please refer to the battery manufacturers recommendations for maximum charge voltage and minimum voltage. The default settings can be reset to meet the manufacturers requirements (See page 4, Battery Settings)

- Check solar panel voltage polarity (if used)  
The YELLOW Powerpole connector should be connected to the positive terminal of the solar panel  
The BLACK Powerpole connector should be connected to the negative terminal of the solar panel

Confirm the connections are correct using a DC voltmeter (DMM).before connecting to POWERmini

# OPERATIONS

POWERmini optimizes the life of the battery by protecting the battery from overcharging or excessive discharge. It accomplishes this by constantly monitoring the battery voltage and solar panel voltage and determining the state of charge of the battery.

POWERmini USB is a programmable device allowing you to configure it to use with different types of battery.

User settings include

- Low battery voltage trip point, reset point and early warning of low battery
- Automatic disconnect – provides protection from deep discharge
- Max charge voltage -customize to suit specific battery
- Over voltage trip point and reset point

This section provides information about how to get the most out of your POWERmini.

## Menu Navigation

Moving between the different screens is accomplished by briefly pressing the SEL button. Each push of the button steps the display through the different pages as shown in Figure 4 below.

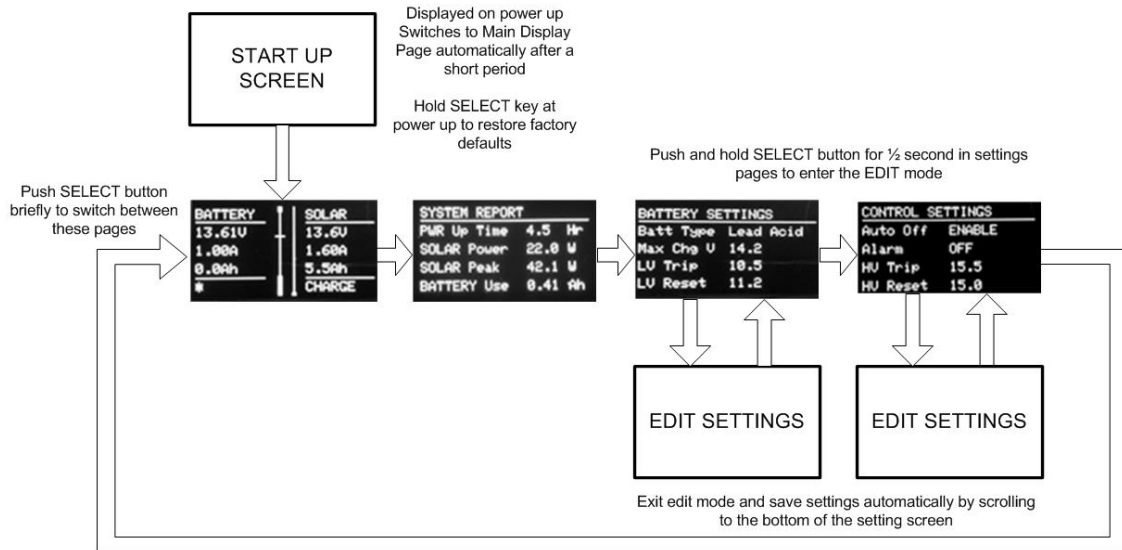


Figure 4 Menu Selection

## OPERATIONS

### Changing User Settings

There are eight parameters that you can set to configure the POWERmini USB to better suit your needs. These settings are saved in non-volatile memory for automatic recall the next time you power up the unit.

The eight parameters are contained in the BATTERY SETTINGS and CONTROL SETTINGS pages.

Parameters in both the Battery Settings and Control Settings pages can be changed and saved to memory.

- **Edit Mode**  
Press and hold the SEL button for about ½ second to enter the edit mode in the Battery settings and Control settings pages. When the edit mode is active a white edit box is drawn around the parameter selected for adjustment beginning at the first line
- **Parameter Adjustment**  
Use the UP / DOWN buttons located either side of the SEL button to change the value. The value will change by one increment for each push of the button.

The figure below shows the edit page for the Control Settings.

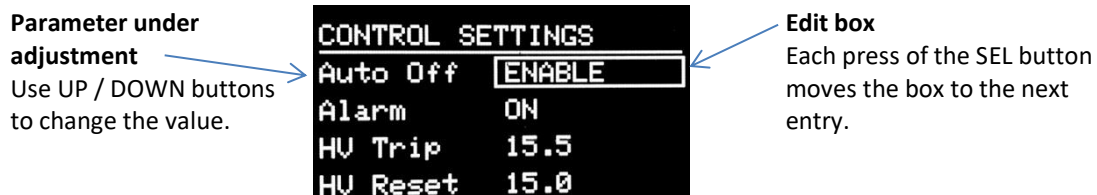


Figure 5 Edit Threshold Voltage Edit page

- **Moving to the next line**  
To skip to another line briefly press the SEL button to move down the list and repeat until you have reached the parameter you want to change.
- **Saving parameters**  
To exit the edit mode and save your changes press the SEL button sequentially until the edit box scrolls off the bottom of the list. A beep will sound to indicate that the changes have been saved.

### Battery Settings

The Battery Settings page contains settings for the battery type, maximum battery charge voltage, the low battery disconnect voltage, and the voltage at which POWERmini will reconnect the outputs following an automatic disconnect. See Figure 6 below.

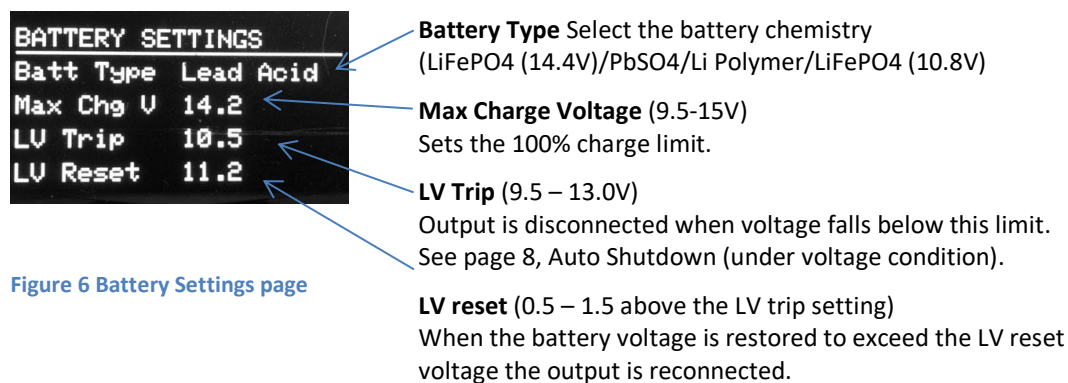


Figure 6 Battery Settings page

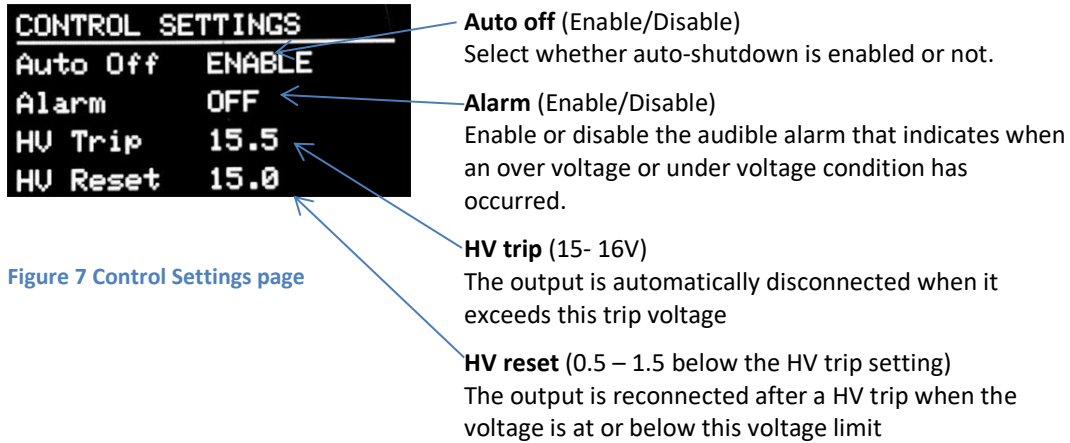
## OPERATIONS

### **Control Settings**

This page contains settings for auto-cutoff audible alarm, over-voltage and under-voltage limits.

When Auto-Off is enabled POWERmini will automatically disconnect the load from the battery. When Auto-off is disabled the output will not be disconnected but an audible alarm (if enabled) will sound.

Over voltage settings control the point at which POWERmini USB will disconnect or reconnect the battery and the load.



The screenshot shows a terminal window with the following text:

```
CONTROL SETTINGS
Auto Off  ENABLE
Alarm     OFF
HV Trip   15.5
HV Reset  15.0
```

Four blue arrows point from the text descriptions on the right to the corresponding settings in the terminal window:

- Auto off (Enable/Disable)**  
Select whether auto-shutdown is enabled or not.
- Alarm (Enable/Disable)**  
Enable or disable the audible alarm that indicates when an over voltage or under voltage condition has occurred.
- HV trip (15- 16V)**  
The output is automatically disconnected when it exceeds this trip voltage
- HV reset (0.5 – 1.5 below the HV trip setting)**  
The output is reconnected after a HV trip when the voltage is at or below this voltage limit

Figure 7 Control Settings page

## Power System Monitoring

The Status and Systems Report pages provide information about input and output power and the state of the battery.

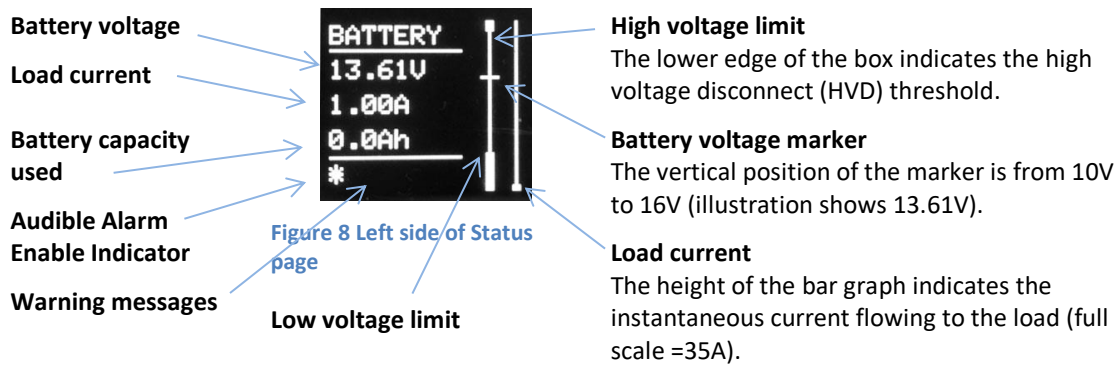
### Status Page

The left side of the Status page provides digital information about the battery including battery voltage, load current and the amount of charge that has been provided by the battery to the load since power has been applied.

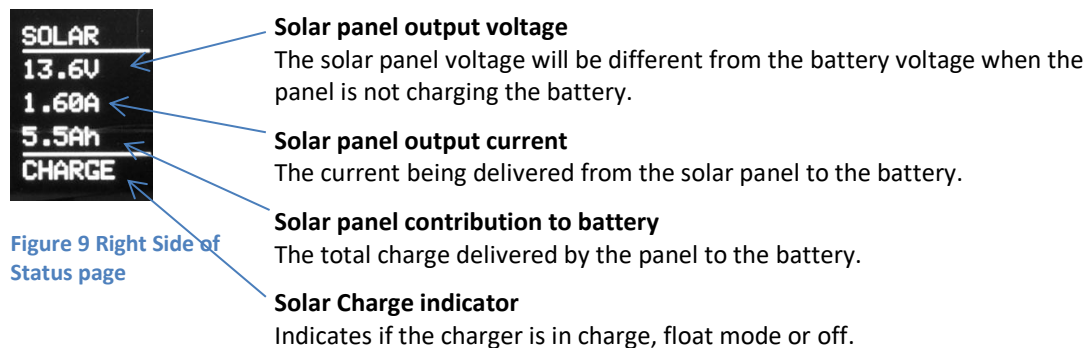
The status of the audible alarm is also indicated here. When the alarm is enabled an asterisk is displayed at the lower left of the page. The asterisk is not shown when the audible alarm is disabled.

Two vertical bar graphs are displayed at the center of the status screen. These provide a view of the battery state of charge and the instantaneous load current (see Figure 8).

The upper and lower voltage thresholds are also shown as the thicker bars at the top and bottom of the voltage bar.



The right side of the Status page provides information about the solar panel performance. See Figure 9 below for a brief description of the various fields.



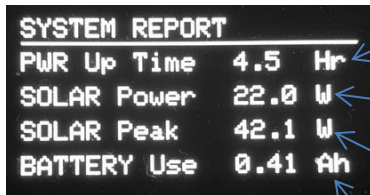


## OPERATIONS

### **System Report**

The System Report page displays information about the system since the time when the POWERmini USB was powered up.

See Figure 10 below for more details.



| SYSTEM REPORT |      |    |
|---------------|------|----|
| PWR Up Time   | 4.5  | Hr |
| SOLAR Power   | 22.0 | W  |
| SOLAR Peak    | 42.1 | W  |
| BATTERY Use   | 0.41 | Ah |

Figure 10 System Report page

#### **Power Up Time**

The operating time since the unit was powered on.

#### **Solar Power**

The instantaneous solar panel power output.

#### **Solar Peak**

The maximum output of the solar panel since the unit was powered on.

#### **Battery Use**

Net battery charge used. The difference between charge used and charge replaced by the solar panel.

(A negative value shows more charge has been put into the battery than taken out).

## ***Other Functions***

### ***Display Timeout***

The display is active as soon as the unit is powered on. After a period of about 5 minutes of inactivity the display is automatically blanked. To turn the display back on briefly press any of the front panel buttons.

When the display is blanked the Front panel LED flashes periodically to indicate that the system is operational.

### ***Auto Shutdown (under voltage condition)***

Auto-Shutdown automatically disconnects the battery from the load when the voltage falls below the Low Voltage Disconnect threshold (LVD) The Auto-shutdown may be enabled or disabled by the user.

If the Auto-shutdown is enabled, when the battery voltage falls below the LVD, the Shutoff warning is indicated at the bottom of the Status screen. Both the POWER LED (red to show alarm condition), and the audible alarm (if enabled) will sound for a period of approximately 10 seconds. After this warning period the POWERmini will disable the output and the audible alarm will stop.

The output will be automatically reconnected when the battery voltage rises above the Low Voltage Reset threshold (LVR). (See page 4, Battery Settings) for information on how to change this value.

If the Auto-shutdown mode is disabled, the POWERmini will not disconnect the battery and after the warning period the alarm will cease to sound. The shutdown message will be displayed on the bottom of the Status page regardless of whether Auto Off is enabled or not.

**IMPORTANT:** Regardless of whether the auto-shutdown mode is enabled or not, if the battery voltage falls below 10.1V POWERmini USB will automatically shut down and will not restart until it is reset by disconnecting and then reconnecting the battery from the unit.

### ***Auto Shutdown (over voltage condition)***

Most amateur radio equipment is designed to operate from a power source of 13.8 V +/- 15% which is a range from 11.7V to 15.8V. Check the specification for your specific radio as some have an upper limit of 15V and some are designed to operate at voltages below 11 V.

The output will be automatically disconnected when the battery voltage rises above the High Voltage threshold (HVR).

Operating at higher voltage than the maximum may cause damage to the equipment and operating below the minimum voltage may result in below normal performance (especially on transmit).

### ***Output Overload***

POWERmini USB protects the system from overload by automatically disconnecting the load if excessive load current is detected. This is indicated by the Power LED flashing RED and an audible warning if the audible alarm is enabled. The source of overload should be investigated and rectified before using the system. The following procedure should be used to remedy the fault condition.

1. Disconnect the load from POWERmini USB (both ports) by removing the Powerpole load connectors at the POWERmini USB end of the cable.
2. Disconnect the battery from the POWERmini USB
3. Reconnect the battery from the POWERmini USB and confirm that the unit powered up normally.
4. Visually inspect the output cables for damaged insulation or strands of wire shorting at either end of the cable.
5. Check with an ohmmeter for a short circuit between conductors of the output cable.

## OPERATIONS

6. Resolve any issues found in steps 4 and 5 above and reconnect the output cables to the POWERmini USB.

### ***Audible Alarm Cancel***

If the audible alarm is enabled, you can silence the audible alarm from the Status page by pushing the SEL button and releasing after about 1 second. The audible alarm will remain disabled until you manually re-enable it (see Figure 7 Control Settings page). The audible alarm is enabled when the asterisk is shown at the lower left of the Status page (see Figure 8).

### ***Solar Charger Disconnect***

When a solar panel is only partially illuminated it may not provide enough voltage to charge the battery. If POWERmini determines that the solar panel voltage is not sufficient then the solar panel input is disconnected from the battery.

The POWERmini enables charging only when the battery is in the safe area. To prevent charging of a possibly defective battery, POWERmini will not charge a battery at or below that voltage.

If POWERmini USB detects a solar panel output current greater than 11A the POWERmini solar input will be automatically disconnected and the warning message "FAULT" will be displayed in the bottom of the solar panel window. To reset the POWERmini solar input, disconnect the solar panel from POWERmini and then reconnect it.

### ***USB Dedicated Charger Port (DCP)***

The 5V USB charge port is compatible with the requirements of the USB Battery Charging Specification 1.2. This supports different charge current limits for a wide variety of devices including most popular cell phones and tablets. The maximum charge current is set by the device connected to the USB charger port. This requires a standard 4 conductor USB cable. Note that if you do not use the standard cable the charger will default to a maximum charge current of 500mA (900 mA USB3.0).

The maximum output is current limited by specification to 1.5A.

### ***Fault reporting***

The POWER LED serves dual functions. When the unit is working normally the LED is green indicating normal operation. A fault condition is indicated by the front panel POWER LED changing color to flashing red. Examples of fault condition are over-voltage and under voltage battery voltage.

### ***Operating Time***

POWERmini USB keeps track of the amount of time that has passed from power up time and displays the information on the System Report page.

## OPERATIONS

### ***Default Settings***

The following table shows the values that are set at the factory, but these can be changed to better suit your needs if required.

| PARAMETER          | DEFAULT VALUE                         |
|--------------------|---------------------------------------|
| Battery Type       | Lithium Iron Phosphate (LiFePO4 -14V) |
| Max Charge Voltage | 14.4 V                                |
| Auto Off           | Disabled                              |
| Audible alarm      | Enabled                               |
| Low voltage limit  | 11.0 V                                |
| Low voltage reset  | 11.5 V                                |
| High voltage limit | 15.5 V                                |
| High voltage reset | 15 V                                  |

### ***Restore Factory Defaults***

Use the following procedure to reset the unit back to the default factory settings.

- Disconnect the POWERmini USB from the battery and solar input
- Press and hold the SEL button and connect the battery to the battery input port
- When the start-up screen has displayed, and you hear a brief beep, release the SEL button
- Reconnect the solar panel (if in use)

The default values will have been restored to the system. Before using the device please check that you have settings that are suited to your system. It is particularly important to check that the correct battery type has been selected.

## TECHNICAL REFERENCE

### Battery Types

For best results you should be sure to set the charge and cut-off parameters to suit the battery chemistry that you are going to use. POWERmini allows you to save settings for the maximum and minimum battery voltages separately for different types of batteries.

Different types of battery chemistry have different voltage vs capacity characteristics. The characteristic Capacity (Ah) vs voltage curves of three popular battery types are shown in Figure 11 below.

### Battery Comparison (Ah vs Battery Voltage)

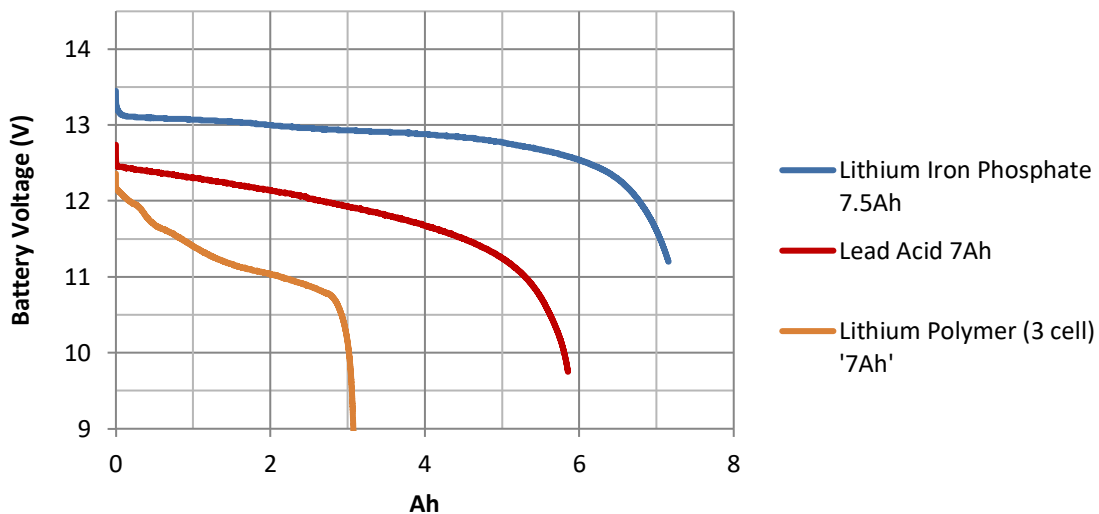


Figure 11 Comparison of battery characteristics for different battery chemistry

The three types of batteries shown in the chart above are Lithium Iron Phosphate (4 cell), Lead Acid (6 cell) and Lithium Polymer (3 cell). Notice that the curves are similar in shape but have very different values for the fully charged and depleted states.

- Lithium Iron Phosphate battery  
The LiFePO<sub>4</sub> battery a higher maximum voltage (100% charge level) and a relatively flat discharge curve. These batteries can also provide very high output currents relative to their Ah rating.
- Lead Acid battery  
The battery a lower maximum voltage, a steeper discharge curve and a lower cut-off voltage.
- The Lithium Polymer  
This is popular in car jump start battery packs and cell phones because it has a higher per-cell voltage. The 12V jump start version uses only 3 cells, resulting in a battery that has an even lower maximum voltage and a lower cut-off voltage than Lead Acid batteries  
Also, beware - the surprisingly low capacity of the battery shown in the orange curve above is because the 7Ah manufacturers rating applies only to the battery USB charge port not the 12V battery output.

Although some QRP radios work well with this battery type, the low nominal terminal voltage of this battery is problematic for other radios, many of which require a battery voltage of over 12V to function normally.

## ***Battery Health***

A healthy battery has a low internal resistance. Internal resistance causes the battery terminal voltage to fall as the load current increases. You can see this effect in real time by viewing voltage bar on the POWERmini USB status screen (Figure 8). When you key up the transmitter, the increase in load current (relative to receive current) will cause the battery voltage to fall. A small reduction in voltage is normal, but if the voltage drop is excessive it is an indication that the battery is either under-sized, or, has high internal resistance.

Another more dramatic problem that causes the battery voltage to fall dramatically on load results when one (or more) of the battery cells is damaged. An unfortunate aspect of having a defective cell is that during the charge cycle the remaining cells will become overcharged. For this reason, battery chargers (including POWERmini) will not charge a 12V battery if the total battery voltage is below 10V.

If you have a battery that has an abnormally low terminal voltage, then you may be able to recover it by using a very low charge current for a short period of time. This is known as trickle charging. If the terminal voltage can be brought over the 10V limit then you can continue charging it normally.

## ***Battery Settings***

CAUTION: Always follow the battery manufacturers recommendations for maximum charge voltage. Note that the default factory settings for maximum voltage are generic. You should consult the specific voltage settings from the specific battery that you are using.

Setting the maximum charge setting too high may result in damage to the battery, while setting the voltage too low will mean that the battery will not reach the 100% charge point.

## ***Battery Management Systems (BMS)***

IMPORTANT NOTE: Some batteries are equipped with internal intelligent battery management systems (BMS) which have a strict maximum voltage limit which should not be exceeded.

Batteries with BMS may disconnect power internally if the maximum voltage is exceeded shutting down the complete power system.

## SPECIFICATIONS

|  |   |
|--|---|
| Battery Type                               | LiFePO <sub>4</sub> , Lead Acid, Li Polymer, 3 cell LiFePO <sub>4</sub> |
| Maximum Battery Input Voltage <sup>1</sup> | 24 V DC   |
| Minimum Battery Input Voltage <sup>2</sup> | 9 V DC  |
| Maximum Solar Input Voltage                | 24 V DC   |
| Minimum Solar Input Voltage                | N/A   |
| Maximum Load Current (total) <sup>3</sup>  | 35 A (continuous)   |
| Maximum Solar Charge Current <sup>4</sup>  | 11 A  |
| Number of 12V DC output ports              | 2   |
| DC power connectors                        | Anderson Powerpole® 45A   |
| USB charger output connector               | USB type A connector  |
| USB charger output voltage                 | 5V  |
| USB charge maximum output current          | 1.5A  |
| Reverse Polarity Protection                | Battery input   |
| Over voltage disconnect range              | 14 – 16 V (user adjustable)   |
| Low voltage disconnect range               | 9.5 – 13 V (user adjustable)  |
| Maximum Charge Voltage                     | 10-15 V (user adjustable)   |
| Audible alarm                              | User settable enable, disable   |
| Overall Size                               | 4.5 (W) x 3.2 (D) x 1.3 (H) inches<br>115 (W) x 82 (D) x 33 (H) mm      |
| Weight                                     | 6.2 oz (176g).  |
| Operating Temperature Range                | 0 – 40 degrees Celsius  |

---

<sup>1</sup> The maximum battery input voltage is the maximum that the POWERmini will accept. The voltage will not be applied to the radio unless it is below the High Voltage Limit set in the user settings.

<sup>2</sup> To protect the battery, POWERmini is designed to shutdown with voltages below the minimum voltage.

<sup>3</sup> POWERmini will automatically disconnect the outputs if the maximum load current is exceeded.

<sup>4</sup> POWERmini will automatically disconnect the solar input if the maximum solar input current is exceeded.