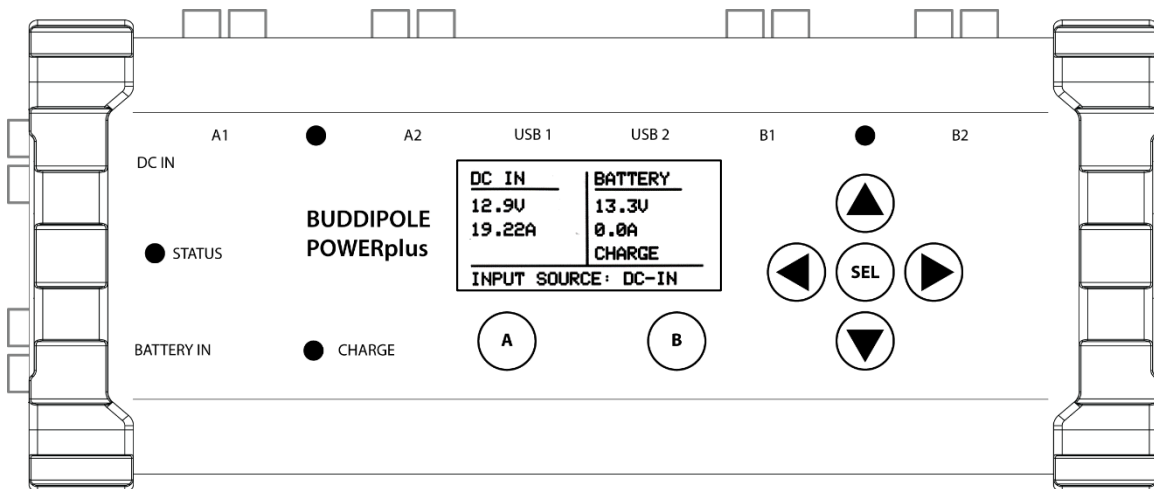


# BUDDIPOLE

DC POWER MANAGEMENT SYSTEM  
WITH BUILT IN BATTERY CHARGER

## POWERplus

### USER GUIDE



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## General Description

The Buddipole POWERplus is a DC power management system with a high performance internal battery charger and multiple power outputs. Two USB charger outputs are provided in addition to four 12V DC power outputs.

The unit is an excellent choice for field, base or mobile stations that require a backup power battery power source to protect from the loss of the DC power input.

## BASIC FEATURES

The following is a list of the basic POWERplus features:

- Automatic control of outputs
  - User adjustable low voltage battery disconnect point threshold setting
  - User option to enable / disable low voltage battery auto-disconnect feature
- User adjustable over voltage disconnect voltage threshold setting
- Two independent power output groups
  - Each group with individually set current limit
  - Manual reset of current trip from front panel
- Manual control of individual output groups (ON/OFF)
- High performance battery charger
  - Support for Lead Acid or Lithium Ion battery types
  - User adjustable charge current up to 6A
- Automatic and manual changeover from DC power to battery power
- Aux Battery mode automatically disconnects from vehicle power when engine stopped.
- Two independent 1.5A USB charger ports
- Audible warning for error conditions
- Status LEDs
  - Output power status (A and B)
  - Input power status (DC/Battery selection)
  - Battery charger status
- Front panel display providing extensive system monitoring
  - DC power supply voltage
  - DC input current
  - Battery voltage
  - Battery status (charge / discharge)
  - Battery charge current
  - Input source status
  - Load current for each output group
  - Output group status (LED indicator)
  - Graphical display of output current for each group
- Front Panel switches
  - Five button navigation system
  - Dedicated output ON/OFF switches

## QUICK START

You can plug a DC power supply and connect outputs to POWERplus and start using it right away, but before you connect a battery you must select the correct setting to match the type of battery that you intend to use. The default battery type is Lithium Iron Phosphate (LiFePO4) and the default charge current is 1A. Please refer to the **OPERATIONS** section for information on how to setup the POWERplus to suit your operational needs.

### Connections – Base Station

The unit can be setup with a DC power supply and an optional external battery backup as shown in the figure below. In this example the main station is connected to output group A and a second station (VHF) is connected to output group B. This provides an easy way to manage the stations separately.

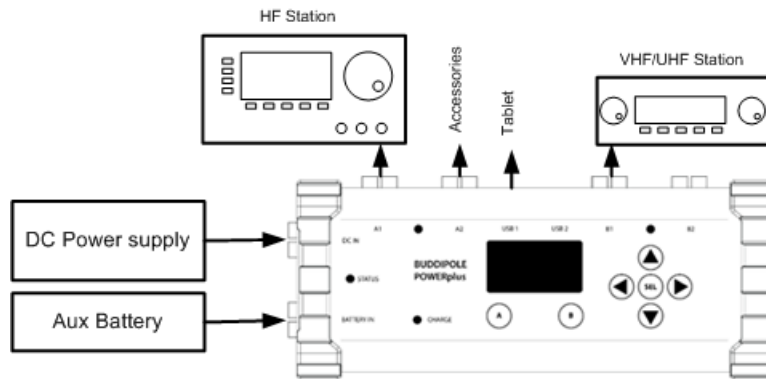


Figure 1 Example POWERplus connections for base station

### Connections – Mobile Station

POWERplus can operate from a vehicle battery directly or it can be used with a vehicle battery as the primary source and an auxiliary backup battery as a secondary power source. When the vehicle engine is running and the alternator is charging the vehicle battery, POWERplus will power the radio and charge the auxiliary battery from the vehicle battery. When the engine is stopped the alternator will stop charging the battery and POWERplus will automatically disconnect from the vehicle battery and switch to operating from the Auxiliary battery.

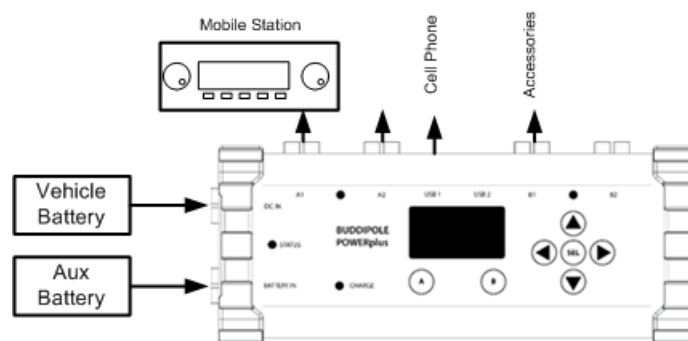


Figure 2 Example POWERplus connections for mobile station with auxiliary battery

## General Considerations

A 100 W radio requires about 20A of current and for best performance the voltage at the radio should be about 13.8 V. The use of 10AWG wire is recommended to minimize the voltage drop in the cable.

All cables should be terminated at the POWERplus with Anderson Powerpole connectors. The use of 40A contacts is recommended for applications that are using the full 40A capability of POWERplus. Remember that a 100W station uses at least 20A.

- Connect the input cables to the appropriate Powerpole connectors on the left side of the unit. Use the Red/Black connectors for the DC input port and the Blue/Black for the (optional) battery input.
- Connect the output cables to the Powerpole connectors located on the long edge of the POWERplus enclosure. There are four DC outputs arranged in two groups, each with two output ports. Refer to the **OPERATIONS** section for information on how to setup current limiting for each group of outputs.
- In addition to the 12V outputs there are also two USB charger ports. These can be used to charge a cell phone or tablet with a maximum current of 1.5A each.

## Settings

Recommended initial settings for a POWERplus with external battery.

Details of how to changes these settings are provided in the OPERATIONS section.

BATTERY MENU	Options	Initial Recommendation
Battery Type	Choose Lead Acid or Lithium Phosphate (LiFePO4)	Select the type that matches the battery chemistry you will be using.
Charger	Enable/Disable	ENABLE if battery is connected, disable if you are not using an external battery.
Charge current	1- 6 A	Set to suit battery size. If unsure set to 1A.

CONTROL MENU		
Power Mode	Auto/Battery	DC IN
Auto-Off	Enable to allow POWERplus to disconnect output when battery too low.	ENABLE
Display Timer	Select ENABLE to have display shut off after a period of time or OFF to have display always active.	OFF
Alarm	Enable/Disable	ENABLE

# FUNCTIONS

## Front Panel Overview

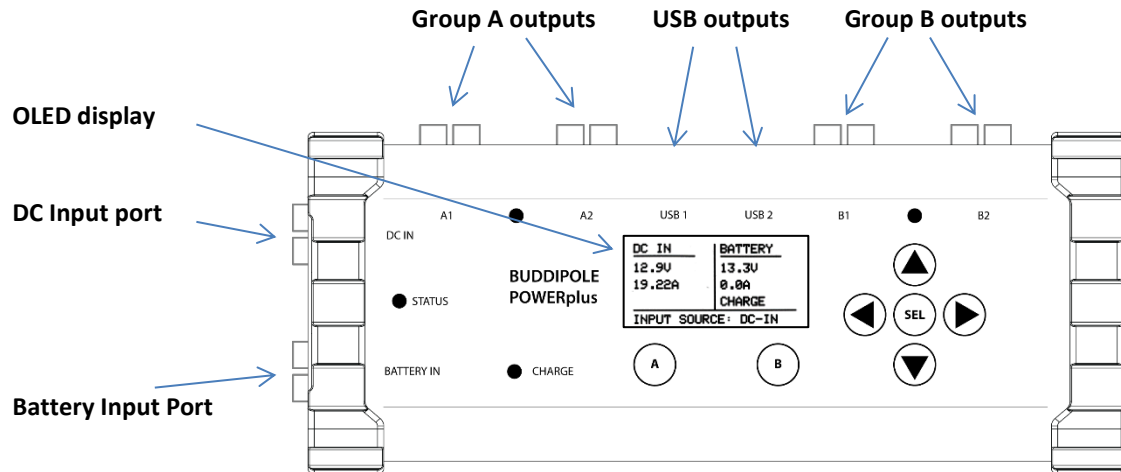


Figure 3 POWERplus front view

The front panel contains the following:

- OLED graphical display.  
Provides a comprehensive view of the 12 VDC power system status and user editable parameters.
- Five navigation buttons provide simple control of the front panel display.
  - SEL button (SEL) is the center button used to enter edit mode.
  - ADJUST buttons located on either side of the SEL button used to change user settings.
  - UP/DOWN buttons located above and below the SEL button used to switch between menu pages and to select parameters for adjustment in the setup menus.
- A and B output control buttons located below the display used to reset the GROUP A and B output circuit breakers.  
Turns A and B output groups on and off independently.

## ***Input Selection***

When the DC input voltage is in range, POWERplus automatically selects the DC input as the power source to feed the outputs. If the DC input is out of range, then POWERplus will automatically switch to the battery input.

If you want to use the battery (for example to test the battery under load), choose the Battery input selection (BATT). This is a manual way to use the battery as the power source even when the DC input is within the normal range.

When using POWERplus in a mobile application you can configure it to use an additional (auxiliary) battery which will be used when the vehicle engine is not running. POWERplus will automatically select the auxiliary battery when the engine is not running.

## ***Input Status Indicator***

The input status LED is located midway between the DC input and Battery input connectors on the left side of the control panel. The LED glows GREEN when the DC input is selected and glows RED when the Battery input is selected (see also Alarm Status Indicator).

## ***Output Control***

The two output groups (A and B) are individually protected by high efficiency output switches. The outputs are independent and are automatically disconnected from the loads if the output current exceeds the current set by the user for that output group.

The maximum total output current (A+B) is 40A. Output group A has priority over the maximum current. For example, if you set group A to have a maximum output current of 35A, group B output cannot exceed 5A. See the [AUTO OFF](#)

- Select ENABLE to allow POWERplus to disconnect the battery from the output when the battery voltage falls below the VL Limit.  
Selecting the OFF option will keep the battery connected to the output even when the voltage falls below the VL limit.

Limit Settings page for information on setting the output current limits.

If an output is disconnected because of excessive current the associated front panel group LED will be extinguished. After clearing the fault, you can reset the output by pressing the appropriate A or B output button. These buttons are alternate-action, so you can also use them to manually operate the output switches.

## ***Output Status Indicators***

LED indicators are located midway between each of the two DC output groups. These LEDs glow green when DC is applied to the associated group and extinguished when DC is disconnected to the output.

## ***Alarm Status Indicator***

The RED STATUS led will flash when the battery is connected, and the voltage falls close to the battery cut-off threshold. If the beeper is enabled the audible alarm will also be sounded. The low voltage disconnect threshold can be set in the [AUTO OFF](#)

- Select ENABLE to allow POWERplus to disconnect the battery from the output when the battery voltage falls below the VL Limit.  
Selecting the OFF option will keep the battery connected to the output even when the voltage falls below the VL limit.

## Functional Description

Limit Settings page.

### **Audible Alarm**

The audible alarm sounds when the battery voltage has fallen to around 0.5V above the programmed shut-off voltage. See the [CONTROL SETTINGS](#) page for information on how to set enable or disable the alarm.

### **Battery Charging**

POWERplus includes a built-in battery charger suitable for charging either Lead Acid or LiFePO4 battery types. The battery charger uses the DC input supply to charge the battery. If the DC input supply is not connected, then the charger cannot function.

The factory default for the battery type is Lead Acid but you may change this by changing the user setting.

The charger can deliver charge currents up to 6.0A. Note because this charge current is provided from the DC input you must size the DC power supply so the total load on the power supply is the sum of the load current delivered to the output connectors in addition to the charge current.

You must use the User Settings to set the maximum amount of charge current to suit your battery. For Lead Acid batteries it is normal to charge at the C/10 or C/20 rate. C is the capacity of the battery so as an example using the C/10 rate with a 55Ah battery the maximum charge current should be set to  $55/10 = 5.5A$ . You can of course charge at a lower rate.

It is important not to charge a battery too quickly. For example, it could be dangerous to charge a 5Ah lead acid battery at 5A (effectively a rate of C/1).

Some types of batteries can be charged at a higher rate, but you should always consult with the manufacturer of the battery you are using to get the information relating to the specific battery.

If you disconnect a battery from the unit it is recommended that you disable the battery charger and re-enable when you reconnect the battery. Refer to the [BATTERY SETTINGS](#) page for information on enabling or disabling the battery charger.

#### *Lead-Acid Charging*

The charger uses a three-phase charging cycle for Lead-Acid batteries. Before starting the cycle, the charger checks the battery voltage to determine whether the battery is in good condition. If the battery voltage is below 10V then the charger will enter the pre-condition phase and trickle charge the battery to get the voltage into the acceptable range.

When the voltage rises above the minimum threshold, the charger will exit this pre-condition mode and enter the normal charge cycle. If this voltage is not achieved, after a pre-determined period of time, the charge cycle will be automatically terminated.

A battery in good condition but in the discharged state will initially be charged at a constant current (set by the user) until the battery is close to the float voltage. The charger then switches to a constant voltage mode.

It will continue to provide a small charge current to keep the battery in the fully charged state.

#### *LiFePO4 Charging*

The Lithium charger has two charging phases in addition to a pre-conditioning phase used to deal with over discharged or defective batteries.

Initially with a normally discharged battery the charger will enter a constant current charge state with the current set by the user.



## Functional Description

When the battery nears the float stage voltage the charger transitions to a constant voltage mode. Float charging continues at this voltage and is automatically terminated after a period of time. The charge cycle is repeated when the battery voltage falls to the lower edge of the float cycle.

If the charger establishes that the battery is below the fully depleted discharge level it will enter the pre-conditioning phase and trickle charge the battery. If the battery voltage rises sufficiently the charger will switch to the normal charge cycle, but will automatically terminate if the voltage does not rise to the required level.

### *Other battery types*

The charge requirements for other battery types may differ from the types supported by POWERplus. Do not use the charger with battery types such as Lithium Polymer batteries which have markedly different charging parameters.

### *Charge Indicator*

A front panel LED shows which phase of the charge cycle the charger is in. The LED is displayed as RED, GREEN or AMBER (RED/GREEN) but the meaning of the indicators is different depending upon whether you are charging a Lead-Acid or LiFePO4 battery type.

#### LEAD-ACID BATTERY

LED	PHASE	DESCRIPTION	STATUS
OFF	Disabled	Manual shutdown	Not charging
OFF	Shutdown	Automatic if battery fault is detected.	Not charging
AMBER	1)Bulk	First phase, constant current	Charging
GREEN	2)Absorption	Second phase, transition to constant voltage	Charging
RED	3) Float	Third phase, constant voltage	Charging

#### LITHIUM IRON PHOSPHATE BATTERY

LED	PHASE	DESCRIPTION	STATUS
OFF	Disabled	Manual shutdown	Not charging
GREEN	1) Absorption	Absorption charge in process	Charging
OFF	2) Float	Float charge mode	Float charging
RED	Fault	Battery fault detected	Not charging

When a LiFePO4 battery is in the charge mode, the color of the LED is green. It is illuminated when the battery is being charged and extinguished when the battery is not charging, is in the float charge mode or the charger has been disabled.

## ***USB Charging***

POWERplus provides two USB charge ports. These ports automatically detect the type of device connected and can each charge up to 1.5A (depending upon the device connected). Current limiting to prevent overload is provided.

## Functional Description

Note that when used with devices that do not comply with the USB Charging Specification the maximum charge current may not be delivered.

There are no user settings associated with the USB charge ports.

# OPERATIONS

This section provides information about how to use your POWERplus.

## Display Navigation

The POWERplus display has several pages of information and settings accessed sequentially as shown in Figure 4 below.

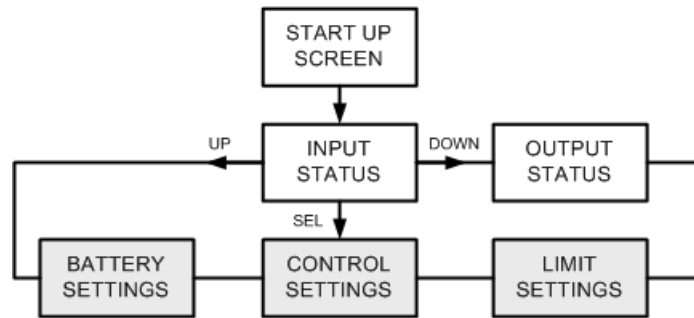


Figure 4 POWERplus display screens

The shaded boxes in Figure 4 indicate the screens that have user settings that can be edited to suit your needs.

When POWERplus is first powered on the Startup screen is displayed briefly. The Input status screen is then automatically displayed.

- Use the UP/DOWN buttons on the front panel (FIGURE 5) to navigate either forwards or backwards through the series of screens. For example, press the DOWN button from the INPUT status page to go to the OUTPUT status page.

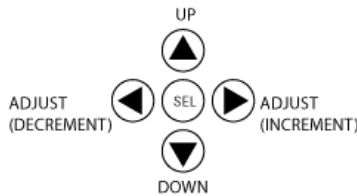


Figure 5 Menu Navigation Buttons

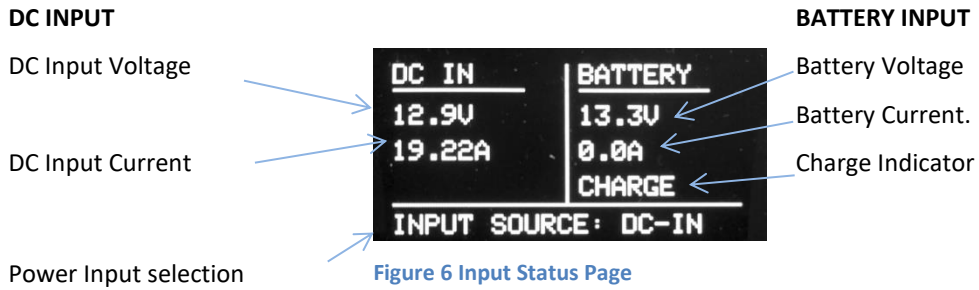
- Use the SEL button to enter the edit mode. Exit the edit mode by using the UP button to scroll off the top of the parameter list. Changes to your settings are automatically saved when you exit the page.
- Briefly press the SEL button from INPUT status or OUTPUT status pages to go directly to the CONTROL settings page.
- Use the ADJUST buttons to make changes to user settings in the settings pages.

## Viewing Status

### Input Status

View the Input Status Page (FIGURE 6) for information about the DC and Battery inputs. Information about the DC input power is displayed in the left panel and Battery power information is displayed in the panel on the right side.

The currently selected input is shown at the bottom of the Input Status page.

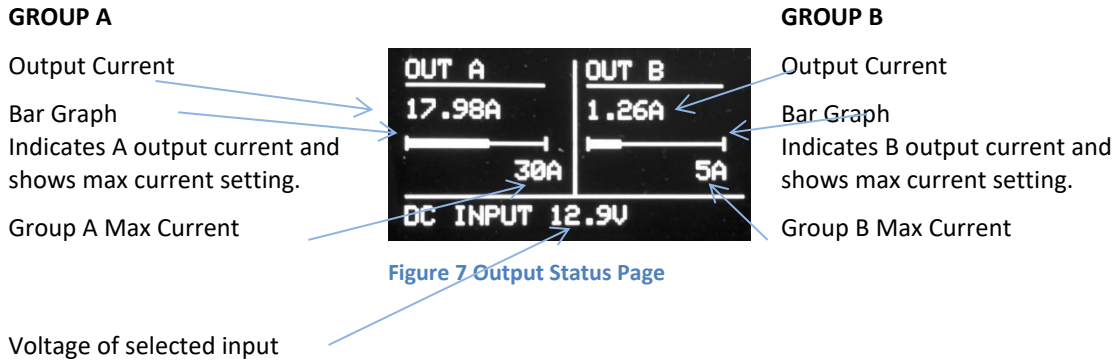


### Output Status

View the Output Status page for useful information about the output groups.

The two output groups (A and B) are displayed side by side. Real time display of the load current for each group is provide as well as a graphical display of the load current in the form of a horizontal bar graph. Each graph is scaled to correspond with the maximum current you have selected in the user settings.

The output voltage is displayed at the bottom of the Output Status page (Figure 7).



## Changing User Settings

View the current user settings by using the UP/DOWN buttons to navigate to the specific page (Figure 4).

- Edit the current user settings by briefly pressing the SEL button to enter the edit mode. A white box is drawn around the item that is selected for change.
- Select the line that you wish to change using the UP/DOWN buttons
- Change the selected parameter using the ADJUST buttons.
- Exit the edit mode and return to navigating the menus using the UP button to scroll off the top of the parameter list.  
All settings are saved automatically when you exit the edit mode and confirmed by a long beep.

### Control Settings

Use the Control Settings page (Figure 8) to view and change system settings.

CONTROL	PARAMETER	RANGE
Power Mode	DCIN	DCIN/BATT/MOBILE
DC Trip U	13.50	11—14 V
Display Timer	ENABLE	Off/Enable
Alarm	ENABLE	Off/Enable

Figure 8 Control Settings Page

- Power Mode
  - **DC IN** - Selects the DC input source. If the DC input is below the DC threshold, POWERplus will automatically switch to the battery input.
  - **BATT** - Forces the Battery input to be used even if the DC input is connected.
  - **MOBILE** - In the mobile mode POWERplus will select the DC input if the DC input is above the DC trip voltage. When the DC input falls below the DC trip voltage the battery input is selected. The DC Trip voltage should be set so the changeover to the battery input occurs when the vehicle engine is not running (See below).
- DC Trip Voltage
  - In the MOBILE mode POWERplus will accept power from the vehicle battery if the vehicle battery is above the DC Trip Voltage threshold. When the vehicle alternator is charging the vehicle battery the battery voltage will be above the DC Trip Voltage. When the engine is stopped the alternator will not be providing charge to the battery and the voltage will fall below the DC Trip Voltage. The default trip voltage of 13.5V works well with many vehicles. If POWERplus does not switch to the Auxiliary battery when the engine is shut-off, or does not re-connect to the vehicle battery when the engine is restarted adjust the DC Trip Voltage to a value better suited to your vehicle.
- Display Timer
  - Select Enable to turn on the display timer so that it will automatically blank the display after 5 minutes.
  - Disable the timer to keep the display always on.
- Alarm Off
  - Select ENABLE to activate the audible alarm or OFF to prevent the alarm from sounding.

## Operational Description

### Battery Settings

The Battery Settings Page (Figure 9) shows the user settings relating to the battery connected to the POWERplus system.

BATTERY		PARAMETER	RANGE
Battery Type	LiFe	Battery Type	LiFePO4/ (PbSO4)
Charger	DISABLE	Charger Enable	Off/Enable
Max Charge	1	Maximum Charge Current	1 – 6 A
Auto Off	DISABLE	Auto Off	Disable/Enable

Figure 9 Battery Settings Page

- Battery Type
  - Choose the battery type corresponding to the battery connected to POWERplus. This configures the charger to suit the specific battery.
- Charger Enable
  - Set ENABLE if you have a battery connected and want to use the internal battery charger. It is recommended to disable the charger if no battery is connected.
- Maximum Charge Current
  - Choose the value suitable to charge the capacity of the battery (Ah) connected. The actual charge current will be at or below this level depending upon the state of charge of the battery. Consult with the battery manufacturer if you are not sure of the recommended charge current.
- Auto Off
  - Select ENABLE to allow POWERplus to disconnect the battery from the output when the battery voltage falls below the VL Limit. Selecting the OFF option will keep the battery connected to the output even when the voltage falls below the VL limit.

### Limit Settings

The Limit Settings page (Figure 10) shows the user settings related to the upper and lower disconnect voltages and the maximum output current settings.

LIMITS		PARAMETER	RANGE
VH limit	15.20 V	Over-voltage limit	14-16V
VL limit	11.00 V	Low voltage limit	9-13V
OUT A MAX	30 A	Grp A Max Current	5 – 35 A
OUT B MAX	5 A	Grp B Max Current	5 – 35 A

Figure 10 Control Settings Page

- VH Limit
  - Set the upper limit trip voltage to suit the maximum value your equipment is rated for. A voltage higher than this threshold will cut off the voltage to the outputs. The output will remain disconnected until the voltage has fallen at least 1 V lower than this setting.

## Operational Description

- VL Limit
  - Set the lower limit trip voltage to a value suitable for the type of battery that you are using. This setting is intended to avoid damage to the battery due to deep discharge. It is the battery voltage at which the battery will be disconnected in Auto Off mode.
- OUT A Max
  - Set the value for the A output first because this may limit the maximum current available for the B outputs. The adjustment range is in 5 A increments from 5A to 35A.
- OUT B Max
  - Set the maximum current for the B output. Because the maximum input current for POWERplus is 40A the combined A and B output current cannot exceed this value. The B output will be automatically adjusted down if you attempt to set both outputs so the total current (40A) is exceeded. (see [OUTPUT CONTROL](#) for more information).

## WARRANTY

*POWERplus* is warranted against failure due to defects in workmanship or materials for a period of one year after the date of purchase from Buddipole.

Warranty does not cover damage caused by abuse, failure to follow instructions, improper installation, alteration, lightning, or other incidence of excessive voltage or current. If failure occurs within this period, return the *POWERplus* to Buddipole at your shipping expense. The device will be repaired or replaced at our option, without charge and returned to you at our shipping expense. Repaired or replaced items are warranted for the remainder of the original warranty period.

You will be charged for repair or replacement of the *POWERplus* made after expiration of the warranty period.

You will be charged for repair or replacement of the *POWERplus* made after expiration of the warranty period.

Buddipole shall have no liability or responsibility to customer or any other person or entity with respect to any liability, loss or damage caused directly or indirectly by use or performance of the products or arising out of any breach of this warranty, including but not limited to, any damages resulting from inconvenience, loss of time, data, property, revenue or profit, or any indirect, special incidental, or consequential damages, even if Buddipole has been notified of such damage.

## SPECIFICATIONS

Battery Type	Lithium Iron Phosphate (LiFePO4) or Lead Acid (PbSO4).
Absolute Maximum DC Input Voltage <sup>1</sup>	20 V DC
Minimum DC Input Voltage	11 VDC
Minimum Battery Input Voltage	10 V DC
Maximum Battery Input Voltage	16 V DC
Maximum Load Current	35 A (total 40A max)
Maximum Charge Current	6 A
Number of DC output ports	4
Number of USB outputs	2
Maximum USB output current	1.5A maximum (each port)
DC power connectors	Anderson Powerpole® 45A
Reverse Polarity Protection	DC and Battery inputs
Over voltage disconnect range	14 – 16 V (user adjustable)
Low voltage disconnect range (battery)	10 – 13 V (user adjustable)
Audible alarm	User settable enable, disable
Overall Size	7.5" (W) x 3.2" (D) x 1.3" (H) 190 (W) x 82 (D) x 33 (H) mm
Weight	11.3oz (320.3 g).
Operating Temperature Range	0 – 40 degrees Celsius

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<sup>1</sup> The maximum dc input and battery voltage is the maximum that the POWERplus will accept. The voltage will not be applied to the radio unless it is below the High V limit set in the user settings.