

# OpenUPS

6-30V Intelligent Uninterruptible Power Supply

## Installation Guide

Version 1.0f  
P/N OPENUPS-06

### **Before you start...**

Please take a moment and read this manual before you install the OpenUPS.

Often times, rushing into installing the unit can result in serious damage to your OpenUPS board, computer. Always double check the polarity of your wires with a voltmeter.

### **Introduction**

Thank you for purchasing the OpenUPS Uninterruptible power supply.

The OpenUPS was designed to provide user specified regulated power output from a wide input voltage, battery backup, multi-chemistry charging and cell balancing in a single PCBA.

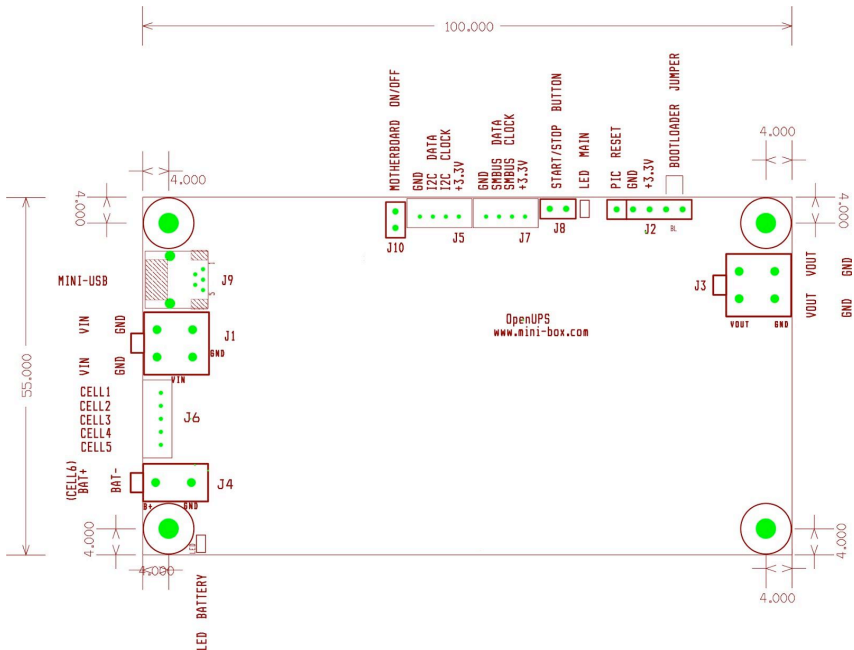
## OpenUPS features include:

- USB interface, works with Windows devices (Linux API planned)
- SMBUS slave and I2C master
- Input between 6-30V
- Programmable voltage thresholds
- Generate any output voltage between 5-24V
- Supports multiple battery chemistry
- Balances up to 6 series batteries
- Charge voltage between 6-30V, charge current up to 3A, battery balancing up to 6 cells
- Coulomb counting (fuel gauge)
- Motherboard ON/OFF pulse control\*
- Windows detects device as "Battery", no special drivers required \*\*

\*Motherboard ON/OFF control: The device is able to send ON/OFF 'pulse signals' to motherboard based on coulomb counter and/or battery voltage level, or based on input voltage level or when starting.

\*\*Windows "no driver support": Installs itself as a battery in Windows, using the Windows hid driver without any driver installation, visible as an icon in tray bar.

OPENUPS Connection diagram



### **Power Input/Output Connectors:**

|   |                     |
|---|---------------------|
| J1: Input voltage,                                | (4pin mini-FIT JR)  |
| J4: Battery positive (+) and Battery negative (-) | (2 pin mini-FIT JR) |
| J3: Output voltage                                | (4 pin mini-FIT JR) |

### **Balancing header:**

|  |                          |
|--|--------------------------|
| j6: cells 1 to 5, cell6 already connected to Battery (+) | (JST PH connector, 5pin) |
|--|--------------------------|

### **Interface connectors:**

|  |                          |
|--|--------------------------|
| J9: Mini-USB connector                               | (mini-USB)               |
| J10: Motherboard ON/OFF control                      | (0.1" header)            |
| J5: I2C master                                       | (JST PH connector, 4pin) |
| J7: SMBUS slave                                      | (JST PH connector, 4pin) |
| J8: START/STOP button                                | (0.1" header)            |
| J2: Programming header, bootloader jumper, MCU reset | (0.1" pitch)             |

### **Display:**

Main LED (see status Main LED below)  
Battery LED (see Battery LED status below)

### **Bootloader Mode**

The device can start in bootloader mode so firmware updates are possible without using the programming header. Place a jumper between J2.4 and J2.5, then connect the unit to USB to enter bootloader mode.

Start the HIDBootLoader.exe software provided to flash the new firmware.

### **Resetting the MCU**

Placing shortly a jumper between J2.1 and J2.2 will reset the internal MCU reloading your reconfigured parameters and restarting the UPS. Care should be taken when using this feature.

## Getting Started...

Before you start you would need to connect the unit to USB and configure:

- battery type and capacity (default is PbSO4 and 7000mAh)
- number of cells connected to the balancing headers (default is CELLS=1)
- charge voltages and currents, (default is 14.1V and 1700mA when fast charging)
- output voltage (default is 12V)
- input start/stop voltage thresholds (default start at 11V, stop at 6V)
- other advanced parameters if needed

**NOTE:** The device needs to be restarted so the new configuration becomes active. Simply remove the power and disconnect USB cable to shut down, settings will be permanently saved.

Warning: Improper configuration (ex: wrong under voltage, over-voltage, reverse polarity) can lead to battery damage or your system damage (ex: wrong output value)

### Battery Configurations:

This device is a multi-chemistry device. Multiple batteries (up to 6 cells, 4.2V max) can be connected in series (1S, 2S, 3S, 4S, 5S, 6S configuration). Parallel configurations are also supported but not recommended due to possible decrease in lifespan.

It is possible to connect a battery with more than 4.2V/cell but in this case only 1 cell should be configured (CELLS=1). Balancing is disabled in this case. This is a typical example of a 12V SLA battery.

Connect your main battery terminals to the J4 connector. Always double check the polarity of the connections.

Connect the internal cells to the balancing header J6, if needed. If more than 1 cell and less than 6 cells are used connect the negative terminal of the battery to the next free pin on the J6 header.

**NOTE:** If no balancing wires are connected through the J6 header the CELLS parameter should be set to 1.

**Example:** connecting 4 cells (cells 6, 5, 4 and 3)

- The "highest" cell, cell\_6, is always connected to the power terminal BAT+ (no need to connect anywhere)
- connect cell\_5 to position 5 on J6 header
- connect cell\_4 to position 4 on J6 header
- connect cell\_3 to position 3 on J6 header
- connect the battery's negative terminal (or GND) to position 2 on J6 header

## Starting and Stopping with battery power....

If everything correctly configured pressing shortly the J8 button will turn on the output and your UPS will be started, energy will be flowing from battery to the output.

Long pressing (5 sec) J8 button will initiate shut down of the UPS. A pulse is sent to the motherboard than the UPS waits a predetermined UPS\_HARDOFF\_TOUT (60s by default) before the output voltage is turned off.

The motherboard's state is sensed by measuring the output power via. If the motherboard was shut down by the OS no pulse will be sent. The output power thresholds can be set by setting the POU\_LO and POUT\_HI parameters. If the motherboard consumes more than the POUT\_HI threshold (meaning motherboard is not shut down by OS) the pulse will be sent in case shutdown conditions are fulfilled.

## Connecting DC input power....

Connect a proper input voltage source to the J1 connector.

If input voltage is present (configurable by thresholds), OpenUPS will enable the proper power path and energy will be flowing from input to output and, if necessary, battery charging is started. Each cell is carefully monitored so that in case of an under voltage

or over-voltage event proper actions are taken.

## Operating modes:

-Auto restart when Input Power is Present=YES

Output and charging is started once the input power is present.

-Auto restart when Input Power is Present=NO

Only charging is started once the input power is present. The output will be started once the Start button is pressed.

## Main LED blink modes:

1) 5 x (30ms ON,30ms OFF) quick blinks during 750ms period repeatedly: initial delay.

2) 500ms ON, 500ms OFF: UPS is in standby (waiting for proper starting conditions).

The unit will stay in this state if one of the following conditions does not fulfill:

-Improper battery configuration

-Cell under voltage and input voltage is not present

3) Steady ON: UPS is running from Input

4) 500msec ON, 2.5 sec OFF: UPS is running on Battery

5) 1 sec ON, 1 sec OFF: OFFDELAY (time between a shutdown condition fulfilled

and the off pulse is sent to the motherboard) set by the UPS\_VBAT\_UVP\_OFF\_TOUT parameter.

6) 3x (500ms ON,500ms OFF) + 3 sec OFF repeatedly: Hardware OFF delay (time between the off pulse is sent and cut off of the output voltage) set by the UPS\_HARDOFF\_TOUT, entering deep sleep

### **Status of Battery LED:**

-Fast blinking: incorrect configuration of the cell numbers, or wrong connections on the balancing header.

-Toggle every 1 sec: Battery is being charged

-Steady ON: Battery is fully charged (100%)

-Steady OFF: (together with main LED's 500msec ON, 2.5 sec OFF:) System is running on battery

### **All LEDs OFF:**

Unit is in Deep sleep mode consuming very little power. MCU is not powered. Can be waked up by shorting J8 or if input voltage is present.

Setting Power plans under Windows Operating Systems:

Ex: Vista, Win7

-Right click on the battery icon from the tray bar then choose power options from the context menu. Alternatively, you can choose Power Options also from Control Panel Items.

-Select/create a power plan or modify existing ones.

-In the "Change Advanced power settings" section the critical and low battery levels and actions can be also modified

## OPENUPS Characteristics

|                                      |   |
|--------------------------------------|---|
| Minimum Input Operating. voltage     | 6V  |
| Maximum input Operating voltage      | 30V   |
| Deep-Discharge shutdown threshold    | configurable  |
| Input current limit (fuse protected) | Mini-blade 10A  |
| Deep Sleep Current Consumption.      | < 50uA  |
| Storage and operating temperature    | -40 to +85 degrees Celsius (storage), -40 – 65C (operating) |
| MTBF                                 | 50K Hrs @ 85C, >200K Hrs at 65 (projected)                  |
| Efficiency (Input 10-16V)            | >80-95% (95% max), depending on load V(in) and V(out)       |
| Input connectors                     | Mini-Fit JR   |
| Output Connector                     | Mini-Fit JR   |

Output/Input Rail Output Current (buck/boost converter):

Maximum input current: 6A\*

Peak Input current: 10A (<30 seconds) Maximum output current: 6A\*

Peak output Current: 10A (<30 seconds)

**\*NOTE:** When operating at high voltage (input or output) or/operating at elevated temperatures de-rating up to 30% might be necessary, forced ventilation required. For long life operation, please ensure that hottest component on-board is kept below 65C.

Support and warranty: Standard Hardware Warranty 1Year / US, 2 Year EU.

## Parameter List:

| NAME                      | DESCRIPTION   |
|---------------------------|---|
| OPENUPSMODE               | OPENUPS mode<br>0- Auto restart when Input Power is Present=YES<br>1- Auto restart when Input Power is Present=NO   |
| UPS_CONFIG                | Configuration register. Used for enabling disabling modules. LSB bit is b0.<br>b6- Stop impulse<br>b5- Start impulse<br>b4- Coulomb counter<br>b3- A/D Low Pass Filter module<br>b2- Balance module<br>b1- Charge module<br>b0- Output module<br>Default is all enabled |
| UPS_INIT_DELAY_TOUT[s]    | Initial delay before starting the UPS.<br>Default is 1 sec.   |
| UPS_VIN_MAX_SHUTDOWN[V]   | Max allowed input voltage. In case input voltage exceeds predefined value shutdown will be initiated.<br>Default is 35V.  |
| UPS_VIN_MIN_START [V]     | If input voltage is above this threshold the UPS will start and take power from the input.<br>Default is 11V.   |
| UPS_VIN_MIN_STOP [V]      | If input voltage is below this threshold the UPS will try to run on battery.<br>Default is 6V.  |
| UPS_VCELL_MIN_START [V]   | If Vin is not present and all the battery cells are above this threshold the UPS can start and runs on battery<br>Default is 11.7V  |
| UPS_VCELL_MIN_STOP [V]    | If VIN is not present and one of the battery cells are less than this threshold during the time period specified by UPS_VBAT_UVP_OFF_TOUT parameter the UPS will initiate shut down procedure. Default is 11.4V   |
| UPS_VBAT_UVP_OFF_TOUT [s] | During this period battery cells are checked against UPS_VCELL_MIN_STOP. If cell voltage exceeds UPS_VCELL_MIN_STOP the timer is rearmed so it can filter unwanted noise in the system.   |



|                               |  |
|-------------------------------|--|
|                               | Default is 5 sec.  |
| UPS_HARDOFF_TOUT[s]           | After UPS_VBAT_UVP_OFF_TOUT passed motherboard is signaled to shut down. The UPS will wait this period so that the Motherboard can shut down gracefully, then cut power and enter deep sleep. This period should not be too long to prevent battery drain.<br>Default is 60 sec. |
| UPS_SWITCHOVER_VBAT_TOUT [ms] | After UPS switches to battery, can switch back to Vin only after this time elapses. Default is 1000ms.   |
| UPS_SWITCHOVER_VIN_TOUT [ms]  | After UPS switches to input, can switch back to battery only after this time elapses.<br>Default is 1ms.   |
| DCHG_IMAX[mA]                 | Max allowed discharge current. In case discharge current exceeds this threshold shutdown will be initiated.<br>Default is 10000 mA.  |
| CAPACITY [mAh]                | Battery Capacity.<br>Default 7000mAh.  |
| CHG_BAT_TYPE                  | The battery chemistry to be charged.<br>0- PbSO4 (float charge is applied)<br>1- LiFePO4 (float charge is not applied)<br>2-LiPO (float charge is not applied)<br>Other (float charge is not applied)<br>Default is 0.   |
| CHG_VCOND[V]                  | Conditioning/Pre-charge voltage. Charge current is limited to CHG_ICOND until cell voltage exceeds this value and for at least CHG_TCOND time.<br>Default is 11.2V.  |
| CHG_ICOND[mA]                 | Conditioning/Precharge current. Charge current is limited to this value until cell voltage exceeds CHG_VCOND value and for at least CHG_TCOND time.<br>Default is 100mA.   |
| CHG_TCOND [s]                 | Conditioning/Precharge time. Charge current is limited to CHG_ICOND value until cell voltage exceeds CHG_VCOND value and it is applied during this time.<br>Default is 30 sec.   |
| CHG_IBULK[mA]                 | Fast charge current limit (constant current mode)<br>Default is 1750mA.  |

|                               |  |
|-------------------------------|--|
| CHG_BULK_STOP_VOLTAGE[V/cell] | Maximum allowed bulk charge  |
|                               | voltage/cell during constant current/constant voltage charging Default is 14.1V  |
| CHG_HYSTERESIS[V/cell]        | An over-voltage value (CHG_BULK_STOP_VOLTAGE +CHG_HYSTERESIS) that it is allowed when charging.<br>If one of the cells exceeds this value charging is immediately stopped.<br>Default is 100mV/cell.                           |
| CHG_START_VOLTAGE [V/cell]    | If cell voltage is below this value charging can be started. For PbSO4 battery this also sets the floating charge voltage. Default is 13.5V/cell   |
| CHG_IMIN [mA]                 | If charge current in CV mode is less than this value<br>PbSO4 : enter maintenance mode and apply the float charge voltage(CHG_START_VOLTAGE)<br>LiFePO4, LiPO: cut off the charge voltage<br>Default is 290mA                  |
| CHG_IFLOAT                    | Charge current limit in float charge mode for PbSO4 batteries.<br>Default is 100mA.  |
| CHG_GLOBAL_TOUT               | Global charge timeout.<br>Default is 1260 minute.  |
| CHG_TOPPING_TIMER             | For Lithium based batteries after an overvoltage condition is detected for a cell a resting period is set by this timer before applying a small topping charge in case other cells are still not charged.<br>Default is 1800s. |
| CHG_TEMP_PCB[°C]              | Charge current is limited by CHG_ILIMIT_TEMP_PCB amount every 30s, if board temperature exceeds this value. Can limit the charge current till CHG_IBULK/4 value.<br>Defaults is 60°C.  |
| CHG_ILIMIT_TEMP_PCB [A]       | Limit charge current with this amount if board temperature exceeds CHG_TEMP_PCB.<br>Default is 50mA.   |

|                    |   |
|--------------------|---|
| CHG_FREQUENCY[kHz] | The working frequency of the charger buck-boost converter<br>Default is 333kHz. |
| CELLS[pcs]         | Number of configured cells to charge/balance                                    |

|                             |   |
|-----------------------------|---|
|                             | Default is 1pcs.  |
| BAL_VCELL_MIN[V]            | Balancing is allowed if cell voltages are above this value.<br>Default is 3V  |
| BAL_VCELL_DIFF_START [V]    | If the voltage difference between cells exceed this value start balancing the cells.<br>Default is 70mV.  |
| BAL_VCELL_DIFF_STOP[V]      | If the voltage difference between cells is less than this value stop balancing the cells.<br>Default is 40mV.   |
| OUT_VOLTAGE[V]              | The output voltage.<br>Default is 12V.  |
| OUT_FREQUENCY[kHz]          | The working frequency of the output buck-boost converter.<br>Default 300kHz   |
| OUT_MAX_REGULATOR_STEP [nr] | Maximum allowed regulation step number for output module (0-255)<br>Default 100.  |
| MOB_ONOFF_TOUT [ms]         | The power switch on the motherboard (if connected) will be shorted this period to turn the Motherboard ON or OFF<br>Default is 500ms  |
| POUT_LO[W]                  | Output power low threshold for motherboard alive sensing. If output power is lower than this threshold shut down impulse will NOT be sent to the motherboard when shut down conditions are fulfilled.<br>Default is 2W. |
| POUT_HI[W]                  | Output power high threshold for motherboard alive sensing. If output power is higher than this threshold shut down impulse can be sent to the motherboard when shut down conditions are fulfilled.<br>Default is 6W.    |

|           |   |
|-----------|---|
| OCV_SOC0  | Open Circuit Voltage State Of Charge detection for initial 0% fuel gauge estimation.<br>Default is 11.8V  |
| OCV_SOC10 | Open Circuit Voltage State Of Charge detection for initial 10% fuel gauge estimation.<br>Default is 11.9V |

|                    |  |
|--------------------|--|
| OCV_SOC25          | Open Circuit Voltage State Of Charge detection for initial 25% fuel gauge estimation.<br>Default is 12V    |
| OCV_SOC50          | Open Circuit Voltage State Of Charge detection for initial 50% fuel gauge estimation.<br>Default is 12.3V  |
| OCV_SOC75          | Open Circuit Voltage State Of Charge detection for initial 75% fuel gauge estimation.<br>Default is 12.6V  |
| OCV_SOC100         | Open Circuit Voltage State Of Charge detection for initial 100% fuel gauge estimation.<br>Default is 12.8V |
| WRITE_COUNT[cycle] | Number of times the flash memory has been written. Parameter is Read only.                                 |