

4 Port USB Power Bank

With 4A SAB-CHRG Technology

Output 5V 1A (Dual Protection) / 2A (With OTG) / 2A / 3A (3.2A OC)

Charging Input 5V 1A - 4A(Max), With SMART CHARGING CONTROLLER

Simple Introduction

This Powerbank consist of 4 USB Port.

Port 1: 5V 1A Dual Protection with Current limit System and Short circuit Protection.

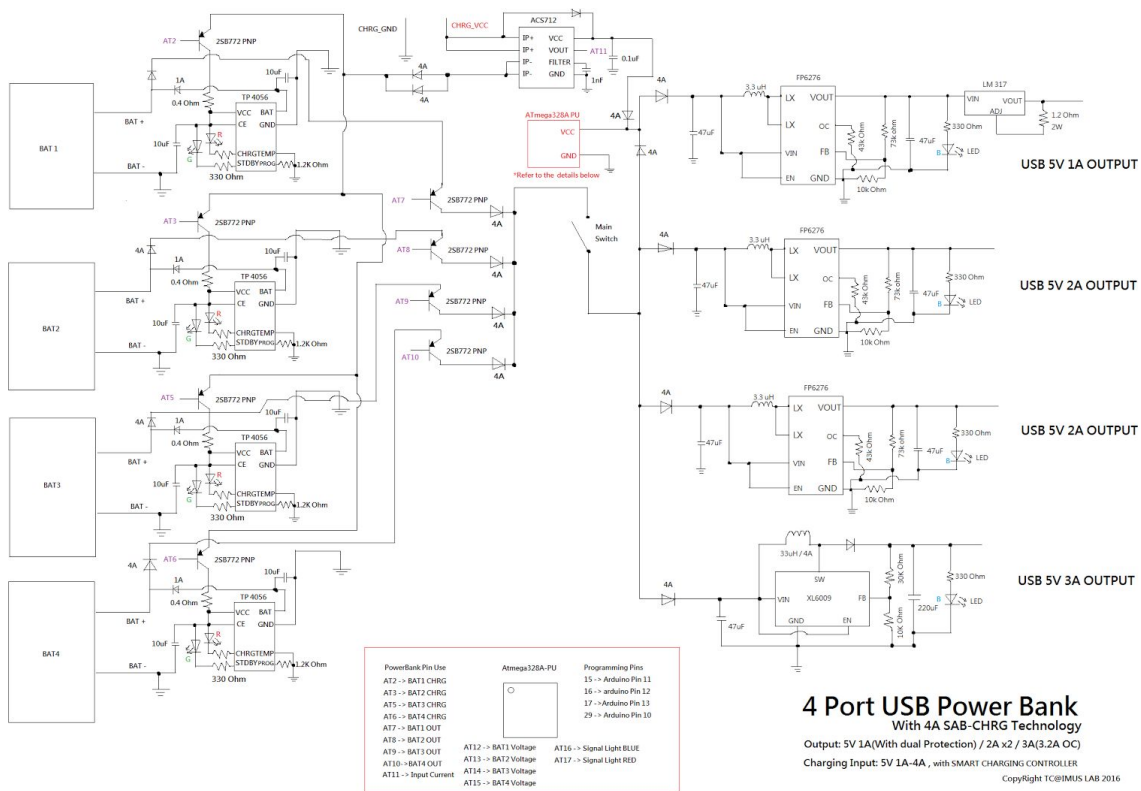
Port 2: 5V 2A With OTG Function connected to the Power Bank Port 3 (For Phone)

Port 3: 5V 2A With OTG Function connected to the Power Bank Port 2 (For OTG USB)

Port 4: 5V 3A High Current Output for Tablet

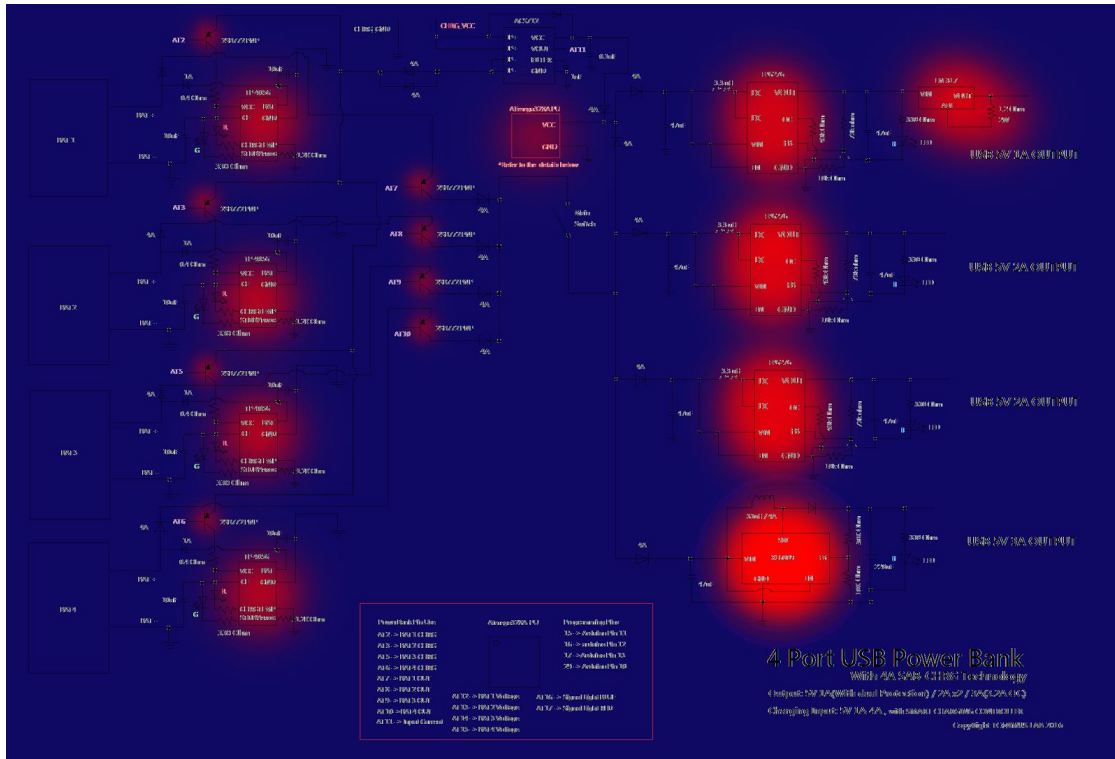
Controlled by ATmega328P-AU Micro-controller, high charging current with SAB-CHRG (Stand Alone Battery CHaRging System) Technology can be achieved.

Overall Wiring Diagram

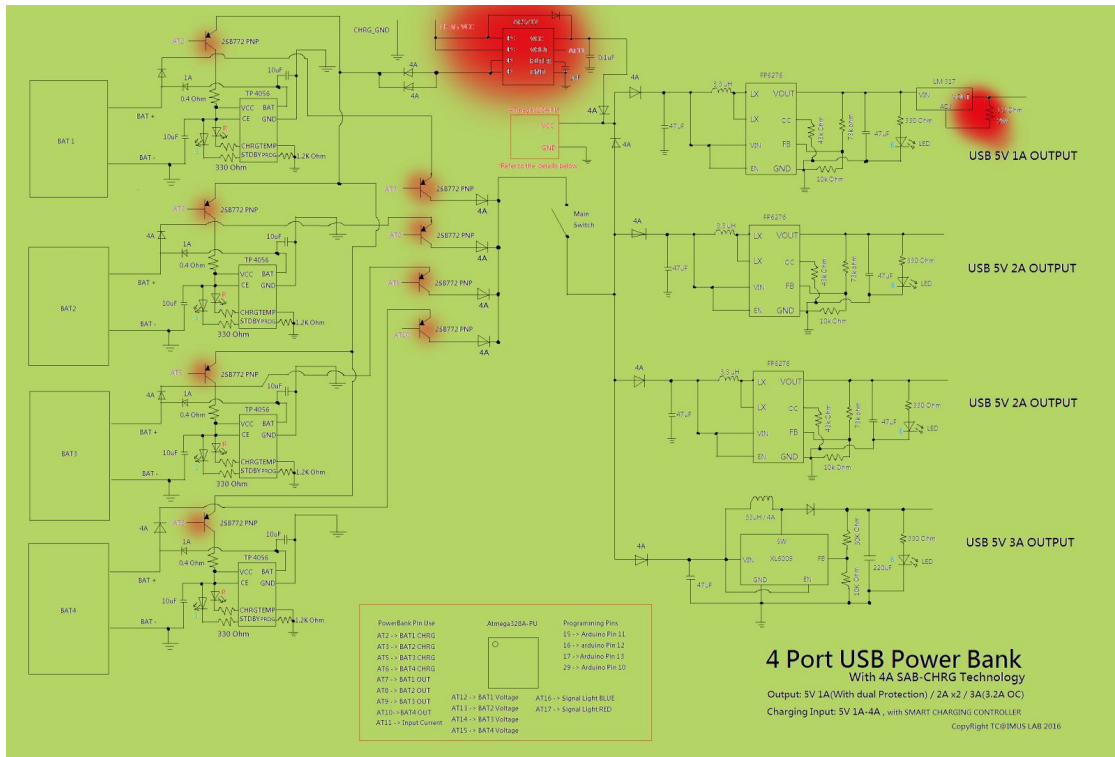


*See Appendix for this diagram in FULL HD

Thermal Estimation Diagram



Electric Signal Leak / Error risk diagram



Part List

Intergrated Circuits

Item Name	Specification	Amount Needed
2SB772 PNP Transistor	SOT-89	8
Atmega328P-AU	TQFP32	1
LM317	SOT223	1
TP4056	SOP8	4
ACS712TELC-20A	SOP8	1
XL6009	TO263-5	1
FP6276	SOP8	4

Resistors

Resistance (Ohm)	Power (W)	Amount Needed
330 *One extra for ATmega Pin 13	1/4	13
0.4	1/2	4
1.2K	1/4	4
73K	1/4	3
10k	1/4	4
43k	1/4	3
30k	1/4	1
1.2	2	1
150	1/4	8

Diode / LED

Maxmium Current	Amount Needed
1A	4
4A	18
LED RED	4
LED GREEN	4
LED BLUE *One extra for ATmega Pin 13	5

Capacitor

Capacitance	Amount Needed
10uF	8
47uF	7
200uF	1
0.1uF	1
1nF	1

Inductor

Inductance	Amount Needed
3.3uH	3
33uH (4A)	1

Others

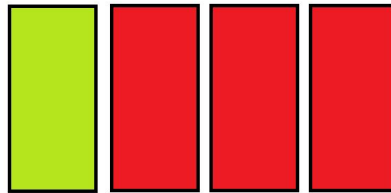
Items Name	Properties	Amount Needed
On Off Switch	>6A	1
Button	Mode Switch	2

Modes

The Power Bank comes in few different modes

Modes related to Power Bank Charging

1. Standard Charging Mode



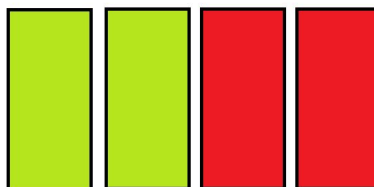
Charging

Not Charging / Waiting to be charged

Explanation:

Standard Charging Mode will charge the Powerbank with ONLY 1A CURRENT DRAW. That means the powerbank will charge its internal Lithium battery ONE BY ONE. IF you unplug it during charging, its internal battery voltage will be different amount All Lithium ion battery. Hence, it can only output Maximum of 1A until all Li-ion battery reached the same voltage.

2. High Current Charging Mode (Recommended)



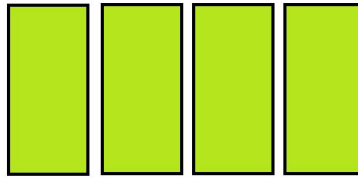
Charging

Not Charging / Waiting to be charged

Explanation:

High Current Charging Mode will enable auto current detection system to check if you have a power supply that can handle more than 1A charging current. If the maximum charging current is equal to 1A, one battery will charge at a time. If the current is 2A, then battery 1 and 2 will charge in the same time, battery 3 and 4 will start charging after 1 and 2 are finished charging.

3. Full Charging Mode



Charging

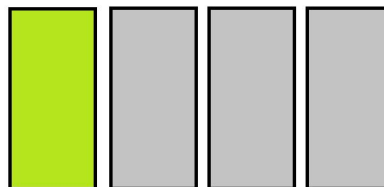
Not Charging / Waiting to be charged

Explanation:

Full Charging Mode Enable all Li-ion Battery to be charged on the same time ignoring the Maximum Current output of your power supply. Hence, The power supply may become over-heated or supplying its maximum power output until all battery charged. This mode can charge your Powerbank with the least amount of time, but it also reduced your power supply's life spends.

Modes related to Power Bank Output

1. Single Battery Output



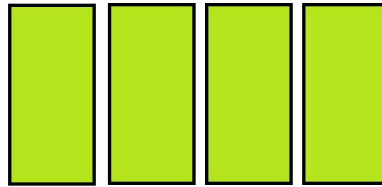
In Use / Outputing Current

Non- in use/ Sleep Mode

Explanation:

Single Battery Output Mode Enable one battery at a time. Hence, limiting the total current draw to be equal or under 1A. Thus, suitable when you borrow your powerbank to your friends or you want to extend the powerbank battery life up to its limit.

2. Full Burst Output (Recommended)



In Use / Outputting Current

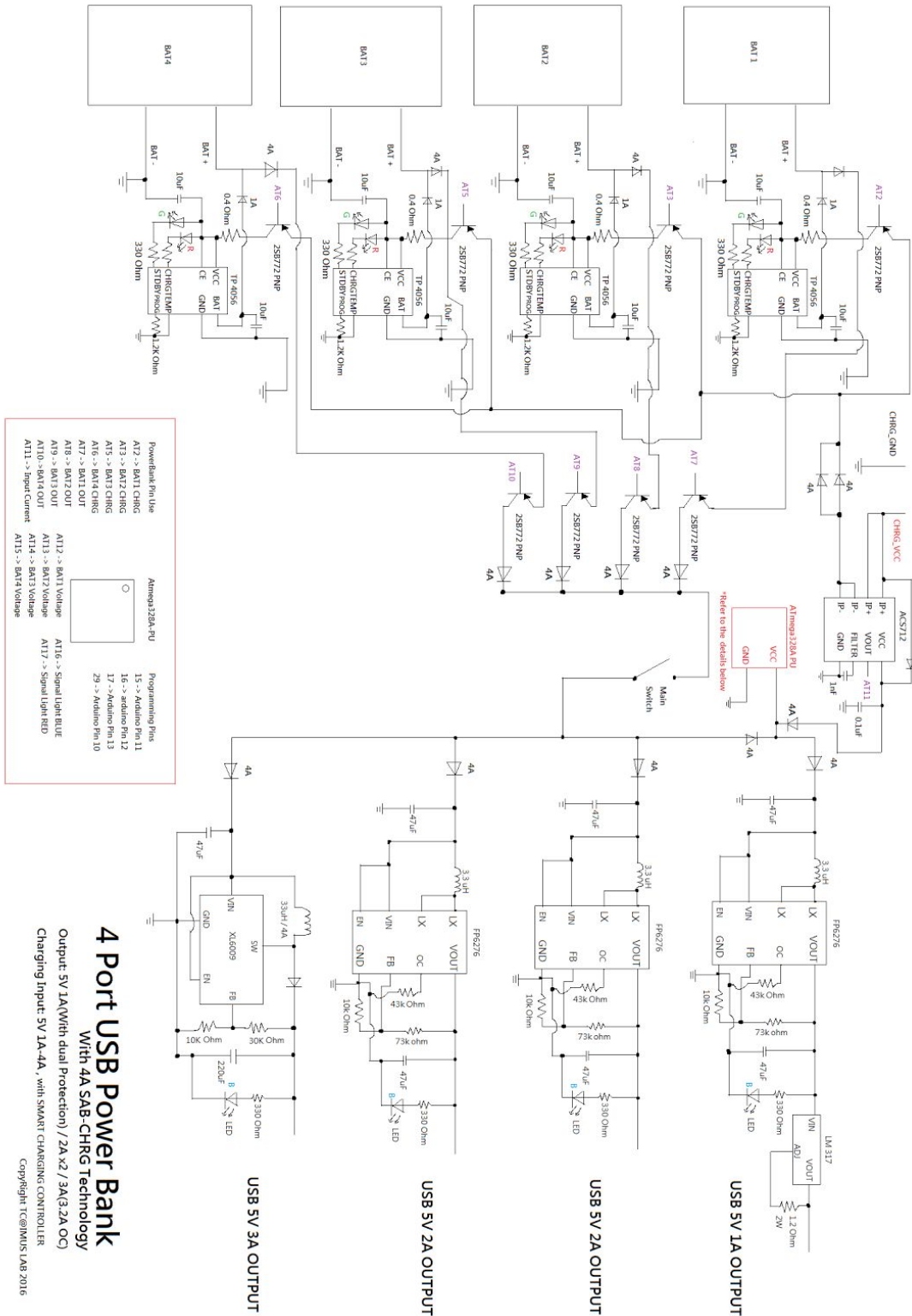
Non- in use/ Sleep Mode

Explanation:

All batteries are used to output their maximum current. Hence, it can output of total 5V 4.5A on all outputs. In this mode, the control systems and transistors which control the battery output may become hot. Hence, power bank should be placed on a surface where there is enough ventilation in case of over-heating.

(The Output circuits have built in temperature sensor. Outputs will shut down in case of over heating / short circuit)

Appendix (Wiring diagram in FULL HD)

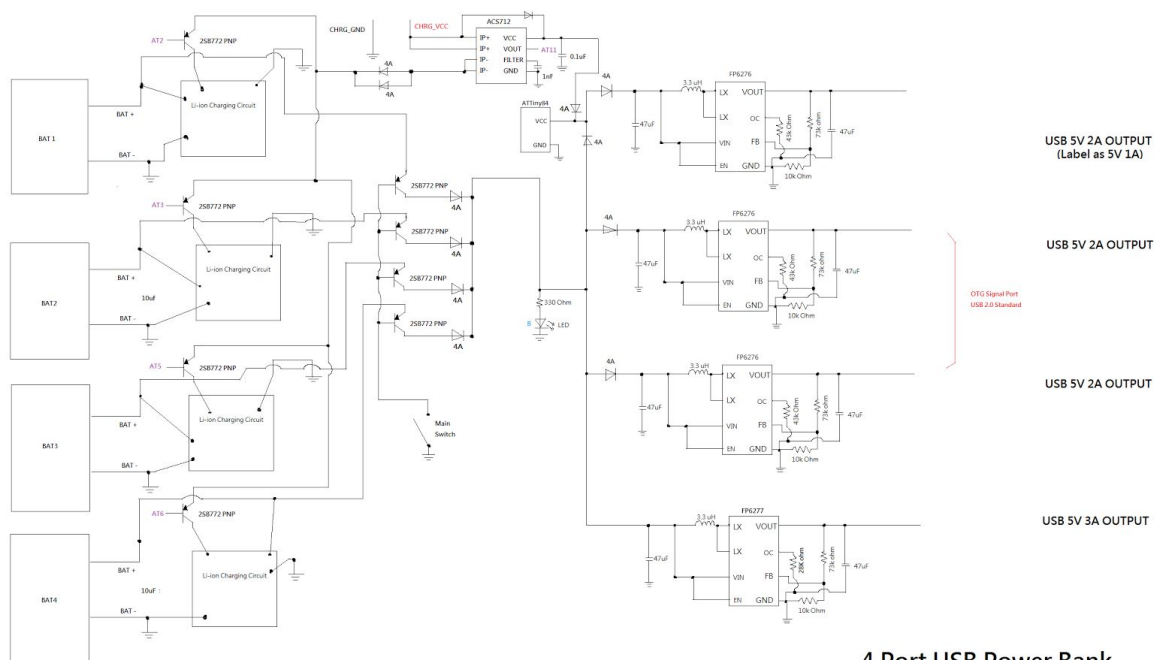


Update 1 on 4 Port USB Power Bank Project

Aim for redesign

Due to the need of cost reduction and ease of control, the micro-controller will be removed and hence, to reduce programming time and also prevent any damage cause by re-programming.

Wiring diagram



4 Port USB Power Bank

With 4A SAB-CHRG Technology

Output: 5V 1A(With dual Protection) / 2A x2 / 3A(3.2A OC)

Charging Input: 5V 1A-4A , with SMART CHARGING CONTROLLER

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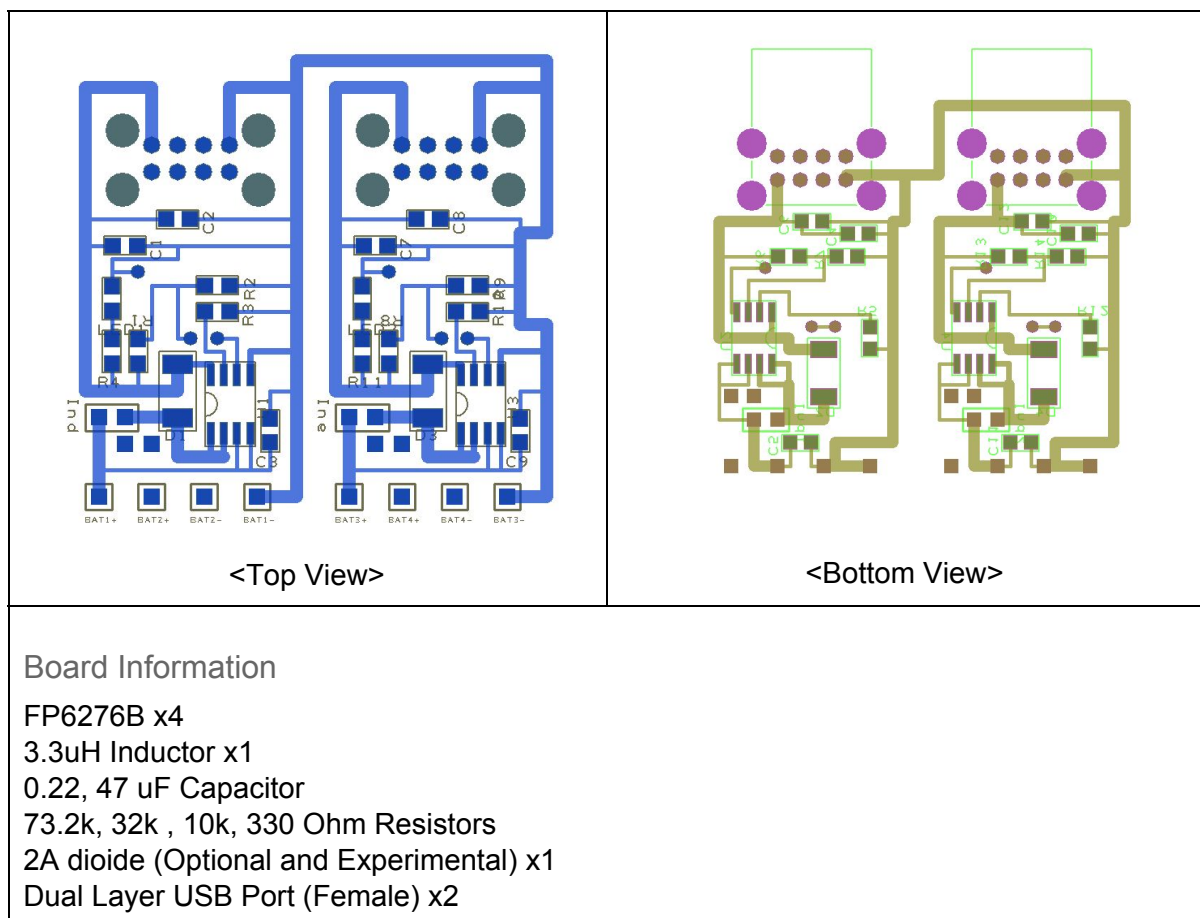
- Processor changed from ATmega328 to ATtiny84
- All transistor controlling the output was switched to Manual (Soft Output)
- All Charger are switched to modular Charging module (TP4056)

Update 2 on 8 Port USB Power Bank Project

Aim of complete redesign

The old concept is too complicated to make or manufacture. We need a power bank that is so powerful and easy to make (i.e. PCB and SMT based). Hence, I added 4 more ports (In which they come from the same module of the 4 port usb power bank project on the original planning. The project is now renamed as “Eletochondrion” as it is a symbol of “Power House”).

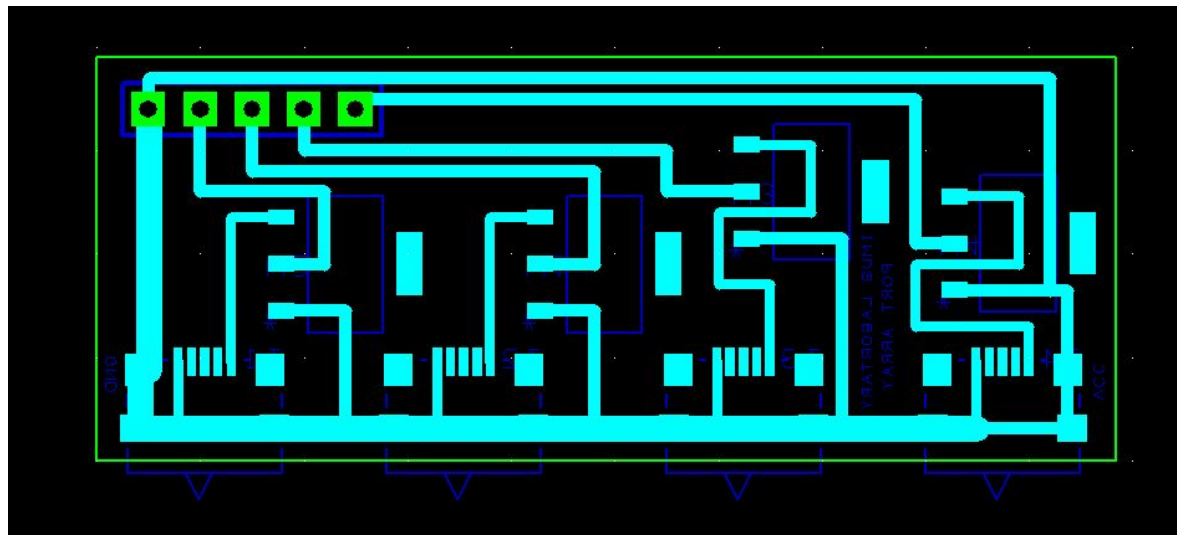
Convertor Module (AKA Quad Port Voltage Step Up Module)



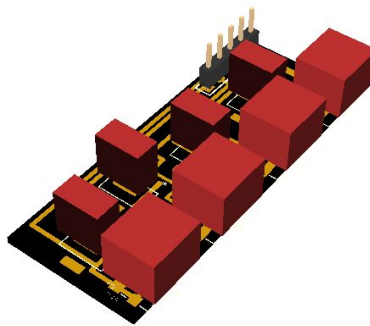
** Two of the above modules will be used in ONE Power Bank

** Maximum Output Power of each port suppose to be 5V 2.0A (10W). When all port are drawing 2A, the system may lower the current for each port down to 1.5A due to safty and heating issue.

Charging Micro USB Port with Voltage Regulator



<Single Sided PCB Layout>



<Parts Position Referencing>

Board Information

AMS1117-5.0 x4

Micro USB Port (1A Max) x4

** ALL Inputs will be handled by the AMS1117-5.0 Intergrated Voltage regulator. Hence, you can charge it via Maximum 12V. Its internal circuitry will automatically regulate the charging voltage and pass 5V Output to the main charging board.

Minor Modifications

One more PCB will be splitted from the original 3 boards. Hence, there will be intotal 4 type of PCB inside the Power Bank. Here are the modification in details:

Original

Voltage Step Up Module x2

Charging Managment, LED display array, Main CHRG Port Module x1

Stand Alone Battery Charging Port Board With Voltage Regulator x1

New

Voltage Step Up Module x2

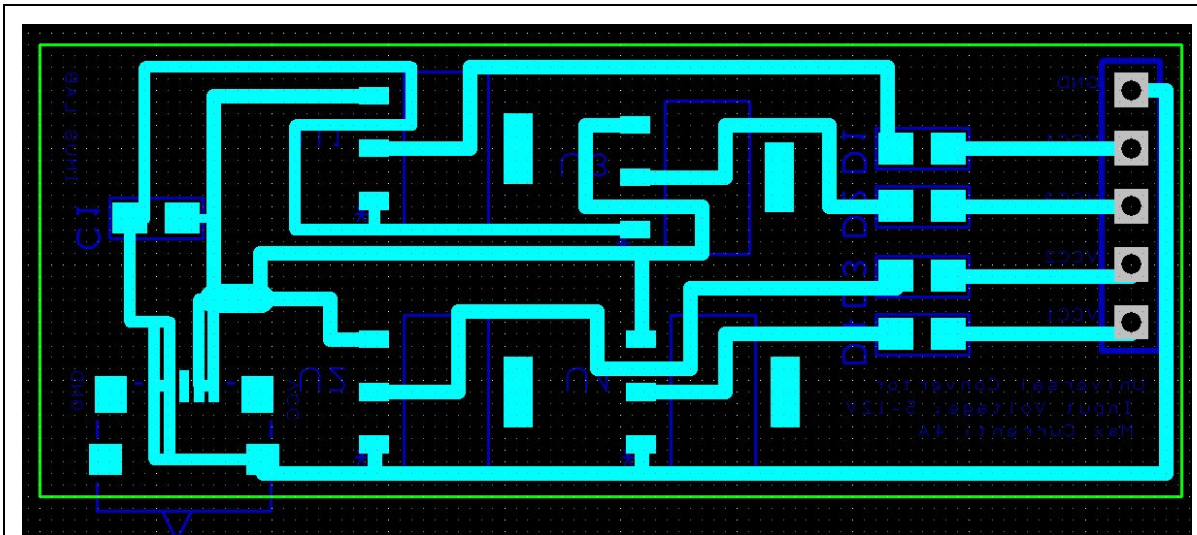
Charging Managment and LED display array x1

Stand Alone Battery Charging Port Board With Current limiting resistors x1

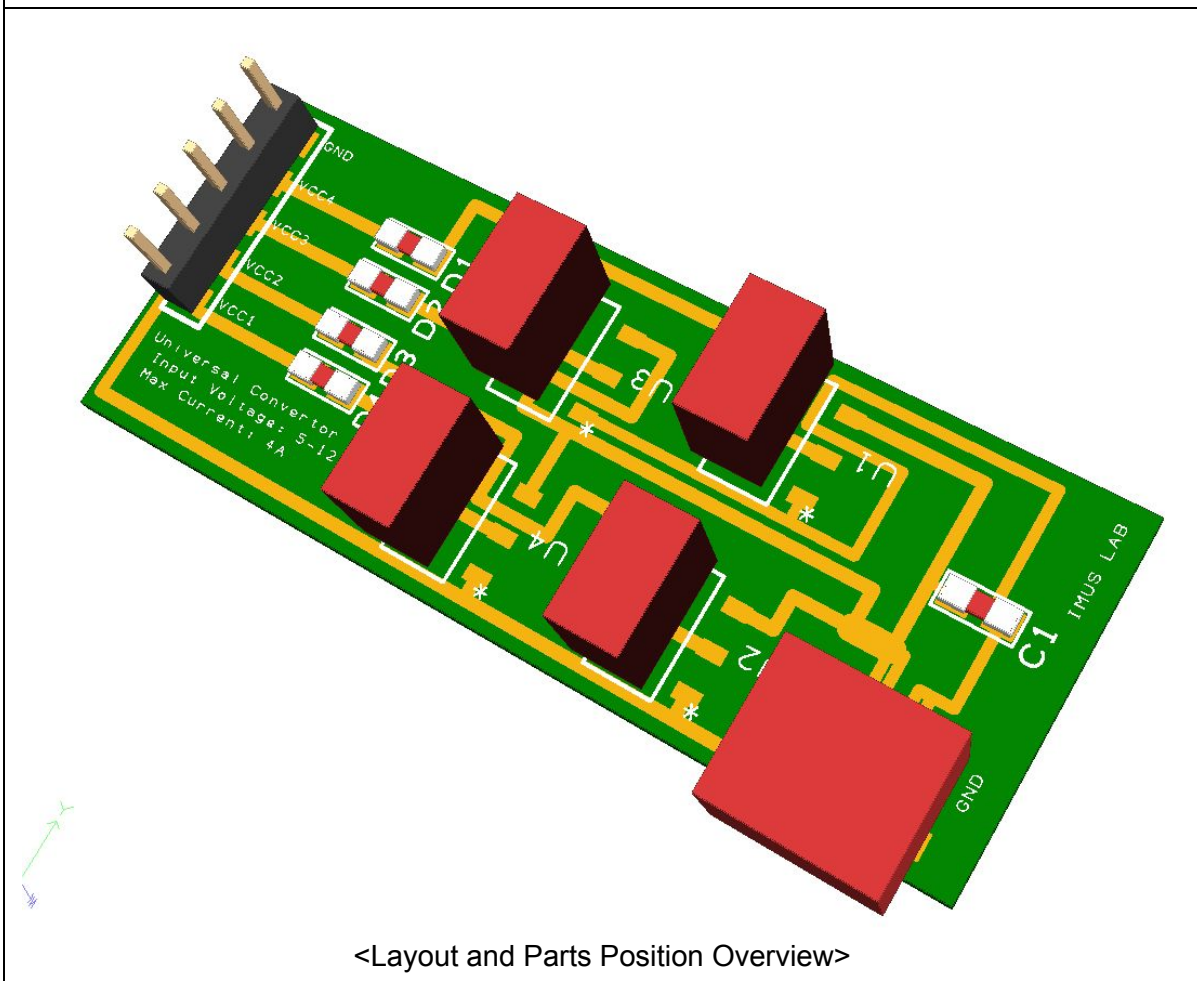
Universal Voltage & Current Input Regulator Port Board x1

(Input Voltage between 6 to 12v, Overall power = 20W (Or 5V 4A))

Universal Input Port PCB Layout

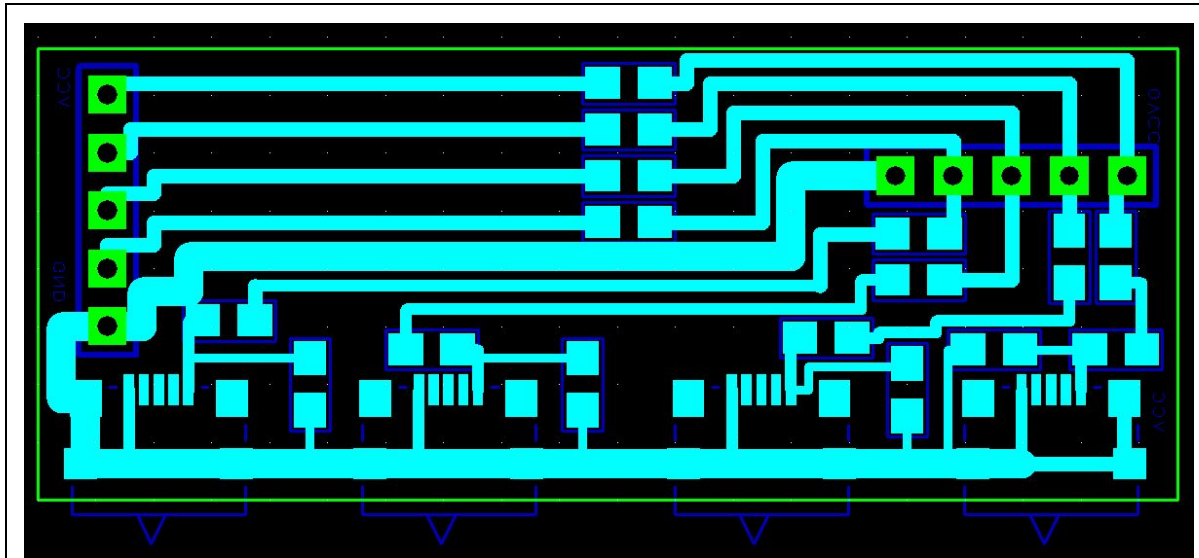


<Single Layer PCB Layout>

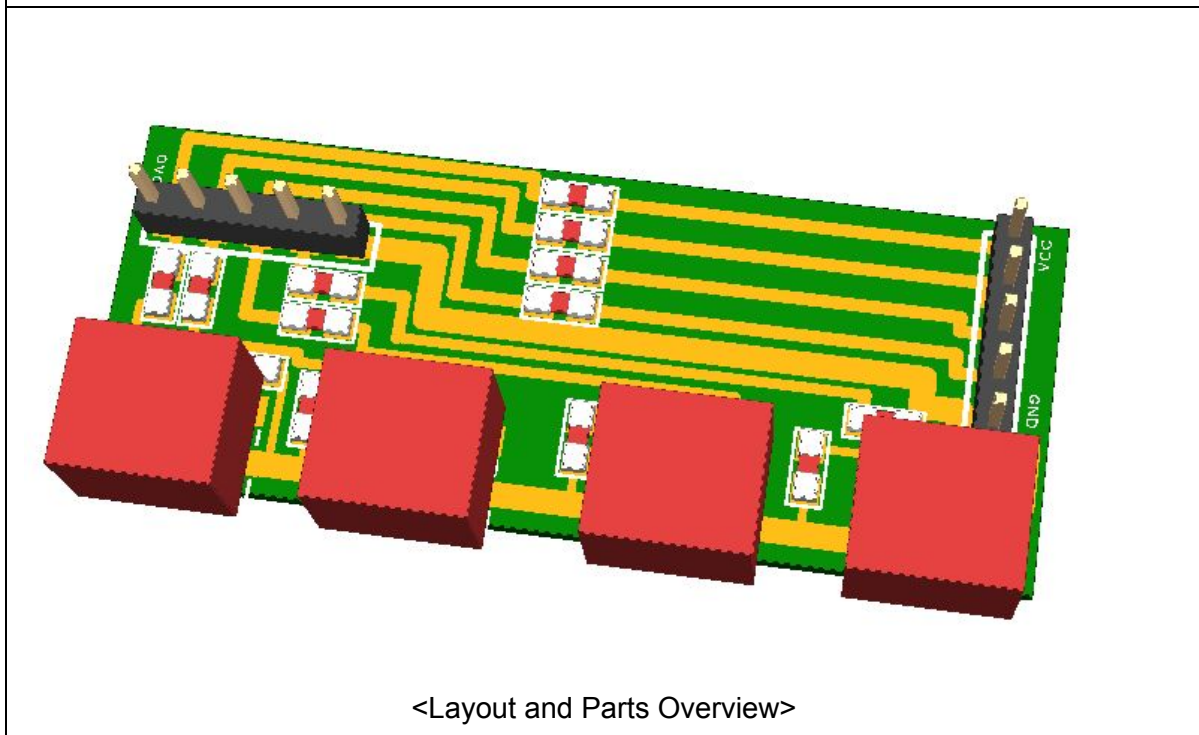


<Layout and Parts Position Overview>

4 Port Charging Port PCB

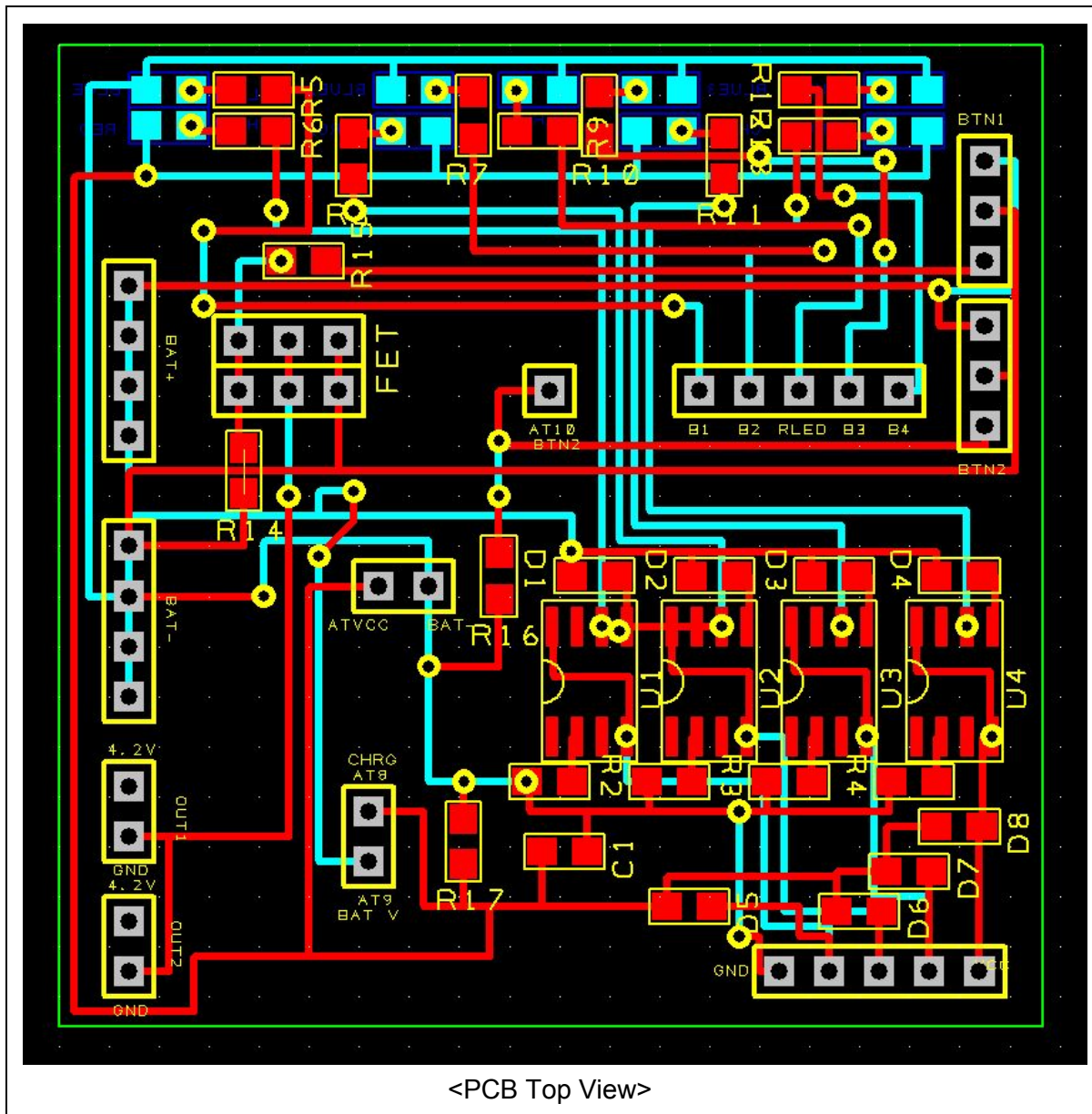


<Single Layer PCB Layout>



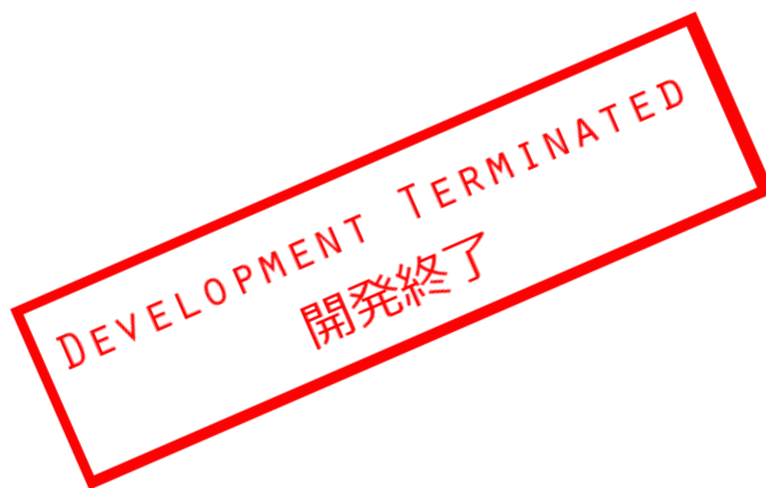
<Layout and Parts Overview>

Main Charging and Battery Life Displaying Module



Alpha PCB Development Failed Log

- Alpha version PCB failed due to unknown reason.
- FP6276B was used in the system. EN was given to its input voltage (3.7V, high) and a reading of 3.6V reading was found at the output
- Tried to add a Diode (3A) and replacing the inductor from 3.3uH to 4.7uH, no change has been done to the system
- Conclusion: Find alternative voltage step-up method and not using any FP62xx Series ICs.
- Alpha Development Terminated on 26/11/2016



IMUS Power Hub

8 Port USB Power Bank BETA

With 4A SAB-CHRG Technology

Output 5.2V 1.2A x 8

Charging Input 5V 1A - 4A(Max), With Universal Port (2014 Standard Compatible)

Simple Introduction

This Powerbank consist of 8 USB Port.

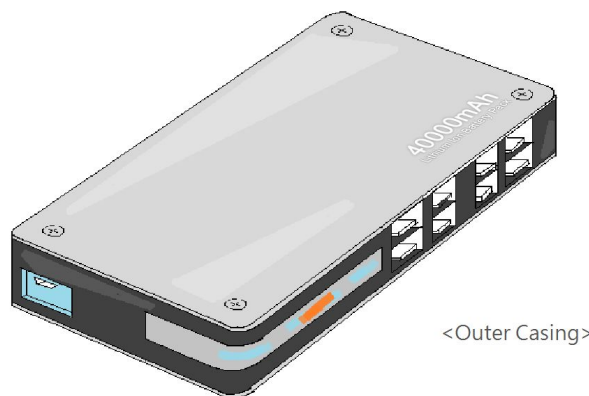
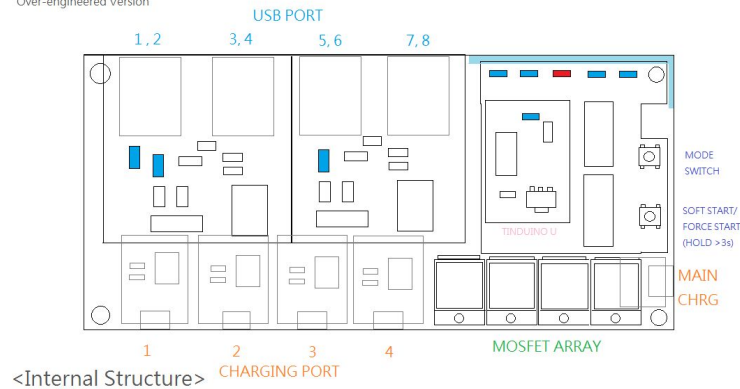
All Port: HX3242 based 5.2V 1.2A(MAX) Output

Controlled by Tinduno (ATtiny48) , high charging current with SAB-CHRG (Stand Alone Battery CHaRGing System) Technology can be achieved.

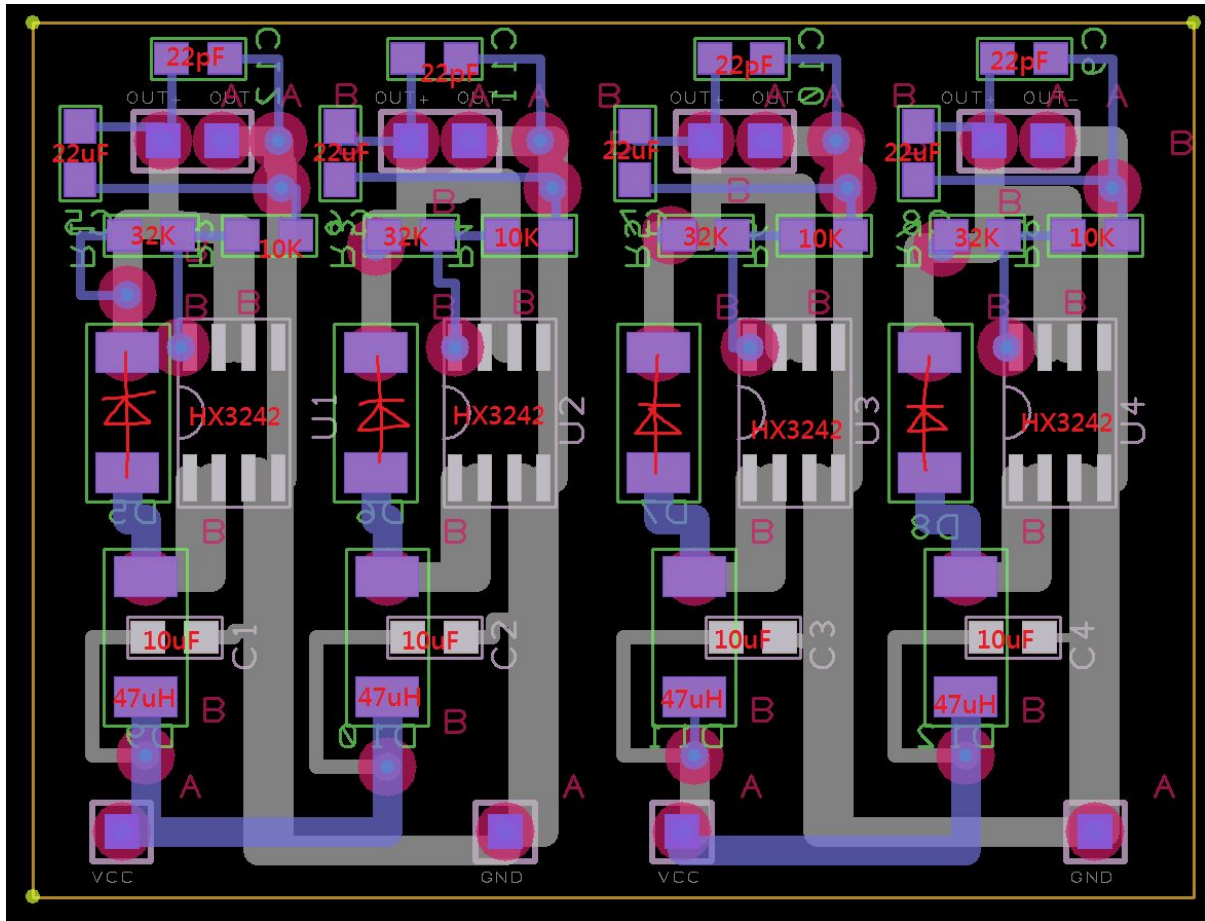
Target Casing Design

The Power Bank Ver 2.0

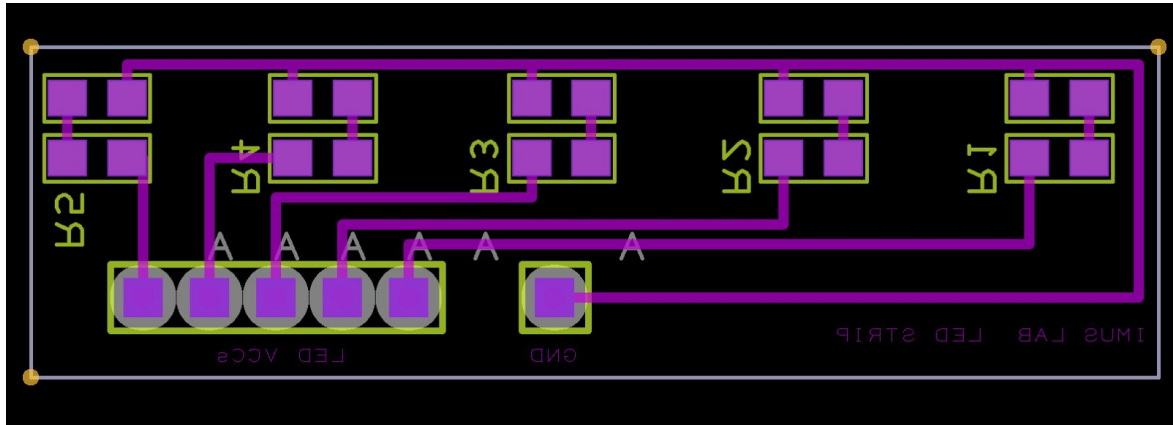
Over-engineered Version



Main Step Up Circuits Diagram

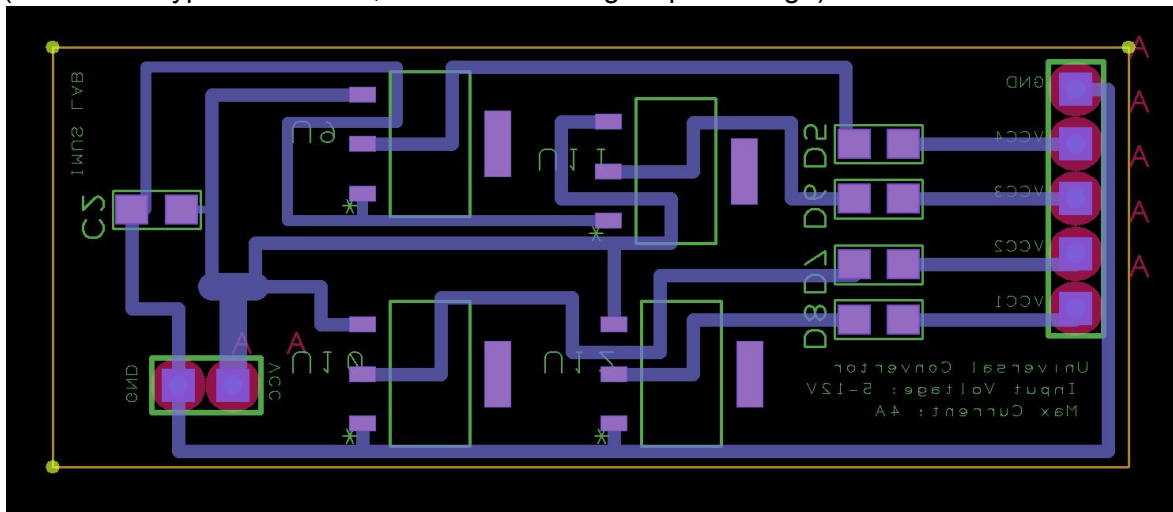


LED Strip (Battery Life and Status Displaying System)



Universal Input Port

(2014 USB Type A Standard, 5-12V Wide Range Input Voltage)

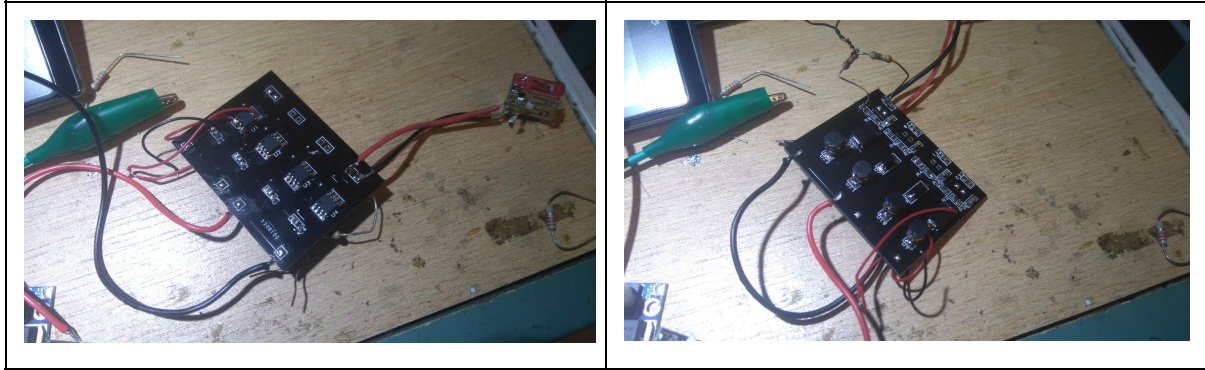


Electronic parts item list

Part Name	Quantities
LED Strip: <ul style="list-style-type: none"> - Yellow LED 0805 - RED LED 0805 - 220Ohm 	LED Strip: <ul style="list-style-type: none"> x4 x1 x5
Universal Port: <ul style="list-style-type: none"> - AMS1117-5.0 - 47uF (0805) - Diode (1A) 0805 	Universal Port: <ul style="list-style-type: none"> x4 x1 x4
Step Up System: <ul style="list-style-type: none"> - 1uF - 10uF - 22uF - 4.7uH - Diode(8A) - HX3242 - 32K Ohm - 10K Ohm - 220 Ohm 	Step Up System: <ul style="list-style-type: none"> x8 x8 x8 x8 x8 x8 x8 x8 x8 x5

Beta Build Final Report

- Main Step Up Circuit PCB build semi-succeed
- LED Strip Circuit Succeed
- Universal Charging Port Circuit Succeed (With removed diode)



Succeed version of LED strip and Universal Charging Port Transformer

Failure Log on Main Step Up Circuit PCB

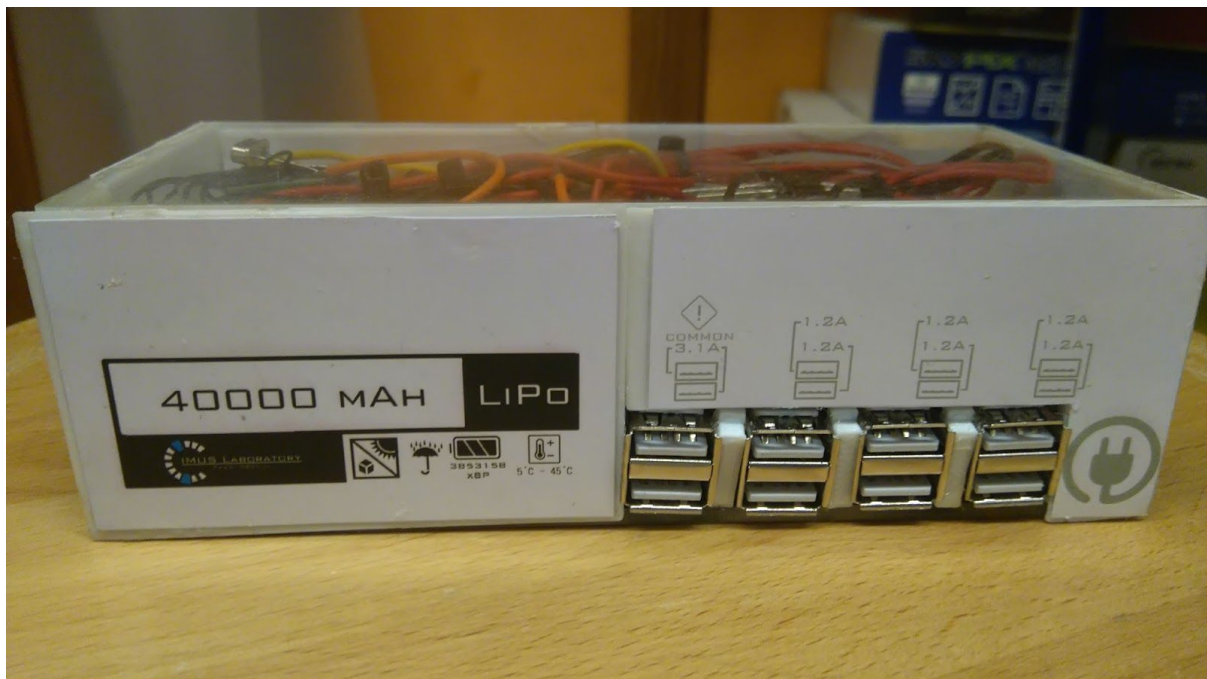
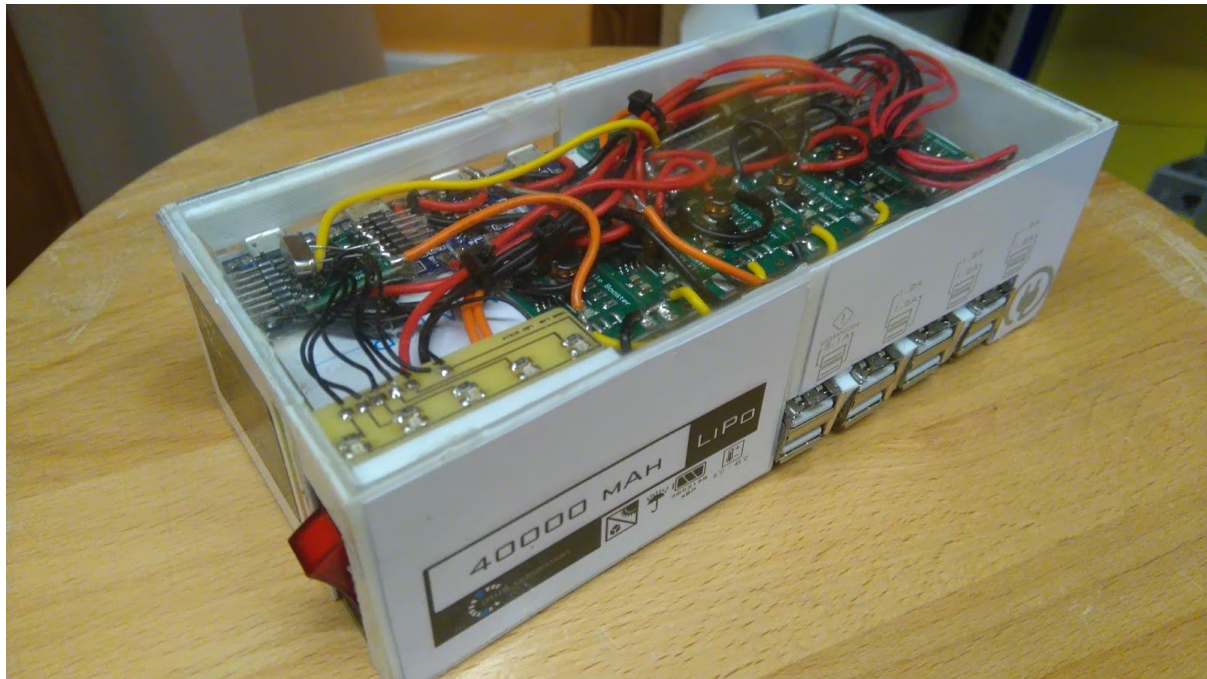
1. When there is no load, with 32K (3302) and 10K (106) have an output of 5.18V
2. When there is load (Sony Xperia, 15000mAh Thin Powerbank Rebuilt 1, 21000mAh Camping Power Bank), the voltage dropped to 4.7V with 0.5A
3. Modifying the resistor to 8.2K and 32K, which have an output voltage of 5.8V. 5.4V and 0.86A while with load.
**Sony Xperia Cut off charging due to over voltage
4. Modifying the resistor to 8.0K (3.9K * 2) and 32K (28K reading on multimeter) gives 6.0V, charging load with 5.6V and 0.97A.
**Sony Xperia cut off charging due to over voltage
5. Development of Beta Step Up PCB Terminated



Developed by Toby @ IMUS Laboratory, 2016

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Finalized Version



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Development Ended

30/12/2016