

Project : x1-G v1

Internal Material Design sector.

Lithium Battery Related Documentation:

Lithium - ion Battery is the most viable option for this project. Obviously we cannot use lead based batteries both due to heavier reasons and other perspectives as well.

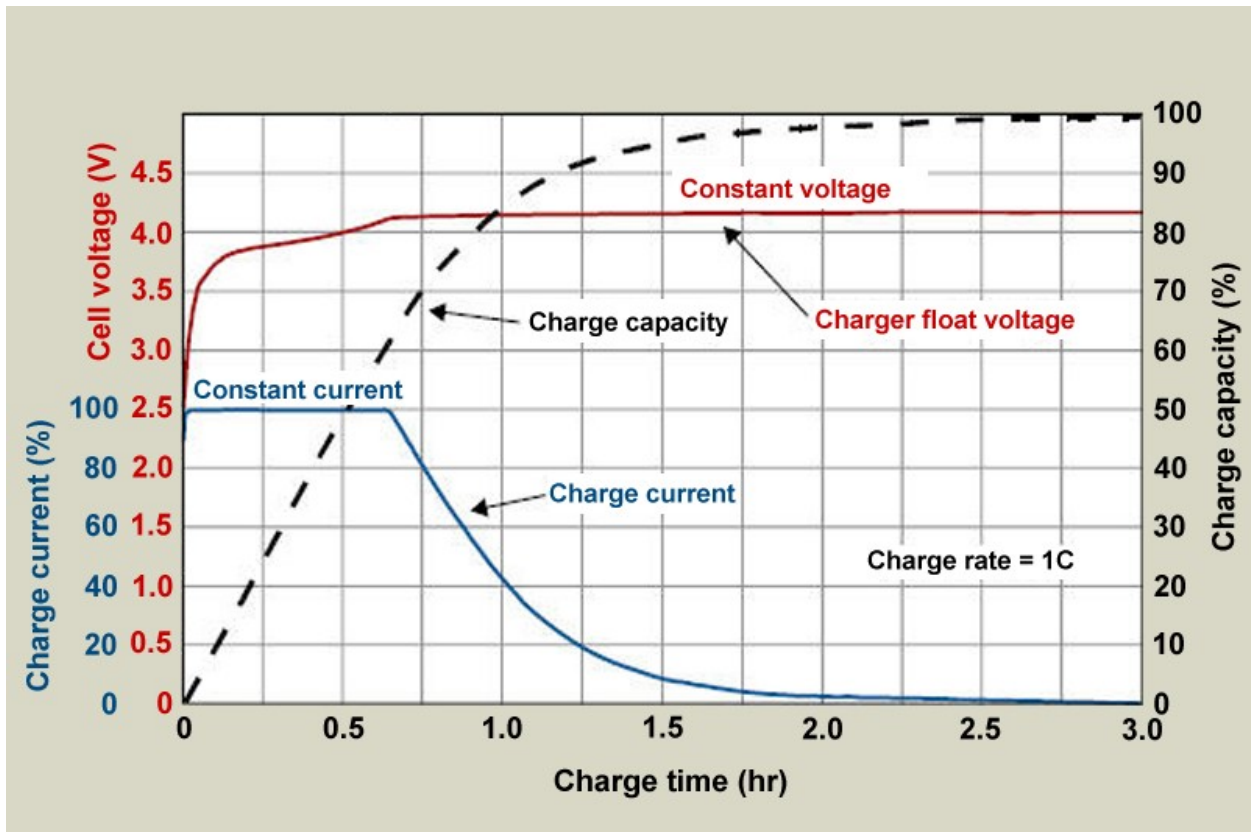
Recharging factor is most important, as this is a power bank, we need to be able to recharge our battery in the most efficient way possible. We have already tried a few modifications to our older battery modules.

We are currently using Apple's iPhone 5s Battery for building version 1 prototype. Using design file x1-G v1. We are constructing our software based on that.

Charging profile (CC + CV)

Lithium-ion (and LiPo) batteries require a controlled algorithm when charging. Commonly:

1. **Pre-charge / trickle** (if deeply discharged) — low current until voltage reaches safe threshold.
2. **Constant Current (CC) stage** — charge with a fixed current (say 0.5 C, 1 C, etc.) until the cell voltage reaches the “charge cutoff voltage” (commonly ~4.20 V for many Li-ion cells).
3. **Constant Voltage (CV) stage** — hold the cell at that final voltage (4.20 V) and let the current taper down as the battery “tops off.”
4. **Termination / end charge** — when current falls to a small threshold (e.g. 3–5 % of the initial CC value), stop charging.
5. Optionally, small **topping pulses** or “trickle” may be applied to keep the charge topped up (though many Li-ion chargers don't do trickle to avoid overcharge risk).



✗ Discharging & limits

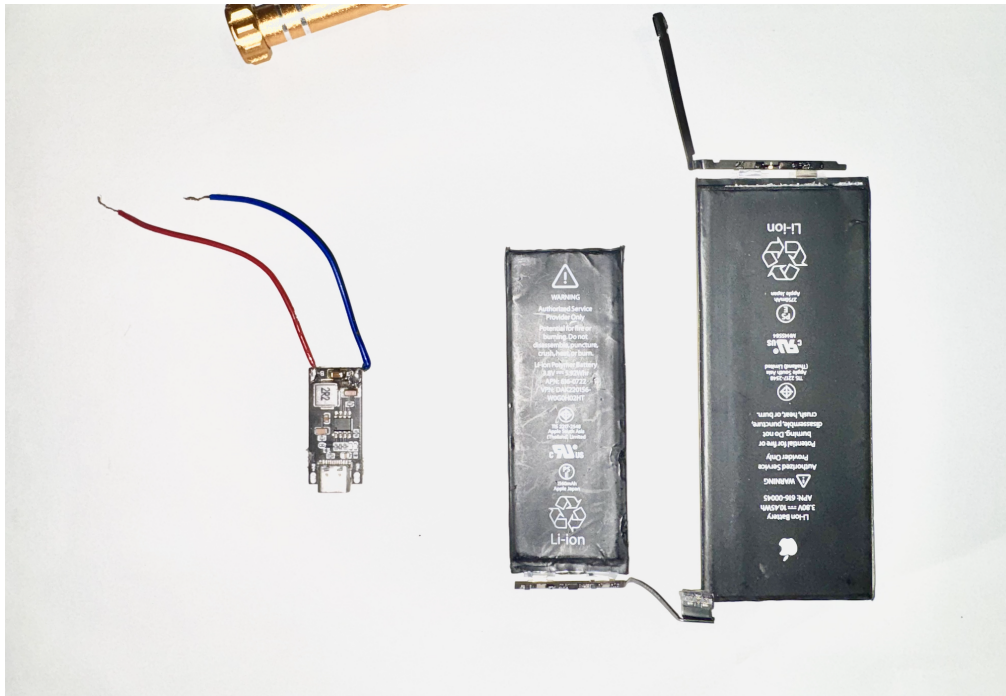
- You must **not discharge the battery too far**. Many Li-ion cells have a safe lower voltage (e.g. ~3.0 V). Going too low may degrade the cell permanently or cause instability. [IMPROVE BATTERY+2Battery University+2](#)
- The discharge current must also stay within rated limits (e.g. many batteries are rated for e.g. 1C, 2C, etc.). If you draw too much, internal heating, voltage sag, or damage may occur. [IMPROVE BATTERY+2Wikipedia+2](#)
- Overdischarge protection is typically built into a Battery Management System (BMS) or protection circuit so that when the voltage falls below a threshold, the load is cut off to protect the cell. [DNK Power+3IMPROVE BATTERY+3Wikipedia+3](#)

Protection type	What it covers / why needed	Typical implementation
Over-voltage / Overcharge protection	Prevents charging beyond safe voltage, which can lead to plating, overheating, or thermal runaway	Monitor cell voltage; when voltage > threshold (e.g. 4.20 V), disconnect charging MOSFET. Many BMS / protection ICs include this. (IMPROVE BATTERY)
Under-voltage / Over-discharge protection	Prevents discharging below safe limit (which can damage the cell)	Monitor voltage. If cell < cutoff (e.g. 2.8–3.0 V), disconnect load MOSFET. (IMPROVE BATTERY)
Over-current / Short-circuit protection	In case too much current is drawn (e.g. a short), must cut off immediately to prevent heating / damage	Sense current (via shunt resistor) or detect voltage drop across sense resistor. Use MOSFET / switching transistor to break the circuit. Many BMS chips do this. (ResearchGate)
Temperature monitoring / thermal protection	If cell or circuit gets too hot, disconnect or limit current — thermal runaway is a major safety hazard	Use NTC thermistors or temperature sensors. In extreme heating, shut off charging or discharging. Some cells also have internal thermal disconnects. (IMPROVE BATTERY)
Balancing (for multi-cell packs)	Ensure that all cells in a series stack have the same state-of-charge so one cell doesn't overcharge or overdischarge	Passive (bleed resistors) or active (charge transfer) balancing circuits. Part of a full-featured BMS. (Wikipedia)

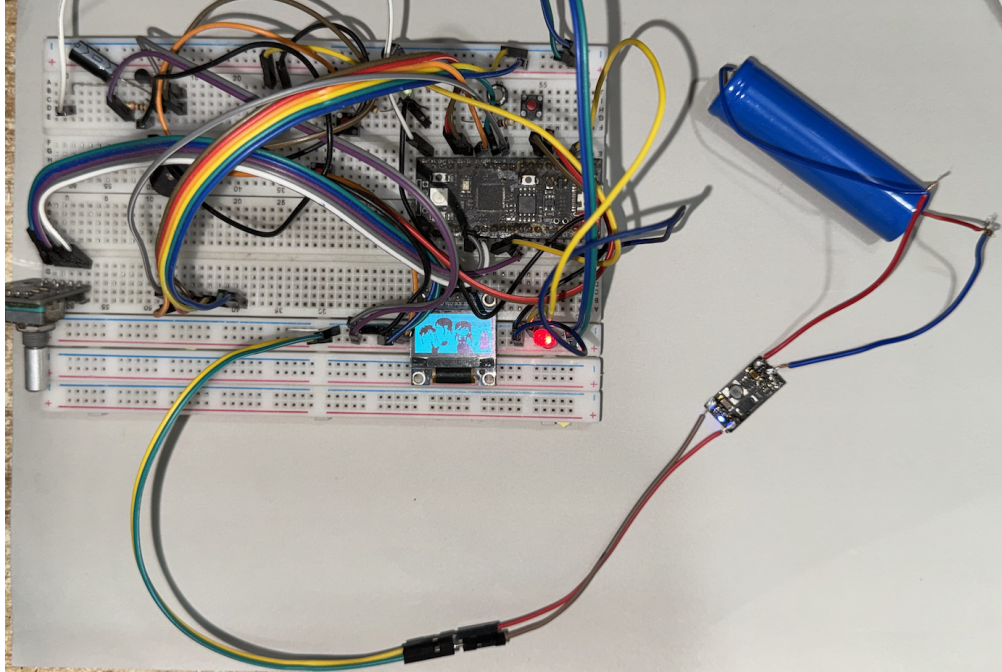
**Delay / timing /
hysteresis /
lock-out**

Protect against transient spikes or bounce; ensure protection circuits don't oscillate or "chatter"

Use internal capacitors, delays, hysteresis thresholds, lock modes (once a protection hits, don't immediately re-enable) (DNK Power)



The following Batteries are from Apple's iPhone 5s and iPhone 6s. The battery health indicated below 75% by apples software.



3.7v to 5.1v buck converter in action. Testing parameter set to work with an rp2040 dev kit.

BMS Board (Battery Management System)

A Battery Management System (BMS) is the brain of a battery pack.
Its job: monitor, protect, and manage every individual cell so the battery operates safely, efficiently, and lasts long.

In short:

A BMS keeps your battery **healthy, safe, and smart.**

Project Look

Project Look We are trying to Achieve here.



ESP32

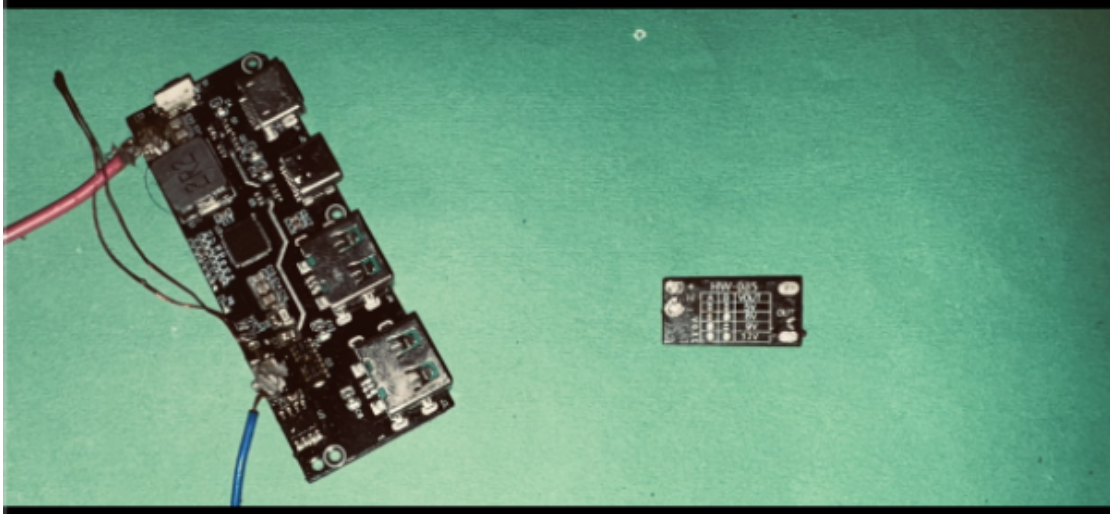
ESP32 the main hardware to provide all the necessary things.

Plan:

Previously I have built a Macropad. Which was a very ammatue level of circuit board, but anyway I enjoyed that work! As it was my first circuit board ever! Now I want to step into the big leagues, so what I am going to do is, using my previous mistakes and making all the necessary tweaks, I am going to make the ultimate macropad, disguised as a batterypack. The primary objective remains the same, making a powerful batteryBank, but it would also function as a bonus macropad.

It would also offer wireless keyboard functionality, mainly as wireless keyboard functionality. The code mainly should provide proper access to both wireless protocol and keyboard functionality.

PowerBank Circuit Module.



Output fast charging protocol:

- Support PPS / PD3.0/ PD2.0
- Support QC4 +/- QC4 / QC3.0/ QC2.0
- Support AFC
- Support FCP
- Support SCP
- Support PE2.0/ PE1.1
- Support SFCP
- Support for VOOC

Input fast charging protocol:

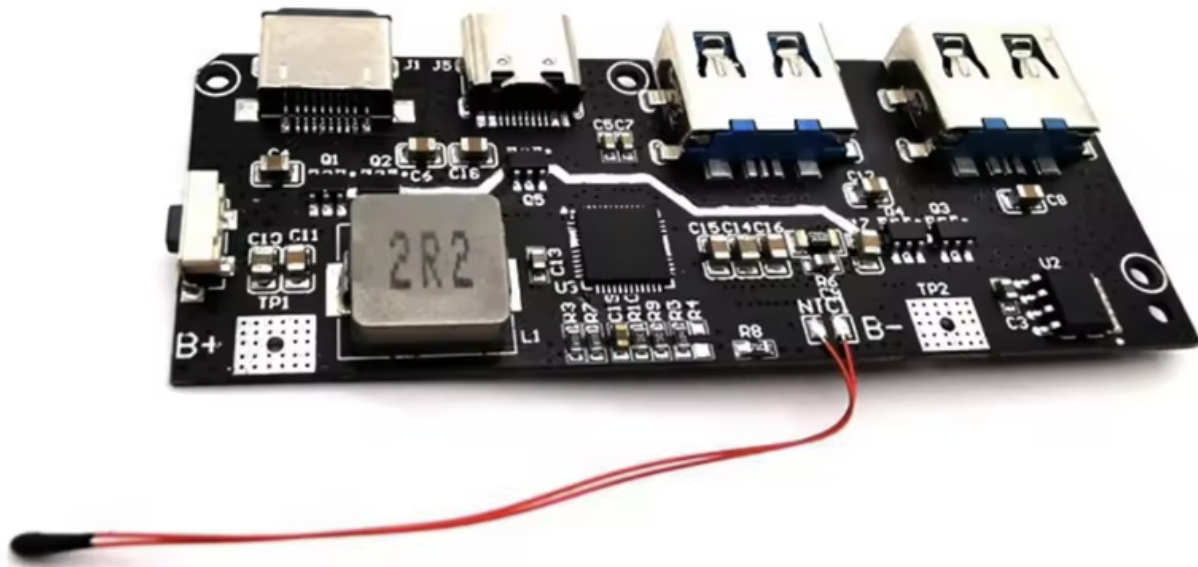
- Support PD3.0 / PD2.0
- Support AFC
- Support FCP
- Support SCP
- Support pe1.1

Type-C Interface:

- Built in USB type-C interface logic
- Support Try. SRC function

BC1.2 Module:

- Support bc1.2 DCP mode
- Support for apple / for Samsung mode



Extra Functions:

- Built in lightning port function
- Built-in 12bit ADC for power metering and display
- Built in coulomb meter for accurate electric quantity

Protections:

- Input Overvoltage Protection
- Output over current / short circuit protection
- Charging timeout / overvoltage protection
- Temperature protection

Switch Charging:

- Current up to 5A, efficiency up to 95%
- Support 4.2/4.35/4.4/4.5v battery type
- Support for JEITA specification
- Support temperature loop control

Charging Process:

- The charging process is divided into the following three processes
- Trickle mode, constant current mode and constant voltage mode.
- When the battery voltage is lower than 3V, the charging module is in trickle mode and the charging current is 300mA;

- When the battery voltage is greater than 3V, the charging module will enter the constant current mode. At this time, it will charge at full speed according to the set target current, and the power can be about 21W;
- When the battery voltage rises to the charging target voltage (such as 4.2V), the charging module enters the constant voltage mode, and the current gradually decreases while the battery terminal voltage remains unchanged;
- When the charging current decreases to the cut-off current, the charging ends. After full charge, if the battery voltage drops to 0.1V lower than the target voltage, it will automatically restart charging.
- (Note: if the voltage exceeds 4.2V, it is normal and the battery will not be damaged. When the voltage is 4.2V, the light is still flashing, which means it is not fully charged. Full charge depends not only on the charging voltage.)

Features:

- There are five USB ports in the motherboard, which are Type-A1 + Type-A2 + Micro-B + Type-C + Lightning.
- Type-A1 and Type-A2 support QC3.0/ QC2.0/ AFC/FCP/ SCP/PE2.0/ PE1.1/ SFCP/ VOOC fast charging output.
- Type-C supports PPS/ PD3.0/ PD2.0/ QC4+/ QC3.0/ QC2.0/ AFC/ FCP/ SCP/ PE2.0/ PE1.1/ SFCP fast charging output.
- Support PD3.0/ PD2.0/ AFC/ FCP/ SCP/ PE1.1 fast charging input;
- Micro-b supports QC2.0/ AFC/ FCP/ SCP/ PE1.1 fast charging input.
- Lightning supports PD fast charging and 5v2.4a slow charging.
- When the input matches the fast charging, the default input is 9V, and the input power can reach 21W.
Support filling and discharging at the same time. It supports fast charging input and output in single port operation and 5V input and output in multi port operation.
- Support simultaneous external discharge of Type-A1/ Type-A2 / Type-C ports.
- Integrated PPS/PD3.0/PD2.0 fast charging protocol, support input and output bidirectional fast charging. PPS output supports 5-5 9V@3A , 5-11V@2A , PD3.0/PD2.0 output support 5V@3A , 9V@2A, 12V@1.5A . The input voltage supports 5V/9V/ 12V.
- Integrated QC fast charging protocol, support QC4+/QC4/QC3.0/QC2.0, support class A. QC2.0 supports 5V/9V/ 12V output voltage. QC3.0 supports 5V-12V output voltage, 200mV / step.
- Integrated AFC fast charging protocol, output support 5V / 9V/ 12V. The input supports 5V/ 9V voltage.

- Integrated FCP fast charging protocol, output support 5V / 9V / 12V. The input supports 5V/9V voltage.
- Integrated SCP fast charging protocol, output support 5V@4.5A. Input support 5V 3A.
- Integrated with PE2.0 and PE1.1 fast charging protocol, PE2.0 supports 5V ~ 12V output voltage, 500mv / step. PE1.1 supports 5V / 7V/ 9V/ 12V output voltage. The input supports 5V/ 9V voltage.
- SFCP fast charging protocol is integrated to support 5V /9V / 12V output voltage.
- Integrated vooc fast charging protocol, output support 5V 4A
- The layout is reasonable. The high current part has been windowed and tinned to reduce the loss and improve the charging and discharging efficiency.
R8 sets the resistance for the battery capacity.
- If the later replacement battery capacity difference is not big, you can leave it alone, if the difference is too big, please replace the resistance again
Calculation formula of resistance value:
- Resistance value $\Omega = (\text{Total battery capacity MAH} + 2000) * 5/3$
- For example, the resistance of 30000 MAH should be $(30000 + 2000) * 5/3 = 53333 \Omega$
- It can be replaced by a similar resistor, such as 53k.

Notes:

- Motherboard external battery line needs to be able to pass 10A current, at least with more than 1 square copper wire, ordinary wire to use 1.5 square. It's not necessary to be too thick, but it can't be too thin, too thin will have security risks. (because of the high current at the battery end)
- Motherboard comes with a protection chip, the battery can not add a protection board, if you have, please remove the protection board, directly connect our motherboard cell.(because the built-in current can't be too high, it will be protected as soon as the output power is high.)
- Use crocodile clip motherboard test, please don't charge mobile phone. If the phone needs to be charged, it must be soldered (many buyers don't listen to it. Whenever there is a problem, they will tell us how the motherboard is broken, how the motherboard can't be charged quickly, how the motherboard can power off and restart, etc. Please operate according to the requirements, thank you for your cooperation)
- The 4.2V 18650 / polymer / ternary lithium battery can be used as the battery. Large monomer and multiple 18650 can be used in parallel. Iron lithium battery, disposable dry battery, Ni MH battery, lead-acid battery and Ni Cd battery can not be used. Batteries cannot be connected in series. For the first time, there will be

inaccurate power display. Please discharge the battery and then fill it up. For the first time, you can continue to charge the battery for more than 5 hours when the 4 lights are all on. There is no need to worry about it.

- The motherboard must preset the battery capacity, so the approximate battery capacity must be noted or explained to the customer service. Otherwise, the preset battery capacity of the case is 30000MAH, and that of the single motherboard without the case is 20000MAH. Or replace the resistor by yourself later.
- For OPPO flash charging and for Huawei super fast charging are supported. Different protocols have different power. Please understand clearly before shooting. Except that some mobile phones do not support fast charging, others do. (the reason why the mobile phone is not supported is that the mobile phone's own agreement is not open, and the third party can't use it. If you want to use it, you can only go to the official website of each mobile phone to buy it.)

Key Functions:

- Short press to activate the output (this method will delay the fast charging request of the later inserted device. It is recommended to insert electric equipment in standby mode, which will automatically start the output.)
- If you double-click it, it will shut down by force
- Long press will enter the small current charging function or flashlight function (the small current function can charge the watch Bluetooth and other small current devices. There will be water flow prompt on the four power lights. Long press again to exit, and it will not turn off within 2 hours. It's not that it's on, it's low power charging, low current mode # low power charging)

DC to DC Converter

(3.4v - 4.2v converted to 5v constant)

