LifePO4 Mini Pro 3.3V

The Next Generation Pure Battery Power Supply

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A. Introduction

LifePO4MiniPro 3.3V is a very well-designed next generation advanced pure battery power supply. It has a lot of new features and would be a big step forward upgrade over the current LifePO4 Mini series.

LifePO4MiniPro 3.3V employs four 18650 battery cells in parallel to get a up to 8000mAH capacitance with extremely low output ESR. With the USB-C PD protocol, 12V/9V fast charge mode will be enabled when a qualified USB power adapter is connected. Even more, a Super-Pure Mode (UPS mode) is first time being introduced to run it as an AC/DC input free ultra-pure battery power supply for evaluation and other noise sensitive applications.

LifePO4MiniPro could be so far the best battery based 3.3V ultra-low-noise and high dynamic power supplies in the real world. Because it is a pure passive power supply, there will be no feedback and no active components being involved. Sound quality of sensitive audio applications such as low jitter clock oscillators, DACs, FIFOs and many other circuits will be benefited from this LifePO4 Mini pro power supply.

With this new state of art LifePO4 Mini Pro 3.3V power supply, many high-end digital audio DIY projects can be built in a more professional way and more improvement will be expected.

B. Specifications and Highlighted Features

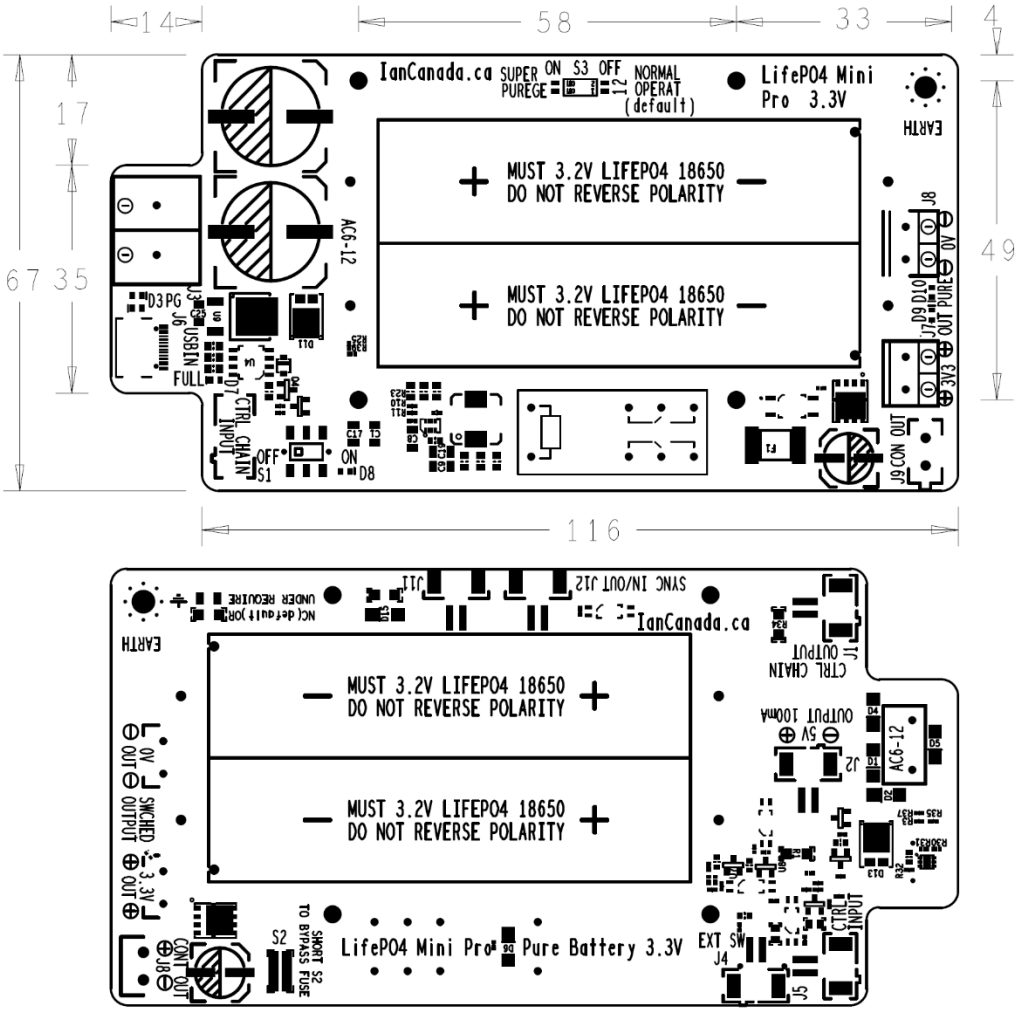
- 8000mAH high capacitance (4 18650 2000mAH LifePO4 battery cells, two sides mounted).
- Capable of 12A continuous output current and 50A dynamic output current.
- Real measurement output ESR results @1kHz:

  6.1mOhm (Fuse bypassed).

  8.9mOhm (With the default 12A resettable fuse).
- In pure mode, outputs will be 100% isolated from the input. Ground loop will be cut and common mode EMI noise will be eliminated.
- Can use either AC or DC(USB-C) as power input.
- 6V-12V wide AC input range
- With the built-in PD protocol, USB-C 12V/9V fast charge mode can be enabled when qualified USB power adapter is connected as power input.
- Super-Pure (UPS) mode, can provide pure battery output even without any input power supply.
- Ultra-low ESR resettable fuse no longer need for fuse replacement
- Low ESR independent output terminal connectors.
- Both internal and external ON/OFF switch.
- ON/OFF control chain input (isolated) and output
- SYNC charging IN/OUT (isolated)

- Low current (100mA) AUX 5V output to provide an additional 5V output for project that requires it.
- Fixed 3.3V output
- Can be upgraded to ultracapacitor/battery hybrid power supply when work with a UcConditionerPro 3.3V or UcHybird (lower cost).
- Has both switched and continuous (great for clock oscillators) outputs
- Protection mode to prevent battery cells from exhausted or low output voltage
- Four layers PCB design with two more layers for low-ESR and high-current trace and additional low-noise shield
- Lower profile design suitable more to the project
- Mounting screw positions are compatible with Pi size PCBs
- Precision manufacturing
- Heavy duty design for 24/7 operation

C. Layout and Dimensions (in mm)



D. Getting started

Please run the LifePO4Mini Pro power supply separately first to ensure fully functioning before connecting to your project.

1. Install four 3.2V 18650 LifePO4 battery cells into the battery holder holders on both PCB sides. Please be **very very careful not to reverse the batteries**. Otherwise, a short circuit can be led to.

   Lower ESR and higher capacitance batteries will be preferred. Please don't use the standard 3.7V lithium batteries.

   Please also make sure the ON/OFF switch S1 is at OFF position.

2. If you want to use a USB power, please connect it to the J6 USB-C connector. Please use high quality standard USB power adapter such as Anker or UGREEN 65W. Avoid using Apple or RaspberryPi USB power adapters because they run private PD protocol and may only work properly for their own products. If it is possible, please use a USB-A to USB-C cable for higher output current (USB-C cables are also OK).

   If you prefer AC input, please connect a 6V-12V transformer output to the J5 connector. 1182L6, 1182M9 or 1182L12 or equivalent or higher rated current transformers are all good to be use. Please keep the USB connector J6 unconnected when using AC input.

   Once power input is connected, the Power Good indication LED D3 will light up. Single red LED means it in normal charging mode (input voltage is 5V). Both red and blue LEDs means it's in fast charging mode.

3. The FULL LED D7 will light up once the batteries are fully charged. It may take a couple of hours to charge if the batteries are fully empty. After that, please turn the ON/OFF switch S1 to the ON position. Both OUTPUT LED D9 and PURE LED D10 will light up. The LifePO4 Mini Pro is now running in pure mode and the 3.3V voltage is output to J7(+) and J8(-).

4. It's fully functioning now. Turn off the power switch S1 OFF and disconnect the power input. Your LifePO4Mini Pro 3.3V is now ready to be installed to your project. (Please switch S1 ON and then OFF to reset if D3 is still ON)

E. Principle of operating

LifePo4 Mini Pro has four operation modes

1. Pre-charge mode

   LifePO4Mini Pro will work in pre-charge mode when it is off while the input power supply is connected. In this mode, the battery cells will be connected to the dedicated onboard CC-CW battery charger. The FULL LED D7 will be lit after the battery pack is fully charged to 3.42V. Then the charger will continuously chare the batteries until reaching the 3.52V if the it's still at off.

2. Pure output mode

   LifePO4Mini Pro will go to the pure output mode if it is turned on while the FULL LED D7 is lit. In this mode, only the battery pack will be connected to the outputs. The charger and all other circuits will be disabled and disconnected from the output. All the monitoring and controlling jobs will be performed through the optical isolators. The outputs will be 100% isolated from the rest of the circuits. Both PURE LED D10 and OUTPUT LED D9 will be lit to indicate the LifePO4Mini Pro is running in the pure output mode.

3. Protection/re-charge mode

   Because only the battery pack will be connected to the load, after running for a very long time at pure mode, the battery voltage will keep drop. When the voltage is below 3.10V, LifePO4Mini Pro protection mode will be triggered to protect the batteries from damage by low voltage. The CC-CV charging circuit will be connected automatically to re-charge the battery cells. The output doesn't stop in this protection mode but the low noise performance will be degraded slightly (active circuits involved). After battery cells get fully charged, the LifePO4Mini Pro will be automatically switched back to the pure output mode again.

   Note:

   If the power input is absent, the battery pack will be disconnected from the circuit by the relay. The switched output J7 will be also off. However, the continuous output J8 will still be connected to the battery cells.

4. SYNC charge mode

   SYNC mode is a powerful feature of the LifePO4Mini Pro. You can enable this feature by connect a SYNC control signal to J11 or J12 from the MUTE output of a MonitorPi Mini or a FifoPi Q7. In this case, the Ultracapacitors can be charged when music is paused or stopped even if it's already in pure mode. SYNC mode can be used to avoid the output voltage drop or trigger the protection mode even if listening to music for a very long time. UcPure will be back to the pure mode again when music is playing.

F. Connectors

J6: USB-C DC input connector

A standard USB power adapter such as Anker or UGREEN 65W can be connected to this connector to function. The 12V/9V high voltage output will be triggered for fast charging mode if that USB-C power adapter supports PD protocol. Both high quality USB-C to USB-C and USB-A to USB-C cable can be used. But the USB-A to USB-C cable usually can provide higher output current. Please don't use the Apple or RaspberryPi USB power adapter because they use private PD protocol and may not work very well for devices other than their own products. Please leave J6 unconnected if you use AC power input.

J3: AC input terminal block connector

An 6V-12V 2A or higher current AC power input can also be connected to J3 as power input. 1182L6, 1182M9 or 1182L12 or equivalent or higher rated current transformers are all good to be use. Please keep the USB connector J6 unconnected when using AC input.

J7(+) and J8(-): Switched 3.3V output

They are the switched 3.3V output of LifePO4Mini Pro. To make the connecter ESR to an even lower level, two independent terminal block connectors are used for positive J7 (+ both pins) and negative J8 (- both pins) outputs. These outputs will be turned ON and OFF flowing the LifePO4Mini Pro ON/OFF switch. More than one load can be connecting to those outputs.

J9: Continuous output (2 PIN Molex Mini-Fit connector)

This continues output is specially designed for clock oscillators, sine to square convertors and many other analog applications that need continuous power for a long-time break-in. J9 can also connected to a UcHybrid to upgrade for a low cost ultracapacitor/battery hybrid power supply. The continuous output is non-switched, so no matter LifePO4Mini Pro is turned on or off, the output will be always connected to the LifePO4 battery cells. Unplugging the cable is the only way to disconnect this output from the load.

The related Molex P/Ns of the cable are
Housing: 39012020
Terminal: 39000038
F1 fuse is also applied to this output to protect from over current or short circuit.

J4: External ON/OFF switch connector, PH2.0 2-pin

The external ON/OFF switch will be parallel to the on-board switch S1 to provide an equivalent function. To use the external ON/OFF switch, On-board switch S1 must be at OFF position. Please don't connect J4 to the ON/OFF control chain signals.

J5: Slave ON/OFF control chain input (2-pin PH2.0, isolated and non-polarity)

LifePO4Mini Pro can be remotely turned ON/OFF when a 3V-12V control voltage is applied or removed on this input. The control signal is non-polarity and will be optically isolated.
To use the ON/OFF/ control chain, On-board switch S1 or external ON/OFF switch must be at the OFF position.

J1: Master ON/OFF control chain output (2-pin PH2.0)

1: Control signal –
2: Control signal +(5V)
To create a control chain as a power supply group, we can connect J1 to a slave ON/OFF control input of the following power supply through the control cable, and so on.

J11, J12: SYNC control signal input/output (2-pin PH2.0)

1: SYNC control signal –
2: SYNC control signal +
To enable the SYNC mode, SYNC control signals need to be connected from the MonitorPiPro or the FifoPiQ7's MUTE output.
With a built-in isolator, this control signal is non-polarity and will be optically isolated.
J11 an J12 are equivalent.

J2: AUX 5V output (2-pin PH2.0)

This AUX 5V output is designed to provide an additional 5V output in case it is required by a project, such as powering a MonitorPiPro. To prevent from short circuit, a 150mA current limitation is applied to this output. This output is only suitable for low current (lower or around 100mA) applications. Please never use this output powering high current devices such as a RPi.

G. LED indicators

D3: Input Power Good indicator. Indicating that the power input voltage is applied when lit. Buth red and blue LEDs will be lit if the input voltage is higher than 9V as a fast charging mode.
D7: Full indicator. Indicating battery cells are fully charged above 3.42V when lit.
D9: Power on indicator. Indicating that the LifePO4Mini Pro is turned on and output voltage is applied to J7 when lit.
Note: D9 has no business with the continuous output
D10: Pure output indicator. When lit it indicates the LifePO4Mini Pro is in pure output mode and 100% isolated from the input.

H. Application notes

1. How to run the LifePO4Mini Pro in Super-Pure (UPS) mode

1. Make sure the S1 is at OFF position and the LifePO4Mini Pro batteries are fully charged or being charged overnight. Remove the USB or AC power input cable.

2.Set both of the pin1 and pin2 of the setting switch S3 to the ON positions using a needle or other tool.

3. Connecting your device to the output connectors J7 and J8. Turn the ON/OFF switch to the ON position. 3.3V output will be applied to the output connectors. The LifePO4Mini Pro is now running in Super-Pure mode independently without needing for any input power supply. Both D9 and D10 will light up. The voltage will be drop slowly while running in this mode according to the output current. D10 will be off if the voltage is dropped below 3.42V. But no matter D10 is ON or OFF, it's still in the Super-Pure mode.
To protect the batteries from damaging by low voltage, it will be highly suggested to re-charge the battery manually if the voltage is lower than 3.1V by connecting the power input. But there will be no LED indications for reminding. The ON/OFF control chain may still work for the Super-Pure mode.

4.Once the evaluation or testing job finished. Please set both of the pin1 and pin2 of the setting switch S3 back to the OFF positions for a normal operation mode.

2. About the fuse

The ultra-low ESR resettable fuse is first time being introduced by LifePO4Mini Pro Power supply. Both contact resistance and the fuse resistance are all reduced significantly to an another much lower levels comparing with standard glass fuses. The fuse can support constant output current up to 12A. And in case there is a short circuit, it will cut the circuit when the current is reached to higher than 14A. The fuse can be reset/recovered after the short circuit is removed. So, there is no longer in need for replacing the fuse.
The ESR of the fuse is only 3mOhm. However, you can still reduce the total output ESR by up to 3mOhm if bypassing the fuse by shorting the jumper S2 using a soldering ball. But that is not recommended for normal project. If you really want, to reduce the risk, please only do it after your project runs stable.

3. How to set up an ON/OFF control chain as a power supply group?

Setting up a ON/OFF control chain as a power supply group would be highly recommended and it will be very easy to do. Please specify one unit as master power supply. Then connect the Master control output J1 to the control input J5 of the following slave LifePO4Mini Pro using a control cable, and so on to the rest slave units.
You can install an external ON/OFF switch (#61C) to the J4 of the master unit or use its on-board switch S1 as the main control switch. Please also make sure the on-board S1 switches of all slave power supplies are at the OFF position. LifePO4Mini Pro's slave control input will be optical isolated and non-polarity.

4. How to enable the SYNC charging function

The SYNC charging function is disabled by default. To enable this feature, you just need simply connect the two-pin control cable to either J11 or J12 from a MonitorPi Pro or FifoPi Mute output.
If you want more LifePO4Mini Pros run the SYNC mode as a group, you can connect the rest of SYNC connector (J11 or J12) to J11 or J12 of the next LifePO4Mini Pro by the control cable as a control chain.

5. Is it possible to upgrade the performance with ultracapacitors?

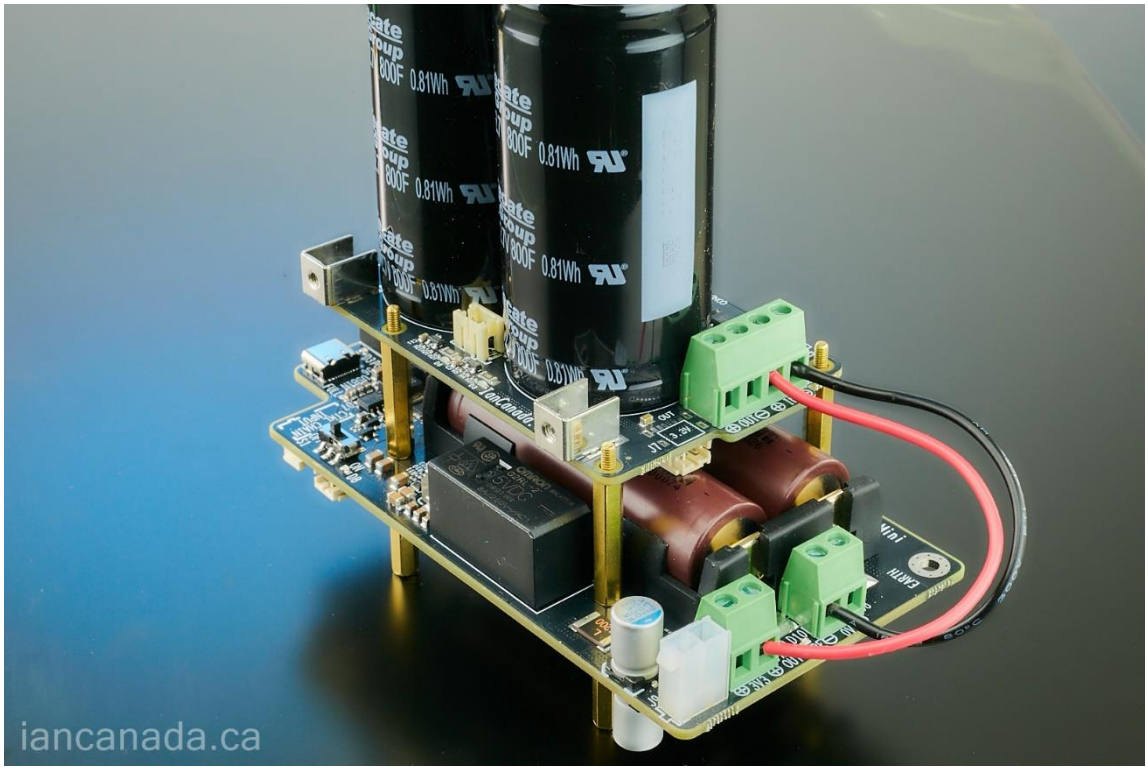
The performance of this LifePO4Mini Pro 3.3V is still possible to be improved by upgrading it to an ultracapacitor/battery hybrid power supply.

1.Upgrade with a UcHybrid (the low-cost way)

You just need to connect a UcHybrid to the LifePO4Mini Pro using a power cable. That's all, very simple to do. The output ESR can be reduced by up to 20% according to the ultracapacitors that the UcHybrid used.

2.Upgrade with an UcConditionerPro 3.3V

You just need to connect the output from J7 and J8 to the input of a UcConditionerPro 3.3V input. Then take the 3.3V output from the UcConditionerPro. The output ESR can still be reduced by up to 35% according to the ultracapacitors that the UcConditionerPro uses.
The 25mm M2.5 standoffs could be required for this configuration.



6. Does the quality of the input power supply have business with the LifePO4Mini Pro output quality?

LifePO4Mini Pro outputs are 100% isolated from the input when it's turned on in pure mode. And the on-board CC-CV charger is also disabled at the same time. So theoretically the quality of LifePO4 Mini outputs will have no business with the quality of the input power supply.

However, a cleaner input power supply generally introduces lower EMI noise to the environment. Please use higher quality input power supply as possible. AC transformer normally has lower noise than a switching mode USB power adapter. However, an ultra-low noise high current linear power supply with USB-C output, such as a LinearPiPro, would be always better than a AC transformer.

CmChoker common mode noise filter would also be highly recommended to install between the transformer and the AC input to suppress the common mode noise.

I. Application examples of LifePO4 Mini Pro 3.3V

1. LifePO4MiniPro/LinearPi Pro hybrid 5V +3.3V power supplies KIT (#96J)

   Configurations:

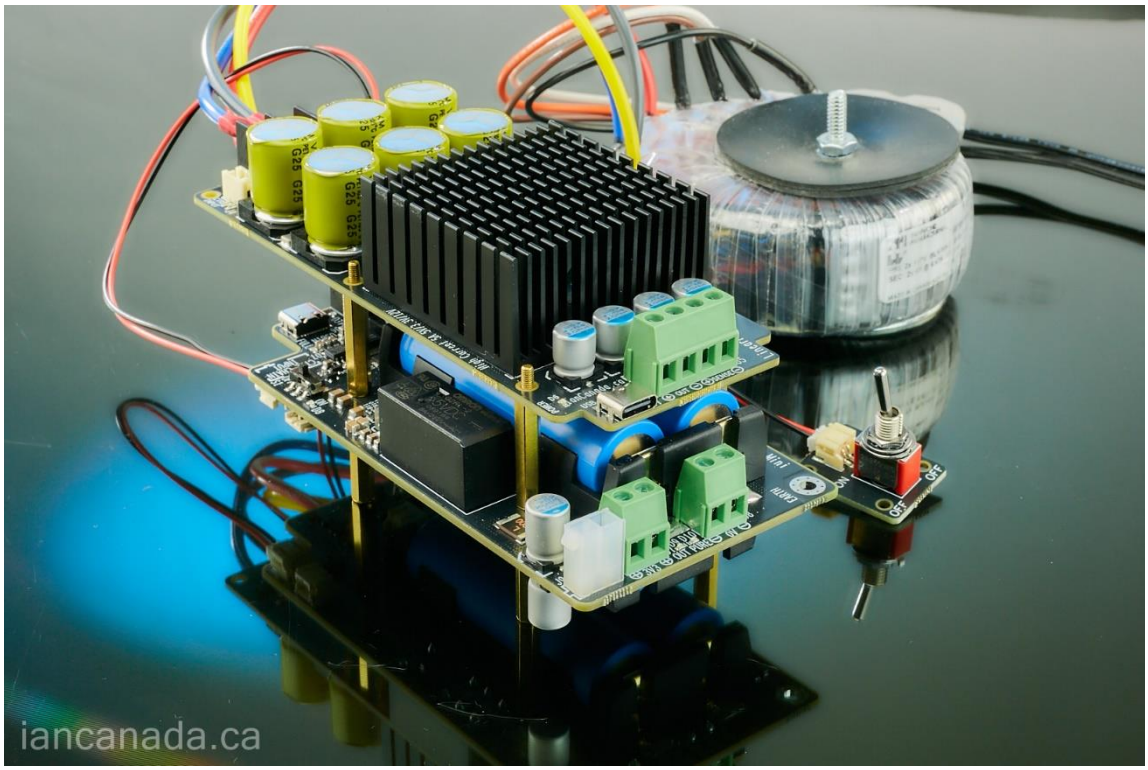
   . #38B LinearPiPro Sold 5V/5A Ultra-low noise Linear Power supply

   . #42B LifePO4Mini Pro 3.3V Pure Battery Power supply

   . #61C External ON/OFF switch

   . #34D 25mm M2.5 LifePO4Mini Pro standoff/screw SET

   Note: The AC 6V+6V Transformer is not included, recommend P/N: Hammond 1182N6 or 1182Q6



2. LinearPi Pro/LifePO4Mini Pro/UcConditionerPro Hybrid 5V+3.3V power supply KIT (#96K)

Configurations:

. #38B LinearPiPro Sold 5V/5A Ultra-low noise Linear Power supply

. #25C800 UcConditionerPro 5V

. #42B LifePO4Mini Pro 3.3V Pure Battery Power supply

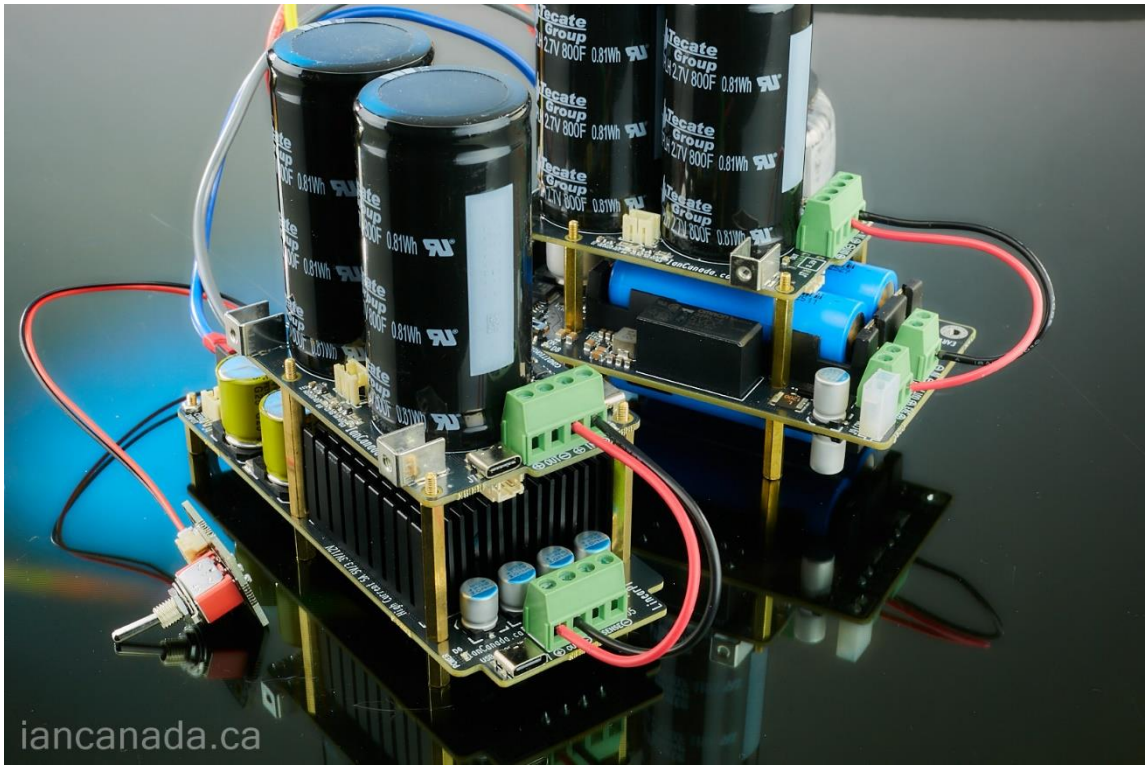
. #26C800 UcConditionerPro 3.3V

. #61C External ON/OFF switch

. #34C 35mm M2.5 LinearPi Pro standoff/screw SET

. #34D 25mm M2.5 LifePO4Mini Pro standoff/screw SET

Note: The AC 6V+6V Transformer is not included, recommend P/N: Hammond 1182N6 or 1182Q6



J. LifePO4MiniPro 3.3V as shipped

K. History of revising