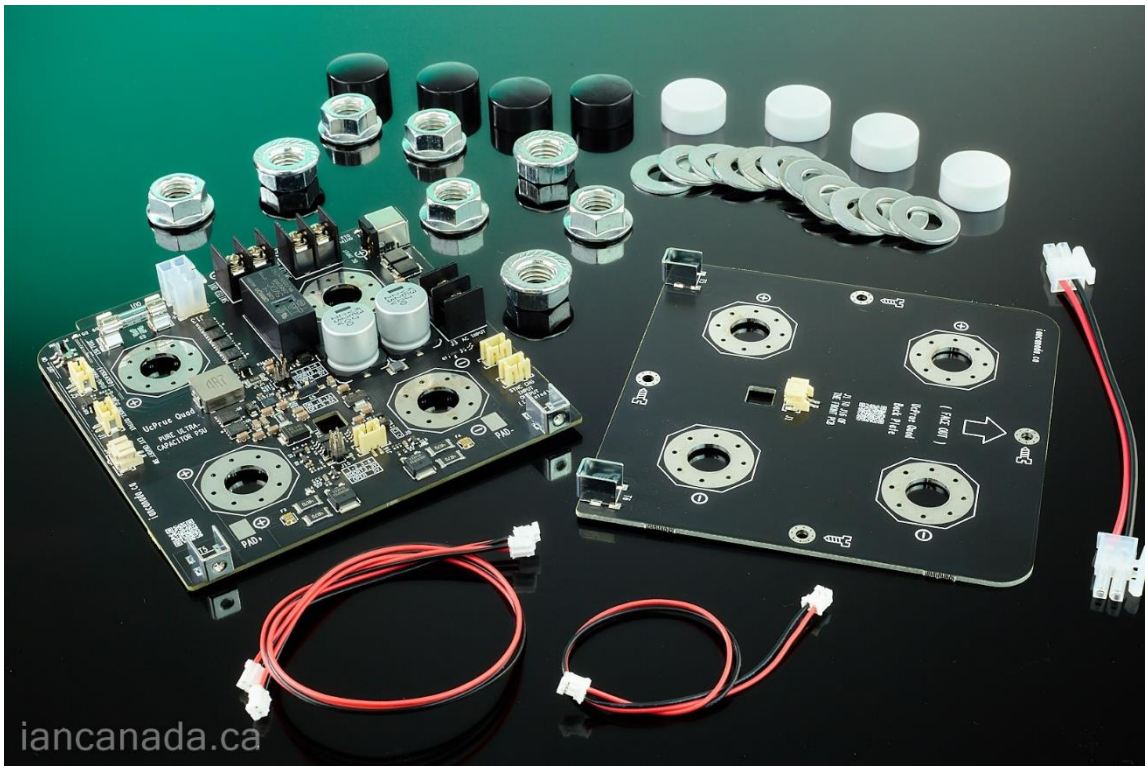
UcPure Quad

The Pure Ultra-capacitor Power Supply

By IanCanada



A. Introduction

UcPure is a pure ultracapacitor power supply. It makes use of the huge 3000F or higher capacitance ultracapacitor pack to achieve an ultimate power supply performance. Because it is a pure passive power supply, there will be no feedback and no active components involved when it's turned on. At the pure output mode, only the pre-charged ultracapacitor pack will be applied to the load.

UcPure equipped with a SYNC charging function to be able to re-charge the ultracapacitors during music stops.

UcPure Quad is an upgraded solution over UcPure. It uses a new architecture to make four 3000F ultracapacitors working in parallel (two groups) to achieve an ultimate performance. It's capable of delivering up to 4800A dynamic current with only 0.23mOhm internal ESR (continuous output mode). UcPure Quad could be the best low noise high dynamic power supply on this planet so far.

Sound quality of sensitive audio applications such as low jitter clock oscillators, DACs, FIFOs and many other circuits will be benefited greatly from this UcPure Quad power supply.

B. Highlighted Features

- Pure ultracapacitor power supply
- Ultracapacitors work in class A mode which current going only in one direction.
- Output can be configured to 3.3V and 5V(default) by jumper setting switches
- Outputs are 100% isolated from charger and power input at pure mode
- Can be controller by the on/off control chain (optical isolated) as part of power supply group
- Also comes with both built-in and external on/off control switches
- Optical isolators are used for all internal operating logics
- Built-in protection scheme to prevent ultracapacitor from exhausted and low output voltage
- With powerful SYNC UC charging function. Can re-charge the UCs during music stops. This feature can avoid the output voltage drop or trigger the protection mode even if you listen to music for a very long time. SYNC control signal can be connected to the MUTE signal of a MonitorPi pro or a FifoPiQ7. More UcPure can work together with this signal as a control chain. This signal is isolated from UcPure so it doesn't affect the power supply performance at all
- Heavy duty design for 24/7 operation

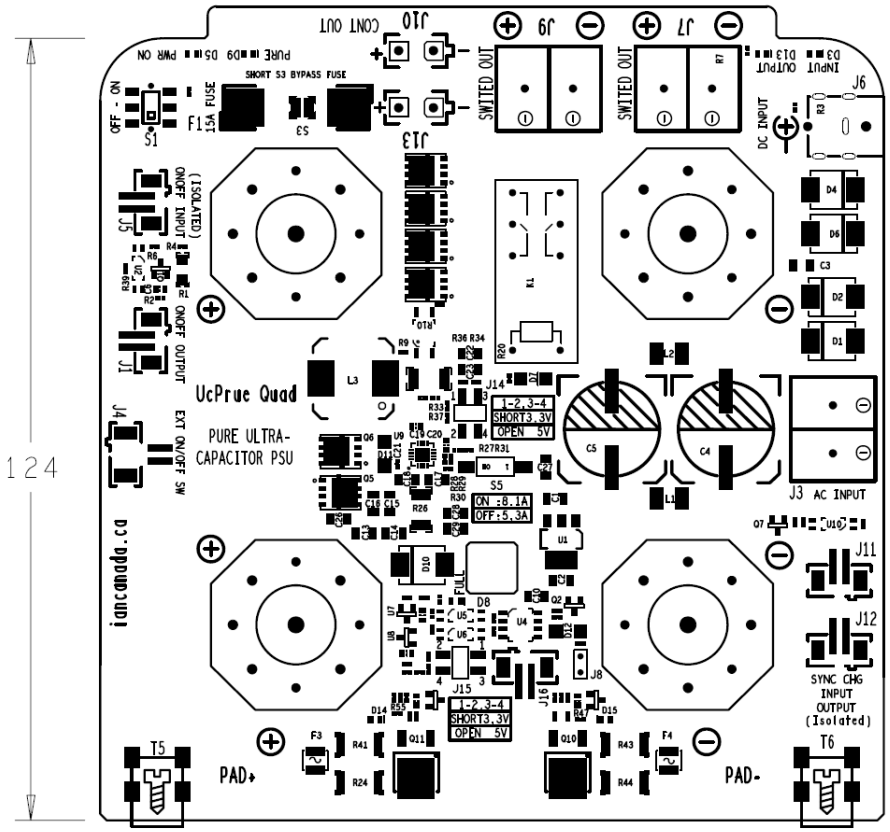
C. UcPure Quad new Features

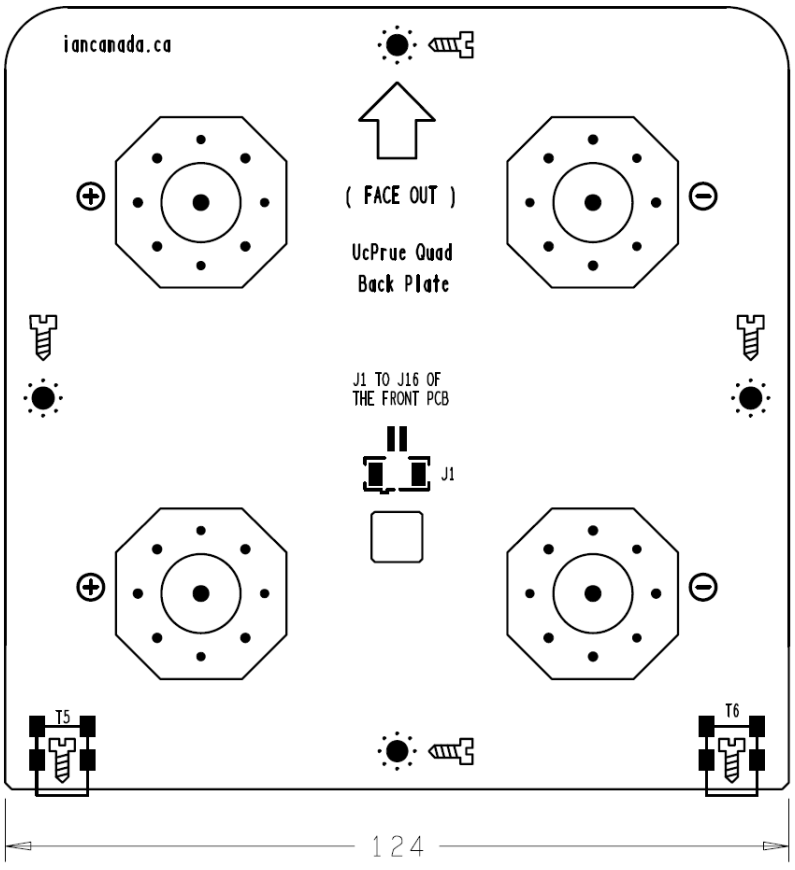
- Four 3000F ultracapacitors work in parallel (two groups), to reduce the output ESR to an ultimate lower level which has never been reached before. Noise was also reduced by 1/sqrt(2) in principle.
- New dual PCB architecture to completely eliminate the wires between UcPure and ultracapacitors, thus significantly improving the performance. Because the resistance of the wires can be even higher than the ultracapacitor ESR itself
- ESR

  Continuous outputs J10, J13: 0.23mOhm

  Switched outputs J7, J9: 0.43mOhm + Fuse ESR
- The pure time will be double
- Balancing functions have already been integrated on PCB, so no longer need external balancer/protection boards.
- With both horizontal and vertical mount brackets.
- 5.3A or 8.1A fast charging current, jumper configurable
- Optimized to 12V AC input, can also work with 15V to 20V DC input.
- Double copper thickness, four layers PCB design to ensure the lowest ESR performance
- Two groups of switched and continuous output to make it easier to share this great power supply with different circuits of the system
- Full set of accessories
- DIY friendly. super easy to assemble, just screw and play.

D. Layout and Dimensions (in mm)


124
J10
CONT OUT
J9
J7
SWITED OUT
SWITED OUT
INPUT OUTPUT
D13
D3
J6
DC INPUT
PWR ON
D5
D9
PURE
SHORT S3 BYPASS FUSE
F1 15A FUSE
S3
S1
OFF - ON
J13
J5
ON/OFF INPUT (ISOLATED)
J1
ON/OFF OUTPUT
J4
EXT ON/OFF SW
UcPrue Quad
PURE ULTRA-
CAPACITOR PSU
iancanada.ca
J14
1-2,3-4
SHORT 3V
OPEN 5V
S5
ON :8.1A
OFF:5.3A
J15
1-2,3-4
SHORT 3V
OPEN 5V
J3 AC INPUT
J11
J12
SYNC CHG
INPUT
OUTPUT
(Isolated)
T5
T6
PAD+
PAD-
F3
F4


iancanada.ca
(FACE OUT)
UcPrue Quad
Back Plate
J1 TO J16 OF
THE FRONT PCB
J1
T5
T6
124

E. Getting started

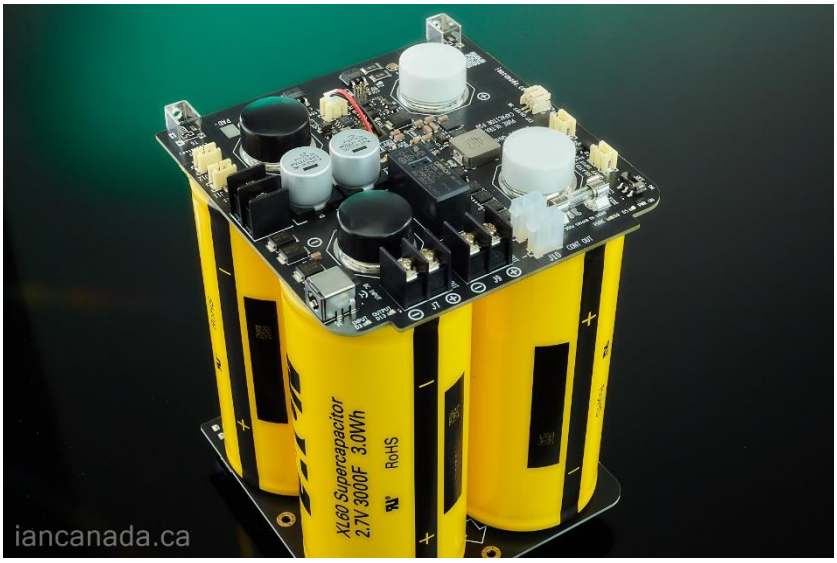
1. Make sure all the ultracapacitors are fully discharged (voltage less than 0.1V).

   Make sure J14 and J15 are set properly for the desired voltage. Make sure S5 is set correctly for the charging current.

2. Mount each of the UCs to the UcPure Quad PCB using the two 1.5mm (3mm total thickness) washers and one self-locking nut. Follow the signs of the positive and negative terminals, must not be reversed. Also need to make sure nothing touches to the ultracapacitors at the back of the PCB. Don't forget the installing balancing cable to J1 of the back plate PCB.

3. Mount the other side of the four ultracapacitors to the back plate PCB using 1.5mm washers and the self-locking nuts. Tighten all the nuts using suitable hex bit socket (3/4). Be very careful no damage the components on the PCB. Please Connecting the balancing cable to J16.

4. Install the 8 nut covers. That's very important for safety.



5. Connect an AC 12V with rated current 3A or higher to J3. 1182M12 or 1182P12 or higher power transformers are recommended. You can also use a 1182L12 with two secondary coils in parallel. After the AC input is powered, the input LED D3 will light up. It can take up to an hour to charge the four ultracapacitors from empty at the fist time of use.

6. Full LED D8 will light up when the ultracapacitors are fully charged. After that, turn on the power switch S1. Both Output LED D13 and the Pure LED D9 will light up, as well as the Power on LED D5. Output voltages should be applied to J7 and J9. Turn off the S1, the UcPure Quad is ready to use now.

F. Principle of operating

UcPure Quad has four operation modes

1. Pre-charge mode

   UcPure Quad will work in pre-charge mode when it is off while the input power supply is connected. In this mode, the ultracapacitor pack will be connected to the dedicated onboard CC-CW ultracapacitor charger. The constant charging current can be programmed to 5.3A (default) or 8.1A according to the S5 jumper settings. The full LED D8 will be lit after the ultracapacitor pack is fully charged.

2. Pure output mode

   UcPure Quad will go to the pure output mode if it is turned on while the full LED D8 is lit. In this mode, only the ultracapacitor 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. So, the outputs will be 100% isolated from the rest of the circuit. Both pure LED D9 and output LED D5 will be lit to indicate the UcPure Quad is running in the pure output mode.

3. Protection/re-charge mode

   Because only ultracapacitor pack is connected to power the load, after running for a long time at pure mode (normally hours), the output voltage will be dropped below a threshold voltage. To protect the output from going low voltage, UcPure Quad protection mode will be triggered in this case. The CC-CV charging circuit will be connected again to re-charge the ultracapacitor pack. The output doesn't stop in this protection mode but the low noise performance will be degraded slightly meanwhile (active circuits involved). After a couple of minutes, the UcPure Quad will be automatically switched back to the pure output mode once the ultracapacitor pack is fully charged again.

4. SYNC mode

   SYNC mode is a powerful feature for UcPure Quad. You can enable this feature by connect a SYNC control signal to FifoPi Q7. In this case, the UcPure Quad can charge the ultracapacitors by synchronized to the music 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 you listen to music for a very long time.

   UcPure will be back to the pure mode again when music plays.

Note:

The ultracapacitor pack will be disconnected by the relay from the UcPure Quad when the input power is absent. The switched output J7 and J9 will be also off in this case. However, the continuous output J10 and J13 will still be connected to the ultracapacitor pack without stop.

G. Jumper settings

Configurations	J14	J15
3.3V	1-2: short 3-4: short	1-2: short 3-4: short
5V (default)	All open	All open

Charging current	S5
5.3 A (default)	OFF
8.1 A	ON

H. Connectors

J3: AC/DC input barrier terminal block alternative to J6 (not installed by default)

Configurations	AC input	Or DC input (bi-directional)
3.3V/5V	AC 12V/3A or higher	DC 15-20 V

Note: J6 has to be kept unconnected if J3 is used.
Note: AC coil has to be independent and cannot be shared with other devices.

J6: DC power input connector (5.5/2.5mm, positive terminal inside)

A good quality 15V to 20V standard laptop power supply with 3.5A or higher rated current is recommended for all the configurations. J3 must be kept unconnected when J6 is used. DC input is not recommended for UcPure Quad because of the higher EMI noise.

J7, J9: Switched output (barrier terminal block)

This is the switched output of UcPure Quad. This output will be turned on and off when UcPure Quad is on or off. J7 and J9 are equivalent. UcPure Quad can be shared by more than one load if using the two outputs at the same time.
A 16A fuse F1 is installed to this output to protect from over current or short circuit.
The Littlefuse P/N of this fuse is 0218016.MXP, but you can use any 16A fast acting 5*20mm standard glass fuse. The resistance of the fuse has to be taken into account for a power supply reached at this level. High-end fuses with lower resistance would always be preferred.

J10, J13: 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 long time break-in. The continuous output is non-switched, so the output will be always there no matter UcPure Quad is on or off. The only way to turn off this output is to disconnect the connector by unplugging the cable.
J10 and J13 are equivalent to each other. J13 could be optional
The related Molex P/Ns of the cable are
Housing: 39012020
Terminal: 39000038
To keep the lowest output ESR, no fuse is applied to these outputs, so must be very careful to avoid any over current or short circuit.

J4: Optional external on/off control switch connector, in 2-pin PH2.0

External on/off control switch is functionally equivalent to the on-board switch S1.
To use the external on/off control switch, On-board switch S1 must be at off position.
External on/off switch is not supplied by default.

J5: Slave on/off control input in 2-pin PH2.0, isolated and non-polarity

UcPure Pure can be controlled remotely from this slave control input. UcPure Quad will be turned on when a 3V-12V control voltage is applied to this input. The control signal is non-polarity and will be optically isolated from UcPure Quad.

To use the remote on/off control, On-board switch S1 or external on/off switch must be kept at off position.

J1: Master on/off control output in 2-pin PH2.0

1: Control signal –

2: Control signal +

To set up a control chain of a power supply group, we can connect J1 to the slave input of the following UcPure Quad or other power supplies through the supplied control cable.

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

1: SYNC control signal –

2: SYNC control signal +

To enable the SYNC mode, SYNC control signal + needs to be connected the FifoPiQ7's MUTE output, while the SYNC control signal – needs to be connected to the FifoPiQ7's clean side GND.

With a built-in isolator, this control signal is non-polarity and will be optically isolated from UcPure Quad.

J11 an J12 are equivalent to each other.

S3: Fuse bypass jumper

To eliminate the fuse ESR, F1 can be bypassed when jumper S3 is shorted by a solder ball.

Please don't do it unless you can ensure it's safe enough.

I. LED indicators

D3: Power input indicator. Indicating that the power input voltage is applied when lit.

D5: Power on indicator. Indicating that the UcPure Quad is turned on.

Note: D5 has no business with the continuous output

D13: Output indicator. Indicating UcPure Quad output voltages are applying to J7 and J9.

D9: Pure output indicator. Indicating UcPure Quad is in pure output mode.

D8: Full indicator. Indicating ultracapacitor pack is fully charged when lit.

J. Application notes

1. How long the pure time will last before triggering the protection mode

The pure time can be calculated.

Take for instance. If the output voltage drops from 3.4V to 3.0V (UcPure 3.3V configuration), the charge released will be Q = 3000 * 0.4 = 1200 (Coulombs).

If the load (FifoPi clean side together with SinePi) consumes 50mA current, the pure time will be:

T = 1200 /0.05 = 24000 seconds = 6.66 hours

After that time, the protection mode will be trigged to re-charge the ultracapacitor pack. However, the protection mode will take only 3.33 minutes to fully charge the ultracapacitor pack again. UcPure Quad will go back to the pure output mode after that time. So, this scheme doesn't really affect the listening experience much.

2. How to integrate UcPure Quads into a power supply group

For a power supply group, please connect the Master control output of the first power supply (3V to 12V) to the Slave control input J5 of UcPure Quad, and then the master control output J1 of UcPuer Quad to the next power supply or another UcPure Quad to make a control chain. UcPure Quad slave control input is optical isolated and non-polarity.

3. What are the suitable applications using a PurePi Quad

UcPure Quad will work greatly for all kinds of ultra-low noise applications such as low jitter oscillators, sine to square convertors, FifoPi clean side, DAC/ADCs, I/V stages, MM/MC phone amplifiers, pre-amplifiers and many other circuits. UcPure Quad could be the best possible performance power supply for those applications. However, high current applications may not suitable very well for UcPure Quad though it can deliver up to thousands of amperes dynamic current, because high output current can trigger the protection mode often.

4. How to enable the SYNC mode

SYNC mode is disabled by default. To enable this feature, you just need simply connect the two-pin connector cable to either J11 or J12 from a MonitoroPi or FifoPi Mute connector.

If you want more UcPure Quad run SYNC mode as a group, you can connect the rest of SYNC connector (J11 or J12) to J11 or J12 of the next UcPure Quad by a PH2.0 cable as a control chain.