UcPi
Universal Ultracapacitor Power Supply for Raspberry Pi
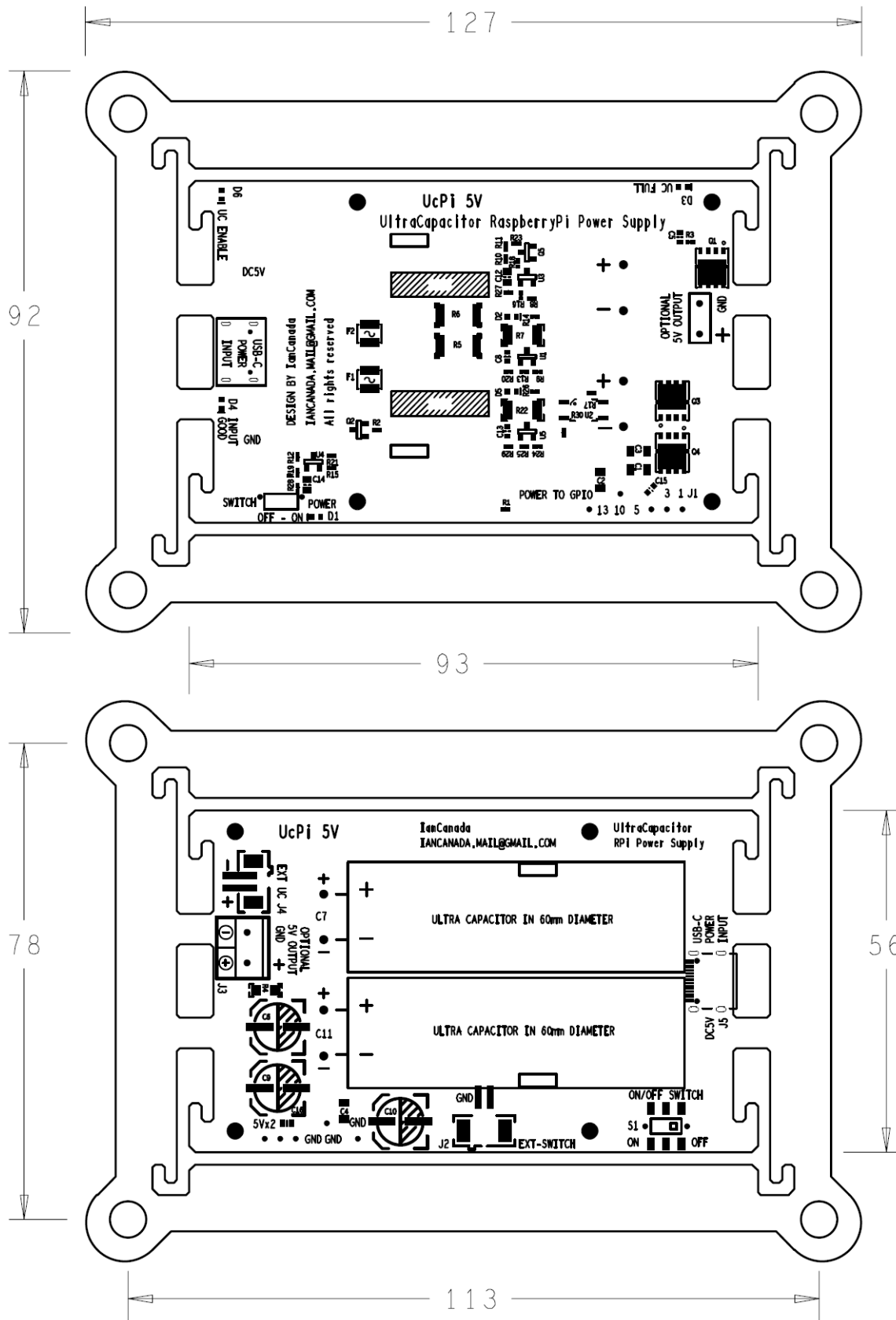
By IanCanada

Jul.12, 2022 Ver. 0.9b

A. Introduction

UcPi is a high performance low cost 5V universal Raspberry Pi ultracapacitor power supply. It was specially designed for all Raspberry Pi audio applications to achieve better sound quality by improving the power supply performance. UcPi uses spring contacts to connect to the RPi GPIO directly from the bottom side of the PCB, so the installation will be very easy. UcPi can also be used as a seat base of an audio project with anti-vibration spike feet and the possible rubber ring suspensions. Any existing RPi audio projects can be upgraded by the UcPi right away by just simply installing the stack on top of it. UcPi will be in fully finished with ultracapacitors pre-installed as shipped.

B. Features and Specifications

- 5V ultracapacitor power supply with two 100F/2.7V ultracapacitors pre-installed. ESR less than 10mOhm

- Very well designed gold plated spring contacts to power a Raspberry Pi directly to GPIO from the bottom side of PCB without any additional connections

- Works as a seat base of the whole project. Anti-vibration spike feet can be installed. And the rubber ring suspensions are also possible to be installed.

- Uses a standard 5V/2.5A or higher current USB-C power supply as input.

- On-board power ON/OFF control switch. This switch can also be extended as an external ON/OFF switch.

- Ultra-low resistance MOSFETs controlled by optical isolators to eliminate any possible leakage current

- Built-in active balancers for ultracapacitor protection.

- Low cost but no compromise on performance

- Fully finished with all ultracapacitors pre-installed

- Upgrade any existing Raspberry Pi audio projects right away by just simply installing them on top of the UcPi

- DIY friendly.

C. Layout and Dimensions (in mm)

Top board (dimensions: 127 × 92, inner 93):

UcPi 5V
UltraCapacitor RaspberryPi Power Supply

D6
UC ENABLE
UC FULL
D3
DC5V
OPTIONAL 5V OUTPUT
GND
+
−
+
+
−
USB-C POWER INPUT
DESIGN BY IanCanada
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All rights reserved
D4 INPUT GOOD
GND
F2
F1
R6
R5
R7
SWITCH
POWER
OFF − ON
D1
POWER TO GPIO
13 10 5
3 1 J1
R1

Bottom board (dimensions: 78 × 113, 56):

UcPi 5V
IanCanada
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UltraCapacitor RPi Power Supply

EXT UC J4
OPTIONAL 5V OUTPUT GND
GND
J3
+
−
+
C7
ULTRA CAPACITOR IN 60mm DIAMETER
+
−
C11
ULTRA CAPACITOR IN 60mm DIAMETER
C9
C8
5Vx2
C4 GND
C10
GND
J2
EXT-SWITCH
GND
ON/OFF SWITCH
S1
ON
OFF
USB-C POWER INPUT
DC5V J5
GND GND
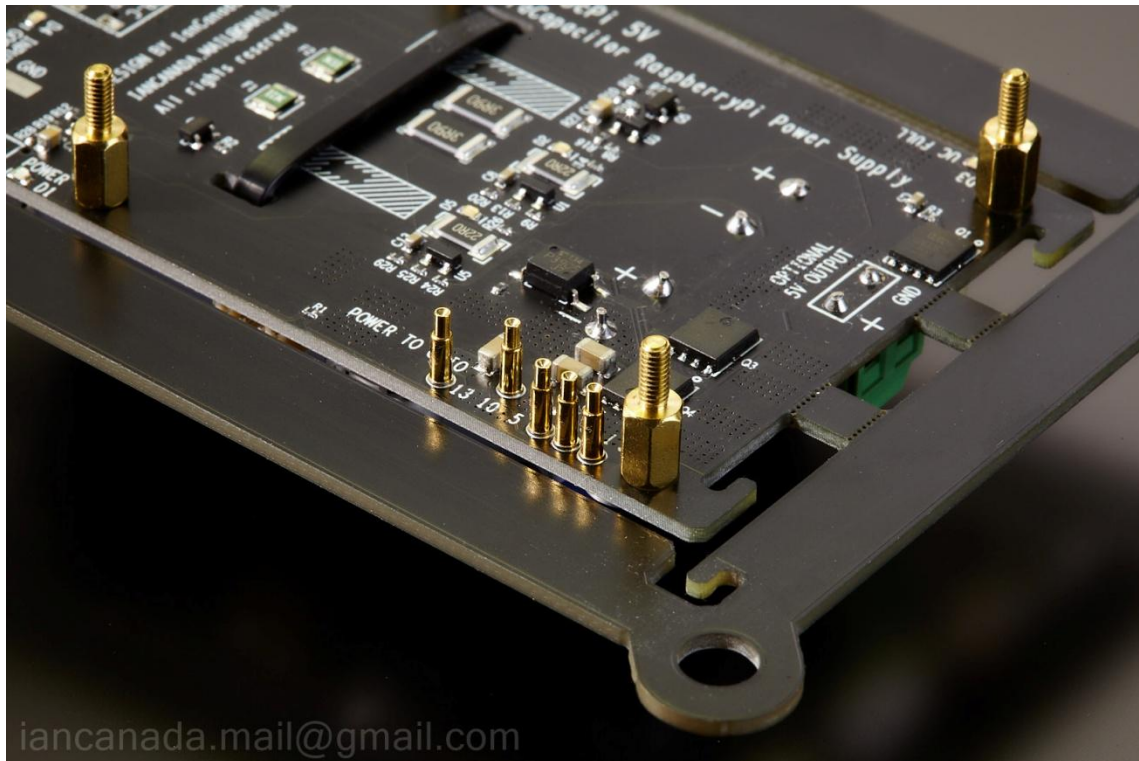
D. UcPi picture

UcPi as shipped

Kit includes:

UcPi (fully finished with ultracapacitors pre-installed)
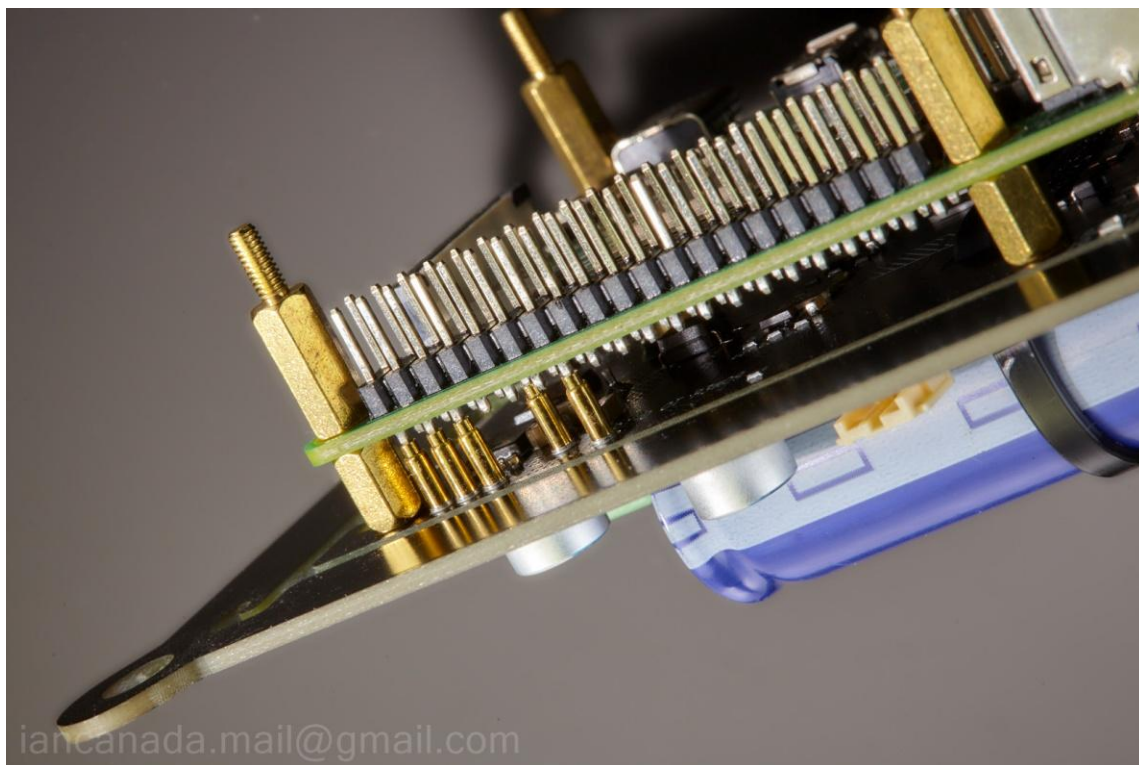
4 of M2.5*7 mm standoffs

4 of M2.5 screws

E. Getting started

1. Install the 4 supplied 7mm standoffs to the UcPi.

2. Install Raspberry Pi on top of the UcPi through the installed standoffs. Make sure the five spring contacts are connected to the GPIO pins properly at the bottom side of the Raspberry Pi.

3. Install the other audio HATs on top of the Raspberry Pi properly.

    (Using 11mm to 13mm standoffs according to the height of their GPIO connectors)

4. Connect a standard 5V USB-C power adapter with 2.5A or higher rated current to DC input J5 of the UcPi. The DC input indication LED D4 will light up shortly, or flash as while before lit up.

5. If it is the first time using the UcPi from empty, please wait for a couple of hours until Uc full LED D3 is lit up. Then turn the power switch S1 to the ON position. Both power on LED D1 and Uc enable LED D6 will be lit up.

6. Make sure everything is configured properly.

7. Enjoy the music.

8. Turn S1 to the OFF position when finish.

Tips:

1. It's strongly advised to leave the DC input always connected to J5, so that the ultracapactors can be kept in fully charged before turned on.

2. If D4 doesn't light up when USB power input is plugged, it means either the USB power cable is too long or the USB power adapter doesn't have enough output current. You can replace with a good USB power cable or the power adapter to fix the issue.

F. Connectors

J5: DC power input connector in USB-C

A standard 5V USB-C power adapter with higher than rated 2.5A current must be connected to this connector to function.

J1: 5V ultracapacitor power output in spring contacts

1, 3: 5V
5, 10, 13: GND

This is the main output of UcPi. This output will be turned on and off when ON/OFF switch is turned on or off. It designed to connect to the GPIO of a RaspberryPi directly from the bottom side.

J3: Optional 5V ultracapacitor output in 5mm terminal block

J3 works as an optional backup output. It is internally connected to the same 5V output of J1. This output can be used as long as the application required.

J2: External on/off control switch connector, in 2-pin PH2.0 connector

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 in the package.

J4: External ultracpacitor connector in 2-pin PH2.0

1: Ultracapacitor –
2: Ultracapacitor +

Though it is not recommended but if you really want to increase the utracapacitor capacity of a UcPi, you can install an external ultracapacitor pack to this connected. But it has to be very very careful:

1. The external ultracapacitorPi must in 5.4V or higher rated voltage
2. **Both internal and the external capacitors have to be discharged (by a 5-20 ohm power resistor) completely before connect to J4.**
3. The pre-chagre time of UcPi will be much longer.

G.   LED indicators

D4: Power INPUT GOOD indicator. When lit, it Indicats that the power input voltage is applied and higher than 4.9V.

D1: Power ON indicator. Indicating that the UcPi is turned on and output voltage is applied to J1 and J3 when lit.

D6: Ultracapacitor enabled indicator. When lit, it indicates that the ultracapacitors are fully charge and applied to the output. If this LED is off when power on, it means that the voltages over ultracapacitors are not enough to be enabled for output. They still need to be charged more.

D3: UC FULL indicator. Indicating that the ultracapacitors are fully charged when lit.
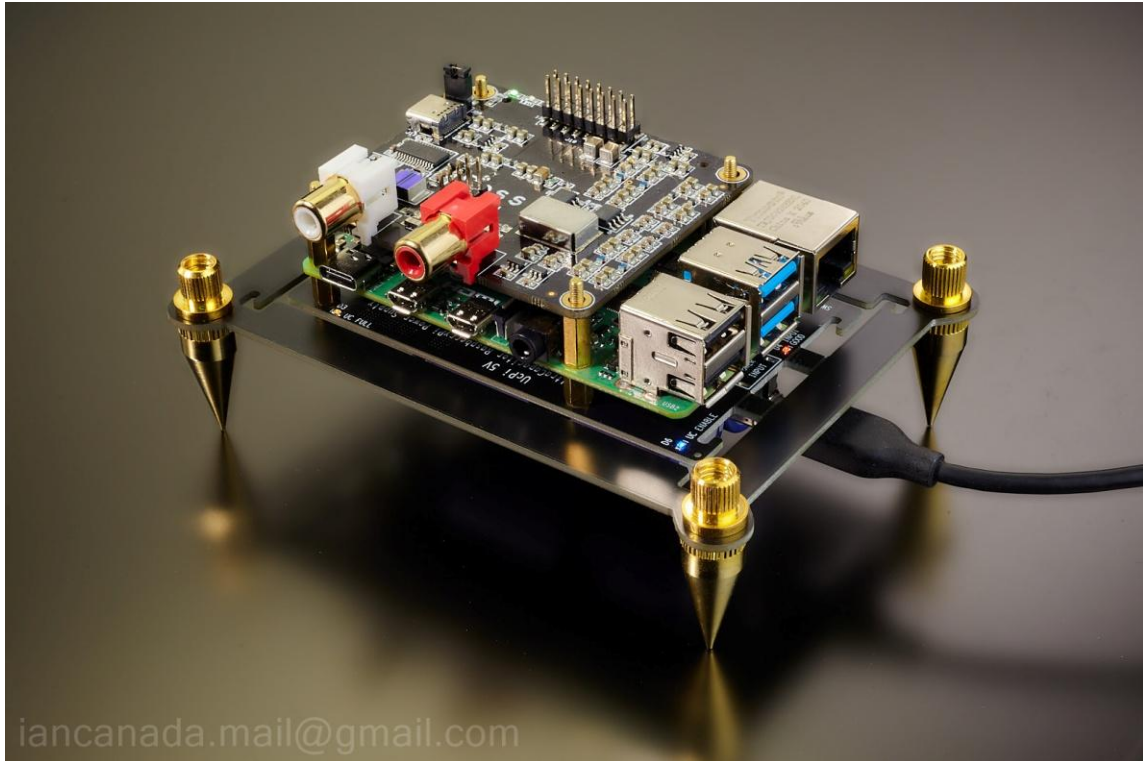
H.   UcPi example projects

1. Low cost audiophile grade ultra-low jitter Raspberry Pi streamer transport
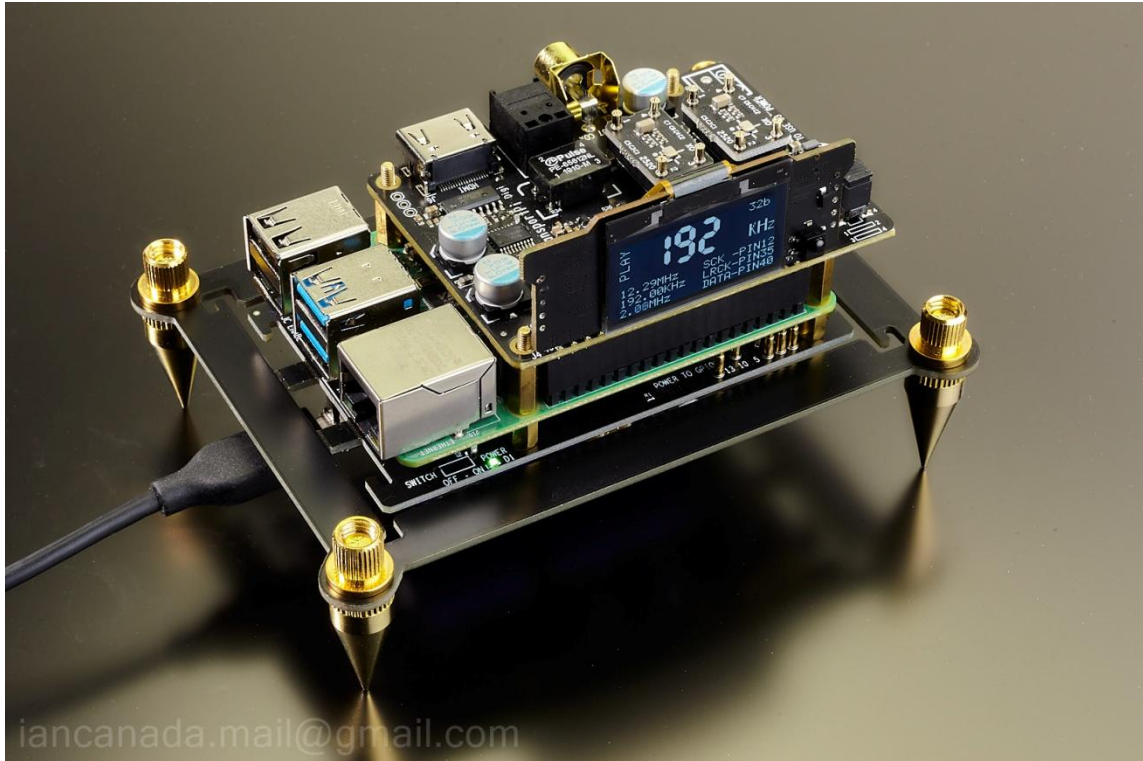
Project includes:

(1). UcPi

(2). Raspberry Pi

(3). TransportPi Digi (In master mode, with XO sockets, has RCA, OPT and I2S over HDMI outputs)

(4). MonitorPi (optional)

2. Upgrade a standard Raspberry Pi DAC with an UcPi

UcPi **+** Raspberry Pi **+** Boss DAC

3. Upgrade Audiophonics I-Sabre ESS DAC with an UcPi

UcPi + Raspberry Pi **+** Audiophonics I-Sabre ESS DAC

4. Upgrade a standard Raspberry digital interface streamer with an UcPi

UcPi + Raspberry Pi **+** Hifiberry Digi Pro digital interface

I. Application notes

1. Safety notes

Once charged, the ultracapacitors will store energy even UcPi is switched at the OFF position. Please be very careful during installation not to short the circuit, especially when using the metal tools.

2. Where can I buy the spike feet?

Spike feet kit can be found at Amazon. You can just search "Spike feet kit". For example:

https://www.amazon.com/Tihebeyan-Isolation-Shockproof-Amplifier-Turntable/dp/B07TVP547J/ref=sr_1_7?crid=2LTB2SSHUQBI5&keywords=spike+feet+kit&qid=1657989109&sprefix=%2Caps%2C76&sr=8-7

3. How to install the anti-vibration rubber ring suspensions?

Rubber ring suspensions help the XO oscillators to improve phase noise performance by reducing mechanical vibration. It is possible to implement this solution on an UcPi. To do so, you will need:

a. Break the UcPi PCB form the frame.

b. Hook up 4 rubber o-rings (5x2 or similar) between the frame and the UcPi. (O-rings can also be found at Amazon)

Note: Please don't break the UcPi PCB unless you really decide to.

J. History of revising

Jul. 12, 2022 V0.9b released