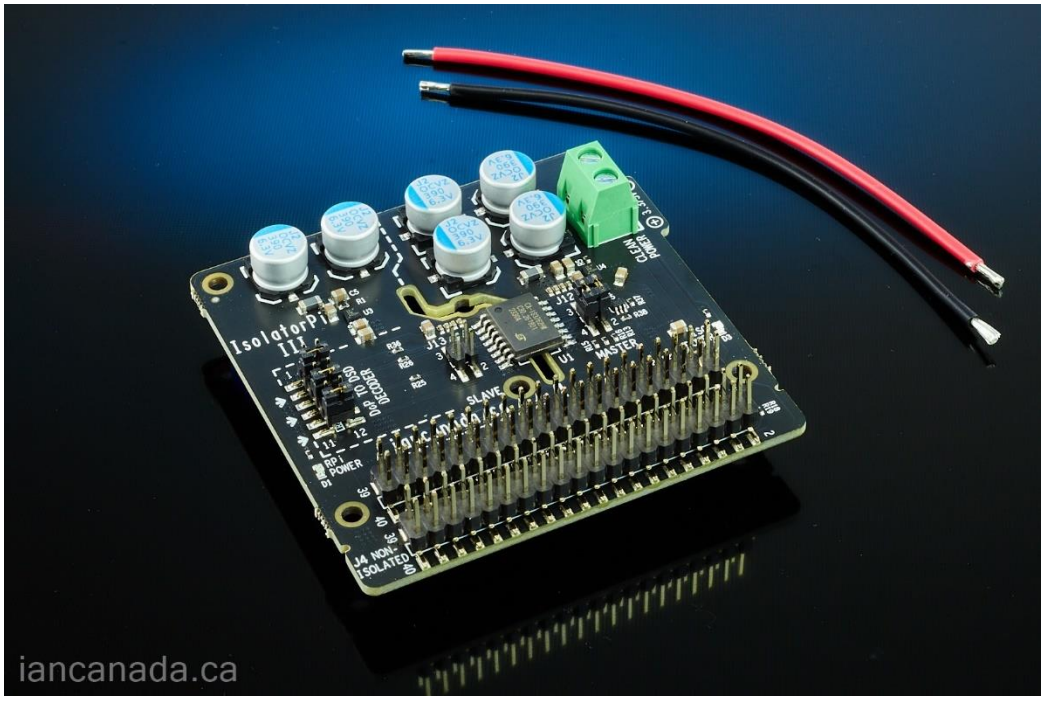
IsolatorPi III

User's Guide

IanCanada.ca



A. Description

IsolatorPi III is a HAT board that provides galvanic isolation for I2S/DSD/DoP signals, I2C bus, some GPIO pins and power between the RaspberryPi and the digital audio boards. It prevents transmission of RaspberryPi's EMI noise via ground and signal connections over GPIO.

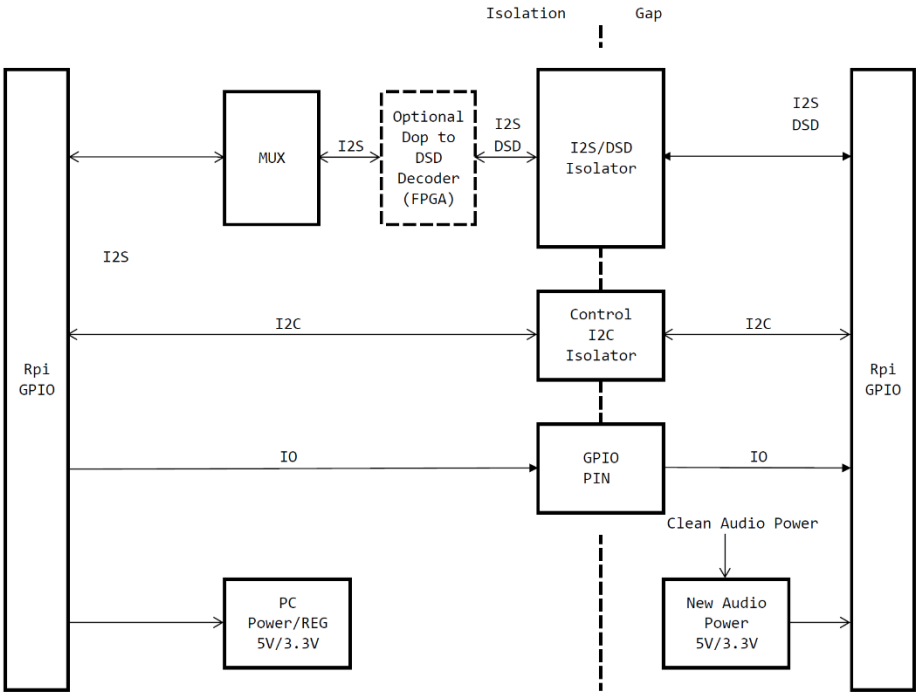
IsolatorPi III is an upgrade version over IsolatorPi II. It uses a 5KV higher grade isolator chip and a real physical isolation gap to improve isolation performance. Some IsolatorPi II un-useful functions and circuits were also removed to optimize the PCB layout for better isolation.

Preventing that noise from getting into your audio boards allows them to work better. AND with lower noise on the ground, when you introduce better power supplies and lower jitter clocks for your audio cards, the positive effects will be enhanced.

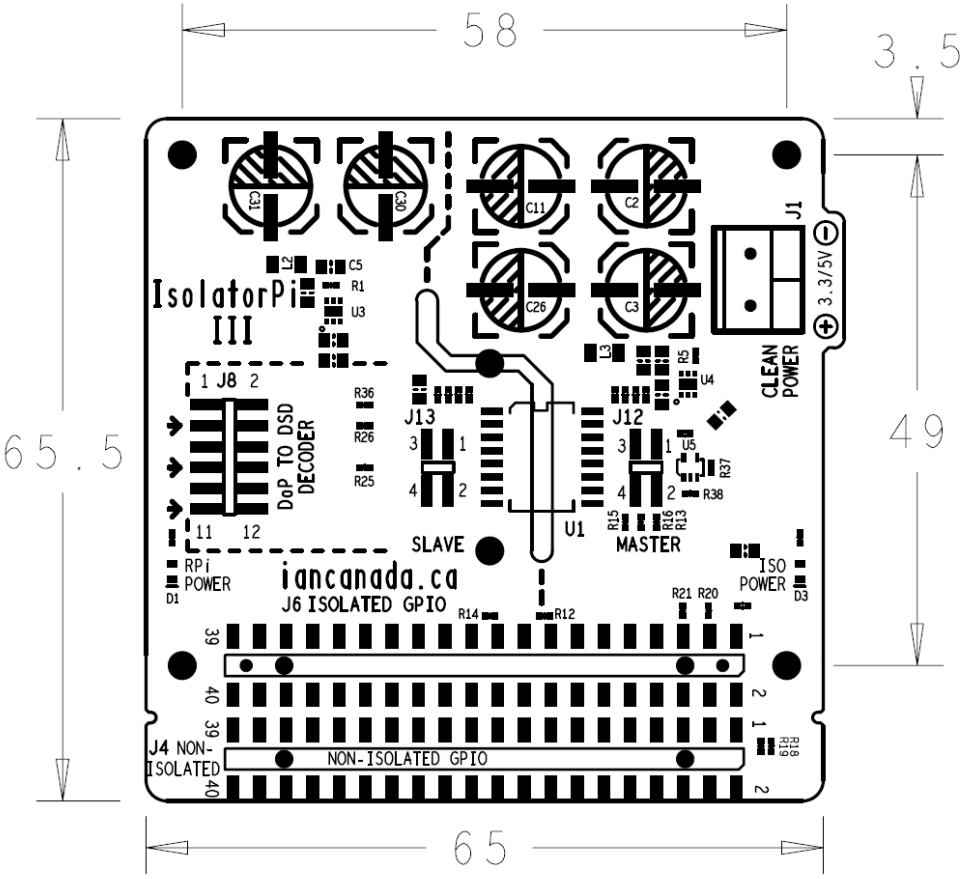
B. Features and Specifications

- 150MHz 5KV high performance digital isolator, 768KHz I2S and DSD512 capable.
- Physical PCB gap slot to ensure the best possible isolation space
- Bi-directional architecture works with audio cards in both slave clock and master clock modes.
- Ready for native DSD output using companion DoP decoder in on-board socket.
- Isolated I2C bus for audio card configuration and control.
- Has an additional 40Pin non-isolated GPIO connector. With which, we can connect the possible MonitorPi/Pro, ESS DAC controller, IR receiver, the rotary encoder and many others to RPi. The good thing is that all of those devices will become 100% isolated from audio devices on top of the IsolaorPi III. DSD signals will also be applied to this non-isolated GPIO when the DoP decoder daughter board is installed.
- Needs no device driver and/or overlay. Works in transparent mode.
- Suitable for most Raspberry Pi audio cards such as DAC HATs, S/PDIF Adapter HATs, I2S Re-clocker HATs and many other RPi HiFi applications.
- Supports 502DAC Pro, Hifiberry Digi Pro +, and all other WM8804 based applications in master clock mode;
- Great to Upgrade a TransportPiDigi, a FifoPiMa or an ESS DAC running at non-sync mode

C. Block diagram



D. Layout and Dimensions (in mm)



E. Connectors

J1: 3.3V-5V DC clean side power input

A 3.3V-5V DC power supply must be connected to this terminal for the IsolatorPi III to operate. This is regulated to 3.3v to run the IsolatorPi III and is also passed to the connected audio board via the RPi GPIO (J4 and J6) power pins. When used with the optional DoP decoder daughter board, IsolatorPi III consumes around 100mA current.

J1 is directly connected to pin2 and pin4 of J6, so alternatively you can also power it from GPIO J6 rather than J1. The clean side power is completely separate from the Raspberry Pi's power and ground.

J6: 40PIN isolated GPIO connector

Pin	Signal	Description
2, 4	Clean side power supply	3.3V-5V DC output for attached audio cards such as DACs. This is a pass-through of the power supply connected at J1 and the available voltage and current are set by that supply. It is entirely isolated from the RPi 5V.
1, 17	3.3V	Isolated and regulated 3.3V 200mA DC output.
3	I2CDA	Isolated I2C bus to configure and control audio cards
5	I2CCL	
12	SCK/BCK	Isolated I2S or DSD output
35	LRCK/DL	
40	DATA/DR	
6,9,14,20,25,30,34,39	GND	Isolated ground
15,22	PULL UP	Pull up to 3.3Vcc with 4.7K resistor, reserved for some audio cards
29,31	XO selection	Isolated GPIO5 and GPIO6
All other pins	NC	Not connected

J4: Non-isolated 40PIN RPi GPIO

This connection parallels all power and signal connections from the input 40PIN GPIO connector (pin to pin connected). This provides access to GPIOs for applications such as IR receivers, rotary encoders and other non-analog devices while preserving isolation with the audio cards. You can power the RPi through this connector by connecting 5v to pin 5 (and/or pin 2) and ground to pins 6 (and/or pins 9,14,20,25,30,34,39).

J3: RPi GPIO socket

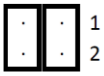
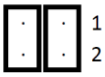
Connect to the source SBC’s (RaspberryPi or ODROID) 40PIN GPIO connector.

F. Jumper settings

J12 and J13: Slave/Master mode selection

In slave mode(default), the RPi generates the three I2S (SCK, LRCK and DATA) signals using its internal clock. These I2S signals are fed into the audio card through the IsolatorPi III.

In master mode, the audio card contains two dedicated audio clock oscillators (XO) that are used to generate the SCK and LRCK of I2S signals. These two I2S clock signals are fed back into the RPi through the IsolatorPi III. The RPi uses these two I2S clock signals to generate the DATA signal instead of using its internal clock.

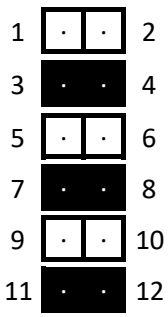
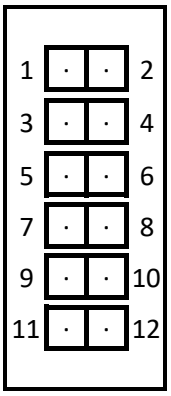
Mode Settings	J13	J12
Slave clock mode (default)		
Master clock mode		

Because the RPi internal clock is not dedicate audio clock AND must be converted to the audio clock frequencies by internal PLL and CTC, it is a very high jitter clock. Audio cards that operate in master mode can produce better quality results when they use high quality / low jitter clocks and feed high quality / low jitter SCK and LRCL I2S signals to the RPi. Using the IsolatorPi III with an audio board operating in master mode can further improve the sound quality by preventing transmission of EMI noise via the RPi ground AND by powering the audio card (and isolated side of the IsolatorPi III) using a separate power supply.

Audio cards operating in master mode typically require dedicated Linux device drivers. Please see the audio card's user manual for details.

G. DoP to native DSD decoding

Conversion of DoP to native DSD can be enabled using the DoP decoder daughter board into J8. With this card installed, the IsolatorPi III will output native DSD signals when playing a DSD music file. Most of current software for RPi can support DoP. For this to work, the music player on the RPi must be set to enable the DoP output function.

	I2S only mode,default (No DoP function 3-4,7-8,11-12 need to be shorted by jumpers)	I2S/DSD mode (Remove all jumpers, plug the DoP Decoder daughter board into J7)
J8		

H. LED indicators

LED	Descriptions	Notes
D1	RPi power LED	On when power is provided to the connected
D3	Isolated power LED	On when clean power supply is applied to J1 or GPIO J6

I. Typical applications

1: Upgrade a TransportPiDigi with an Isolator

IsolatorPi III settings:

J13: 1-2, 3-4 short

J12: All open

TransportPi Digi settings

All default

Power connections

Connecting the 3.3V to IsolatorPi III J1 only

Configurations

TransportPi Digi

IsolatorPi III

PurePi power supply

RaspberryPi

MonitorPi or MonitorPi Pro (optional)

Note: To upgrade any WM8804/5 based Transport/DAC with an Isolator, you can follow this application for the configuration

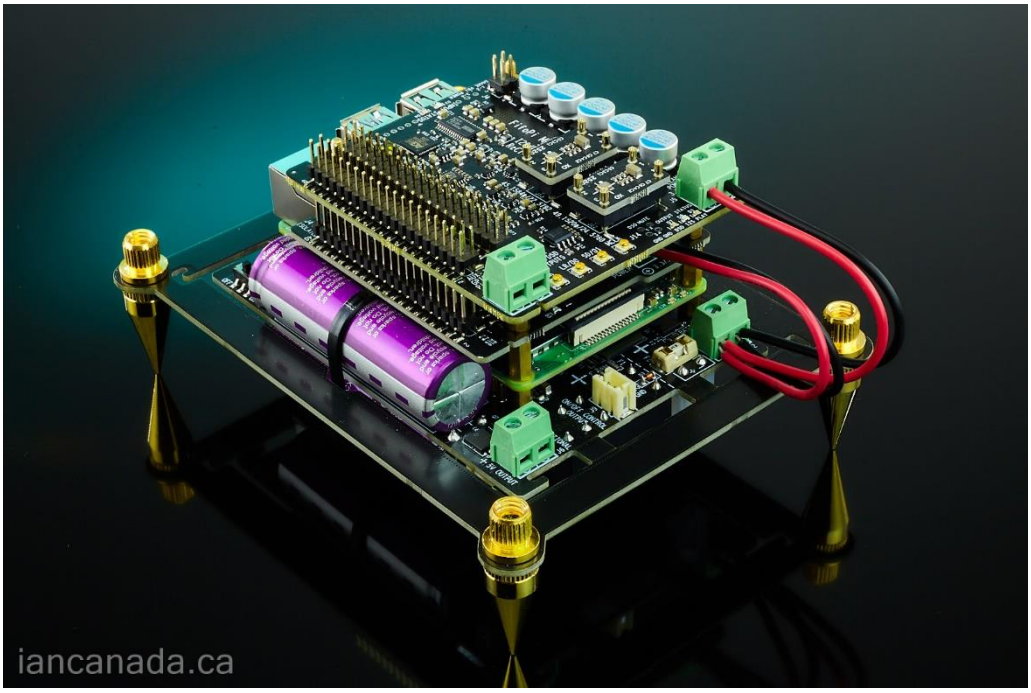
2. Upgrade A FifoPiMa application with an Isolator

IsolatorPi III settings:
J13: 1-2, 3-4 short
J12: All open

FifioPi Ma settings
All default (J4 open)

Power connections
Connecting the 3.3V to both IsolatorPi III J1 and FifoPiMa J5

Configur*ations*
FifoPiMa
IsolatorPi III
PurePi power supply
RaspberryPi



Note: To upgrade any PCM5122 based Transport/DAC with an Isolator, you can follow this application for the configuration

3. Upgrade an Ian ESS DAC with an Isolator

IsolatorPi III settings:
J13: All open
J12: 1-2, 3-4 short

ESS DAC settings
All default (Local clock mode)

Power connections
Connecting the 3.3V to both IsolatorPi III J1 and DAC 3.3V power input

Configurations
ES9038Q2M Dual Mono I/V board
IsolatorPi III
PurePi power supply
RaspberryPi
MonitorPi Pro or ESS controller

Note: All slave mode DACs can follow this application for the configuration

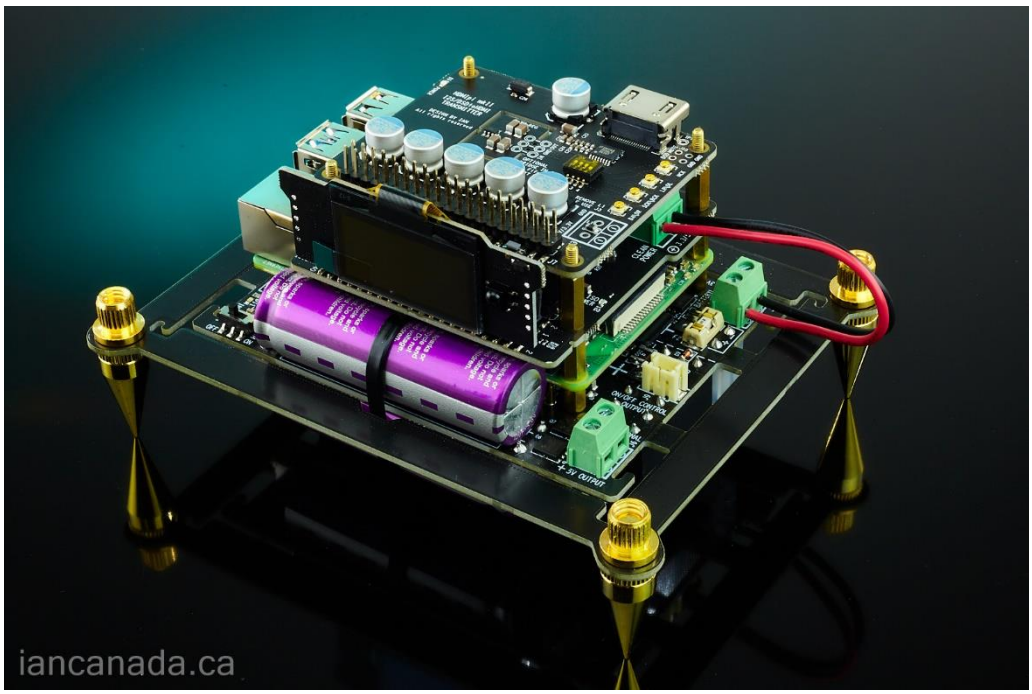
4. Remote isolated I2S/DSD over HDMI network streamer project

IsolatorPi III settings:
J13: All open
J12: 1-2, 3-4 short

HdmiPi MkII settings
Jumper 1,2,3: ON
Jumper 4: OFF

Power connections
Connecting the 3.3V to
IsolatorPi III J1 only

Configurations
HdmiPi MkII
IsolatorPi III
PurePi power supply
RaspberryPi
Optional MonitorPi or Pro



5. Upgrade an Audiophoincs I-Sabre ESS DAC with an isolator and battery power supply

IsolatorPi III settings:
J13: All open
J12: 1-2, 3-4 short

I-Sabre settings
All default

Power connections
Connecting the 3.3V to
IsolatorPi III J1 only

Configurations
I-Sabre ES9038Q2M DAC
IsolatorPi III
PurePi power supply
RaspberryPi
MonitorPi Pro as controller

Note: All slave mode DACs can follow this application for configuration

6. Install a DoP decoder to the IsolatorPi III to enable the native DSD over GPIO

IsolatorPi III settings:
J13: All open
J12: 1-2, 3-4 short

DoP board settings
All default

J. Application Notes and Tips

1. Validate that both your hardware and software functions as expected AND produces audio output BEFORE you install the IsolatorPi III between the RPi and the audio card(s). If you do not do this, debugging any problems will be much more difficult.
2. IsolatorPi III by itself MAY NOT improve sound quality. BUT the ground isolation will enhance the effects of a good audio-quality power supply connected to the Isolator Pi and audio card and use of good clocks.
3. DO NOT make any link or connection between the input side of the IsolatorPi III (non-isolated GPIO) and output side (isolated GPIO). If you do the ground isolation is defeated and no benefit is produced.
4. BE VERY CAREFUL on the orientation of jumpers. Double and triple check before applying power. Incorrectly oriented jumpers can damage the IsolatorPi III.
5. ONLY change the jumpers on J8 when the IsolatorPi III will be used with a DoP decoder daughter board.