TransportPi MkII

Low jitter Digital Audio Interface Transmitter user's guide

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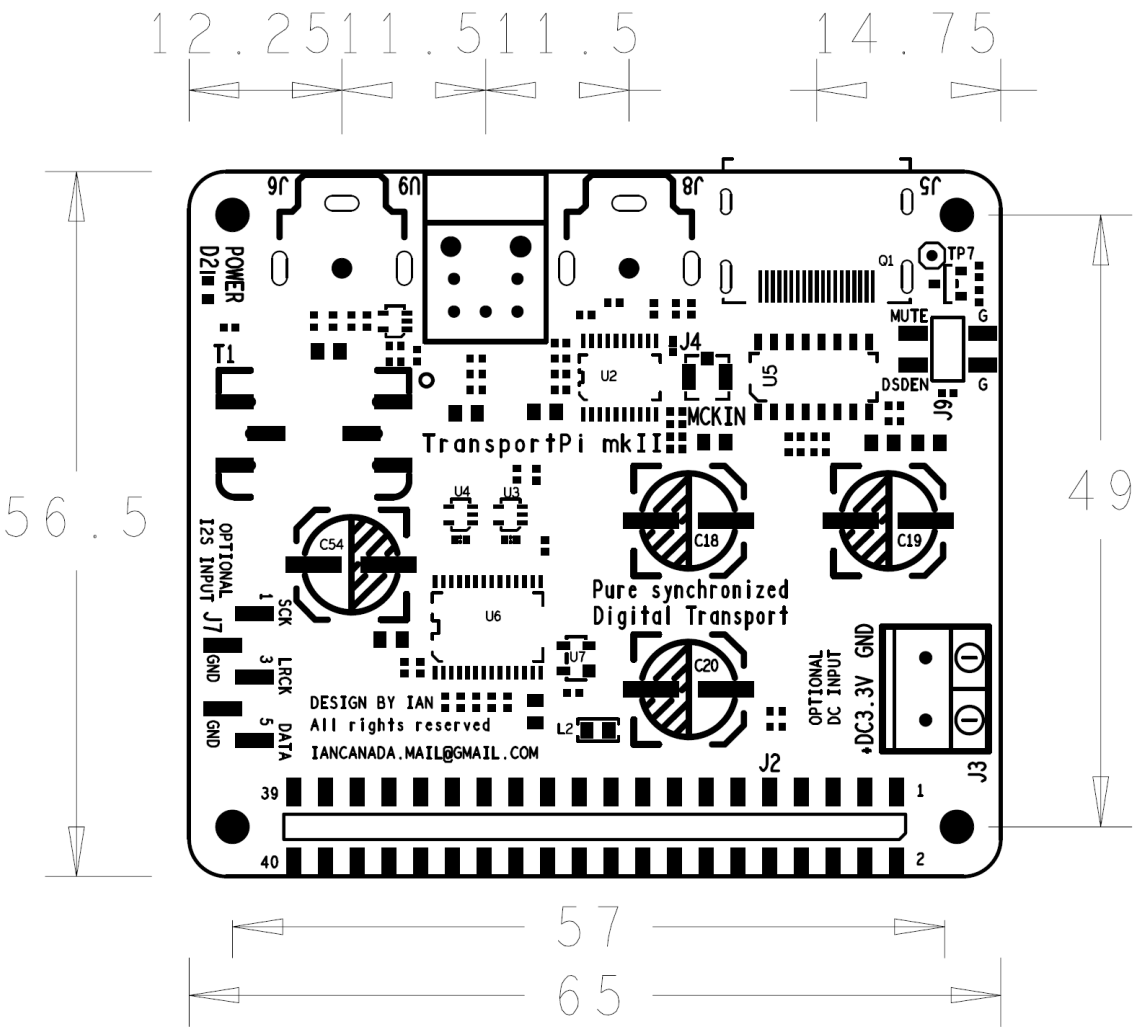
A. Introduction

TransportPi MkII is a low jitter digital audio interface transmitter board that is compatible with Raspberry Pi HAT. It was especially designed in pure synchronized mode to have best possible low jitter performance. When integrates with RPi and FifoPi, you can build an audiophile grade digital transport for ROON and other player software. With ReceiverPi included, it can also be configured as a S/PDIF FIFO or multi sources digital music transport.

B. Highlighted Features and Specifications

- Pure synchronized clock architecture for best possible low jitter performance
- Built-in multi-stages S/PDIF reclocker
- Enhanced impendence matching network to ensure best possible S/PDIF signal quality
- High quality isolated S/PDIF output in RCA connector
- High quality non-isolated direct driven S/PDIF output in BNC connector
- Optical S/PDIF output in TOSLINK connector
- LVDS I2S/DSD/DoP digital audio output in HDMI connector (mode B)
- Mute and DSD enable signals over HDMI output work great for eligible DACs
- 3.3V DC input makes it possible to use high quality ultracapacitor or LifePO4 battery power supply
- Up to 192KHz S/PDIF and 768KHz HDMI outputs
- Max MCLK frequency = 1024*Fs
- Can work independently with other digital audio front ends with MCLK output (RPi free)
- Possible to have independent DC power input
- DIY friendly and plug and play, no software driver is required.

C. Layout and Dimensions (in mm)



D. Getting start

1. Make sure your RPi and FifoPi combination is working properly (with general I2S driver selected). Also make sure all LED indicators on FifoPi are lit correctly when music is playing. Then turn off power supply before going to next step.
2. Plug TransportPi MkII into the GPIO port on top of the FifoPi. Connect the MCK input J4 to the MCLK output of the FifoPi through an u.fl coaxial cable.
3. Power up. Make sure the power LED on TransportPi MkII is lit. Play music from RPi as usual. Make sure all LEDs on FifoPi are still correct and then you will see some leaked red light coming out of the top of the optical transmitter U9.
4. Connect the TransportPi MkII to your external DAC through RCA cable, or BNC cable, or optical cable or HDMI cable.
5. Enjoy the music.

E. Connectors

J6: RCA S/PDIF output

Isolated standard 75 ohm S/PDIF output in RCA connector.

J8: BNC S/PDIF output

Non-isolated direct driven 75 ohm S/PDIF output in BNC connector. Theoretically this output has better signal quality than the standard RCA output, but no isolation (FifoPi already has built in isolator).

U9: OPT S/PDIF output

Standard S/PDIF output in TOSLINK optical connector.

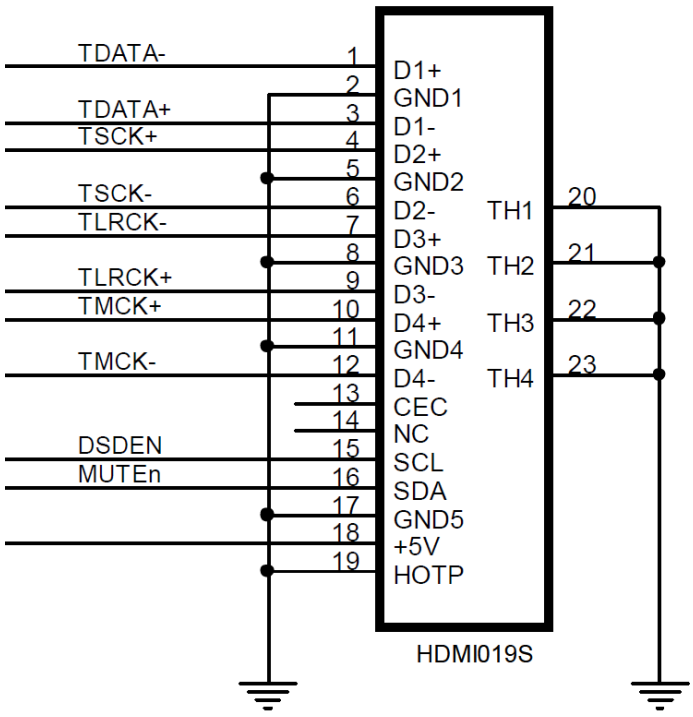
J5: HDMI output connector

Standard HDMI connector. To output PCM/DSD/DoP signals to receiver through HDMI LVDS cable.

For higher signal quality, high speed HDMI cables version 2.0 or higher are recommended.

Please refer the following schematic for signal configurations.

Note: There are two kinds of I2S to HDMI configuration, mode A and mode B. ReceiverPi uses mode B to optimize to high speed PCB layout for best possible signal quality. Please make sure your DAC is set up in the same configuration.



J4: MCK input in u.fl coaxial cable socket

MCK signal must be connected to this socket from FifoPi, FIFO or other digital audio devices through u.fl coaxial cable to function. TransportPi works in pure synchronized mode so this is the most significant signal. It will decide the finial low jitter performance of all S/PDIF outputs and HDMI output.

40 pin GPIO connectors

pin numbers	**J2** 40 PIN GPIO connector to board below (Normally Raspberry Pi)	**J1** 40 PIN GPIO connector to HAT on top (FifoPi or DAC or other audio board)
1,17	3.3V from preceding board	3.3V from preceding board
2,4	5V from preceding board	5V from preceding board
6,9,14,20, 25,30,34, 39	GND	GND
12	SCK input	SCK path through
35	LRCK/DL input	LRCK/DL path through
40	SD/DR input	SD/DR path through
3	I2C DA	I2C DA
5	I2C CL	I2C CL
8	TXD0	TXD0
10	RXD0	RXD0
All other pins	same pin from preceding board	same pin from preceding board

Note: All input/output signals of GPIO connectors are in LVTTL (3.3V) logic level except power and ground.

J3: Optional independent DC power input

By default, TransportPi MkII takes 3.3V power supply from FifoPi clean side through GPIO. For upgrade, you can also connect a 3.3V 100mA (minimum) DC power supply to this optional 2-pin 5.0mm terminal J3. MAINTAINING CORRECT POLARITY!!! Direct-connected 3.3V ultra capacitor / LifePO4 battery power supply would be highly recommended for the best possible performance.

J3 was not installed by default. L1 needs to be removed if feed power supply through J3. However if it works independently without plugged into GPIO port, then there is no need to remove L1.

J7: Optional I2S input in SIP

5Pin, 2.54mm, SIP connector. This connector will only be used to input I2S signal when TransportPi MkII works in independent mode and do not take I2S signals from GPIO port. Must leave all pins of this connector unconnected when works with FifoPi.

1	SCK
2	GND
3	LRCK
4	GND
5	DATA

J10, J11, J12: Optional I2S input in u.fl sockets

These u.fl sockets have exactly the same function as J9. But will have better signal quality. They didn't assembled by default.

J10	DATA
J11	LRCK
J12	SCK

F. LED indicators

D2: Power indicator, indicating that TransportPi MkII is powered

G. Application notes

1. About the pure synchronized architecture

TransportPi MkII doesn't directly use the outputs from the DIT chip for the S/PDIF driver. All output signals will be finally regenerated by multi stages re-clockers before feed into S/PDIF driver. With this architecture, the finial S/PDIF signal quality will no longer have business with DIT chip. It will be decided by the phase noise performance of MCK only. So the best possible signals quality could be expected.

2. How to upgrade or the S/PDIF isolation transformer?

Isolated S/PDIF signal quality could be improved if better S/PDIF transformer is used. To upgrade this transformer you just need to remove T1 and then solder a better one to the PCB. Please make sure the orientation is correct.

3. What's the difference between the isolated and non-isolated S/PDIF outputs?

Standard S/PDIF signal uses digital audio transformer to provide ground loop isolation as well as to ensure better safety. However any S/PDIF transformer will degrade the transmission line performance though some of the transformers were declared having very good quality. So, theoretically non-isolated direct drive S/PDIF signal will have better quality in all meanings of signal integrity. The only issue is that it doesn't provide galvanic isolation. However with the built-in isolator, the story was changed when FifoPi is installed in the system,.

TransportPi MkII has both isolated and no-isolated S/PDIF outputs. But it's hard to tell which one has better sound quality. It will be up to the real listening experiences. So, I would suggest trying both and then use the one you like the most according to your personal preference.

4. How to upgrade power supply?

Power supply of TransportPi MkII can make change to the finial sound quality for sure.

By default, the TransportPi was designed to take 3.3V DC power from GPIO (usually from FifoPi clean side if it's integrated). FifoPi clean side power supply could be already good enough. But you still have chance to improve more to the power supply of TransportPi MkII. If you want to use an independent DC power supply, you will need:

a. Solder the supplied DC terminal connector to the position of J3.
b. Remove FB L1 at bottom side of PCB if you don't want this power supply connected to GPIO anymore.
c. Feed good 3.3V linear or 3.3V LifePO4/ultracapacitor power supply to J3. LifePO4 Mini 3.3V or LinearPi with UcConditioner 3.3V would be good options.

5. **What is the jumper S1 for?**

   If TransportPi MkII shares power supply with FifoPi Q3 or FifoPi Ma, short jumper S1 can reduce the power supply impendence. It's just optional. Please never short S1 if the FifoPi clean side has a 5V power supply.

6. **About DSD and DoP**

   HDMI has no problem to support native DSD and DoP, as well as I2S. However S/PDIF is impossible to transfer native DSD because of the protocol itself. S/PDIF will support I2S and DoP only. DAC could play noise if the native DSD is sending through S/PDIF. If your S/PDIF DAC supports DoP, I would suggest use the DoP pass-through function by disabling the DoP to DSD decoder on the FifoPi or FifoPi Ma.

7. **Can I use 5.6448/6.144 MHz MCLK on FifoPi to work with TransportPi MkII?**

   Yes, you can. But have to enable the half frequency mode. You will need:

   1. Remove R4 at the back side of the TransportPi MkII PCB.
   2. Short S2 and S3 by soldering bridges.

8. **After install 90.3168/98.3040 MHz MCLK in FifoPi, I have problem to play 44.1KHz and 48KHz music, but no problem for all other Fs, what's the reason?**

   The maximal MCLK frequency that a TransportPi MkII can take will be 1024*Fs. So, for 44.1KHz and 48KHz music, the maximal MCLK will be 45.1584MHz and 49.1520MHz. That's why 90.3168 and 98.3040 MHz MCLK don't work.

H. Pictures of TransportPi

1. TransportPi MkII as shipped

2. Works as a ROON Transport (or other player) by integrating with a Raspberry Pi and a FifoPi

3. Works independently as a S/PDIF FIFO by integrating with a ReceiverPi and a FifoPi (RaspberryPI free)

I. History of revising

Mar 28, 2022 Ver. 2.0b released