

TransportPi

Low jitter Digital Audio Interface Transmitter user's guide

By Ian Jin Dec 1, 2019 Ver. 1.0b

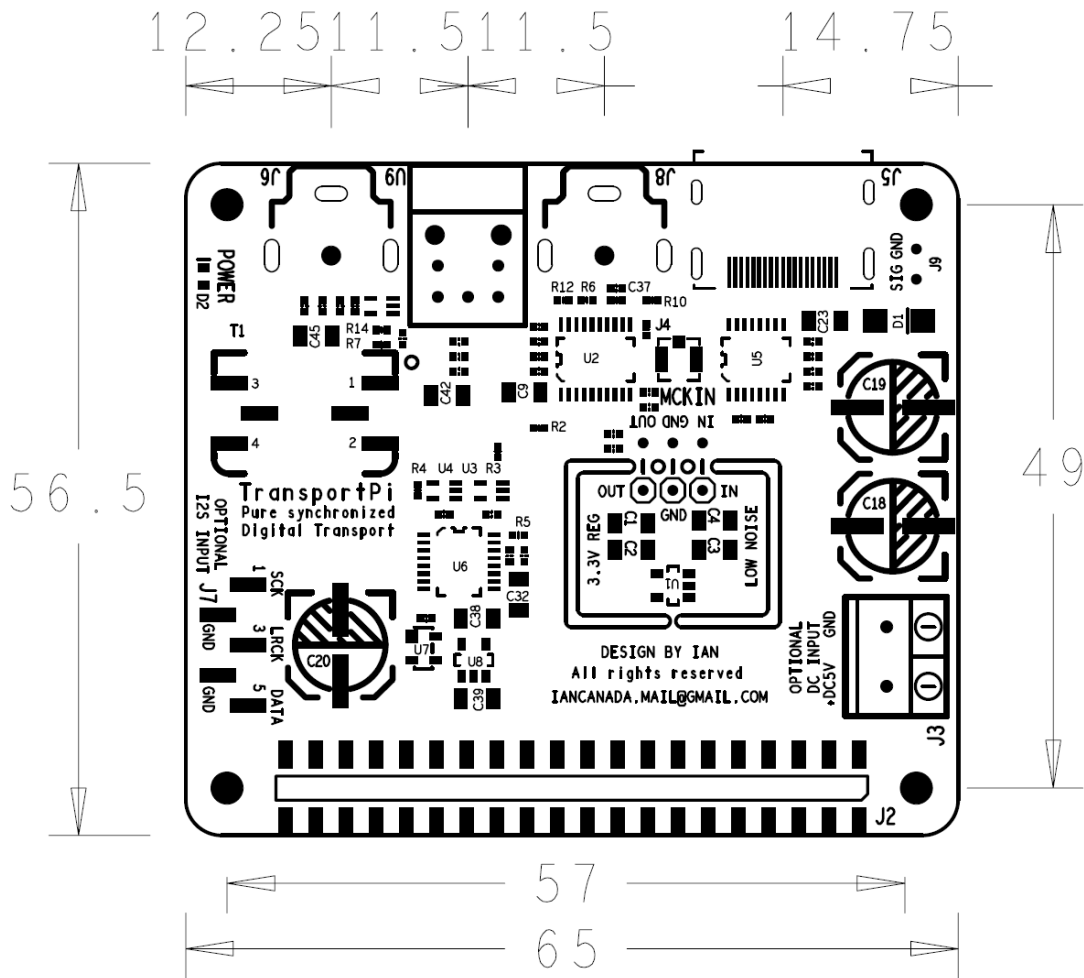
A. Introduction

TransportPi 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 signal quality. 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 all in one digital transport.

B. Highlighted Features and Specifications

- Pure synchronized clock architecture to have best possible low jitter performance
- One step to setup an audiophile grade ROON transport or all in one digital transport
- 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)
- Upgradable S/PDIF transformer
- Upgradeable ultra-low noise on-board LDO board
- Up to 192KHz S/PDIF output and 768KHz HDMI output
- Can work independently with other digital audio front end that has 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 (with general I2S driver selected). Make sure all LED indicators on FifoPi are lit correctly when music is playing. Make sure power is off before going to next step.
2. Plug TransportPi into GPIO port on top of FifoPi. Connect the MCK input J4 on the TransportPi to the MCLK output u.fl connector on FifoPi to through the supplied u.fl coaxial cable.
3. Power up. Make sure the power LED on TransportPi is lit. Play music from RPi as usual. Make sure all LEDs on FifoPi are still correct and you will see some leaked red light coming out of the top of the optical transmitter U9.
4. Power up your audio system. Connect the TransportPi 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.

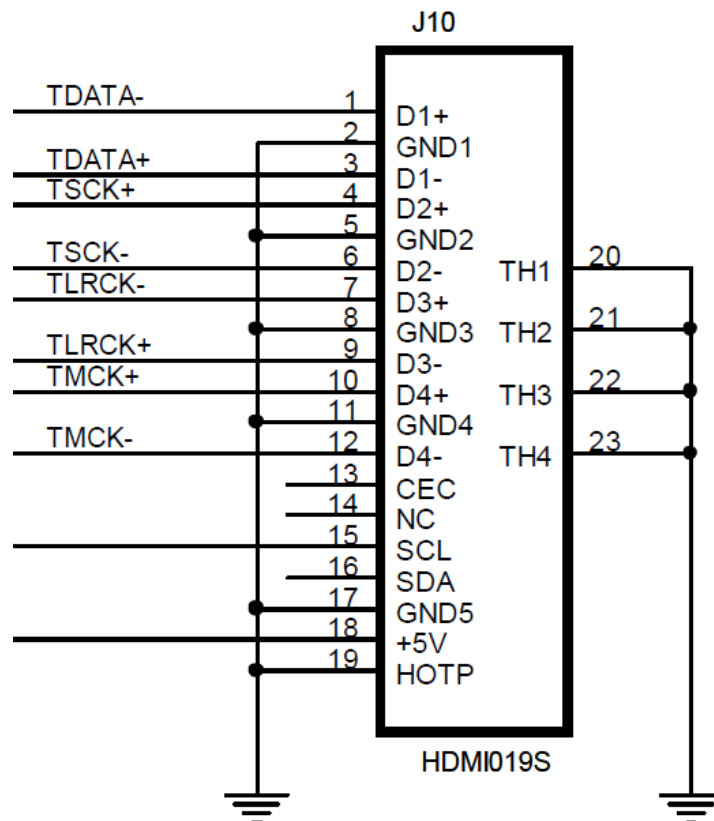
J5: HDMI output connector

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 final 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 LVTTTL (3.3V) logic level except power and ground.

J3: Optional independent DC power input

If don't want to pick up power from GPIO, you can connect a 5V 150mA (minimum) DC power supply to this 2-pin 5.0mm terminal J3. MAINTAINING CORRECT POLARITY!!! Low noise linear 5V power supply will be good for ReceiverPi. Direct-connected 3.3V ultra capacitor / LifePO4 battery power supply can also be used.

J3 was not installed by default. L1 needs to be removed if TransportPi works together with GPIO port. No need to remove L1 if ReceiverPi works independently without plugged into GPIO.

J9: Optional I2S input in SIP

5Pin, 2.54mm, SIP connector. This connector will only be used to input I2S signal when TransportPi works in independent mode that can not pickup signal 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 is powered

G. Application notes

1. About the pure synchronized architecture

TransportPi doesn't use the outputs from the DIT chip for the S/PDIF driver directly. All signals will be regenerated by re-clocking/re-synchronizing at final stage right before the S/PDIF driver. With this architecture, the final 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, with this architecture, the best possible signals quality could be expected.

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

Isolated S/PDIF signal quality can be improved if better S/PDIF transformer is used. To upgrade this transformer you just need to unplug it from the socket T1 and to plug the new one back to the socket. 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 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 system. 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 will affect the final sound quality for sure.

By default, the TransportPi was designed to pick up 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, you can do:

- a. If the FifoPi clean power is a 3.3V LifePO4 or ultra capacitor rail, you can short the IN and OUT pin of the low noise LDO board with soldering jumper wire to bypass the on-board LDO.

- b. If the FifoPi clean power is a 5V rail, you can break the small low noise LDO board from TransportPi PCB and replace it with a higher grade 3.3V LDO board, such as LT3042 or LT3045, by soldering the three pins at the same position.

If you want to use an independent DC power supply for TransportPi, 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 5V linear/ultra capacitor voltage rail or 3.3V LifePO4/ultra capacitor rail to J3.
- d. If 3.3V pure LifePO4 or ultra capacitor voltage is used, it's highly recommended to bypass the on-board low noise LDO by soldering jumper wires between IN and OUT as described above.

5. About DSD and DoP

HDMI supports I2S, DSD and DoP without any problem. However S/PDIF is impossible to support native DSD because of the S/PDIF protocol. It supports I2S and DoP only. If the native DSD is sending through S/PDIF connector of TransportPi, DAC will play noise. Through HDMI will be no any problem. In this case, I would suggest disabling the DoP to DSD decoder in the FifoPi to let DoP music pass through S/PDIF.

H. Pictures of TransportPi

1. TransportPi 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

Dec 1, 2019 V1.0b released

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