

Input, switch and output muting modules for Soekris DAM1021 DAC

Document version: V1.4

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Input and switch modules

This documents describes version 2.3 input and switch boards. For the earlier V1 version, see http://www.diyaudio.com/wiki/Input_and_switch_boards_for_Soekris_DAM1021_DAC

Bill of Materials (BOM) for the input board:

<https://docs.google.com/spreadsheets/d/1ENt40kTZhL9ITpYthZ8c4qUfL6y8ajTpFsxg7ic-8vU/edit?usp=sharing>

Bill of Materials (BOM) for the switch board:

<https://docs.google.com/spreadsheets/d/1gz4L44eWwEkDHWcEnBlwdIYa3pOwWgeSbLcd3dcf6AY/edit?usp=sharing>

Features

- Directly connects to J3 and J2 headers on the DAC without additional cabling.
- Directly connects to Amanero USB adapter without additional cabling.
- Directly connects to DIYINHK USB interface (the non-isolated version) without additional cabling.
- Easy ribbon cable connection to WaveIO USB interface.
- Directly connects to Raspberry Pi without additional cabling.
- Additional connector PCBs can be designed to use other microcontrollers such as Arduino, BeagleBone Black, etc.
- Serial port control from Raspberry Pi.
- Coaxial SPDIF input with BNC connector footprint.
- Optical TOSLINK input with footprints for Toshiba TORX147L and Cliff Electronics ORJ-5 receivers.
- U.FL sockets for other I2S sources (can be installed, but not used simultaneously with Amanero/DIYINHK).
- Optional U.FL sockets for Amanero MCLK OUT, I2S MCLK OUT, FPGA SLV and FPGA MCLK OUT lines.
- External connections possible to ALL pins on DAM1021 J2 and J3, and to Raspberry Pi GPIO connector.
- Two selectable I2S inputs.
- Built-in regulated power supply for the isolated digital part/USB/RPi/other microcontrollers/muting module.

- Amanero/DIYINHK USB status lines readable from Raspberry GPIO pins. WavelO USB status lines can also be connected by manual wiring.
- Supports true balanced (dual mono) configuration with two DAM1021 DACs.

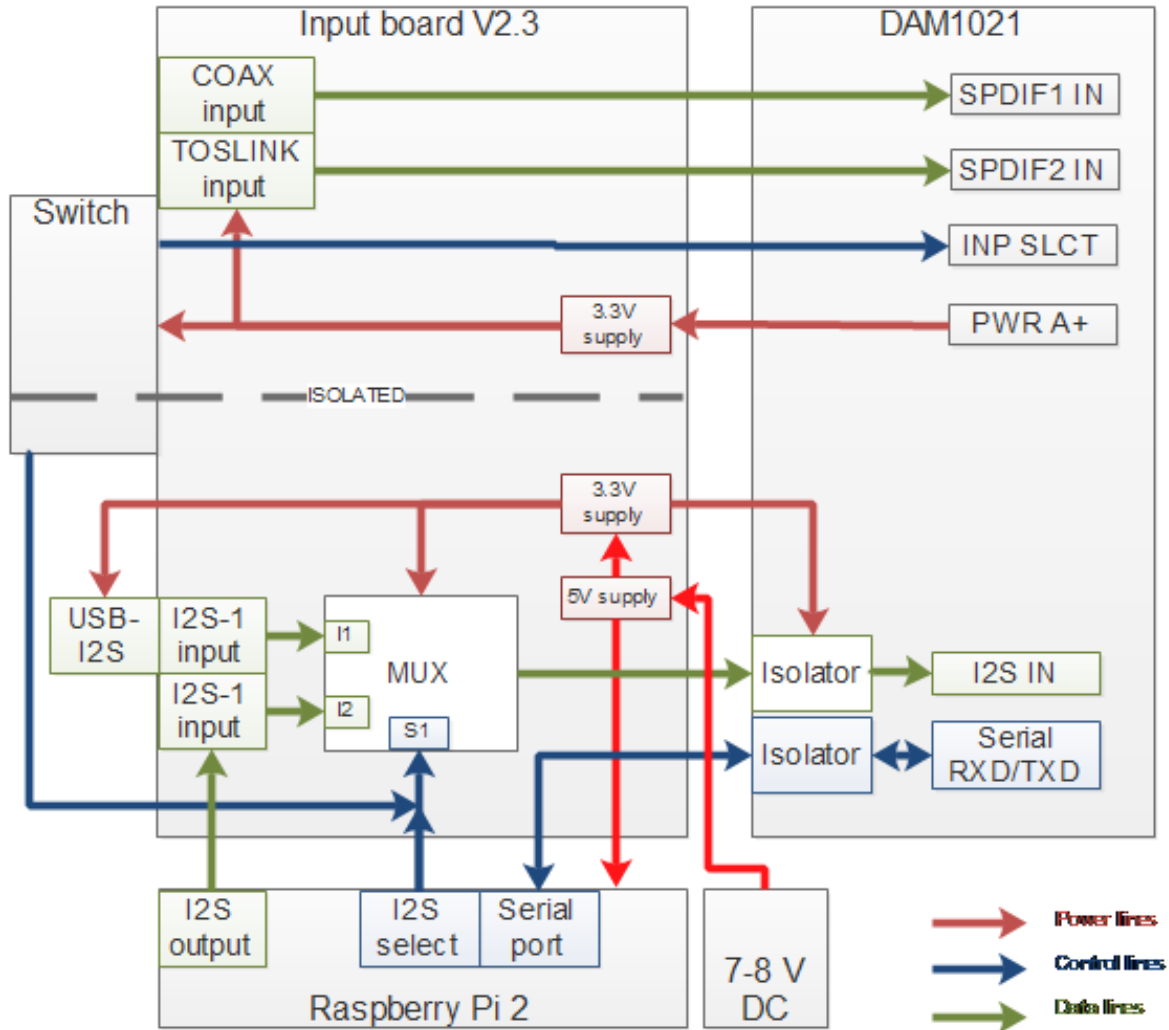


Figure 1 Functional overview diagram

Raspberry Pi connector pinout

RPI					
Pin#	GPIO#	RPI Name	Input board line	Direction ¹	Description
1		3.3V	RPI1	PWR	3.3V DC power
2		5V	RPI +5V	PWR	5V DC power
3	2	SDA1	RPI3		I2C SDA
4		5V	RPI +5V	PWR	5V DC power
5	3	SCL1	RPI5		I2C SCL
6		GND		PWR	Ground
7	4				
8	14	TXD0	RPI8 (ISO_RXD_IN)	IN	DAM Serial RXD
9		GND	ISO_GND	PWR	Ground
10	15	RXD0	RPI10 (ISO_TXD_OUT)	OUT	DAM Serial TXD
11	17	TXD1	RPI11 (ISO_RXD_IN2)	IN	DAM 2 Serial RXD
12	18	BITCLOCK	I2S_BCLK_2	IN	I2S-2 bitclock
13	27	RXD1	RPI13 (ISO_TXD_OUT2)	OUT	DAM 2 Serial TXD
14		GND	ISO_GND	PWR	Ground
15	22	I2S_SEL	I2S_SELECT	IN	I2S input selector HIGH or disconnected – I2S-1 LOW – I2S-2
16	23	IR_RCV	RPI16	IN	IR receiver ²
17		3.3V	RPI17	PWR	3.3V DC power
18	24		RPI18		
19	10	SPI_MOSI	RPI19		OLED SPI DATA ²
20		GND	ISO_GND	PWR	Ground
21	9	SPI_MISO	RPI21		
22	25		RPI22		
23	11	SPI_CLK	RPI23		OLED SPI CLK ²
24	8	SPI_CE0_N	RPI24		OLED SPI SS ²
25		GND	ISO_GND	PWR	Ground
26	7	SPI_CE1_N	RPI26		
27		ID_SD	RPI27		I2C ID EEPROM
28		ID_SC	RPI28		I2C ID EEPROM
29	5	F0	RPI29 (F0)	OUT	Amanero/DIYINHK status
30		GND	ISO_GND	PWR	Ground
31	6	F1	RPI31 (F1)	OUT	Amanero/DIYINHK status
32	12		RPI32		
33	13	F2	RPI33 (F2)	OUT	Amanero/DIYINHK status
34		GND	ISO_GND	PWR	Ground
35	19	LRCLK	I2S_FSCLK_2	IN	I2S-2 LRCLK
36	16		RPI36		
37	26	F3	RPI37 (F3)	OUT	Amanero/DIYINHK status
38	20	I2S_DATA_IN	RPI38		
39		GND	ISO_GND	PWR	Ground
40	21	I2S_DATA_OUT	I2S_DATA_2	IN	I2S-2 DATA

Power lines

GND lines

Audio data input lines

Control and status lines

Notes

- 1) Signal direction is specified relative to the input board.
- 2) Can be used to implement controller on RPI, not directly related to the input board or DAM1021.

Table 1 Raspberry Pi 2 connector pinout

DAH1021 input board by normundss V2.3

Dimensions: 102.87, 82.55, 23.5, 6.35, 25.4, 17.78

Components and Features:

- USB (U4)
- EXT POWER (U5)
- TOSLINK (U3)
- CDAX (U2)
- 7-9V IN (U1)
- TR1
- R1, R2, R3, R4, R12
- C1, C2, C3, C4, C5, C6, C7, C8
- F1, F2, F3, F4, F5, F6, F7, F8, F9, F10
- LED ENVELOPE
- USB MUTE
- ATAHERO HCLK OUT
- DATA BCLK LCLK
- Have10
- J1, J2, J19
- CF3-CP
- SERIAL CHANNEL
- FPGA HCLK OUT
- 12S HCLK OUT
- +5V OUT

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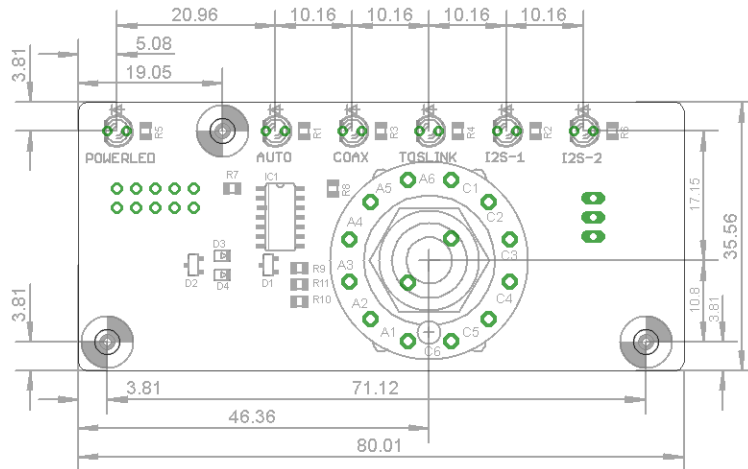


Figure 4 Switch board

Supplied parts

Bill of Materials (BOM) for the input board:

<https://docs.google.com/spreadsheets/d/1ENt40kTZhL9ITpYthZ8c4qUfL6y8ajTpFsxg7ic-8vU/edit?usp=sharing>

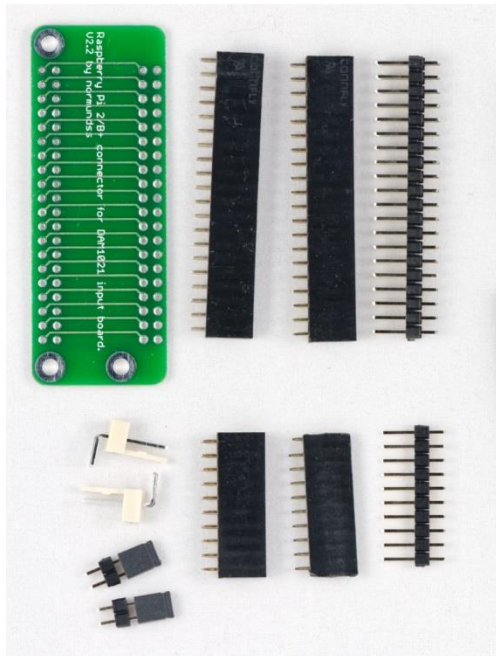


Figure 5 Parts included with assembled input board kit

Bill of Materials (BOM) for the switch board:

<https://docs.google.com/spreadsheets/d/1gz4L44eWwEkDHWcEnBlwdIYa3pOwWgeSbLcd3dcf6AY/edit?usp=sharing>

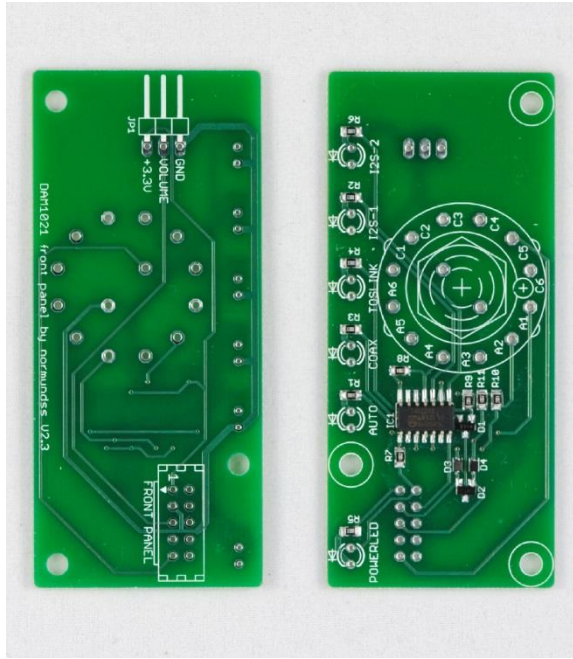


Figure 6 Assembled switch boards as supplied, front and back

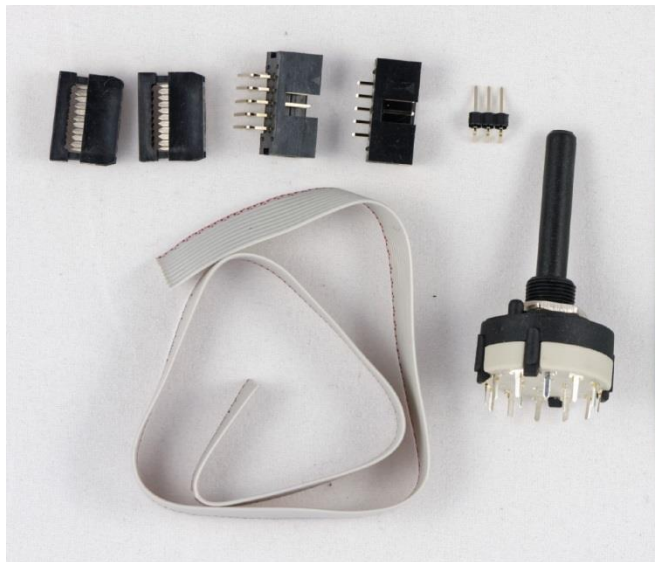


Figure 7 Parts included with the assembled switch board kit

Additional parts not included in kits

TOSLINK optical input

A 3.3V TOSLINK receiver needs to be obtained and mounted on the input board. The PCB has mounting pads for Toshiba TORX147L and Cliff Electronics ORJ-5 receivers.

See the [Input board BOM](#) for supplier part numbers.

SPDIF coaxial input

A right angle PCB mount 75 Ohm BNC Connector and an input transformer need to be obtained and mounted on the input board.

See the [Input board BOM](#) for supplier part numbers.

Input switching

The inputs are switched by a combination of DAM1021 input selection function, and a multiplexer to switch between two I2S sources. To switch to any of the I2S sources, I2S input must be selected on DAM1021.

I2S-1 source selects the USB/U.FL socketed input. The U.FL sockets labeled DATA, BCLK and LRCLK are electrically connected to the corresponding lines from the USB adapters. They should only have one source connected at a time.

I2S-2 source selects the Raspberry Pi I2S outputs. See Table 1 Raspberry Pi 2 connector pinout for details of Raspberry Pi pin assignments.

I2S sources are selected by RPi GPIO22 pin. When high or not connected, I2S-1 is selected. When driven low, I2S-2 is selected.

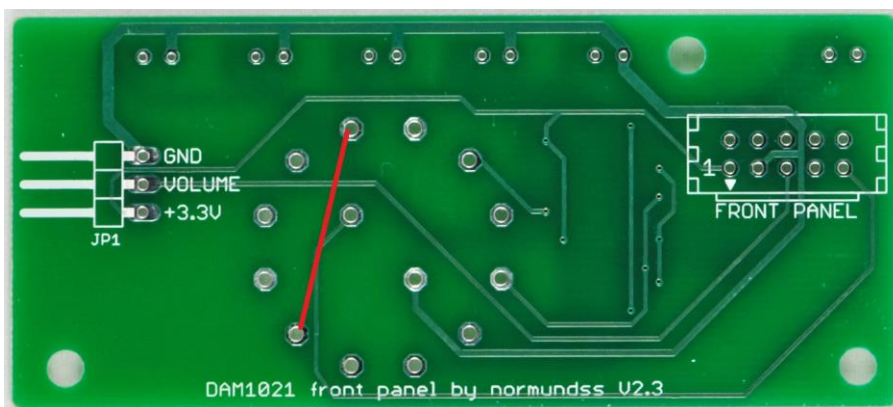
The switch board implements selection function by driving the DAM1021 INPSLCT0, INPSLCT1 and the input board MUX selector lines high or low.

Alternatively, input selection can be implemented by using serial commands for DAM1021 control and by driving Raspberry Pi GPIO22 high or low.

Configuring I2S input for DAM1021 AUTO mode

DAM1021 only has one I2S input that it can sense for auto selection, and it is configured on the input board to be I2S-1 (USB). DAM1021 Auto input selection does not see the I2S-2 (Raspberry) input, so it will not be selected in Auto mode.

To change the I2S input for Auto mode to I2S-2 (Raspberry), connect the C1 and C5 pins of the front panel input selector switch as shown below:



Power supply

Using a single supply

The input board requires an external isolated 7-9 V DC power supply. This supply does not need to be regulated. A 4-10 VA transformer with 6V or 6.3V AC output can be used, with a diode bridge rectifier and a simple CRC filter. It is recommended to use soft recovery diodes and/or install snubbers on the transformer secondary.

The input board includes linear regulators that can provide 3.3V/250mA and 5V/1A power to other devices.

The 3.3V output is used for input and switch board digital logic, and can be used for powering USB interface.

The 5V output is used to power a microcontroller, such as Raspberry Pi. It is not necessary to provide additional power for the microcontroller, unless its power consumption exceeds 1A. The built-in supply can also be used for powering the muting board and other 5V devices that are isolated from DAM1021.

When powering Raspberry Pi from the input board, it is recommended not to exceed 7.5V DC unregulated input voltage. Higher input voltage significantly increases power dissipation in the 7805 regulator, and may require installation of a heatsink. The PCB includes footprints for OHMITE DA-T263-101E heatsink in case it is needed.

Using 3.3V power from the USB interface

Amanero USB interface uses power from USB bus and provides its own 3.3V regulated voltage. Disconnect the EXT POWER jumper on the input board when using an unmodified Amanero USB interface.

Using an external 3.3V supply

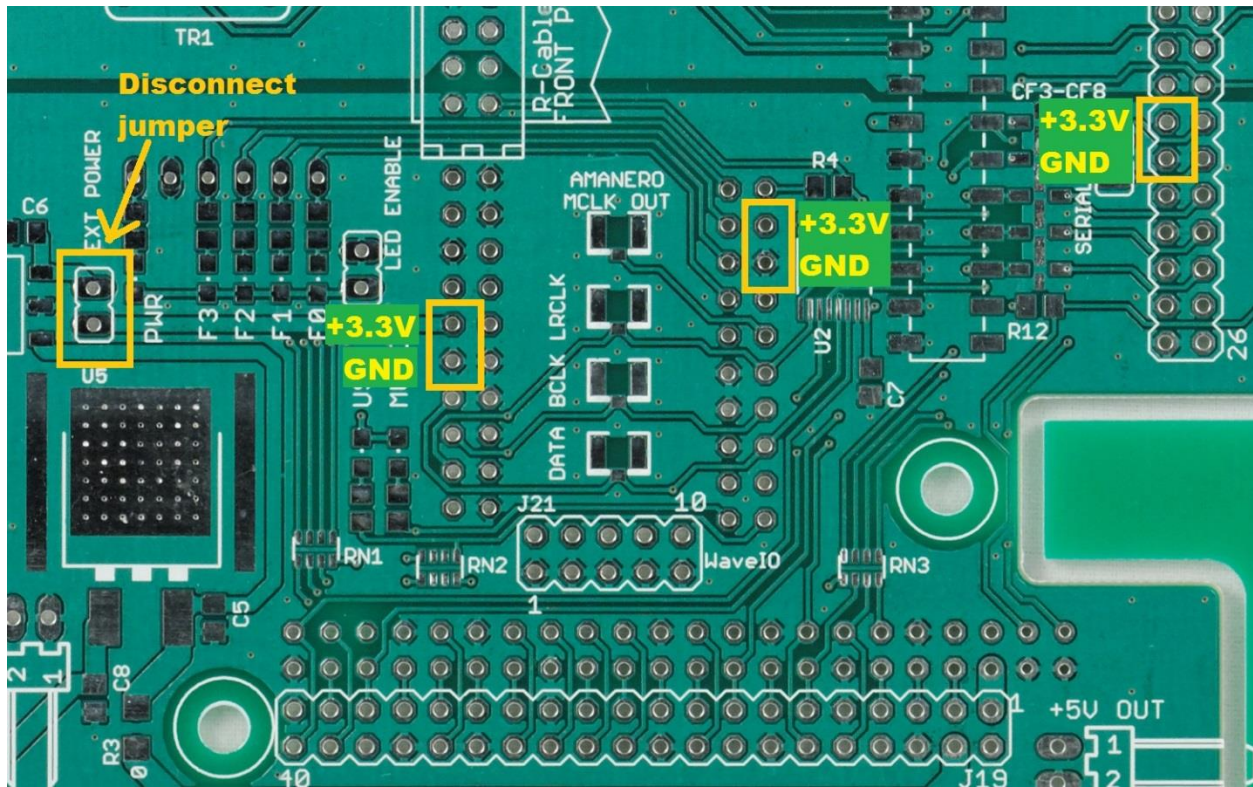


Figure 8 External 3.3V connections

To use an external 3.3V supply, disconnect the EXT POWER jumper. Connect the 3.3V supply to one of the locations shown in Figure 8. It does not matter which location is used, pick the most convenient one.

Powering the microcontroller from external supply

If Raspberry Pi is powered from another 5V supply, and it is connected using the included connector PCB, it is necessary to remove the 0 Ohm R3 resistor from the input board. It is the 1206 size SMD part located next to the +7-9V power input connector.

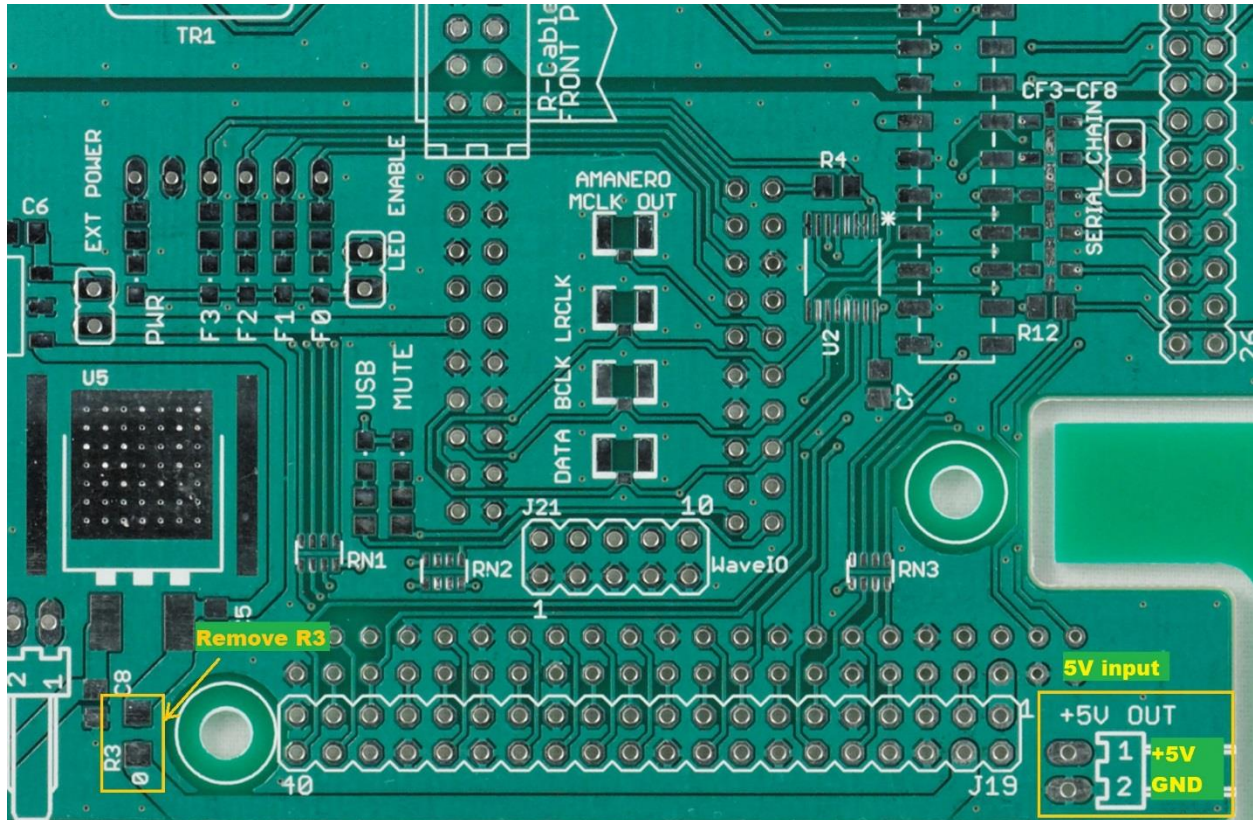


Figure 9 Powering the microcontroller from external supply

When the R3 resistor is removed, Raspberry Pi can be powered through its built in USB power connector. Alternatively, 5V power can be supplied through the +5V OUT connector on the input board.

Using external 3.3V and 5V supplies

If both 3.3V and 5V voltages are supplied externally, there is no need to supply +7-9V power to the input board. Disconnect the EXT POWER jumper and remove R3.

Using external 5V supply with onboard 3.3V regulator

It is possible to use an external 5V supply to power the 3.3V onboard regulator. Desolder and lift from the PCB the onboard 7805 regulator output pin. The output pin is the one close to C5 capacitor. Leave the R3 resistor intact and close the EXT POWER jumper. +5V supply can now be connected to the +5V OUT connector, which becomes power input. Pin 1 is +5V, Pin 2 is ground. Alternatively, +5V can be supplied directly to the Raspberry Pi USB connector power input. The input board will use RPi power in this case.

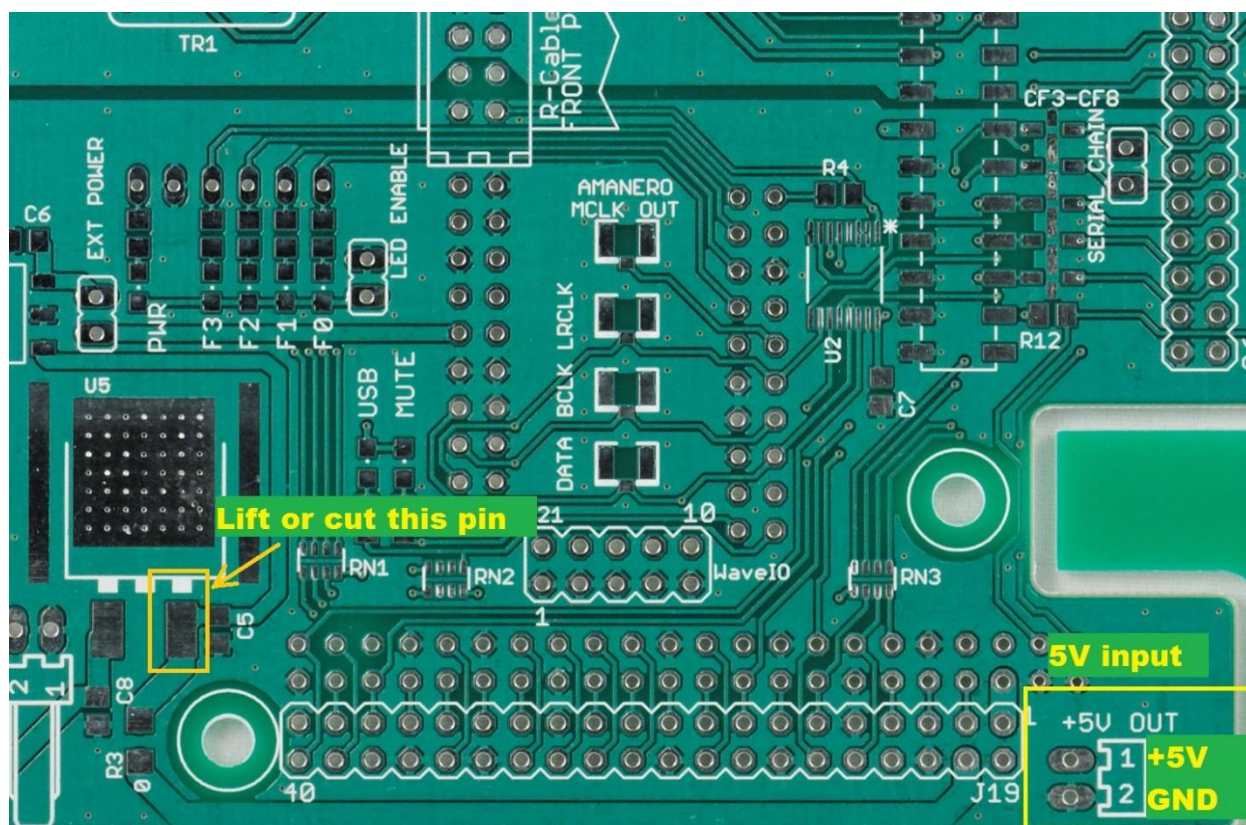


Figure 10 Using external 5V supply with onboard 3.3V regulator

Output muting module

Muting is done by shunting the unbuffered outputs to ground with normally closed relay contacts. When the relay turns on, mute is off. Since the DAM1021 pin18 muting control does not work properly as of the current firmware release V0.99, and it can be quite difficult to attach wiring directly to that pin, mute control is implemented independently with timers.

Bill of Materials (BOM) for the muting board:

<https://docs.google.com/spreadsheets/d/1mkKxI3J7ERI1Ij2h5PFqQ5qZ6s5hMIRs1WoFZ5Vm1gg/edit?usp=sharing>

Features

- Stacks directly onto DAM1021 J7 header (the unbuffered outputs).
- Fits even with the onboard XLR connectors mounted (although I do not recommend using them).
- Power-on muting uses a delay circuit which turns on the outputs approximately 8 seconds after power is applied.
- Power-off muting uses AC detection and will mute the outputs within approximately 30 ms after loss of AC power.

- AC detect input is isolated from all other circuitry. It should be connected to one of the secondary windings of the transformer which powers DAM1021.
- Optionally these timer based circuits can be bypassed and pin18 driven control can be implemented.
- Includes PCB footprints for implementing SE to balanced output buffers using THAT1646/DRV134 chips using easy to solder through-hole parts.
- Supports true balanced configuration with two DAM1021 DACs. A single muting board is needed for dual-DAM balanced build.
- Includes PCB footprints for implementing true balanced output buffers using THAT1606 chips (only available in TSSOP-16 packaging, quite fine pitched SMD parts).
- For true balanced configuration the second DAM1021 stacks directly on top.

Physical dimensions

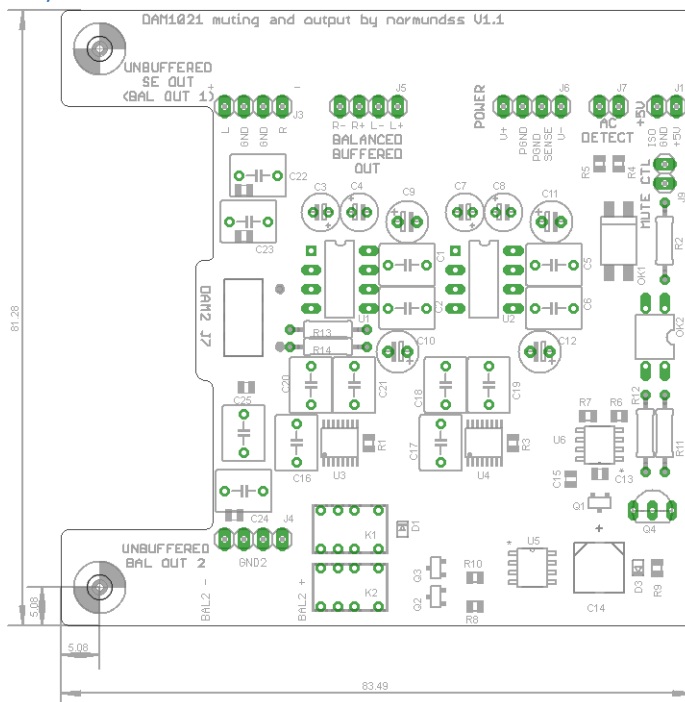


Figure 11 Muting and output buffer board

Power supply

An isolated 5V supply is required. If input board is used, the muting board can be conveniently powered from its 5V output.

AC detect

Connect the AC DETECT pins to one of the secondary windings of the transformer powering DAM1021. The AC DETECT input is fully isolated from all other circuitry. Acceptable voltage range is 6 – 30 V_{RMS} AC.

Build examples

Basic build

On DAM1021:

1. Install the J3 connector supplied with DAM1021
2. Install the J2 connector supplied with the input board kit (1x10 pin male header)
3. If using the muting board, install the J7 connector supplied with the muting board kit (1x4 pin male header)

On input board:

1. Install the power input connector, EXT POWER and LED ENABLE jumpers.
2. Install 1x10 pin J2 socket on the bottom.
3. If using SPDIF input, install TR1 input transformer and BNC connector.
4. If using TOSLINK input, install the TOSLINK receiver.
5. The BNC and TOSLINK connectors should be installed on the bottom of the board.

On switch board:

1. Install the 3 pin right angle connector and the straight 2x5 pin box header to the backside on the switch board. Make sure the box header pin1 is positioned correctly.
2. Install the rotary switch and your choice of LEDs on the front of the switch board. Make sure to leave the LED leads long enough for your mounting requirements. It is much easier to shorten than extend them later.
3. Install the FRONT PANEL right angle 2x5 pin box header to the input board.
4. Assemble the ribbon cable connectors. Make sure the marked wire is positioned at connector pin 1 (the small triangle mark) on both ends.
5. Wire the volume pot. "dupont wires" with female connectors can be conveniently used here. They are widely available on Ebay. Cut off connectors on one end and solder the wires to volume pot. See Figure 12 for an example.

On muting board:

1. Install the supplied 2 pin connectors for +5V and AC DETECT.
2. Install the supplied right angle 1x4 pin header for UNBUFFERED SE OUT.

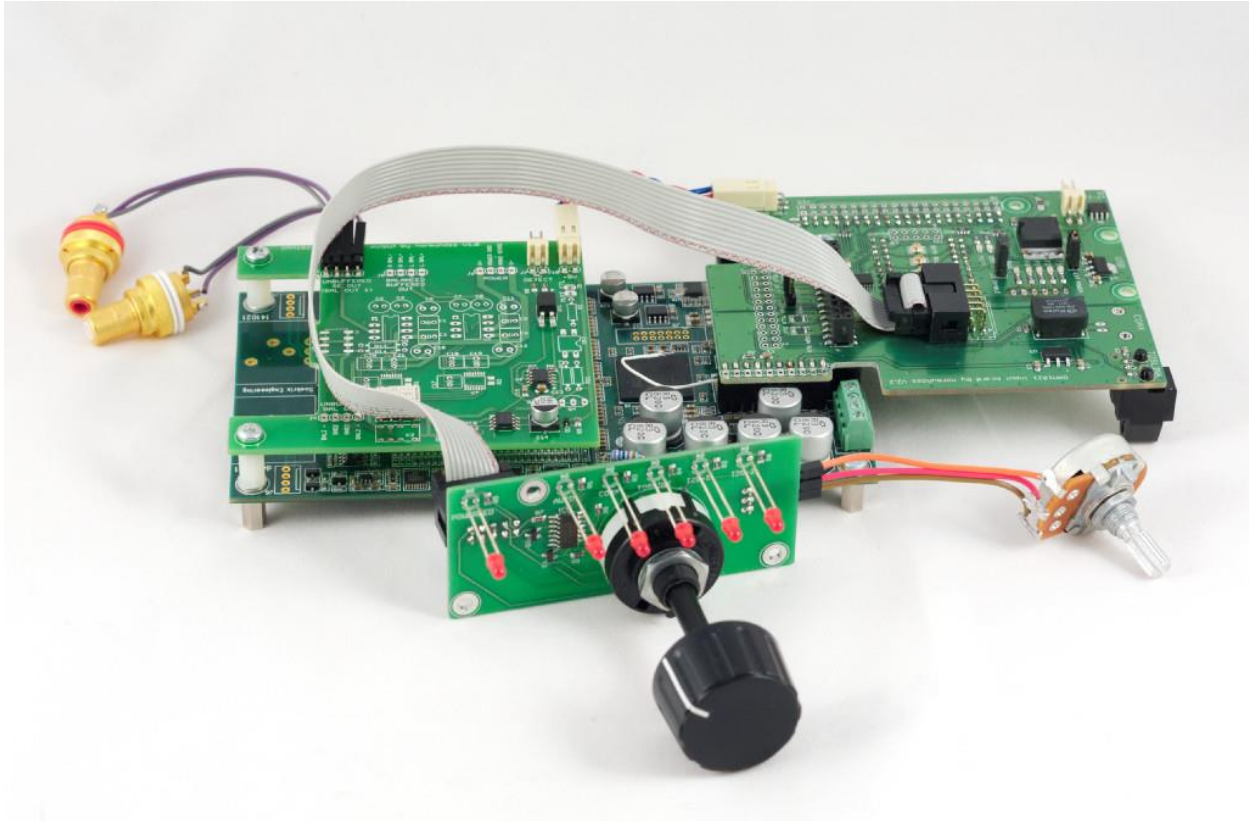


Figure 12 Basic build with muting and switch modules

Note that the input board in Figure 12 has the optional balanced connectors installed. Figure 14 shows an input board without the balanced connectors.

5V power for the muting module is supplied from the input board.

Amanero USB

Solder the included 2x10 pin socket on the bottom of the input board in J1 position marked AMANERO.

Disconnect the EXT POWER jumper. Amanero USB supplies 3.3V power from the USB bus.

Connect the LED ENABLE jumper to enable the status LEDs. They are useful for debugging, but not really needed if the DAC is built into an enclosure. Remove the LED ENABLE jumper when the DAC build is finished to reduce its power consumption.

If the Amanero interface is customized to be powered from external supply instead of USB bus, connect the EXT POWER jumper to supply power from the input board.

DIYINHK USB

Solder the included 2x10 pin socket on the bottom of the input board in J4 position marked DIYINHK.

Optionally, to access the DIYINHK status indicators, solder a 1x6 pinheader to DIYINHK USB board CN2 position. Solder a 1x6 pin J5 socket marked DIYINHK STATUS on the bottom of the input board.

Connect the EXT POWER jumper. DIYINHK USB interface requires external 3.3V power, which is supplied by the input board.

Connect the LED ENABLE jumper to check the status lines. For DIYINHK only the F0-F3 indicators are used.

WaveIO USB

WaveIO USB interface can be connected in of two ways.

1. Using U.FL cables from the non-isolated WaveIO outputs.
2. Using a 10 pin ribbon connector from the WaveIO isolated outputs to J21 connector on the input board. When using this connection, +3.3V power is supplied to the WaveIO isolators from the input board.

Raspberry Pi

The included RPi connector PCB for V2 boards is designed for Raspberry Pi 2 and B+ models.

Install 2x20 pin connectors on the top side of the connector board. SV1 is a male connector, SV1 is female connector.

5V DC power to RPi is supplied from the input board through the RPi connector. No additional power supplies are needed.

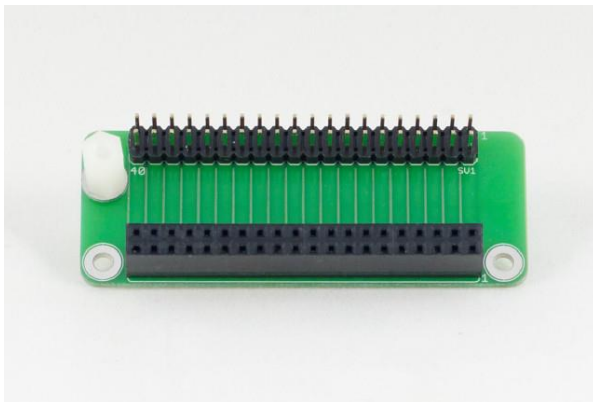


Figure 13 Raspberry Pi 2 connector PCB

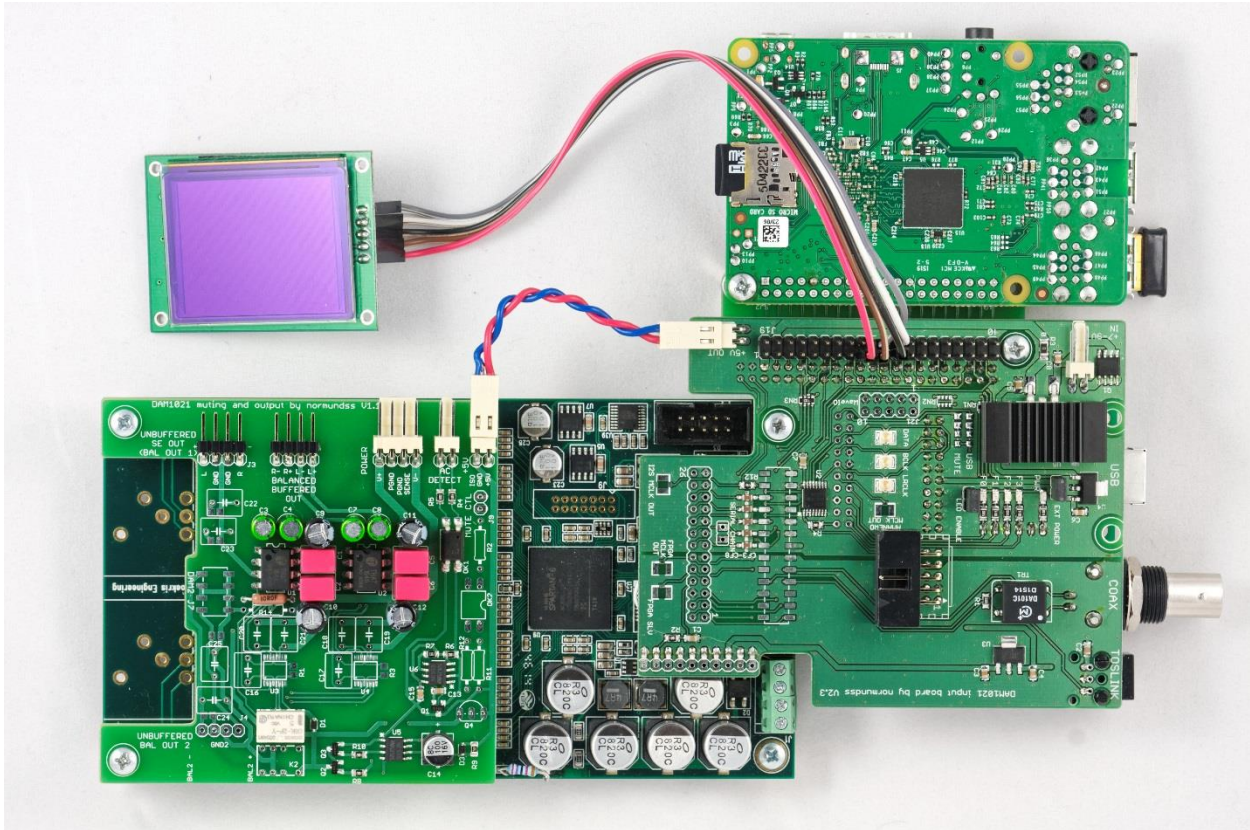


Figure 14 Example build with Raspberry Pi 2 and SE-balanced output buffers

Figure 14 shows a build with Raspberry Pi 2 and muting board with optional SE-to-balanced output buffers with THAT1646 drivers. This buffer has been built with 10uF non-polar capacitors included to reduce output common mode DC offset. These capacitors can be replaced by wire jumpers if offset reduction is not needed. For more details, see THAT1646 datasheet http://www.thatcorp.com/datashts/THAT_1606-1646_Datasheet.pdf

In this build the optional J19 header is installed for access to Raspberry Pi GPIO pins. a Digole OLED display is connected using SPI interface. Optional heatsink for the 5V regulator is also installed.

Other microcontrollers

Other microcontrollers can be used to control DAM1021. They can be wired to the serial port and other control lines through J19 connector on the input board.

For easier installation, a connector PCB can be designed for other microcontrollers.

Simple balanced build

For a dual mono balanced build, the J3 and J7 connectors must be mounted on the bottom side of the second DAM1021. Do not install J2 connector on the second DAM1021.

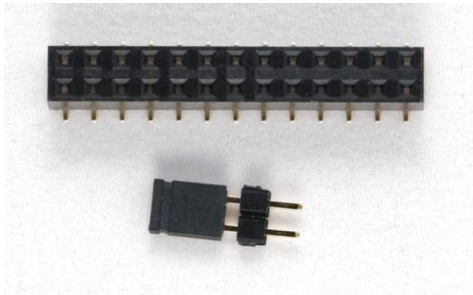


Figure 15 Additional parts for balanced input build

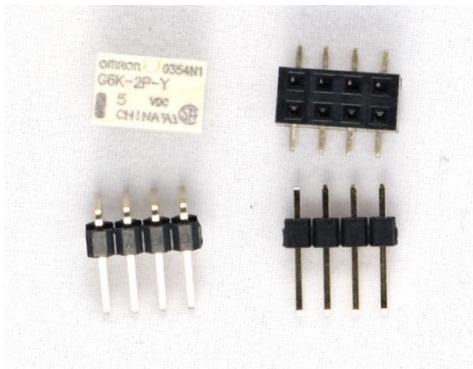


Figure 16 Additional parts for balanced muting build

In this configuration each DAM1021 must be preconfigured individually over their serial ports before connecting them to the input board. The DAC is controlled from the switch board by daisy-chaining the DAM1021 isolated serial ports.

Load each DAM1021 with identical firmware and filters. Set the same power on defaults using umanager, except for the mode setting. On one DAM1021 set mode=bal-left. On the other one set mode=bal-right.

Install the additional input board parts needed for balanced operation.

Close the SERIAL CHAIN jumper on the input board.

The differential output signal for each channel can be taken from pins 1 and 4 of the J7 connector on each DAM1021.

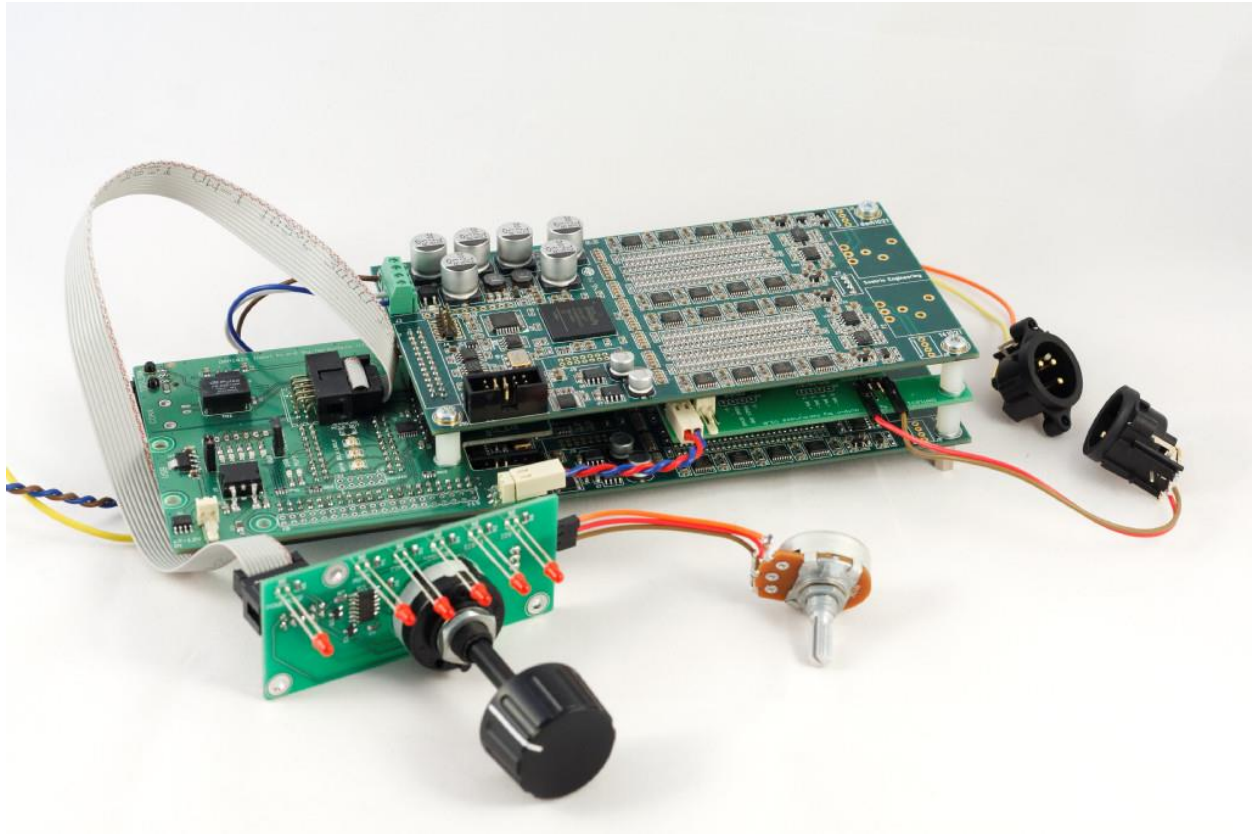


Figure 17 Balanced build example

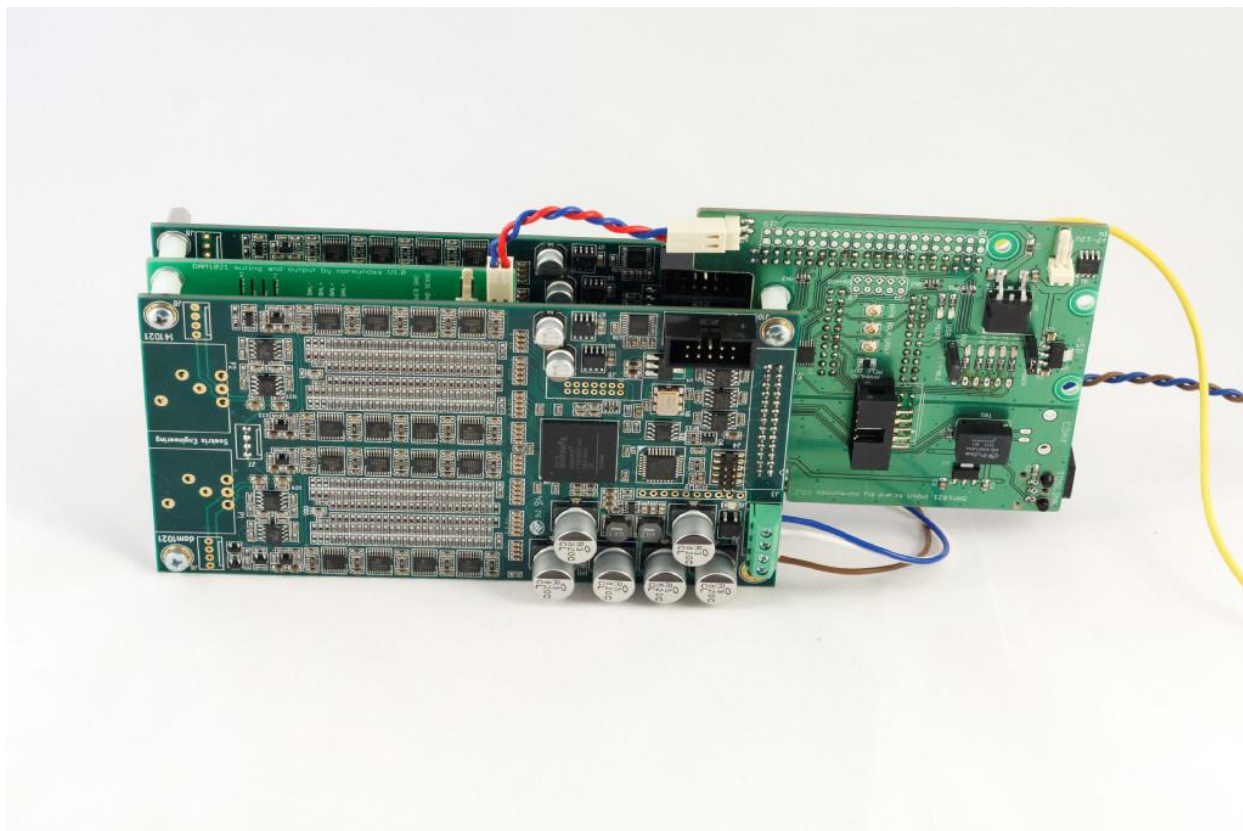


Figure 18 Balanced build example

Unbalanced to balanced output buffers

Install the optional parts listed in [BOM section Additional parts for SE to balanced buffers build](#).

An external dual polarity +/- 9-18V DC power supply is needed for the output buffers.

See Figure 14 for a build example.

For more details, see THAT1646 datasheet http://www.thatcorp.com/datashts/THAT_1606-1646_Datasheet.pdf

Fully balanced output buffers

Install the optional parts listed in [BOM section Additional parts for fully balanced build with output buffers](#).

An external dual polarity +/- 9-18V DC power supply is needed for the output buffers.

For more details, see THAT1606 datasheet http://www.thatcorp.com/datashts/THAT_1606-1646_Datasheet.pdf

Note that only one type of output buffer can be built on a single board – either SE-to-balanced with THAT1646 IC, or fully balanced with THAT1606 IC.

External mute control

Install the optional parts listed in [BOM section Additional parts for external mute control from pin18 or other source](#).

Remove transistor Q2.