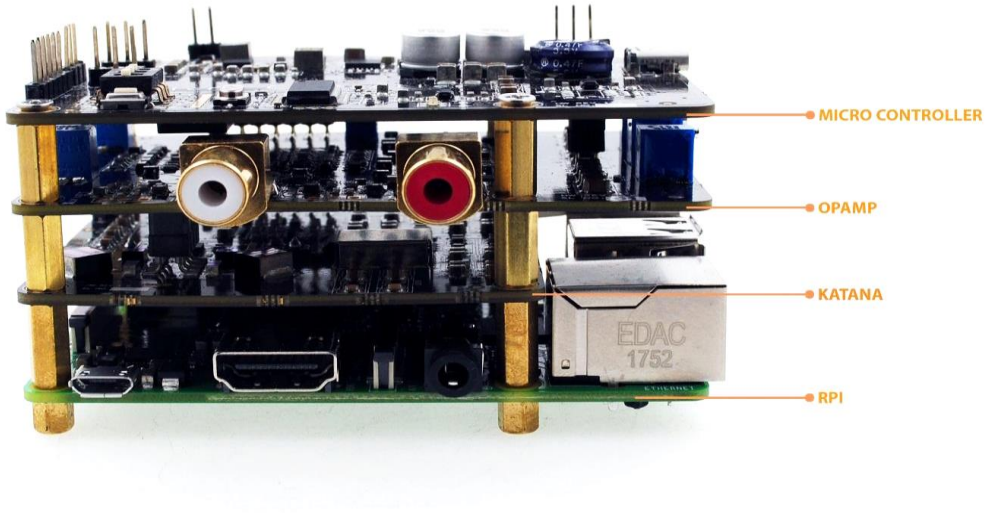
KATANA TECHNICAL MANUAL

Welcome to your Katana master DAC based on the ESS SABRE 9038 chipset. Our most performant DAC yet, compatible with RPI models 2 & 3, featuring:

- Dedicated 384 kHz/32bit ESS SABRE 9038 DAC chip
- Supports DSD 64, DSD 128 & FLAC files through DoP
- Output connectors: 2 x RCA / 2 x XLR soldering points
- DAC THD+N (1Khz , 0 dbfs , a weighted) at -112.75
- Sampling Frequency ranges from 44.1 kHz to 384 kHz



The KATANA stack consists of 3 boards plugged into the 40 pin GPIO header of the RPI.

The 3 boards are: KATANA / OPAMP / MICRO CONTROLLER

1. KATANA BOARD: houses the ESS9038 DAC circuits and ultra low phase noise NDK oscillators for MCLK (clock generation, master DAC).

2. KATANA OPAMP BOARD: this is the analog output stage where all the discrete OP-amps circuits on analog output stage are for left and right channels (XLR balanced and RCA unbalanced)

3. KATANA MICRO CONTROLLER BOARD : It controls the functionality of the DAC with the preloaded firmware. The Micro Controller receives all the configuration parameters for the DAC from the RPI through I2C interface. It also receives the 5V power input and thanks to the onboard DC to DC converter it feeds +/- 14V to the OPAMP below.

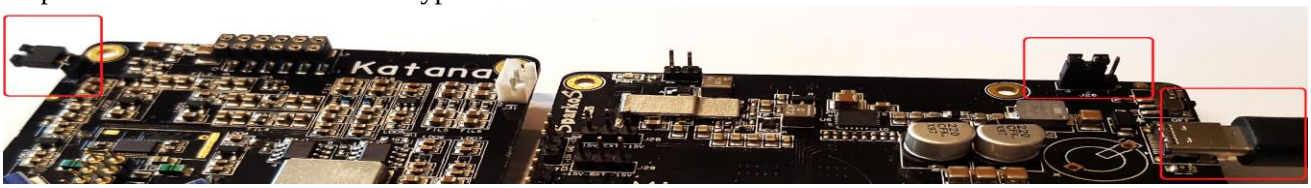
KATANA stack power feeding options

There are 4 ways to feed power to the KATANA player, each affecting the sound quality (SQ).

Single power source Micro Controller:

Connect a 5V 3A PSU to the type C USB connector of the Micro Controller board and it will feed the whole KATANA stack as well as the RPI. It's the easiest method, but don't expect the best SQ results.

Step 1: on KATANA board place jumper on J30 (close the circuit)
Step 2: on Micro Controller board, place jumper on J26 (position 2 & 3)
Step 3: connect the 5V 3A PSU to type C USB of the Micro Controller



Single power source KATANA:

Feeding power to the KATANA board will power the whole stack including the RPI
Feed 5V 3A to the battery connector cable provided (**RED is +** and **BLACK is ground**) . Again, 1 PSU for all the stack won't give the best SQ results.
Step 1: on KATANA board place jumper on J30 (close the circuit)
Step 2: on Micro Controller board, place jumper on J26 (position 1&2)
Step 3: connect the 5V 3A PSU to battery connector adapter cable

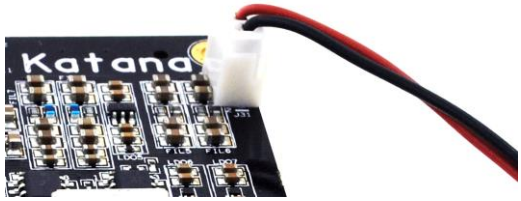
Dual power sources (basic SQ):

Connect a 5V 3A PSU to the type C USB connector of the Micro Controller board and another one to the RPI. Please note to power the Micro Controller board BEFORE the RPI. This method will greatly improve the SQ.
Step 1: on KATANA remove J30 jumper (open the circuit)
Step 2: on Micro Controller board, place jumper on J26 (position 2 & 3)
Step 3: power Micro Controller board with 5V 3A PSU connected to the type C USB connector.
Step 4: power RPI with 5V 3A PSU connected to the micro USB connector

Three Power sources (best SQ):

Connect a 5V 3A PSU to the type C USB connector of the Micro Controller board, connect 5V 3A to the KATANA power cables (**RED is +** and **BLACK is ground**) and use another 5V 3A PSU to power the RPI. This 3 PSU configuration will yield the best SQ results.

Step 1: on KATANA board remove J30 jumper (open circuit)
Step 2: on Micro Controller board remove J26 jumper (open circuit)
Step 3: Power KATANA
Step 4: Power Micro Controller
Step 5: Power RPI



Powering mode		Single Power Not best SQ	Single Power Not best SQ	Dual power sources Basic SQ	Three power sources best SQ
Jumpers positions	Power sequence	Powering Micro Controller only	Powering KATANA only	Powering Micro Controller first , then RPI	Powering KATANA first then Micro Controller then RPI
KATANA J30		Close	Close	Open	Open
MicroController J26 1&2		Open	Close	Open	Open
Micro Controller J26 2&3		Close	Open	Close	Open

Table -1

Warnings: In single power source mode do not feed power to RPI. In 2 power source mode ensure J30 Open. Follow power on sequences

OPAMP power feeding options:

We give the liberty to customers to choose how to feed the OPAMP stage. Either from the power generated by the Micro Controller or with a power supply of their choice. See here Micro Controller setting details for both scenarios.

Please note :
All power to the OPAMP (external or onboard) passes through the Micro Controller.
Micro Controller will still have to be powered 5V 3A even when choosing to power OPAMP externally.

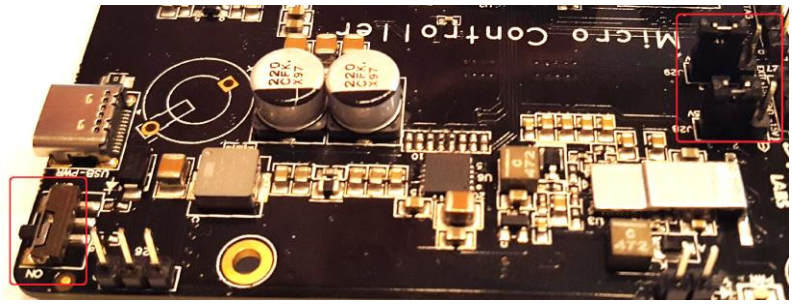
Power to the OPAMP stage can be switched off when player is idle for extended periods of time with switch 3 of Micro Controller.

+/- 15 V input selection to the OPAMP		
Jumper on MicroController	Micro Controller feeds +/- 15V (Default)	External PSU feeds +/- 15V using J27 header
Sw3	ON	OFF
J28 1&2	Open	Closed
J28 2&3	Closed	Open
J29 1&2	Open	Closed
J29 2&3	Closed	Open

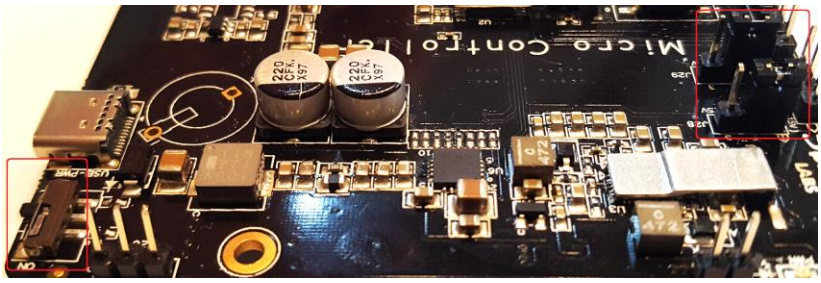
Table-2

J27 input for external +/-15V: +15v (pin 1), GND (pin 2), -15v (pin 3)

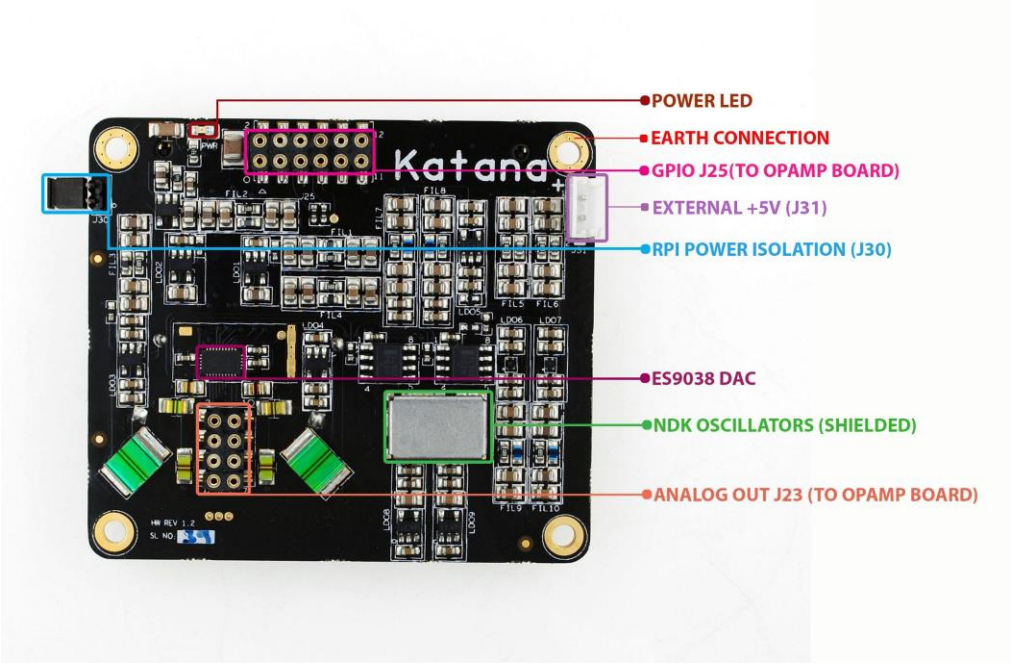
DEFAULT

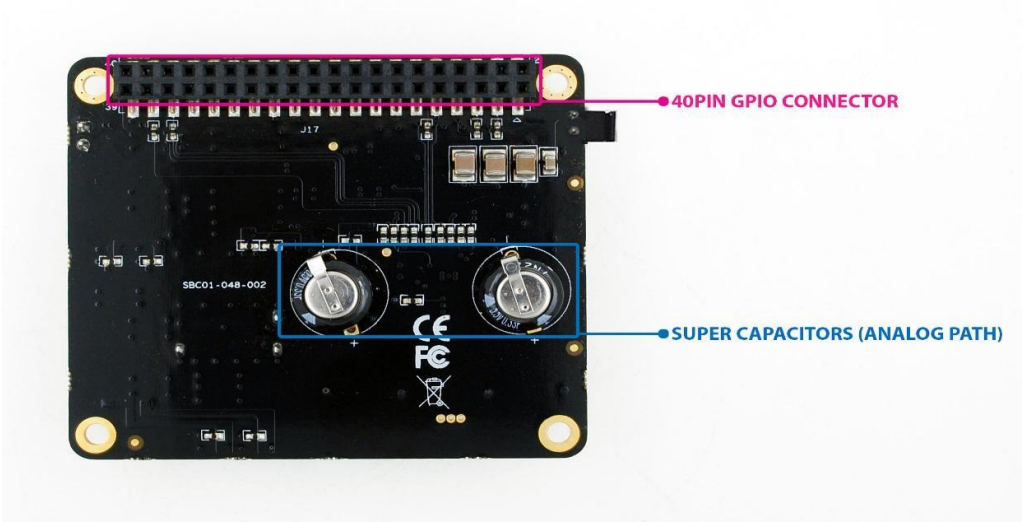


EXTERNAL



KATANA DAC Board TOP & BOTTOM





KATANA BOARD:

It houses the ESS9038 DAC circuits and ultra low phase noise NDK oscillators that generate the MCLK . This makes the KATANA a master DAC.

The analog power section was uses high quality Rubycon film capacitors and super capacitors that purify the power driven to the DAC chip.

On board LED indicates it is powered on.

NDK Oscillator: 45.1584/49.1520 MHz ultra low phase noise oscillators

KATANA Header PIN Out Details

RPI	PIN	PIN	RPI
3V3	1	2	**DC +5V**
SDA1-I2C	3	4	**DC +5V**
SCL1-I2C	5	6	**GND**
GPIO4	7	8	**UART_TX**
GND	9	10	**UART_RX**
GPIO17	11	12	**I2S_BCLK**
GPIO27	13	14	**GND**
GPIO22	15	16	**GPIO23**
3V3	17	18	**GPIO24**
SPI_MOSI	19	20	**GND**
SPI_MISO	21	22	**GPIO25**
SPI_CLK	23	24	**GPIO8**
GND	25	26	**GPIO7**
ID_SD	27	28	**ID_SC**
GPIO5	29	30	**GND**
GPIO6	31	32	**GPIO12**
GPIO13	33	34	**GND**
I2S_LRCLK	35	36	**GPIO16**
GPIO26	37	38	**I2S_DIN**
GND	39	40	**I2S_DOUT**

*highlighted signals are used by KATANA & Controller board

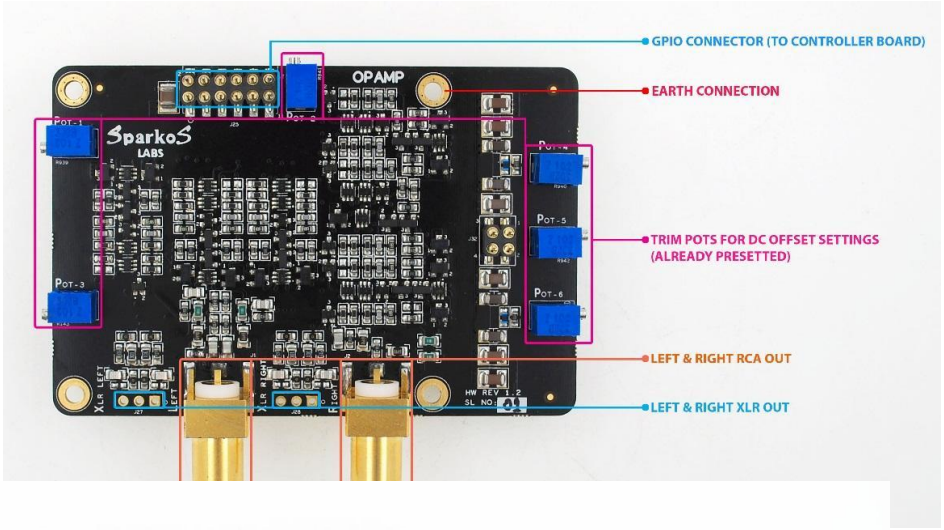
The KATANA will work in I2S Master Mode through the ES9038 DAC chip.

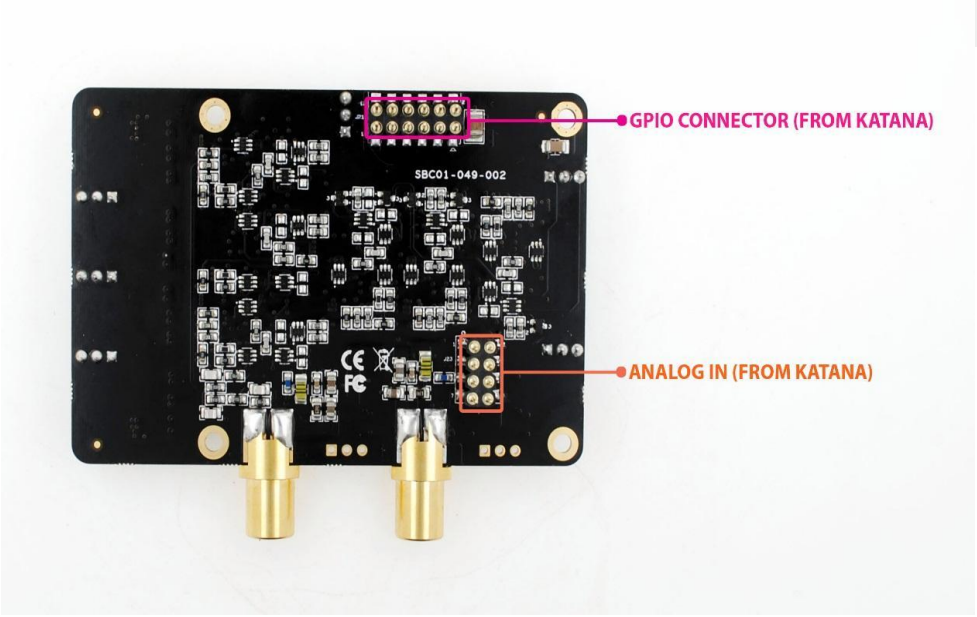
Master clock auto switching will generate sample rate based on I2S clocks out to RPI.

I2S_BCLK & I2S_LRCLK in to RPI

I2S_DOUT - out from RPI

OPAMP Board TOP & BOTTOM



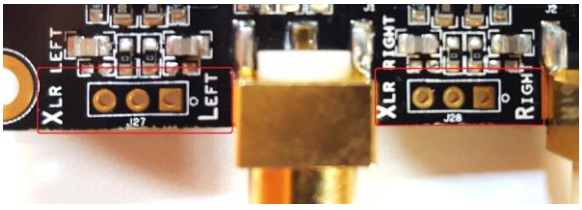


OPAMP BOARD:

It contains the discrete OP-amps circuits on the analog output stage for left and right channels. Current it received as input and is converted to voltage. There are 3 stages: I/V converter, 2P LPF and summing circuits. This boards outputs balanced (XLR) and unbalanced (RCA) audio for left & right.

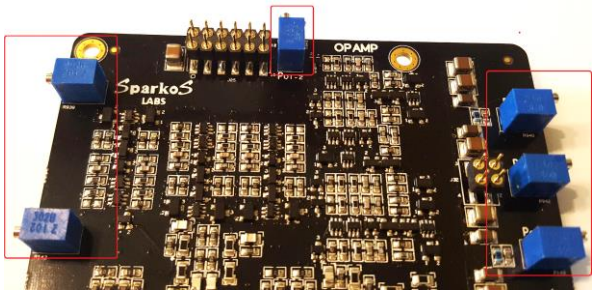
+/- 14v power inputs through 4pin header received from the Micro Controller board.

INPUT: Analog IN, +/- 14V**OUTPUT**: 2 x RCA, 2 x XLR (customer can solder)

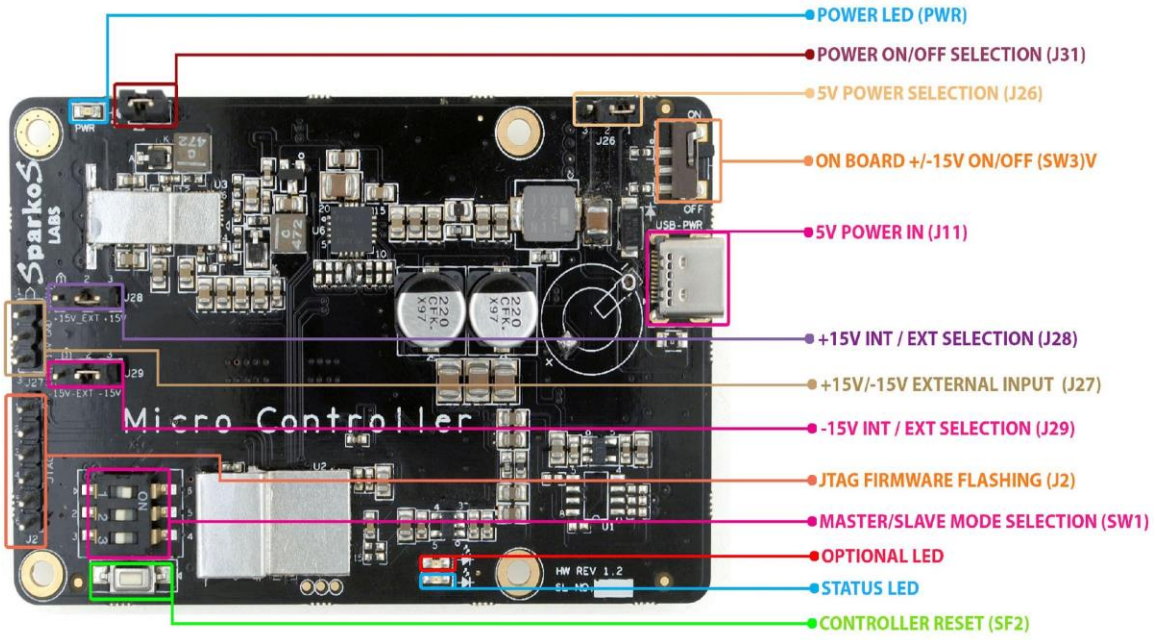


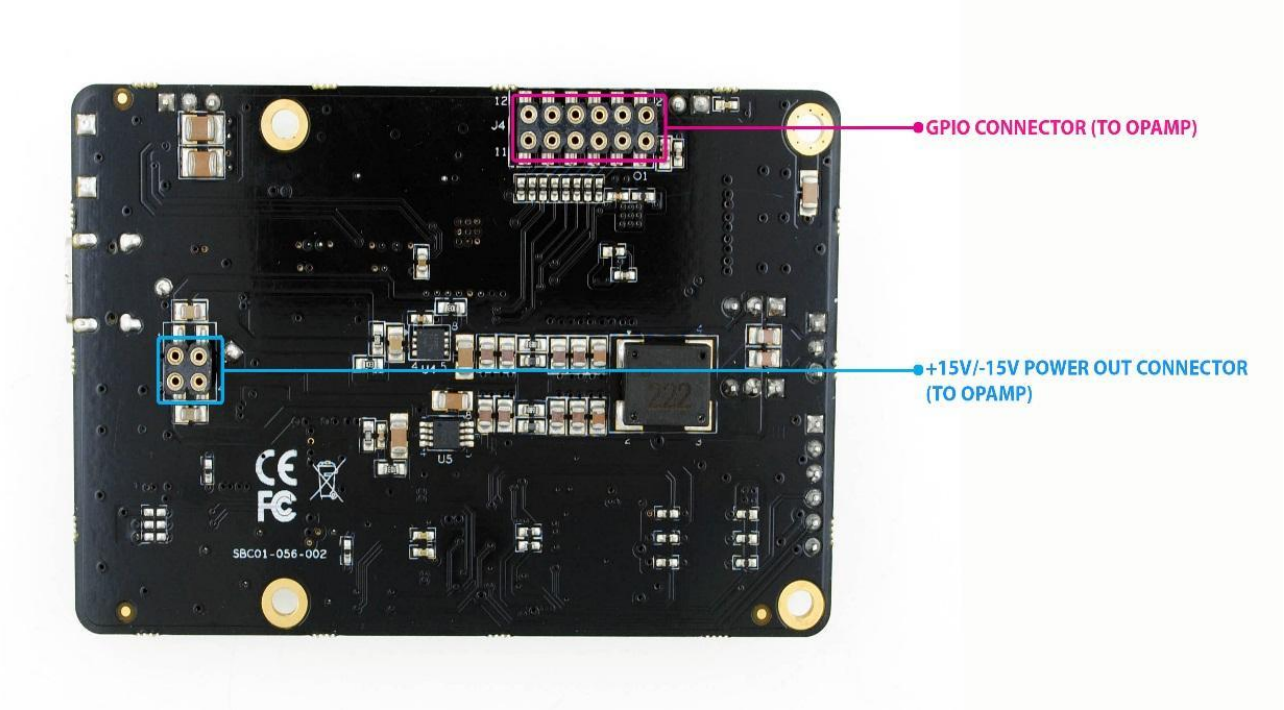
XLR pin outs

Note: All TRIM POTS are preconfigured for suitable DC offset levels of Op-Amps. Its highly recommended not to touch them.



KATANA CONTROLLER BOARD (Micro Controller) TOP & BOTTOM





MICRO CONTROLLER BOARD:

This Module controls the functionality of the DAC with the preloaded firmware. The board receives configuration parameters for the DAC from the RPI through I2C-1 interface.

DIP SWITCH SETTINGS for DSP filter settings

DIP SWITCH position	DSP FILTERS
000	**Software mode selection**
001	Linear phase fast roll-off filter
010	Linear phase slow roll-off filter
011	Minimum phase fast roll-off filter
100	Minimum phase slow roll-off filter
101	Apodizing fast roll-off filter
110	Corrected minimum phase fast roll-off filter
111	Brick wall filter

LED STATUS

Status LED (Green) : Steady glowing (LED ON) means the KATANA is detected and configurations are up & running.

Blinking means the KATANA DAC is not detected

Power LED (Green) : Indicates the 5V input power status. This LED can be on or off depending on J31 jumper status (closed or open)

KATANA Player Power Consumption details

KATANA Player Power Consumption (Measured)			
	Startup (max current)	Music playing/Idle	Remarks
5V Single power Source to Controller board	1.7A	1.5A	RPI3 - without HDMI/keyboard, Wired Ethernet + Katana set

5V Power Consumption split-up			
KATANA + OPAMP + Controller	1.1A	1.1A	Power feed through Katana or C type Connector
KATANA Board	165mA	80 to 100 mA	Power in to J31 battery cable
Controller + OPAMP board	1A	1A	1) 5v-20mA for Controller section 2) 5v-180mA +/- 15v DC-DC converter on Controller 3) 5V-800mA load for OPAMP
Controller Board (15v disable)	20 mA		DisableOnboard 15V(SW3 OFF), feedexternal +/-15v

Software: Firmware is preloaded at our factory through the on board Jtag connector using a specific MCU Tool. Not to be used by customers.

RPI Kernel Version: kernel 4.14.49 or above driver updated.

snd-soc-allo-katana-codec.ko is the device driver required for Allo Katana DAC. On RPi, get this driver active by adding "dtoverlay=allo-katana-dac-audio" in the /boot/config.txt file.

- Device name: Allo Katana DAC
- Audio Interface: I2S
- Sampling rate: 44.1kHz to 384kHz sampling freq
- Data bit length: 16 & 32-bit.
- DoP: DSD 64, DSD 128 & FLAC files

- Device Driver:
  - snd-soc-allo-katana-codec.ko

- Device tree overlay:
  dtoverlay=allo-katana-dac-audio

- Driver Parameter: None

- ALSA card name:
  - card 0: Katana [Allo Katana], device 0: bcm2835-i2s-allo-katana-codec allo-katana-codec-0 []

- ALSA fields:
  - **Master Playback Volume**: Set DAC Volume & control mute
    - Range: 0 - 255
    - Default: 214 [45%] [dB gain: -20.42, -20.42]

Please note that a small glitch/noise is heard on the following events:

* On stop/Pause of DSD files (DoP)

*On changing song file from DSD (DoP) to other DSD (DoP) or PCM file

We are working on improving this.

Enjoy your KATANA and please share your feedback on forums or sales@allo.com