Build Notes for DSD DAC DSC3 from a DIYer **Rev. 1 30/12/2024**

Disclaimer, these are my notes for building the DSC3 board. The information provided in this note is only one way to assemble/test and put in operation the DSC3 board. You might have a better way. This is not advice on what you should do so please use caution and mind the safety implications that might arise. The information contained in this note is not original content but merely copied/pasted from the DSC forum, Pavel's website or the audiodesignguide website (apologies I will not refer/clarify all the specific instances in the note to keep my workload low).

I decided to write this guide to give some idea of what the process of building the card might look like because the lack of a guide has been the single most difficult barrier for me in the realisation of the DSC3 so I wanted to make this easier for the next person to build this beautifully sounding DAC as well as for record keeping.

Some of the information in this note might be obvious to you. In that case you know more than I do :)

1. BOARD ASSEMBLY/TESTING

3.1. Design Files:

Gerbers in post #2,090
https://www.diyaudio.com/community/threads/signalyst-dsc1.254935/page-105

BOM Rev 2 in post #2,114
https://www.diyaudio.com/community/threads/signalyst-dsc1.254935/page-106

3.2. PCB Manufacturing

- Use your favourite PCB Manufacturing house, I use JLC PCB but you don't have to. Group buys are also a way to acquire PCBs.
- Use the copper thickness/surface finish you prefer. I am usually fine with standard 1.6mm FR-4, 1oz copper weight and HASL but you might want to go for something else. I just use the default PCB stack that JLC offers, again you can go as far as you desire with this.
- A solder paste stencil if you want to paste the board (only front side, there is only a switch in the back, easy to solder by hand)

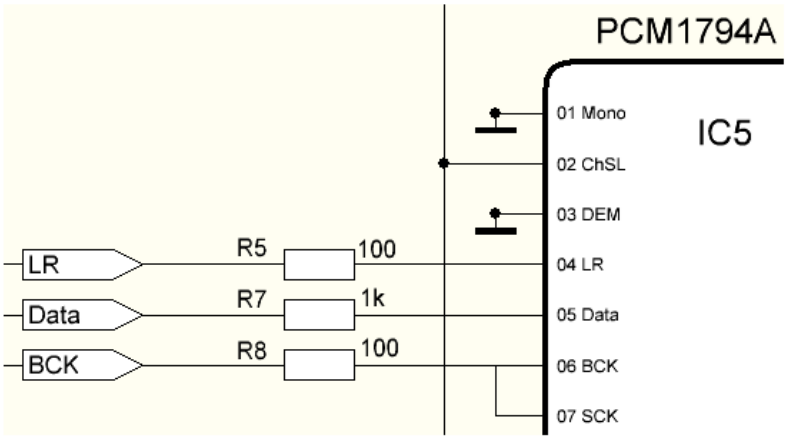
3.3. Component Purchase

- Mouser/Digikey are the usual suspect distributors. For cheap/small components please purchase a few more, it is very easy for some of those components to fly away never to be seen again, especially if they are really small and you are using tweezers to position them. I bought a few more additional SMD capacitors/resistors as those have the highest "fly factor"
- Use the Rev 2 BOM
- Relays K1/K2 seem to be the wrong type to me. I believe that they should be IM03TS non latching (instead of IM43TS latching) – that is unless I am missing something

- Note that the component become obsolete very quickly so do not be surprised if some components the BOM are already obsolete. Please find substitutes of similar specification noting that the SMD capacitors are not all the same, the dielectric type matters (i.e. X5R is quite stable, the capacitance of other dielectric varies significantly with the frequency/temperature).
- When testing with the Amanero adapter I had an issue with noise on the left channel. This has been discussed on the forum and the solution (by user 2A3SE) is to replace R12 with a 1kOhm resistor (from 33Ohm). I have tested this and it appears to work very well with both the Amanero and the Beaglebone. Add this to your BOM.

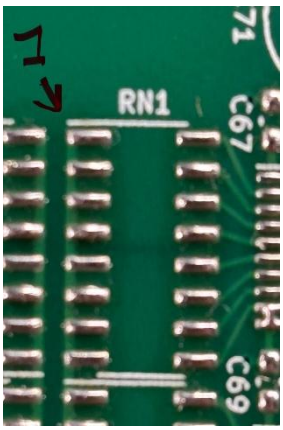
From the DDDAC project the explanation on the 1K resistor:

> Just a small note on why the data line has a 1kOhm decouple resistor, where the others have a 100 Ohm one... Well, simple minds find simple solutions ;-) The 100 Ohm ones are to decouple the digital domains. Good practice in digital design, so very standard stuff. The 1k however is larger than normal and with the Input capacitance from the DAC input, it creates a small delay (RC time) which is needed to align for the lost 1/2 clock cycle in the shift register..... Others do this with D Flip Flops or even more complex solutions. Well, a different value (only that) of a resistor does the job also!

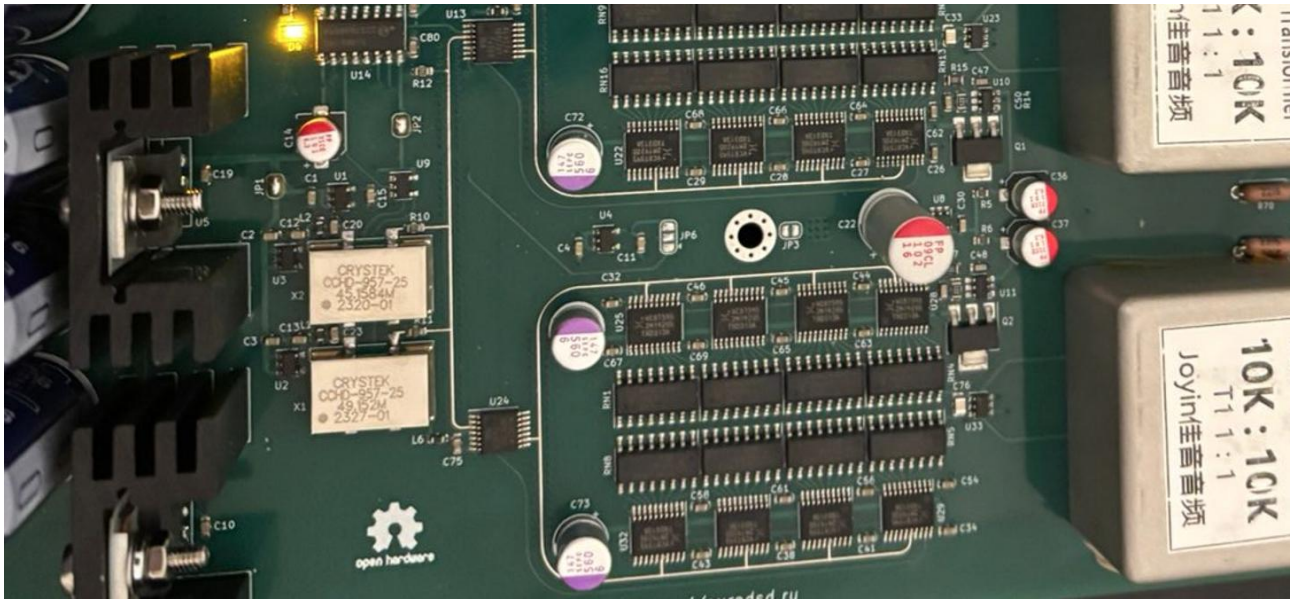


3.4. SMD Component Positioning:

- I pasted the board with 63/37 solder paste (Qualitek DSP 619D) to keep the joint strong whilst having a low melting point, mind that leaded products are poisonous so use the appropriate handling precautions. If you are using a stencil, stencil positioning is a little bit of a faff but really important. Of course, you can use a glue dispenser or even tweezers to apply paste to the pads
- I then positioned the components. Use tweezer/pixel pump/pick and place machine, whatever you fancy or most likely have access to. Note that the paste “abandon time” is about 4 hours. The longer you leave the paste on the PCB the more the solder paste will dry and will make it difficult to “stick” the components on the board so this is not a start/stop kind of job.
- Given that there is not a lot of time for positioning components, I would advise that you have all of the assembly components ordered and ready to go. I numbered all of the bags (using the BOM ref. no) and then order them in a box.
- Make sure that you understand positioning of the ICs before you start. Each IC has a PIN 1 designation. Pin 1 is also designated on the board (silkscreen line extends in front of PIN 1 (see picture below).



- Some ICs are really small, make sure that you have a microscope/magnifying glass to be able to see the pin 1 marking!
- Crystals are positioned like this (position them the right way up):



- I used a re-flow oven to “bake” the board. After a PCB inspection I realised that there were no tombstoned components or solder bridges. Success! You might be less luck and some rework might be required, such is life.
- You might want to solder the components with a different method, this is perfectly fine, some alternative methods that spring to mind are with a hot plate or an old fashion soldering iron and a lot of flux. Some of the packages have pins very close together, it is very easy to create solder bridges, just be aware.

3.5. Through-hole Components Soldering

- I generally go shorter first and then taller last
- No need to isolate U5/U6 from the heat sink. Use either thermal compound or a thermal pads
- There is a small mechanical interference issue between T1 and R71 if both are mounted from the top. I used Kapton tape to isolate the transformer metal can and moved the resistor as further away from the can as I could. It is probably better to mount the resistors on the bottom of the board.

3.6. Cleaning the PCB

I did not clean the PCB because I was worried that the ultrasonic bath would damage the crystals/oscillators and my bath is too small for this board. I did not feel like washing the PCB with IPA because IPA smells a lot and my lab is small but I used no clean flux that is rosin based so it should be a good insulator, also it has been properly activated in the reflow oven. If you use a water-soluble flux then it is probably better to clean it because it can be hygroscopic and might lead to the flux residues becoming conductive over the long run. Up to you how to tackle this.

3.7. Testing the PCB

A multimeter is essential, an oscilloscope is highly recommended (especially for troubleshooting). The aim of the testing is mainly that all the supplies are available and there is a clock signal.

After board assembly check the following:

- Do a visual inspection! A microscope/magnifying lens might help here. I also checked that the IC legs were “SOLID”.
- Do not connect the Amanero or the Beaglebone boards for the initial testing
- Suggest to connect a current limited DC PSU to 1~ 1~ (14V DC about 300mA current limit or even less)
- Check 5V
- Suggest to connect a current limited DC PSU to 2~ 2~ (14V DC about 300mA current limit or even less) use a different PSU channel to keep the grounds isolated
- Check +5(r)
- Check +5(l)
- Check +3.3(b)
- Remove power to board
- Solder JP1 (if not done so already). Provides the supply to the final 3.3V LDO as well as the LDOs supplying the clock generators
- Solder JP2 (if not done so already)
- Provide power to board
- Check 3.3(a)
- Check the clock from X1 with an oscilloscope
- It is not easy to check functioning of X2 at this point so I just checked that the crystal was getting the required supply voltage. Strictly speaking it is possible by sending +3.3V_ to CLK_SEL_ .
- Either provide 3.3_ (3.3V digital) with a PSU or connect a Beablebone with onboard LDO and check the supply voltage across C124
- Check the MCLK_ to make sure that the clock makes it to the Beaglebone/Amanero. Mind the different grounds!

I am sure that more could be checked but at this point I felt confident that the board was ok and there were no major issues with it. Again, please familiarise yourself with the circuit, do not just blindly follow what I am writing, make sure you understand and agree before undertaking any testing.

2. DSC3 with the Beaglebone board (Amanero not installed)

Note, I have not tested both the Beablebone and the Amanero boards connected. I am sure that this is a possibility but the discussion on this is outside the scope of this note.

2.1. Download and Install the Pure Software

https://puredsd.ru/ in the "Software for new DSC2 and PPY`s ReClocker" section.

Direct link: https://puredsd.ru/Pure.gz

Follow the instruction on the site. In essence:

- Flash the ISO on the SD using Balena etcher or similar, insert the SD in the beaglebone and then power the module
- NOTE: no need to press S2 as mentioned on the website, this is not required just make sure that the beaglebone has an active Ethernet cable connected
- Go to http://pure.local/ In system select SD →eMMC.

2.2. General

- At this point you have hopefully either removed the output relays K1/K2 and added jumpers on pins 4-3 and 5-6 or you have installed the IM03TS (note that I have not tried this relay at the time of writing). Avoid yourself the trouble going mad because of this ;)
- Something important to realise is that the MUTE_DSD is logic high when the DSD is not muted and logic low when the DSD is muted. So, the LED is only ON when the DSD is NOT muted (i.e. a play signal is found).

2.3. PCB Jumpers

Jumper	**Status**	**Notes:**
JP1	Soldered	Powers the 3.3V regulators
JP2	Soldered	Powers U14 (DAC side)
JP3	User defined	Connects the analogue ground to the mounting hole in the middle of the board
JP4	Not soldered	For use with Amanero. When using the Beaglebone the 3.3V_ is provided by a regulator on board of the Beaglebone
JP5	- Cut trace between pin 2 and pin 3 - Link P1 and P2 together	NOTE: the Pure manual here https://puredsd.ru/ mentions the following

Jumper	Status	Notes:
		When working via I2S, it is possible to use two types of mute signal 1. Signal generated by the driver - 27 pin P9 2. The signal generated by the system based on data from the players and the Alsa subsystem - 28 pin P9. Setting in the script /opt/mutedsc2.sh I ultimately cut the pre-connect JP5 link to P28 (pins 1 and 2) with a knife blade and connected the MUTE circuit to P27 (pin 2 and 3). I am confident that P28 might also work but I found that P27 was working ok for me.
JP6	Left Untouched	Mute Circuit to reset the shift registers?
JP7	Does not matter	Only relevant for operation with the Amanero

3.8. Configuring HQ Player

There are several Players that could be used to upsample to DSD, see picture below:

SOFTWARE

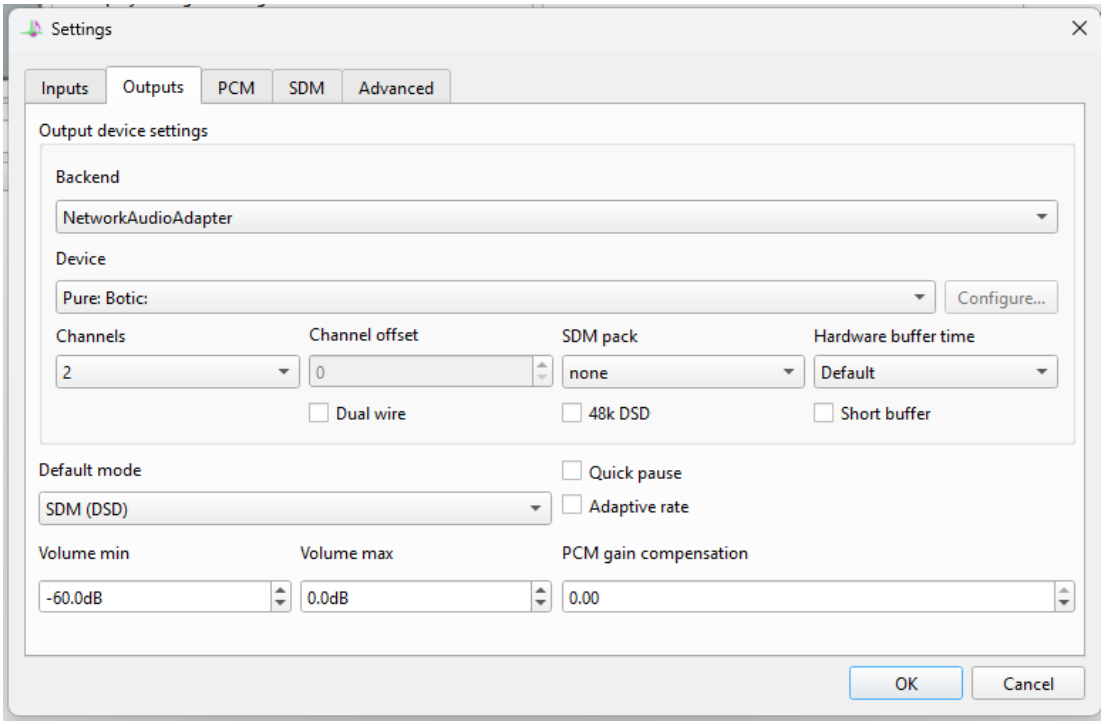
This hardware is compatible with any PCM and DSD signal so to play music you can use any audio player.

Here follows some player in order of sound performances.

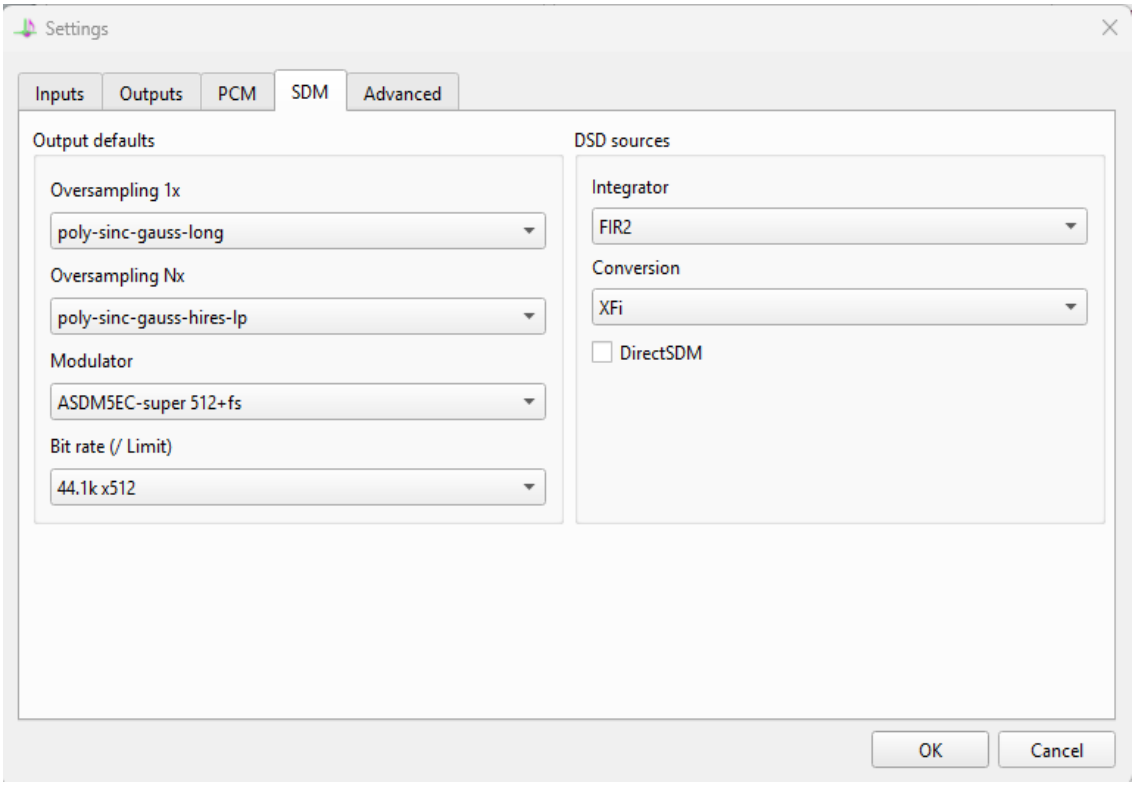
- HQPlayer by Signalyst available for Windows, Mac OS and Linux, there is a Server and a Desktop version at a cost of 145,18 euro
- Daphile Audiophile Music Server for x86 hardware, it is free but it need a dedicated hardware
- JRiver Media Center available for Windows and Mac OS at a cost of $49.98
- Foobar2000 freeware

I decided to use HQPlayer.

Files → settings → output



- Make sure that Pure Botic is selected as output (i.e. beaglebone board)
- On the SDM tab there are a lot of settings and these are beyond this memo. However modulator set to ASDM(5)7EC – super 512+fs has a better bass that the default value (in my opinion), ADSM7ECV3 is also very nice, experiment and decide for yourself
- Set the Bit rate to x512 (assuming that you have a computer that is capable of handling it)

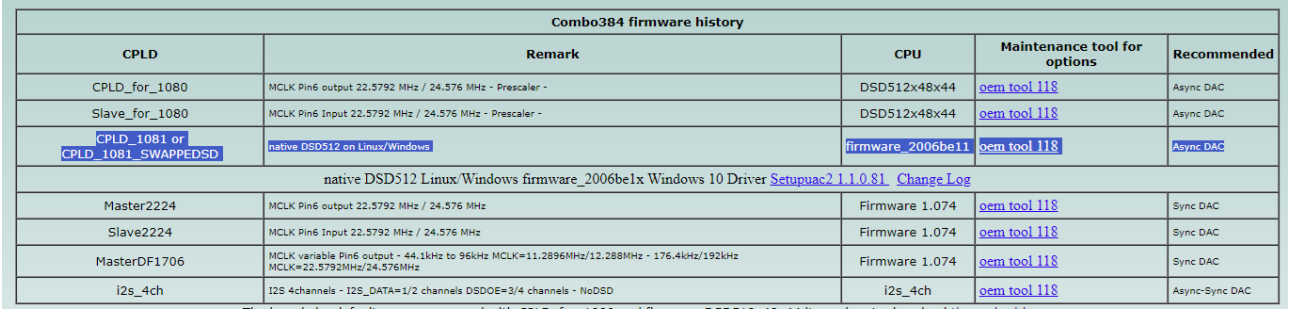


3. DSC3 with the AMANERO Board (no Beaglebone installed)

I only have an original Amanero 384 board so I am not sure how it will work with clones.

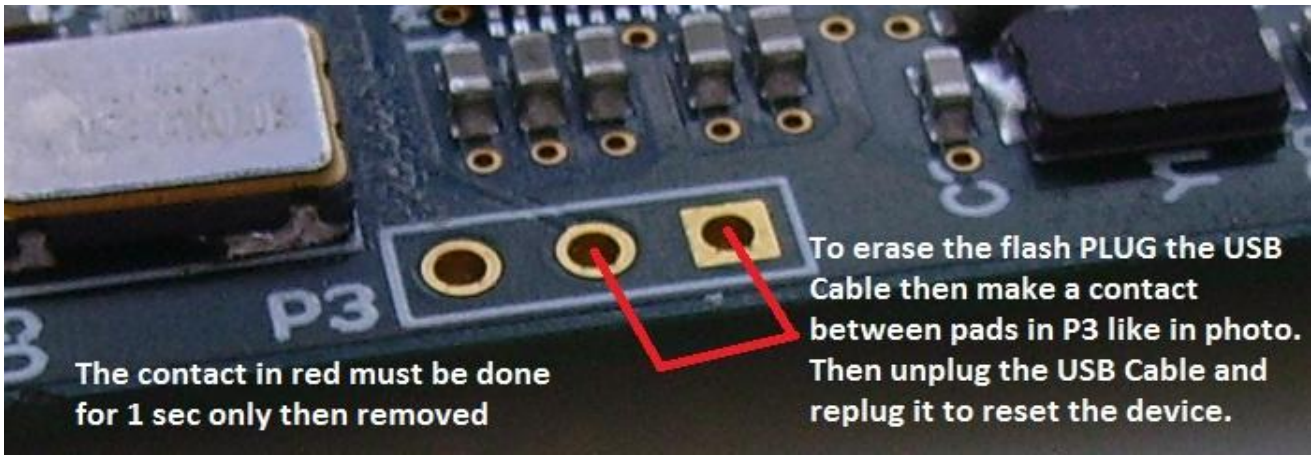
3.1. Set-up/Flash the Amanero

- Download the firmware from https://www.amanero.com/combo384_firmware.htm (see selection in figure below)

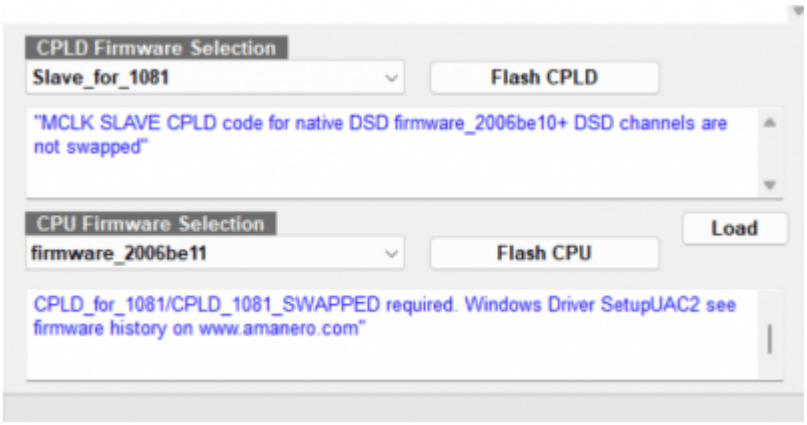


Combo384 firmware history				
CPLD	Remark	CPU	Maintenance tool for options	Recommended
CPLD_for_1080	MCLK Pin6 output 22.5792 MHz / 24.576 MHz - Prescaler -	DSD512x48x44	oem tool 118	Async DAC
Slave_for_1080	MCLK Pin6 Input 22.5792 MHz / 24.576 MHz - Prescaler -	DSD512x48x44	oem tool 118	Async DAC
CPLD_1081 or CPLD_1081_SWAPPEDSD	native DSD512 on Linux/Windows	firmware_2006be11	oem tool 118	Async DAC
native DSD512 Linux/Windows firmware_2006be1x Windows 10 Driver Setupuac2 1.1.0.81 Change Log				
Master2224	MCLK Pin6 output 22.5792 MHz / 24.576 MHz	Firmware 1.074	oem tool 118	Sync DAC
Slave2224	MCLK Pin6 Input 22.5792 MHz / 24.576 MHz	Firmware 1.074	oem tool 118	Sync DAC
MasterDF1706	MCLK variable Pin6 output - 44.1kHz to 96kHz MCLK=11.2896MHz/12.288MHz - 176.4kHz/192kHz MCLK=22.5792MHz/24.576MHz	Firmware 1.074	oem tool 118	Sync DAC
i2s_4ch	I2S 4channels - I2S_DATA=1/2 channels DSDOE=3/4 channels - NoDSD	i2s_4ch	oem tool 118	Async-Sync DAC

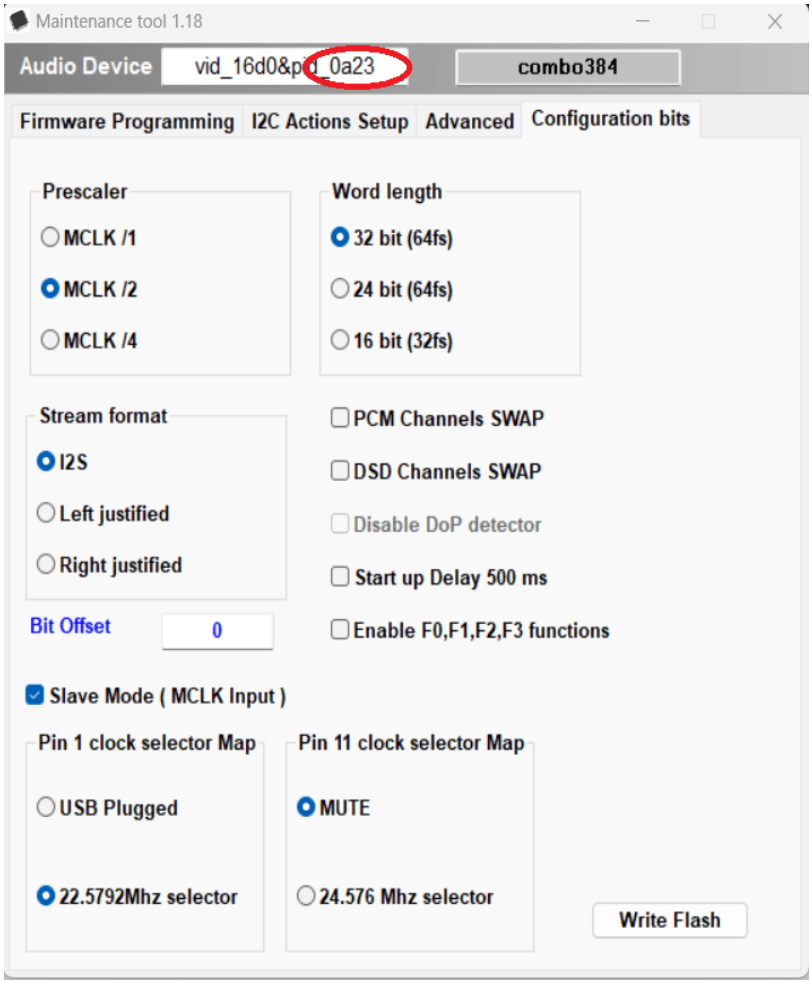
- Erase the flash – for these steps it is not required to install the Amanero board installed on the DSC3 board (see picture below)



- Update the firmware for the CPLD, and the CPU. If the system tells you that you need to erase the flash when updating the CPU disconnect the module, re-connect it and try to flash the CPU again. NOTE: select Slave for the CPLD as the clock signal is provided by the oscillators on board of the DSC3



- Change the value in the title box from 071a to 0a23 (edit the box, otherwise it given an error). Configure the settings as follows, remember slave mode as the card needs the clock from the DSC3 crystals (see picture below)



Note: MCLK/2 is because the DSC on board clock frequencies are double that of the Amanero. Pin 1 needs to be configured to select clock 2 and pin 11 is MUTE.

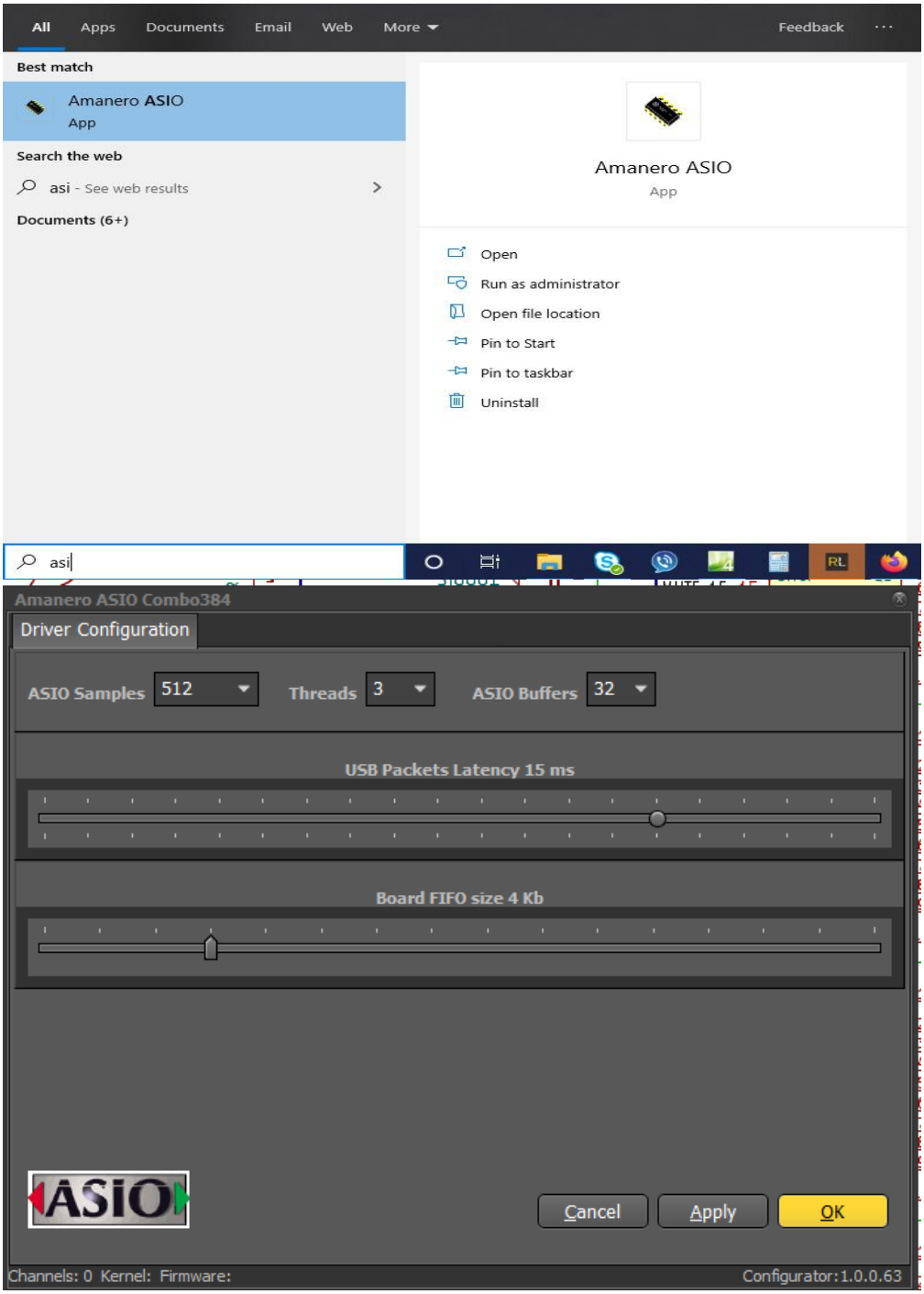
- Install the ASIO drivers on the PC https://www.amanero.com/combo384_firmware.htm (see selection in figure below)

Combo384 firmware history

CPLD	Remark	CPU	Maintenance tool for options	Recommended
CPLD_for_1080	MCLK Pin6 output 22.5792 MHz / 24.576 MHz - Prescaler -	DSD512x48x44	oem tool 118	Async DAC
Slave_for_1080	MCLK Pin6 Input 22.5792 MHz / 24.576 MHz - Prescaler -	DSD512x48x44	oem tool 118	Async DAC
CPLD_1081 or CPLD_1081_SWAPPEDSD	native DSD512 on Linux/Windows	firmware_2006be11	oem tool 118	Async DAC
native DSD512 Linux/Windows firmware_2006be1x Windows 10 Driver Setupuac2_1.1.0.81_Change Log				
Master2224	MCLK Pin6 output 22.5792 MHz / 24.576 MHz	Firmware 1.074	oem tool 118	Sync DAC
Slave2224	MCLK Pin6 Input 22.5792 MHz / 24.576 MHz	Firmware 1.074	oem tool 118	Sync DAC
MasterDF1706	MCLK variable Pin6 output - 44.1kHz to 96kHz MCLK=11.2896MHz/12.288MHz - 176.4kHz/192kHz MCLK=22.5792MHz/24.576MHz	Firmware 1.074	oem tool 118	Sync DAC
i2s_4ch	I2S 4channels - I2S_DATA=1/2 channels DSDOE=3/4 channels - NoDSD	i2s_4ch	oem tool 118	Async-Sync DAC

The boards by default are programmed with CPLD_for_1080 and firmware DSD512x48x44 it requires to download the main drivers

- Open the configurator and select a latency of 15ms (see picture below)



Note: There is also another driver here https://www.amanero.com/drivers.htm but I have not had much luck getting this to work.

3.2. Configuring HQ player

Same as above but this time select the ASIO driver and the appropriate device in HQ player.

3.3. PCB Jumpers

Jumper	Status	Notes:
JP1	Soldered	Powers the 3.3V regulators
JP2	Soldered	Powers U14 (DAC side)
JP3	User defined	Connects the analogue ground to the mounting hole in the middle of the board
JP4	Soldered	Provides the 3.3V_ from the Amanero
JP5	- Cut trace between pin 2 and pin 3 - Link P1 and P2 together	NOTE: the Pure manual here https://puredsd.ru/ mentions the following When working via I2S, it is possible to use two types of mute signal 1. Signal generated by the driver - 27 pin P9 2. The signal generated by the system based on data from the players and the Alsa subsystem - 28 pin P9. Setting in the script /opt/mutedsc2.sh I ultimately cut the pre-connect JP5 link to P28 (pins 1 and 2) with a knife blade and connected the MUTE circuit to P27 (pin 2 and 3). I am confident that P28 might also work but I found that P27 was working ok for me.
JP6	Left as stock	Connecting Pins 2-3 together would set MUTE_ to zero when the Amanero board is connected to a USB cable (i.e. 3.3V supply available). Both options are likely equally ok but I never tried.
JP7	Left as stock	Only relevant for operation with the Amanero

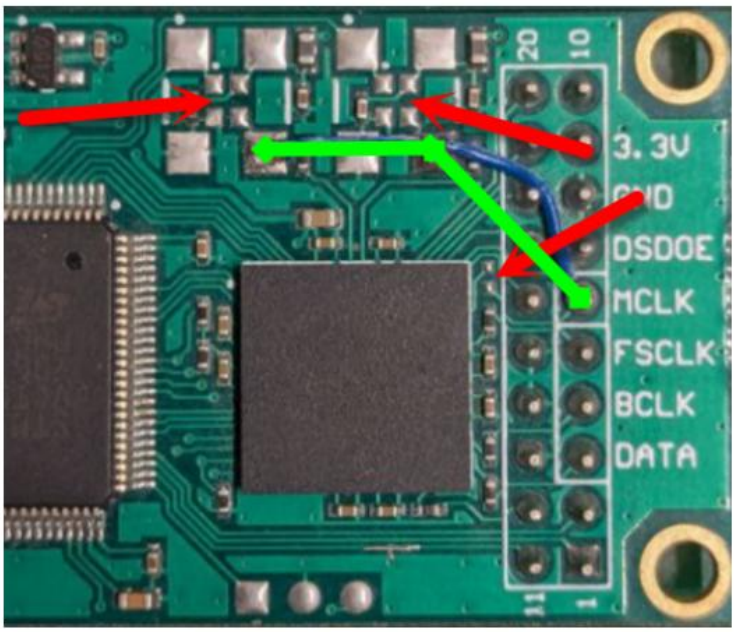
4. Troubleshooting:

- If no sounds come out of the Board I would trace back and check that all voltages are available (including +3.3V_)
- Check that the clock makes it around the board
- Check that the MUTE LED lights up when there is a valid signal
- If still no sound check that data is being sent to the DAC. I would start probing pins 12 and 14 of U14 with an oscilloscope (note: use the correct ground reference for the oscilloscope probe i.e. analogue ground)
- Check that “MUTE_SW” is logic “0”
- If all of this looks good then check is there is a signal across R70/R71 (the I to V resistors). If signal is there but not at the output the output relays (if installed) are not working correctly.
- There might be other troubleshooting steps that you might want to take if everything else fails. The advice is to start breaking down the system and verify if each element works to understand where the issue lies.

5. Using the Xing U30 (from the forum, have not tried this myself)

Remove the Crystals from the board, remove the small capacitor as shown in picture below and link the pads as described below to put the board in slave mode via hardware. Also read post #2,069 https://www.diyaudio.com/community/threads/signalyst-dsc1.254935/page-104

(*)– For slave mode XingU30
red – remove
green – connect



6. Burn-in

The components but especially the crystals need some time to burn in. Please do not listed at this DAC critically for the first 24 hours (at least). My DAC has changed sonically during this time.

7. Thanks

Enjoy this beautifully sounding DAC and from a user perspective thanks to all people that contributed to development of this device, it is fantastic.

Ivan