

Mounting instructions for:

## XO-DAC: a low jitter DAC master oscillator

Congratulations! You just bought a high quality, low jitter DAC oscillator. This document gives guidance to mounting and connecting it in your DAC.

### Introduction

XO-DAC exists in one version only. It improves the clock quality of your DAC, hence perceived sound quality.

### XO DAC

- Needs to be supplied with a DC voltage of 12 to 25V, 50mA
- Needs the recovered bitclock from your DAC as input
- Puts out a new clock, which needs to be fed to point the original bitclock is taken from
- Puts out 2 new clocks that eventually directly feed the DAC chips
- Puts out a diagnostic signal to evaluate and eventually improve the quality of the drive

### Mounting

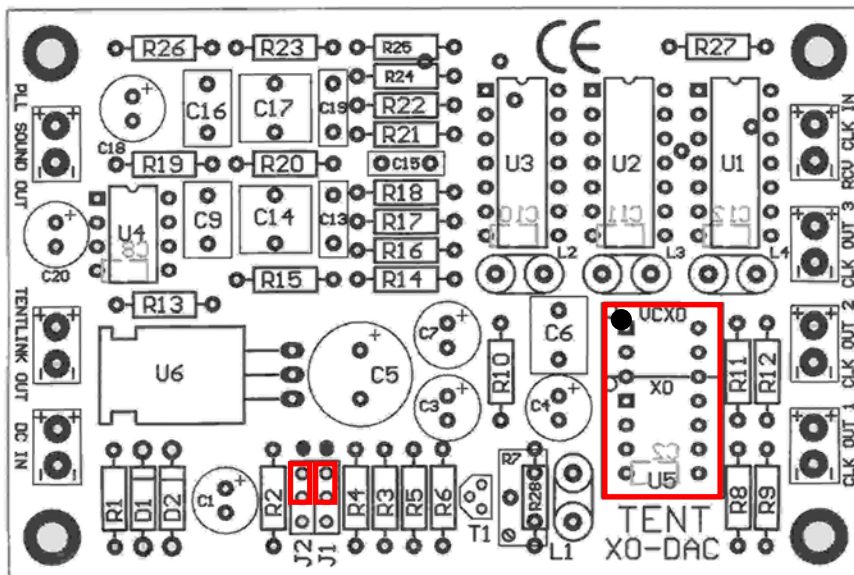
Mounting XO DAC is not that difficult. However some experience is needed to:

- Recognise and locate components
- Find specific connections and IC pin numbers
- Measure voltages using a multimeter
- Solder carefully

If you feel lack of skills and or experience in some of the above listed subjects, please ask someone else to support you.

### Know your connections

### What is on the PCB



The DCin (single red wire), Rcv Clk in (twisted green/black) and Clk out1 (twisted purple/black) are already provided with wire. The drawing above is for reference only, since it may be difficult to read the text on the PCB once mounted

Guido Tent can be contacted for questions and orders at: [XO.info@iae.nl](mailto:XO.info@iae.nl)

# How to connect XO DAC in your converter

## General

Read these full instructions below, before starting any work. This will give you a better overview of what you can expect.

**Unplug the unit from the mains**, and open the cabinet. Make sure you work in a safe environment.

## ESD

Electro Static Discharge may damage chips or lasers or other sensitive parts inside the DAC. Below some preventive measures are listed:

- Connect the ground of your soldering iron to the cabinet or ground or
- Connect the DAC to safety earth via a series resistor (100k $\Omega$ ) if the soldering iron is connected to safety earth
- Some shoes and types of chairs are very good at helping you to get charged. Avoid these!
- Always touch the metal cabinet and or PCB ground first, when touching (hand) or soldering (iron tip) parts inside.

## Disclaimer

I cannot be hold responsible for any damage that may appear to your DAC, due to the installation of the XO modules. In addition, warranty of the player may be void due to installing an XO.

## Warrantee

All XO modules carry a **5-year** warrantee, assumed that they are built in according these instructions.

## Preparation

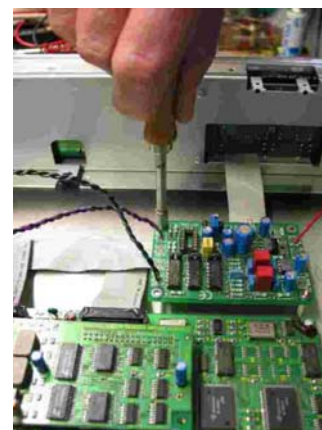
Find a suitable place to mount the PCB within the converter. Best location is close to the input receiver, or in-between the input receiver and DAC chip(s), to keep critical wiring short.

Locate the board such that it can be securely mounted, eventually using stand-offs in the 4 holes of the PCB (3mm).



Furthermore, a good coffee increases chances of success.

Note one of the prototypes of XO-DAC at the back



## Basic and additional connections - working order

The basic connections will be made in the following order:

1. **Power supply +** (red)
2. **Rcv Clk In** (black and green)
3. **Clk Out1** (black and purple)

The additional connections can be made as well:

1. **Clk Out2** and **Clk Out3**
2. **PLL sound out**
3. **TENT link (if applicable)**

## Basic connection - Power supply

A suitable supply voltage can be found inside the converter. A voltage between +12 and +25 is required. Mostly it can be found at the power supply capacitors, sometimes at a separate PCB.

In the example at the right, a 7815 voltage regulator is traced. It supplies a regulated 15V at the right pin.

Switch your multimeter to 200Vdc range and connect the black probe to ground (e.g. the screen of the analogue output RCA connector). Use the red probe to locate the required voltage.

The red wire from XO DAC can be soldered directly to this pin, or any other appropriate voltage in the DAC. Route it neatly away once connected.

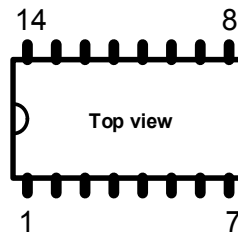


## Chip pin location

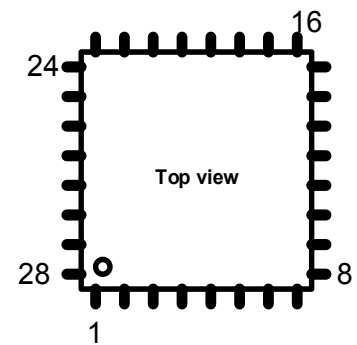
This drawing helps you locating the right pins, required for the connections to be made in the next paragraphs.

As a general rule, pin 1 is located down left, when the chip is laid down at the table, and the text is readable, with the chip pin indicator down left or middle left.

The pin numbers are illustrative only, pin count of chips differs all the way.



DIL package



QFP package

## Bit clock frequency and pin location

The bit clock in general is generated by the input receiver chip. The table below lists most chips in commercial designs. Find the chip by type number, and try to locate the right pins at the printed circuit board. Mark the pins with a thin marker. At the next page I'll show you how to actually measure them if required.

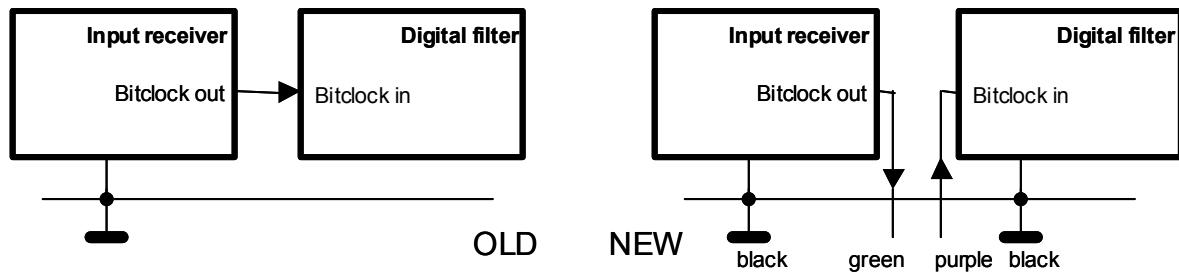
Ground and bitclock output pins are listed as well as the required frequency. All mentioned values are based upon 44.1 kHz sampling frequency which is normal for CD playback, but may be different for DAT tape recorders for example. If in any doubt, please contact me.

Type	Ground	Clk out	Frequency	
CS8412	8	19	11.2896 MHz	
CS8414	8	19	11.2896 MHz	
CS8415	20	10	11.2896 MHz	<b>Note:</b> Only valid if used in hardware mode
CS8420				
CS8427	22	10	11.2896 MHz	<b>Note:</b> Only valid if used in hardware mode
YM3623	14	12	16.9344 MHz	<b>Note:</b> To be verified !!!!
TDA1305	41	40	11.2896 MHz or 16.9344 MHz	<b>Note:</b> Only valid if used in receive mode
DIR1701	6	11	11.2896, 16.9344 / 225792	<b>Note:</b> Only valid if used in PLL mode (pin 28 is low).
	Derive frequency from pins 14, 13		low / high high / low, high / high	

DIR1703: Equal to DIR1701 settings

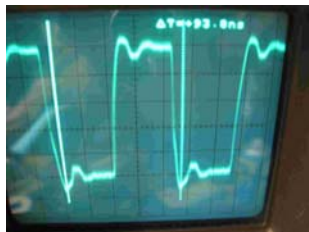
## Basic connection – Introduction

Below, an overview of the input receiver / filter section is given. Normally, the input receiver directly feeds the clock to the filter. This is the point that needs to be interrupted. Once interrupted, the bitclock out needs to be connected to the input of XO-DAC, and a specific output of XO-DAC needs to be connected to the bitclock input of the digital filter



## Basic connection – Rcv Clk in

If in doubt, we may verify if the marked pin is the right one. Connect the ground of the scope probe (10:1 probe required) to a ground point of the circuit. Set the oscilloscope at 200 mV/div and 50 ns timebase. Power up the DAC and put the probe at the predefined pin.



You should find a waveform similar to the waveshape at the left



Once located, the bitclock signal needs to be interrupted. The easiest way to do so, is to interrupt the trace coming from that pin, at a point where you can acceptably solder the new wiring, say few mm right after the chip pin. The green wire shall be soldered to the line, at the chip side. Solder the black wire to the ground pin of the chip, as listed in the table above. In the end it could look similar to the situation at the right.



**Note:** Another colour is used in the picture

## Basic connection – Clk Out1

Since you just interrupted the bitclock, the purple wire from the XO DAC board shall be soldered to the line, just at the other side of the interrupted line. Solder the black wire to the same ground wire as used above.

**Note:** It may be required to use thinner wire. New wire will be supplied with the second generation of XO-DACs

## Testing time

You are now ready with the basic connections; it is time to check the converter. Connect it to the system again, and switch it on. Give it some time to lock, as the new PLL circuit is slow, on purpose, you remember.....

## Additional connections - Clk Out2 and Clk Out3

In general, the DAC chip(s) inside your converter use the same bitclock, however the digital filter often generates it. This clock contains jitter as well. Therefore, XO DAC puts out 2 extra clocks, to directly clock the converters. Below a list of popular chips is given. Locate the converter chips(s) in your DAC, and look for the respective clock and ground pins.

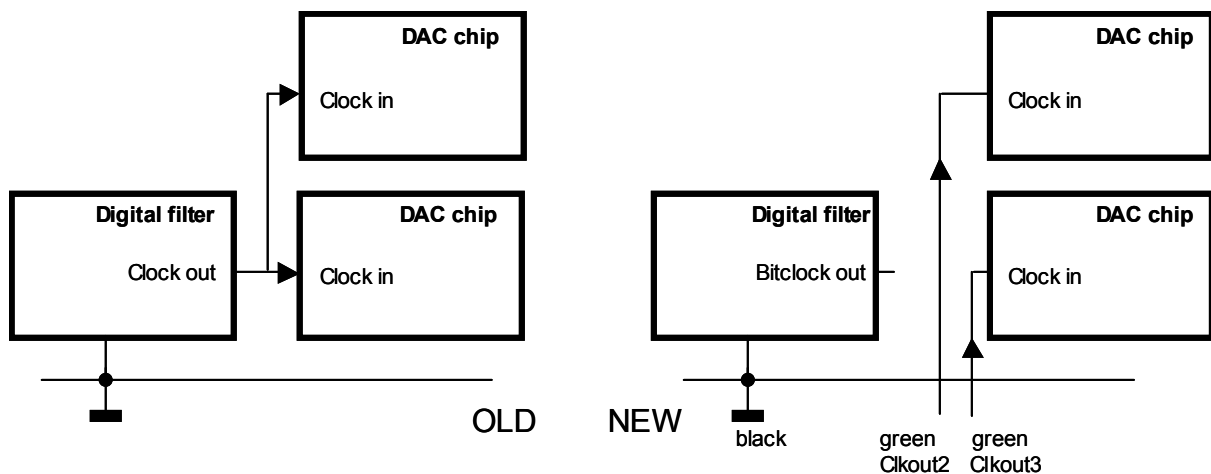
Chip	Ground	Clk in	Most used frequency
TDA1305	15	4	11.2896 and 16.9344 MHz <b>Note:</b> Depends on status of pins 7&8
TDA1311	4	1	
TDA1541	14	2	11.2896 MHz
TDA1543	4	1	8.4672 MHz
TDA1547	1	5&28	<b>Note:</b> Dual channel DAC with 2 clock inputs

TDA1549

PCM63            12        18  
 PCM1702  
 PCM1704  
 PCM1710

AD1860  
 AD1865            1        26

Once the correct pins are found, the line feeding these pins needs to be interrupted a few mm, again close to the chip. Now connect Clk Out2 (and Clk Out3 in case your DAC has 2 chips) to the clock input of the DAC chips. The drawing below may be of help.



Use twisted wire again, if possible green, to stay in line with earlier connections. Use black or brown for ground. At the right, an example is given how practice could look like, and Yes, I never told you it is easy to solder SMD components.....



**PLL sound out  
TENT link**

**Problem solving FAQ**

**Q** I installed the XO but after power up the disc does not spin

**A** It is very likely that your player does not receive the new clock

- Check if the power supply at the input of XO2/3 PCB is present when the player is powered up
- Check if the 2 jumpers J2/3 are present (should be at the inner positions)
- Check if the outgoing clock is fed to the input of the decoder / servo chip
- Measure if the clock is present at that position (oscilloscope required)

**Q** I installed XO3, but my DAC does not lock onto the new SPDIF output

**A** It is very likely that XO3 does not receive the original SPDIF signal from your player

- Verify if the SPDIF is present at the XO3 input (oscilloscope required)
- Check if the reclocked SPDIF is present at pin 6 of the IC

**Update**

I appreciate if you keep me update with data of chips that I did not list so far.