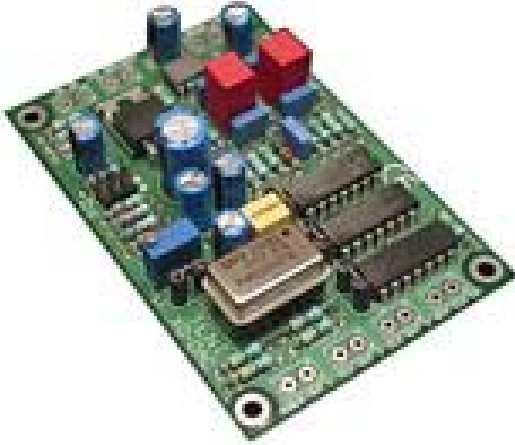


# TENT XO-DAC

## a low jitter clock upgrade for audio DACs



### Introduction

The sound quality of DACs is directly affected by the clock used for the DA conversion. A jittery clock degrades the perceived performance of your DAC. DACs clocked with lower jitter will yield lower distortion figures in the audio spectrum, which directly pays off:

- Lower grain
- More resolution
- Better transparency
- Cleaner sound
- Better bass

Most commercially available DACs suffer from a jittery conversion clock because the designs are based upon industry standard clock recovery circuits, producing typical jitter values up to, and over 200 ps.

XO-DAC is a small (50\*90 mm) module, intended to be retrofitted in your DAC. It offers a plug and play solution to effectively reduce the clock jitter in DACs.

### Principle of operation

XO-DAC module contains a secondary PLL, with a carefully designed low frequency low-pass filter. Within the PLL-loop a dedicated low noise Opamp drives a proprietary custom-made VCXO with low intrinsic jitter (3ps rms typical,  $1\sigma$ ). The resulting clock is one that nearly matches the quality of the VCXO itself, typically of typical 3 ps rms typical,  $1\sigma$ . Needless to state that this fully smokes the 200ps or more, of most commercial DACs.

### Design for low noise

All electronics on board of XO-DAC are fed with an improved version of a low noise power supply. It now exhibits a staggering low 5 nV/Sqrrt. Hz noise level within the critical range of 20 Hz to 100 kHz.

That is 30 times more quiet than an average LM317 based voltage regulator, just to give you a hint of what I mean with "low noise".

Needless to say that all active stages have their own decoupling capacitor, and a novel compound RF series impedance towards the supply rail. It keeps it clean from RF currents generated by the clock and the logic circuitry on board of XO-DAC.

### Measured data

The proof of the pudding is in the eating. Measurements clearly show you the impressive improvements made with XO-DAC.

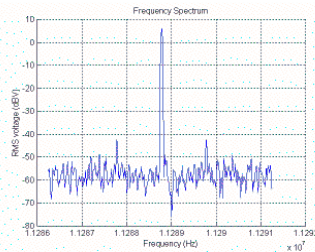


Figure 1

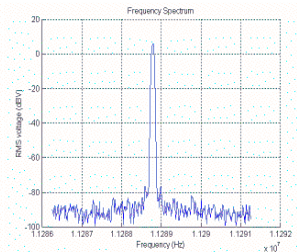


Figure 2

Please note that above measurements differ in amplitude ranges. It is the least commercial way to represent the data as it actually compresses the differences, but it is the way the whole spectrum is captured by the time the measurements were carried out.

Just follow me through the levels, and you'll understand. In both cases the DAC was fed by an SPDIF signal containing 1 kHz at 0 dBfs data.

Figure 1 shows the spectrum of masterclock output of the industry standard input receiver (Crystal CS8412) pin #19. The measured noise floor is at an average -58 dBV while the data related jitter comes through at -43 dBV (at 1 kHz distance from both sides of fundamental).

Figure 2 shows XO-DAC clock output, when fed with the clock signal from pin #19 of the Crystal chip. The noise dropped to -91 dBV whereas the data related jitter is down to -82 dBV.

Conclusions:

- Wideband noise decreased by 33 dB!
- Data correlated residual decreased by nearly 40 dB!

### Available frequencies

Available from stock are 11,2896 MHz and 16,9344 MHz. Both match most industry standard input receivers, however if required, other frequencies can be applied in the same design, and will be made available from stock as soon as request raises.

### Pricing

XO-DAC retail price is set at € 239,- This includes VAT but excludes shipment and payment cost.

### Build quality & warrantee

XO-DAC sits on a double-sided PCB with ground-plane, to ensure signal integrity and maintain low jitter levels.

XO-DAC Comes fully assembled, tested and adjusted with a 5-year full warrantee.

### Orders and information

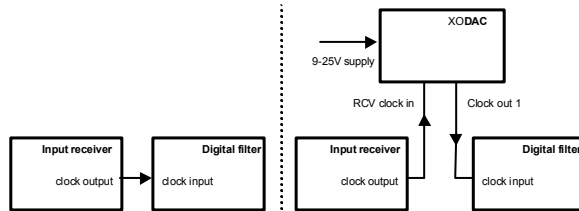
Send an E-mail with your questions or orders to:  
[XO.info@iae.nl](mailto:XO.info@iae.nl)

### Generic instructions for mounting

XO-DAC comes with generic mounting instructions, including pin numbers and outlines of most applied input receivers and DAC chipsets. Below the basics of installation are shown already.

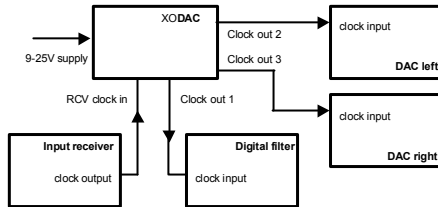
### Connecting XO-DAC

Below left the traditional industrial implementation is shown, whereas the right picture depicts how to insert XO-DAC in your converter.

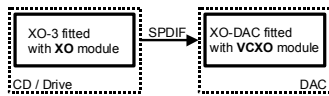


Additionally, extra clock outputs from XO-DAC may be used to directly clock DAC chips, rather than doing so via the digital filter or other digital circuitry, which very likely messes the performance.

This option is shown below. Its' feasibility depends on the DAC chips in your DAC - try it, highly recommended!



So far, it is still assumed that the VCXO within XO-DAC is used as the master oscillator. It is controlled by the PLL within XO-DAC. By doing so, the jitter results into some 10 ps rms, 1σ.

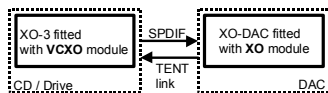


### Alternative configuration

For CD players or drives, I offer XO-3. That is a low jitter clock and SPDIF relock circuit, which greatly enhances the quality of your front end.

If your CD player or CD drive is already equipped with an XO-3 clock module, or you intend to do so, the ultimate alternative is to swap the XO and VCXO (but leave XO-3 and XO-DAC boards and their connections in place). In addition, a simple interconnect (TENT-link) is required, feeding a signal back from the DAC to the CD player or drive.

The configuration becomes then::



### Advantage

The advantage is that we now have a free running oscillator (XO) at the DAC side, which is not pulled by the PLL anymore. It results in jitter values of typical 3 ps rms typical, 1σ.

The actual conversion within the DAC, which is most important, is now carried out with the lowest jitter possible.

The CD player drive is synchronised by the PLL in XO-DAC, which pulls the VCXO inside the player. The signal in-between is very low bandwidth, and sufficiently filtered at both sides, so a simple 2-wire interface can be used.

### Extended mounting instructions

Instructions, with photo's, pin information of popular chips and extended explanations will follow in a short while.

### Feature

XO-DAC contains a diagnostic output, to be connected to an audio amplifier / speaker set-up, or a spectrum analyser. This output supplies you the demodulated, recovered clock from the input receiver.

Demodulation is carried out, of course, with the clean VCXO clock.

The remaining signal is actually the low frequency content of the jitter spectrum around the clock frequency, it is simply mixed down to 0 hertz and as such you can effectively hear the jitter content.

### What can I do with that output?

You can judge the quality of the front-end (CD player or drive, and interface), by connecting it to an audio amplifier, or spectrum analyser. It helps you improving your drive as it enables you to actually LISTEN to the jitter generated in that drive.

### Other TENT products

For those not yet familiar, I would like to point out that I also supply low jitter clock oscillators for CD players or CD drives, like the before mentioned XO-3.

These come in a variety of versions, starting with a price attractive DIY option (called XO), and the range finishes with a fully assembled and tested ready-to-use module (XO-2 or XO-3). Please apply for more information.

### Future products

The following products will be launched in short future:

- Mains power supply for XO products  
This dedicated supply will fit to all XO modules. It features low noise Schottky Barrier diodes, a swinging choke input filter which shows a constant AC load to the transformer and a high quality Black Gate capacitor to reduce the last part of the grain that often stems from the mains power. Available for both 115V and 230V mains voltages.

- Nippon SM5842 digital filter emulator  
A plug-in unit, that replaces the SM5842 digital filter chip, is available developed. The 5842 is often used in DACs. Its' drawback is the price (€ 100,- or more) and availability. Estimated sales price of the plug-in will be € 45,-. This plugin offers full SM5842 functionality and more !

### Orders and information

Send your E-mail to [XO.info@iae.nl](mailto:XO.info@iae.nl)