Aletheia dac-1

A superlative quality 16-bit non-oversampling D to A converter

Manufactured in Wales by Vertex AQ Limited

Background

Aletheia is a new brand of electronics produced by the design team at Vertex AQ. The dac-1 is a high-end, 16 bit, non-oversampling (NOS) DAC of superlative performance.

To understand the dac-1 we need to look first at the development of Vertex AQ, a company that produces a range of accessories covering mains, cables and supports. Their USP is based on the reduction of systematic interaction faults caused by RFI/EMI[1] and microphony. When Vertex products are applied to a hi-fi system, significant gains are achieved. But the design process employed for the Vertex products always started at the electronics inside the box. So the next logical step was to take the 'systematic thinking' inside the box and through every internal process, in just the same manner as at a system level.

Over the past 3 years, the level of development in digital and analogue processing has increased within the company, driven by the desire to apply the proven techniques of the Vertex approach, and the skills and knowledge acquired through our more general research work. This has led us to the dac-1.

Key Design Criterion

The dac-1 employs 16 bit D to A conversion with no oversampling in order to reduce processing complexity. No software or hardware noise shaping, or filtering is used to avoid break-down of signal integrity, phase shifting and filter ringing. So lets be clear here, the dac-1 is deliberately a very basic DAC in processing terms, with the majority of the design effort focussed on reducing systematic interactions right down to a component level. But the essence of the dac-1 development pivots around the desire to prevent systematic interactions around the player, down to a component-by-component level.

There is extensive RFI suppression throughout the design - all internal wiring is fitted with EMI absorptive tubing, and all wiring downstream of the mains transformer is solid-core silver. The major components in the design (mains transformer, pre-regulator, DAC board) are housed in separate modules, each with EM absorptive linings and acoustic absorption. Within these modules is extensive acoustic absorption right down to individual components. The mains transformer and pre-regulator are housed in separate, compliant mounted modules, with extensive EM absorption. The mains input has a built-in 'HiRez Jaya' shunt filter, and input/output signal lines each have an internal RFI/acoustic absorption module fitted, and signal sockets are mounted on isolated sub-panels.

An ultra high-speed, dual-stage power supply topology is used. A pre-regulator feeds 4 discrete component second-stage regulators to separately feed each processor supply. Each analogue output is taken straight out of the DAC chip and converted to a voltage signal passively, across a high quality resistor (passive I/V) to avoid any additional active output stages. Output capacitors are the outstanding Mundorf Supreme (silver/gold in oil).

The balance of engineering decisions for the dac-1 is based more around time domain thinking, not frequency domain thinking. The core processing is simple 16 bit non oversampling with no filtering. In our view the problems that filtering brings are worse, in sound quality terms, than any residual aliasing or sampling noise. The filter ringing problem and phase shifting seems to directly affect the musical performance quite significantly, whereas without filters, any residual high frequency sampling noise does not seem to do any damage to the listening experience, much the same way that vinyl surface noise is quickly ignored.

Our experience has shown us that the systematic faults are far more crippling to performance than most people imagine. The biggest issue is these effects are closely linked to the musical programme, breaking down the structure of the music. We have seen these effects in the measurement alliance[2], and in essence these systematic faults prevent the system from correctly tracking the desired output in the time domain. In our view the musical envelope is broken down and re-mixed into a lower level of reality by too much processing. So, by avoiding as much processing as possible, and minimizing systematic faults at every possible point within the dac-1 design, we believe we have a DAC that outputs very closely the intended waveform - in the time domain.

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[1] RFI = Radio Frequency Interference - high frequency signals carried within and around conductors
EMI = Electro Magnetic Interference - high frequency radio waves transmitted/received through the air between conductors

[2] Research project between Vertex AQ, Nordost and Acuity Products. See www.vertexaq.com and click on Projects > Knowledge Alliance.

Sound Quality

Most digital replay gets blurred and confused when playing complex material, mixing and intermodulating the musical programme in a very obvious way. With the dac-1, the complex threads and intertwining harmonic 'fibers' of dense passages remain clearly separated and accurate. As the intensity of the music increases, you hear a dazzling display of performance and emotion deep into the mix thats incredibly easy to follow. This ability regularly reveals things you never previously heard in your recordings.

Another clear indication of the lack of systematic distortion is the way music from the dac-1 images, and remains detached from the speakers. To explain a bit more, if you play a string quartet piece, well recorded in a nice ambient environment, the image should be spread well around behind the plane of the speakers. When the dac-1 plays the piece, the sound is clearly in the soundstage, and remains there. With lesser sources, parts of the music (particularly with lots of treble content like strings) collapse back onto the face of the speakers.

The next huge advantage with the dac-1 is the vibrancy and richness of the midband, and a total lack of harshness to leading edges. You get a completely realistic sense of the body of instruments - nothing sounds washed-out. And sounds clearly stop and start in a totally incisive, yet completely smooth manner.

And finally there is a significant improvement in the way the dac-1 conveys the energy envelope. Most D to A processing seems to accentuate quieter passages, making them seem artificially spotlit, then as the music builds, it gets to a certain level then wont go any further without quite an obvious increase in distortion levels. With the dac-1 the music scales up and down over a huge range, and remains stable and listenable over its whole output.

Overall, due to the ability of the dac-1 to track accurately, there are huge benefits when playing complex, dense material. Most digital replay gets blurred and confused with such material, mixing and intermodulating the musical programme in a very obvious way. Conversely with the dac-1 the complex threads and intertwining harmonic 'fibers' of dense passages remain clearly separated and accurate. The listening experience is hugely improved with a dazzling display of musical interplay that remains easy to follow. In these situations other equipment clearly loses the plot.

More about tracking.

In our work in the knowledge alliance one of the main drivers was the measurement of the huge improvements brought about by the vertex AQ accessory equipment. As we progressed with this work we were indeed able to see significant amounts of time related errors and that these errors were, predominantly, related to the musical program being played. Looking in the time domain we can see the actual analogue output deviating from the source data quite significantly and that this deviation is proportional to the level and complexity of the signal. In other words, whilst a conventional player might supposedly output it's signal with an error below it's specified noise limits of say +/- 1/2 of the least significant bit (LSB) (ie quantisation noise) when playing a tiny sine wave, there are much more significant processes driving its output well off target when playing complex music (and nobody ever tests with complex music).

The 'Vertex' Point of View

Another way of looking at the dac-1, and perhaps better understand the balance of investment within the product, is to consider it in it's 'Vertex component' guise. There are 2 main elements to this approach:

1. Protecting the DAC process from the outside world.

Although not in the normal heavy aluminum boxes found on the Vertex cables, there are many Vertex modules inside the dac-1. The internal mains feed is fitted with a HiRez Roraima and HiRez Jaya. The S/PDIF input wiring is fitted with a HiRez illimani, and the analogue output wiring is fitted with a pair of HiRez Solfonn modules. Furthermore, the signal input and output sockets are physically decoupled from the back panel to reduce ingress of chassis vibration into these delicate circuits.

2. Isolating the different elements of the DAC processes from each other.

Once we get into the core of the dac-1, the thinking is then applied to the mains transformer, and all the way through the pre-regulation and second-stage regulation - every step of the power supply is vibration and RFI treated with HiRez techniques. Every element of the core digital processing and the analogue output stages equally has extensive HiRez acoustic treatment and RFI absorption techniques applied.

Positioning

The dac-1 should ideally be positioned on a good hi-fi shelf or rack. If a specialist hi-fi rack is not available, a high-quality shelf unit should be used. Even more performance can be achieved if the dac-1 is placed on a Vertex AQ Kinabalu support system.

Users should avoid degrading the performance of the dac-1 by placing it on top of other electronics boxes such as transports or amplifiers. Also, care should be taken with positioning to ensure that cables lead away from the unit without being pinched, trapped or bent in tight radiuses. Avoid cables having high-load contact with rack uprights, or walls to the rear or sides of the hi-fi.

Connectivity

Mains is fed to the unit via a high-quality IEC inlet socket on the right of the rear panel. Use a high-quality mains lead. The mains power on/off switch is situated above.

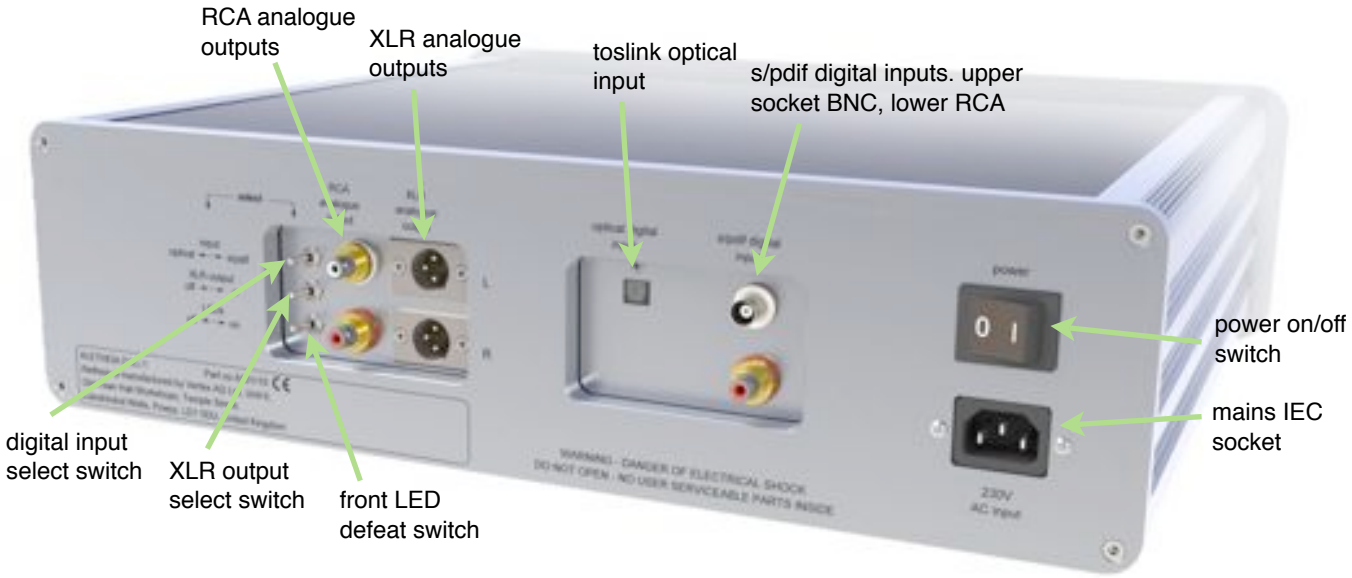
Digital input is via the decoupled sub-chassis panel in the centre of the rear panel. S/pdif can be input via BNC or RCA sockets. Toslink can be input via the optical socket.

Analogue output is via the decoupled sub-chassis panel to the left of the rear panel. RCA analogue outputs and XLR analogue outputs are provided.

Configuration

The left hand decoupled sub-chassis panel is also fitted with 3 switches.

- The top switch toggles between optical input or the s/pdif electrical coaxial input (BNC or RCA). Set to required input.
- The middle switch disables or enables the analogue XLR circuitry. Set to on if using the XLR outputs, set to off if using the RCA outputs.
- The lower switch gives the option to defeat the front-panel LED lamps.



Use

The front panel 'power' indicator is lit when the unit is receiving power. The front panel 'error' indicator is illuminated when the unit is not receiving data. When the unit receives a digital data stream (16 bit, up to 96KHz), the lamp will extinguish.

The unit is internally fused. If it ceases to operate, inform your dealer.

Cleaning. Use only a soft dry cotton duster to clean the case. The perspex top may be polished with a specialist perspex cleaner. We recommend socket contacts are cleaned occasionally with Caig Deoxit.

Features Summary

Inputs/Outputs

- S/PDIF (75 Ohm) and toslink optical
  - 16 bit, 44.1 to 96KHz
  - SPDIF RCA input WBT silver nextgen socket.
- Analogue single-ended RCA outputs. WBT silver nextgen sockets.
- Analogue balanced XLR outputs. Gold-plated Neutrik XLR sockets.

Rear panel

- Analogue and digital input and output sockets mounted on isolated sub-chassis panels.

Internal digital input topology

- SPDIF
  - Silver-plated copper co-ax feed.
  - HiRez acoustic absorption module with full RFI/EMI absorption.

D to A engine

- Digital interface DIR 9001.
- DAC TDA 1543 (current output).
- Non-oversampled.
- No digital noise shaping.
- No output filtering.
- Passive output current-to-voltage conversion (I to V) across Vishay non-inductive thick film resistors (matched pair).
- TDA 1543 reference voltage set by Vishay non-inductive thick film resistor.
- Decoupling capacitors are Sanyo Os-Con.
- All significant components fitted with direct coupled acoustic absorption.
- Housed in poly box with EMI/RFI absorptive lining.

Analogue output topology

- Output wiring is solid-core silver with unbleached cotton insulation.
- Output capacitors are 4.7uF Mundorf MCap Supreme metallised polypropylene silver/gold/oil (99% silver/1% gold), with dual induction-free windings.
- Dual acoustic absorption modules on output lines with full RFI/EMI absorption. Output capacitors and XLR circuitry within. All mounted directly on acoustic absorption labyrinth.

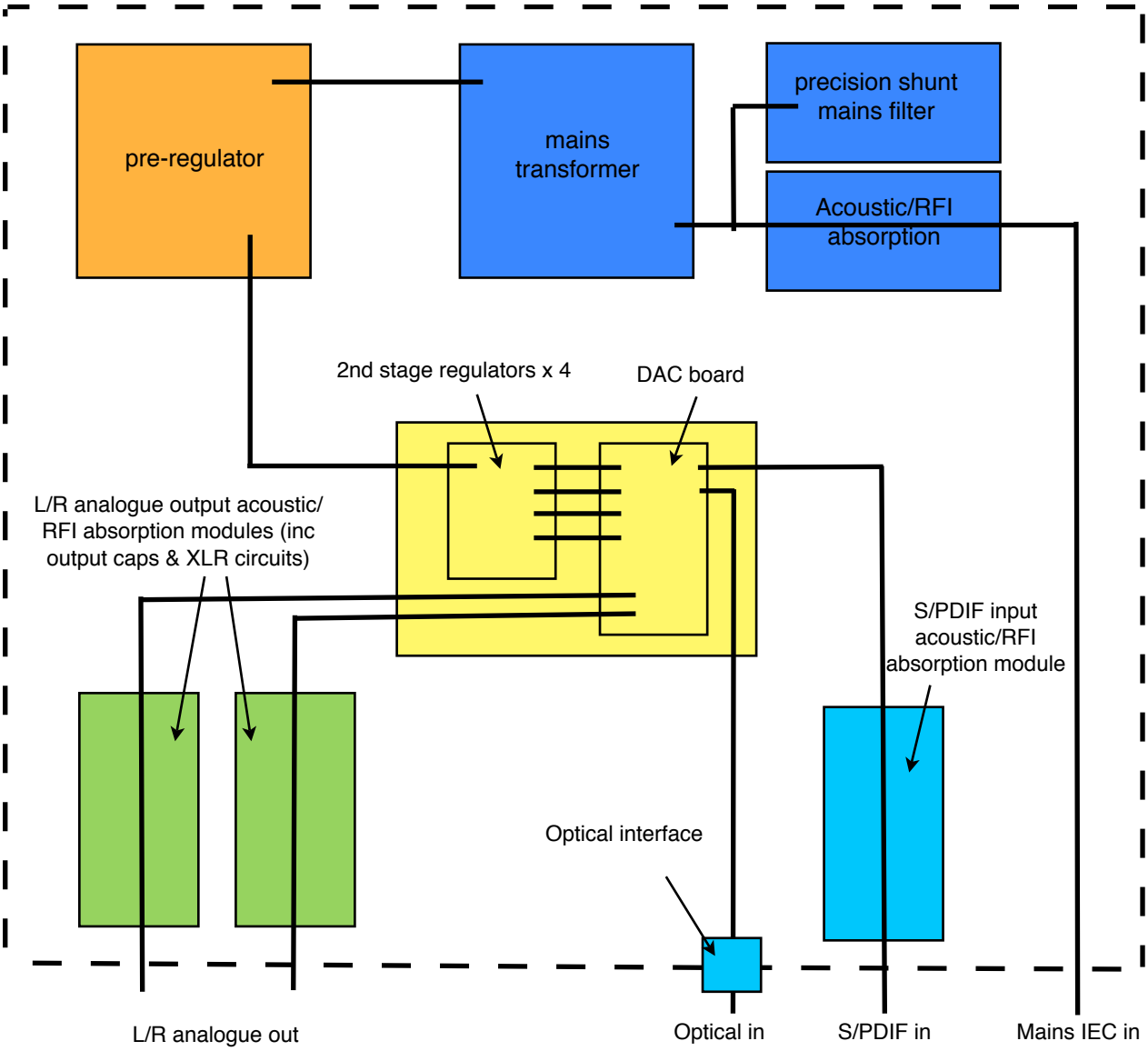
Mains

- Furutech rhodium plated IEC inlet.
- hi-fi tuning mains fuse. 500mA slow-blow, internally mounted.
- Internal mains wiring fitted with acoustic and EMI/RFI absorption module.
- Input mains shunt filtered with high performance passive filter (HiRez Jaya).
- 100VA toroid transformer module.
  - Transformer housed in compliantly mounted poly box with EMI/RFI absorptive lining.
- Power consumption - less than 20W.

Power supplies

- Input mains wiring is silver-plated OFC.
- All ac and dc wiring downstream of transformer is solid-core silver with EMI absorptive tubing.
- Pre-regulation.
  - Input 15Vac, output regulated 13Vdc
  - Housed in compliant mounted poly box with EMI/RFI absorptive lining.
  - Ultra high-speed discreet component regulator with extensive surface-mount components and Panasonic FC and Sanyo Os-Con capacitors.
  - All components fitted with direct-coupled acoustic absorption.
- Second-stage regulation.
  - Ultra high-speed discreet voltage regulators with extensive surface-mount components, Panasonic FC and Sanyo Os-Con capacitors.
    - Three shunt regulators for digital sections
    - One series regulator for analogue section.
  - All components fitted with direct-coupled acoustic absorption and EMI treatment.
  - Pre-regulator and second stage regulators are all Paul Hynes Design modules, heavily modified by Vertex AQ.

The diagram below is a simplified schematic of the dac-1, showing the main modular components that are incorporated within the unit.



If you have any further queries about the dac-1 then please do not hesitate to contact us. Please use the feedback form on the website or use the details below.

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