



# Heritage DAC *MP2*

*Technical Specification*

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## THE HERITAGE DIGITAL TO ANALOG CONVERTER PROJECT

This project has come a long way, maturing from a concept to a reality. It all started with a single question: “What is the true potential of CD audio?” However this question is just a shortcut for our underlying reflection. In today’s world of compressed digital audio, questionable digital audio, digital rights management and uncertain future of DVD Audio and SACD, CD remains as our primary choice of premium audio recording. The question here is not only about how good a digital medium can be but also what musical treasures this very medium is capable of revealing.

Well, listening to a perfect test signal like a 1kHz sine wave, even in ultra-high digital definition has never provided anything like a musical experience! It is thus of limited interest to run after the latest (uncertain) digital formats if what you are looking for is the emotional experience of a live act.

Based on the above thoughts, Orpheus decided to launch the HERITAGE project with the single goal of bringing the listener closer to the only point of reference: the concert hall. The first unit to materialize is the HERITAGE Digital to Analog Converter (in short HE-DAC). No matter how high the definition of digital media may be, our ears are still analog and the digital information needs to be converted to analog in order to be heard (at least today and in the near future). So we decided to start here: right at the bridge between the digital and the analog domains. Further HERITAGE products will follow but this is another story.

Orpheus then gathered extremely talented engineers and long term audiophiles and asked them to closely work together to create a digital to analog converter capable of exploring all the emotional content of a high quality recording. We asked the engineers to go beyond pure science and measurements. We asked the audiophiles to forget about hi-fi and to concentrate on music. Like the two sides of one coin, the two teams worked together, flipping between measurements and listening sessions, to create the HE-DAC masterpiece. Music was the goal without regard to price.

The result is an extraordinary piece of audio engineering with a heart and soul. It combines state of the art digital signal processing with highest quality analog components. The same care taken in the power supply section as in the audio section. Frequency domain behaviour and time domain behaviour are optimally balanced. HE-DAC is not a flashy product and it won’t appeal to those impressed by easy effects. HE-DAC is for the true music lover, not the technocrat (even though he would probably be impressed by the electronic design); it is for the one who is a connoisseur, the one who knows and feels the unique emotion of a live concert.

## **THE HERITAGE DAC TECHNOLOGIES**

Designing a reference grade digital to analog converter is a very exciting engineering challenge. Indeed it is blend of multiple technologies: digital processing, analog processing, clocking and power supply. All these four pillars are equally important in the achievement of the design of the ultimate digital to analog converter.

### **THE DIGITAL SECTION**

The entire digital section is based on an asynchronous audio clocking approach where the audio data are sample rate converted to a local low jitter clock source.

#### ***DSP (Digital Signal Processing)***

The recovered clock signal and data are directly transferred from the receiver chip to the three DSP modules. The first module performs asynchronous sample rate conversion to 384kHz based on ANAGRAM Technologies' Q5™ algorithm to synchronize the audio stream to the local low jitter clock providing a stable time reference for the D/A conversion. The other two modules condition the signal for the D/A chips using a proprietary algorithm (more on this below).

#### ***Digital to Analog Conversion***

The conversion section of the HE-DAC uses 4 D/A converter chips with differential current outputs used in mono mode per channel. The dual signal conditioning DSP modules condition the signal for the D/A converter chips by additional up-sampling and by providing a (slightly) different signal to each D/A chip, but summing up to the original signal. At the output of the D/A chips, the positive phase outputs of two chips are added to the negative phase outputs of the opposing pair. The same happens with the other phase outputs. This results in a total of eight current outputs per channel allowing a high current design of the analog section.

#### ***DSS Architecture***

The entire system is based on a DSS (Data to System Synchronization) architecture. In a DSS architecture all processors inside the system operate at a synchronous rate with the (sample rate converted) audio data stream. All switching noise induced by the processors is therefore synchronous to the new audio sampling rate. As a result, "asynchronous switching noise", which usually contaminates analog signals after the D/A conversion, won't be present.

## THE ANALOG SECTION

The analog stage of the HE-DAC was designed primarily around the principles of high bandwidth and simplicity. The complete analog stage is fully balanced and utilizes two I/V and two gain stages per channel (one for each of the balanced halves). HE-DAC is thus optimized for balanced operation and the XLR socket becomes the preferred connection.

### ***a. The Current to voltage (I/V) stage***

The I/V stage is built differentially using ultra-low noise op-amps and the highest grade “Vishay” resistors as well as ultra-low ESR “Leclanché” capacitors. The I/V stage is usually where most of the audio signal degradation occurs due to time domain artefacts. It is thus critical to design ultra-wide bandwidth I/V converters that do not introduce time domain distortions from insufficient speed. The Heritage I/V stage always operates under high current conditions and is biased in pure class A. The I/V conversion stage employs individual discrete regulators to provide the cleanest possible power for each supply. These regulators are extremely fast, in order to avoid time domain distortion introduced by slow reaction of the power supply.

### ***b. Gain stage.***

After the I/V stage, the audio modulation is directed to the gain stage. We actually prefer to call it an *impedance adaptation stage* in the case of the HE-DAC because the audio modulation reaching it post I/V is already at full swing. These impedance adaptation stages offer high input impedance and low output impedance to minimize sensitivity to the final load (the preamplifier input). They are also built using ultra-low noise op -amps, “Vishay” resistors and “Leclanché” capacitors. The individual power supplies are all fitted with our custom discrete regulators.

## THE CLOCKING SECTION

Accurate D/A conversion can only be achieved if a high quality low jitter clock is used for this process. Indeed digital data is “timeless”. It is a set of bits representing certain information. The process of D/A conversion of a PCM signal requires two things: generating a current (or voltage) proportional to the digital code and generating the corresponding time base. The first is obvious and well known, whereas the second is often overlooked.

It can be illustrated by playing an audio file (not *audiophile*) from a PC. The file on the PC’s hard drive has no real time information in it. However when you listen to it, it is a time based event and a time reference for the music has been created. The clocking section of the HE-DAC has been built around the principle of lowest jitter possible time base generation. If errors are present in the time base (jitter), these will reflect in sound quality degradation.

In the HE-DAC, the asynchronous upsampling process completely decouples the audio data from the incoming audio clocks and is made synchronous (regenerated) to a local master clock acting as a time base. This local master clock also drives the D/A converter chips where the jitter needs to be minimized. The clock used for the D/A conversion process (the only place where jitter actually matters) is thus not the possibly jittery master clock recovered by the receiver's PLL but the local master clock. The HE-DAC, uses an ultra-low jitter TimeLock™ clock as local master clock. This same clock is used to clock all the switching ICs (DSPs, D/A, Latches, CPLD,...) resulting in a full DSS architecture.

## THE POWER SUPPLY SECTION

The power supply section uses a novel type of custom discrete regulators which remain very quiet and fast during balanced operation. Each active element in output stage runs off its own dedicated regulators to provide ultra-low clean DC to the analog circuitry. The Heritage uses a dual-mono power supply with two 180VA toroidal transformers. The reservoir of energy allows the power supply to provide enough current on demand, and most importantly: in time when it is needed. The digital section has its own regulated supply as does the clock section. We use very high quality PCB with gold-plated traces and we implemented dedicated rails for various power supplies and ground paths.

## THE CHASSIS

The final dual chassis was developed by acclaimed industrial designers and is built by specialized subcontractors in the Swiss Watch Valley to the highest mechanical quality standards. Even the footers underneath the casings are a completely new design and custom fabricated.

## AND THE AUDIOPHILES....?

After all this tech-talk, what do the audiophiles say? We are, of course, very proud of the musical performance of the HE-DAC because, at the end of the day, only the ability to wake-up your emotions counts. So instead of false modesty or blind superlatives, we prefer to let others do the talking for us:

“When it comes to live recordings that involve heavy participation by audiences, the Heritage DAC takes me into previously uncharted terrain. The audience now is no longer detached from the soloists. I am not describing a High Definition TV experience where you can see the musical pictures in extreme hyper-realist focus. Instead, I am talking about an *enveloping* experience as if the listener could go back in time and sit among the original attendees. The Heritage indeed possesses such spatial resolution power provided the room acoustics are conducive.

No matter when and where the live recordings were cut, playback via the Heritage -- spanning the Weavers, Belafonte and the Dave Brubeck Quartet in Carnegie Hall of the 50s and 60s to the *Old Friends* tour of Paul Simon and Art Garfunkel in 2004 in the US to *From Beyond/Eason Chan Live* in the Hong Kong Coliseum in 1991 and 2005 -- always triggers a tremendous emotional reaction in my mind, particularly during those live recordings in Hong Kong which I attended. The Heritage brings back many precious memories of the past, making me think of old friends whom I met during the olden days. Who knows, my voice could have been recorded as one of the many in the audience section of the *Beyond* and *Eason Chan* concerts. I may be sitting together with the old me listening to the very same concert now. How is that for emotional realism? »

Linnman, [www.6moons.com](http://www.6moons.com)

« Compared to a top performance DAC, the Heritage DAC conveys new specific and desirable features to the music:

- The sound is much more relaxed, revealing the natural flow of notes coming from the instruments and voices.

This is especially obvious for strings, which, for the first time in my own experience, express their natural silky sonic texture clearly perceived when going to a concert (e.g. listening to *Il Giardino Harmonico*).

- The entry of instruments and attack of notes are much cleaner than usual, which results in a much more realistic soundstage and an unknown sense of depth combined with a precise and rock-stable localisation of instruments.

- Movements of performers are easily perceived.

- Acoustics of the room or hall are clearly conveyed.

- Micro-dynamics are respected. The musical message and the source of surrounding noises become obvious, which prevents listening fatigue (avoids brain torture).

Overall, this DAC provides unmatched transparency and musicality. It reveals all the subtleties that drive profound musical emotions. »

*Ph. Montavon, audiophile and golden ear*