ZeroUno SSD

Digital to Analog Converter (DAC)
&
Preamplifier with an integrated DAC

Technical Description

CanEVER AUDIO®

INDEX

∞ *Introduction*

ZeroUno ᵢₛₛᵈ   is   a preamplifier with integrated the *ZeroUno* ᵢ𝒹ₐᵢ, where the output stage is a Solid-State stage designed   by CanEVER AUDIO® with the same design philosophy as that of the *LaScala PowerAmp,* Best Amplifier of 2019 selected by Mono&Stereo https://www.monoandstereo.com/

At the time, when the *ZeroUno* ᵢ𝒹ₐᵢ was introduced, the main design goals of CanEVER AUDIO® regarding that product have been explained in detail. Now the *ZeroUno* ᵢₛₛᵈ   comes with all the building blocks making the *ZeroUno* ᵢ𝒹ₐᵢ a great digital preamp, while adding a high-end analog preamp section with two analog inputs inside the same cabinet.

The *ZeroUno* ᵢₛₛᵈ can be used as a DAC but can act as the central preamp in a modern high-end audio system to connect all kinds of digital AND analog sources!

∞ *Quick Overview*

The *ZeroUno* SSD is a high-end pre amp, which can handle all kinds of digital and analog sources.

All analog input signals are operated by a separate circuit implemented in one additional board stacked to the main board of the *ZeroUno* DAC.

The analog input board comes with a dedicated power supply and works totally independent from the digital circuit of the DAC section.

In addition to the digital inputs of the *ZeroUno* DAC there are two pairs of single ended RCA connectors for analog sources available on the backside of the *ZeroUno* SSD.

The digital interface of the *ZeroUno* SSD is exactly the same as that of the *ZeroUno* DAC. There are digital inputs for S/PDIF signals via RCA, XLR (AES/EBU), TOSLINK or USB in MQA, PCM and DSD formats. A true 75 Ohms input via a BNC connector is optional as a replacement for the AES/EBU input.

Both analog and digital signals, managed by the *ZeroUno* SSD, are operated by the same Solid State output stage already introduced for the *ZeroUno* DAC-HPA.

All input signals are coupled to the volume control by interstage transformers custom made by Lundahl for CanEVER AUDIO®.

The volume control module works 100% in the analog domain for both digital and analog input signals. It is based on a ladder network of pure 0.1% high precision thin film resistors for the lowest possible noise, channel separation and perfect balance between the left and right channel and independently from the volume level. In total there are 127 different positions for volume setting in steps of 0.5dB possible, reaching a dynamic range of 127dB!

In addition to the volume control, there is a level control implemented. This feature let the user adjust the signals from all analog and digital sources to exactly the same level to avoid any increase or decrease in loudness while switching between input channels. The level can be adjusted in steps of 0.5dB in a range of -26 to +17dB.

Each input channel can be activated or muted. So the user can toggle between only those input channels, which are actually connected to a source. Or, if the user wants to compare the sound quality of two different inputs (e.g.: analog records vs digital sources), he can mute all input channels beside those two, which he would like to compare and switch only between them.

To switch between the active input channels the user can push the INPUT button on the front plate or use the MENU button on the RC.

Following the volume control stage is the heart of all *ZeroUno* products, the Solid State output Stage introduced with the *ZeroUno* DAC-HPA :

> *a Solid-State Device (SSD), working in Pure Class A with a super-linear driver, **no** capacitors or integrated circuits in the signal path and **no** negative-feedback, with the ability to drive loads below to 600ohms.*

This Solid-State Device (SSD) at the output is designed as a small dual mono power amp running in pure Class A mode, which delivers an output power of 2,5 Wrms per channel. The SSD can drive any power amplifier, even if with a very low input impedance.

The output impedance is below 1ohm.

In total the signal path inside the *ZeroUno* $_{SSD}$ is very short and makes use of a minimum number of components for both analog and digital signals.

The final signal of the SSD stage is present via two pairs of single-ended RCA connectors or, optionally, with one pair of balanced XLR connectors (these last are optional).

To balance the output signal a pair of high quality transformers produced by Lundahl due to CanEVER AUDIO® specifications are in use.

Both pairs of output connectors can be used in parallel for bi-amping or to connect an active subwoofer.

Finally, an introduction about the power supplies implemented inside the *ZeroUno* $_{SSD}$.

Basically, the power supplies inside the *ZeroUno* $_{SSD}$ cover about 70% in number of components and board space.

The digital part of the circuit inside the *ZeroUno* $_{SSD}$ is exactly the same as that of the *ZeroUno* $_{DAC}$. It consists of 13 separate ultra-low noise power supplies fed by two toroidal transformers followed by a pre-filtering stage plus 13 discrete analog power supplies designed around four AD797 operational amplifiers.

The analog part of the circuit inside the *ZeroUno* $_{SSD}$ is based upon six independent power supplies and is designed with the same philosophy in mind as the digital circuit:
four dedicated toroidal transformers followed by four pre-filtering stages, two for the left analog channel, two for the right analog channel.

All analog and digital paths are rigidly separated and powered totally independent to avoid any interference or cross talk.

The toroidal transformers are over dimensioned to avoid any saturation and induction of noise.

∞ *Product Specification*

- The circuit of the *ZeroUno* $_{SSD}$ is based on four integrated hardware platforms: Cirrus CS3308/3318 Analog Volume Control, ESS Technology SABRE[32] DAC, XMOS XU216-512-TQ128 and Atmega1284p
- For optimum performance the hardware platforms run on a proprietary implementation of special developed firmware, stored in a flash memory, easy to update
- 2 motherboards based on a four-layer PCB with extra thick copper traces to achieve ultra-short signal paths with minimal wiring, to avoid electromagnetic induction of noise and to insure perfect grounding
- Discrete built power supplies for the digital and the analogue section using 6 toroidal transformers, last generation of ultra-low noise rectifier diodes and high quality audio operational amplifiers AD797
- Discrete built ultra linear power supplies for the output stage using four toroidal transformers with last generation of ultra-low noise rectifier diodes, double π filter, audio grade resistors and capacitors
- Dedicated discrete filters for digital noise suppression
- Comprehensive noise regulation for all analog & digital circuits
- Analog volume control with digital actuator, with a precision higher than 0.1%
- Voltage swing at the outputs, balanced and unbalanced, is 7.0Vrms / 20Vpp for the analog inputs. 4.2 or 8.4Vpp for the digital inputs. Standard – for the digital inputs - is 8.4Vpp
- On board output level setup to match different sensitivity of the direct connected power amplifiers
- Input impedance of the power amplifier not below 600ohm
- True Class A discrete built amplification Device with a super-linear driver, no capacitors or integrated circuits in the signal path, no negative-feedback with ability to drive loads below to 600ohms.
- Jitter free operation by patented high performance algorithm
- PCM and DSD digital roll-off filters as well as asynchronous sample rate conversion of the Delta-Sigma DACs are Voltage-compensated, ultra-low phase noise and low jitter crystal oscillators (clock) acts as master clock. Two separated clocks for sampling families of 44.1, 88.2, 176.4, 352.8 kHz and 48, 96, 192, 384 kHz
- DAC output stage with shortest possible signal path based on custom made amorphous audio transformers produced by Lundahl with first order discrete analogue filter for best THD and digital noise suppression
- Separately powered USB chip by a "quasi battery power supply" using a 1,0 Farad super-cap to avoid any distortion induced by the connected computer (no connection to the +5V powerline of the USB cable)
- USB input based on XMOS xCore audio chip with bit perfect transfer for 16bit, 24bit or 32bit data in PCM format up to 384 kHz including support for native DSD and DoP
- 4 Digital-Inputs: 1x USB 2.0; 1x S/PDIF RCA; 1x S/PDIF OPTICAL; 1x true AES/EBU 110Ohm XLR or (optional) true S/PDIF 75 Ohm BNC or (optional) i2S interface;
  - USB input compatible with following audio formats via PC and MAC:
    - PCM: 44.1; 48; 88.2; 96; 176.4; 192; 352.8 and 384 kHz up to 32 bits
    - DSD (DoP): 2.822 MHz │DSD64, 3.072 MHz, 5.644 MHz │DSD128
  - SPDIF inputs (AES/EBU, BNC, RCA) compatible with PCM signals from 44.1, 48, 88.2, 96, 176.4 and 192 kHz, up to 24 bits. The OPTICAL input accepts music files with a resolution up to 24/96 kHz
- Integrated Official, full features, MQA CODEC
- LCD Display with variable brightness, changing letter size for better reading from listening position
- Infrared remote control with direct function keys for volume, balance, absolute polarity, mute and input switch
- No drivers required for LINUX or MAC OSX - USB Audio 2.0 driver available for Windows XP/Vista/7/8/10
- Dimensions (W x H x D): 400 x 100 x 360 mm
- Weight: 11.5 kg
- Power Supply: AC 220-240 V~ (or alternatively 100-120 V~), 50/60 Hz
- Power Consumption: MAX 30W
- Infrared Remote Control: 38KHz - Standard CR2032 battery for the controller

∞ *Block Diagram*
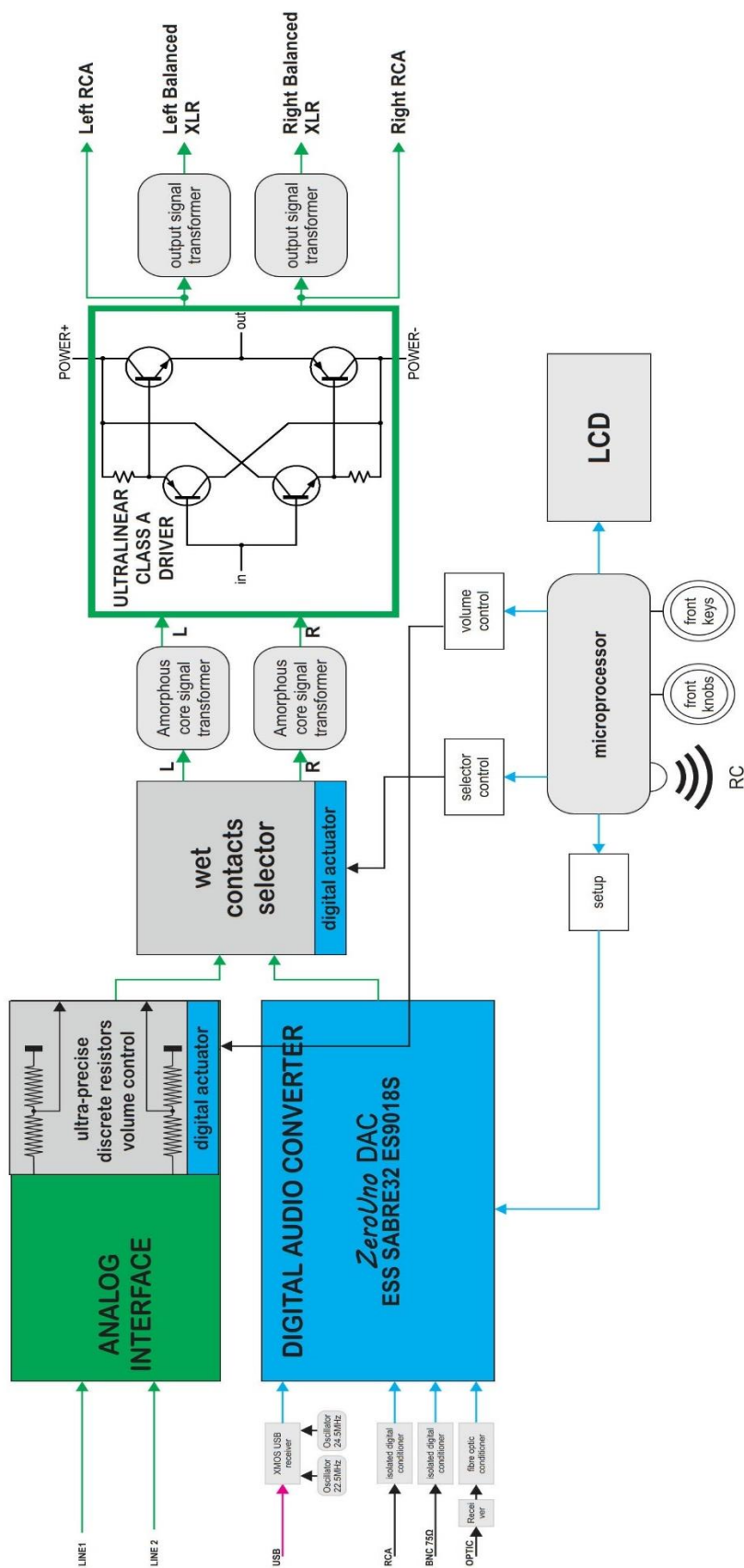
ZeroUno ₛₛ𝒹 split in blocks:

- *Analog Interface*
- *DAC*
- *Wet contacts Selector*
- *Interstage transformers*
- *2 resistors only volume control (ladder)*
- *Tube buffer with ripple cancelling*
- *Output transformers*

∞ *Motherboard*

In many audio products, one can see a number of individual printed circuit boards connected by numerous cables. The higher the frequencies of the operated signals in the circuit are the higher is the potential of negative influence on the signal quality by electromagnetic induction, e.g. into connecting cables.

In a unit like the *ZeroUno* SSD, which operates with digital input signals up to 12.288 MHz and low-level analog input signals with a useful analog bandwidth of at least 50 kHz, the electromagnetic induction can become a nightmare for the engineer.

The same is valid for the correct grounding of all the separate modules of the circuit to reduce any kind of hum to a minimum.

To avoid such problems, the whole circuit of the *ZeroUno* SSD consists of only two four-layer PCBs with extra thick copper traces, where one PCB is dedicated to the analog inputs only and the other for the digital interface and the output stage.

The separate PCB for handling the analog input signals avoids electromagnetic induction of noise and insures perfect grounding.

The SSD stage and its power supply is located on the main PCB.

Both PCBs use very short signal paths with minimal wiring. In both PCBs extra layers are reserved for the analog ground planes, digital ground separation and for the power lines of each stage for the best separation of the signals.
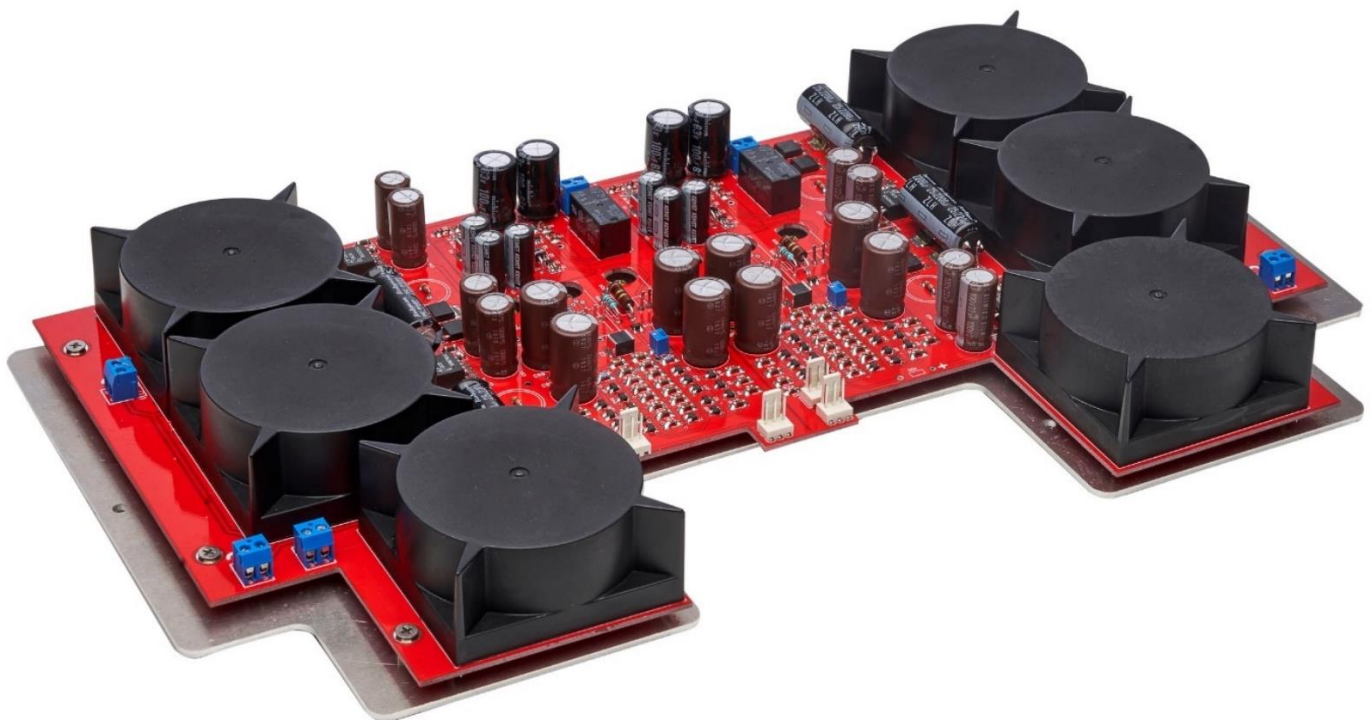
Fig. 1: The Solid State Device (SSD) - True Class A discrete built amplification block with a super-linear driver, no capacitors or integrated circuits in the signal path and no negative-feedback with ability to drive loads below to 600ohms.

Fig. 2:   The main board of the ZeroUno $_{DAC}$ bused also in the ZeroUno $_{SSD}$

∞ *Interstage Transformers*

Switching between the different analog and digital input channels is done by a set of wet-contact relays. These relays are totally sealed and the contacts are free of any spike and oxidation to guaranty perfect signal transfer for a long period in time.

The relays connect the signals of the selected input directly to a pair of high performance amorphous core step up interstage transformers. This results is a minimum number of components in the signal path, which so is as clean and short as possible: no capacitors, no resistors and no active components … only a single transformer for each channel!

The interstage transformers are produced by Lundahl due to CanEVER AUDIO® specifications.

The coils are wounded around an amorphous core resulting in high sensitivity. There is no loss of any detail of the signals even at very low levels. The very special wounding of the transformers guaranty a perfect transmission even of very low frequencies. Furthermore, the transformers perform very linear across the audio band and even more important, within the human audio bandwidth.

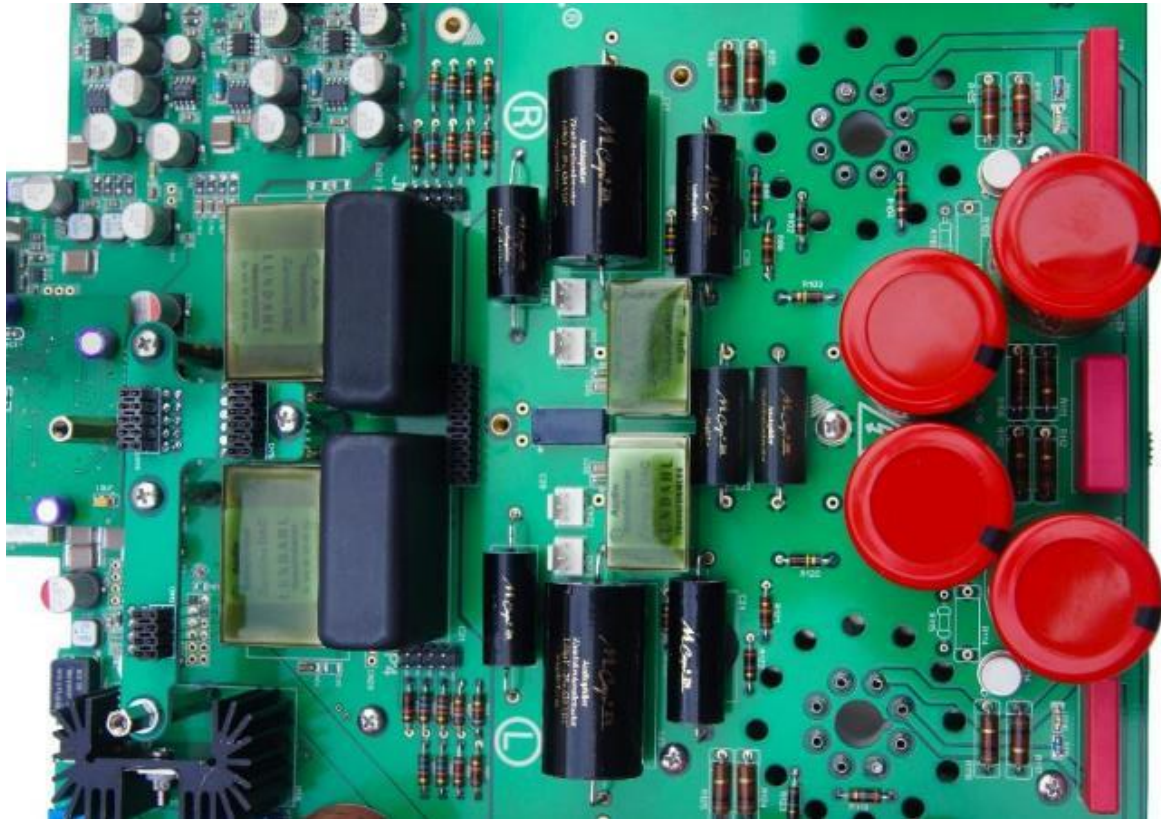The bandwidth is over 75KHz at the maximum output level.

Fig. 4:   The interstage transformers on the left side and the transformers for the balanced outputs in the centre of the board

∞ *Volume Control*

The importance of the volume control cannot be underestimated in the design of high-end and professional audio applications. Unfortunately this fact is not focused enough upon by many manufacturers. Basically there is no sense to talk about "focus" or "3D image" or "soundstage" as long as there is a lack of precise control of the volume in the two stereo channels.

The volume control module inside the *ZeroUno* $_{SSD}$ works 100% in the analog domain for both digital and analog input signals.

The solution used, is the CS3308/CS3318 chip with a special physical and electrical structure inside to cancel the nonlinearity of its polysilicon resistors resulting in minimised distortions.

It is based on a ladder network of pure 0.1% high precision thin film resistors for the lowest possible noise, perfect channel separation and perfect balance between the left and right channel independent from any volume level selected.

For any volume setting selected, there are only a minimum number of resistors operating the music signal.

In total there are 127 different positions for volume setting in steps of 0.5 dB possible within a range of +22 dB to -96 dB, reaching a dynamic range of 127dB!

The tracking control or better the difference between the volume level of the left and right channel in any positon is better than 0.05 dB/step. This level of precision is impossible to reach with any classic potentiometer, even when made of 0.1% precision discrete resistors.

An extremely low total harmonic distortion (THD) plus noise is achieved. THD is virtually below 0.001%. But more important: it is mainly consisting of very low level noise instead of distortion!
In a nutshell: the volume control is very transparent with a very high quality track control.
The volume control itself is digitally actuated either by the RC or the ELMA rotary switch on the right side of the front plane to have the perfect control about all the 127 possible volume level positions.

The rotary encoder mounted behind the volume knob is a high quality ELMA rotary encoder.
To ensure maximum mechanical stability, the axis of the encoder is supported by an additional bearing. While turning the knob the user has a "smooth" but precise tactile feedback.

Fig. 5:   The ELMA rotary encoder with the mechanical structure

∞ *Level Control*

In addition to the volume control, there is a level control implemented too.

This feature let the user adjust the signals from all analog and digital sources to exactly the same level to avoid any increase or decrease in loudness while switching between input channels. The level can be adjusted in steps of 0.5dB in a range of -26 dB to +17 dB.

∞ *The output stage - Solid State Device (SSD)*

The SSD output stage in the The *ZeroUno* SSD is based on the same concept as the CanEVER Audio *LaScala PowerAmp:*

the SSD amplifier is designed as a small dual mono power amp running in pure Class A mode, which delivers an output power of 2,5 Wrms per channel. The SSD output stage can drive loads (power amplifiers) below to 600ohm, and its output impedance is below 1ohm.
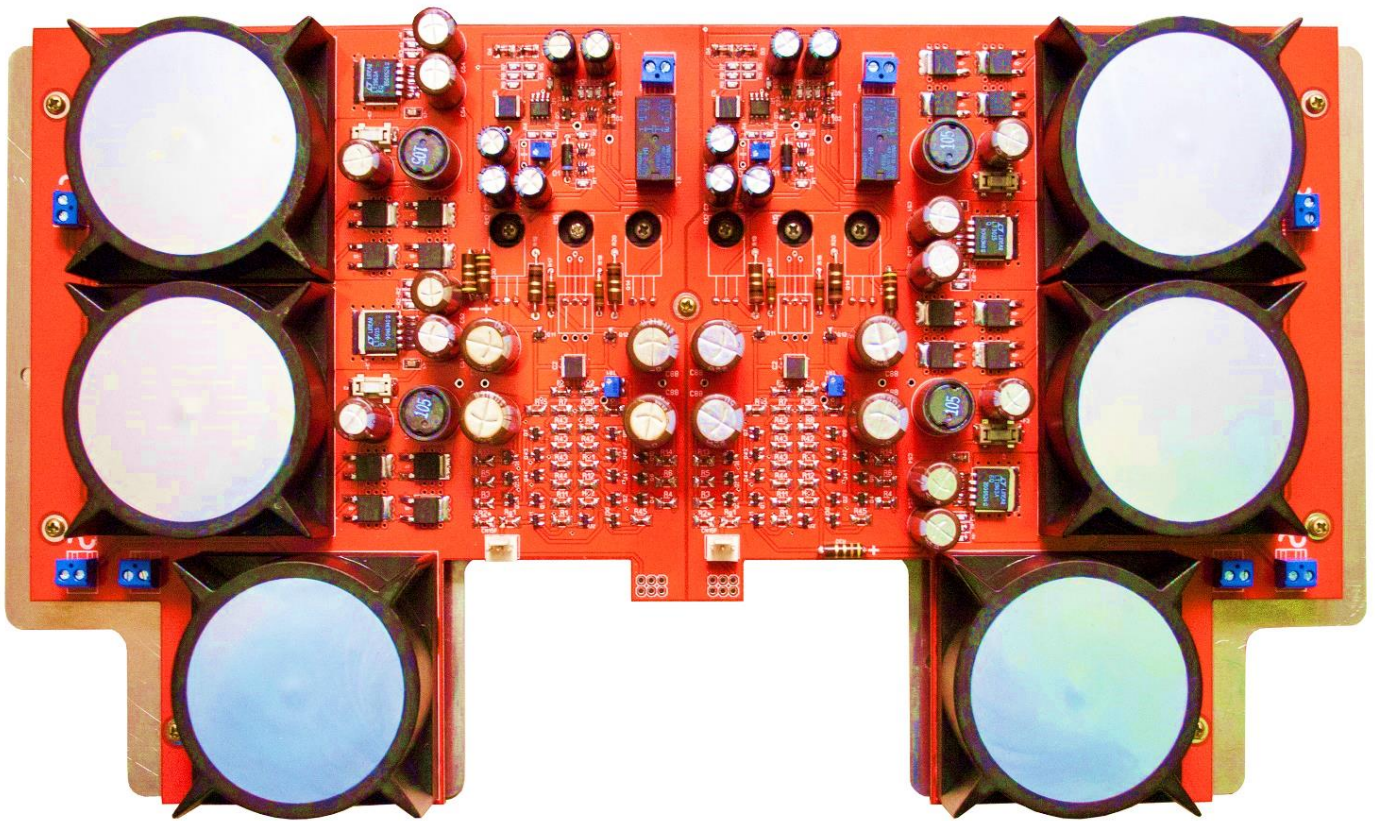
All the design ideas that made the *ZeroUno* DAC a well-respected DAC, at the top level of performance in the market, are present inside the *ZeroUno* SSD, as well. The heart of the DAC board is an ESS Sabre[32] chip, with its eight differential DACs used in a quad-sum configuration. The digital and analog filtering are a special design of CanEVER Audio and incorporate a dedicated output transformer topology inside the D/A interface.

The layout of the main board inside the *ZeroUno* SSD is the same as the *ZeroUno* DAC *to* keep the "no noise" performances from the original circuit.

The use of several different ground planes shields the unit from electric noise coming from outside and isolates the individual modules inside the *ZeroUno* SSD like "islands interconnected by bridges".

All digital inputs of the *ZeroUno* SSD are the same as the *ZeroUno* DAC.

The USB receiver board implements full MQA functionality.

The USB board is powered in "battery mode" and comes with a galvanic isolation from the connected computer or streamer. These additions avoid any injection of noise by the external digital sources.

When implementing an audio circuit without feedback loops some parts of the projects becomes "special":

- the layout of the printed circuit boards
- the topology
- the grounding
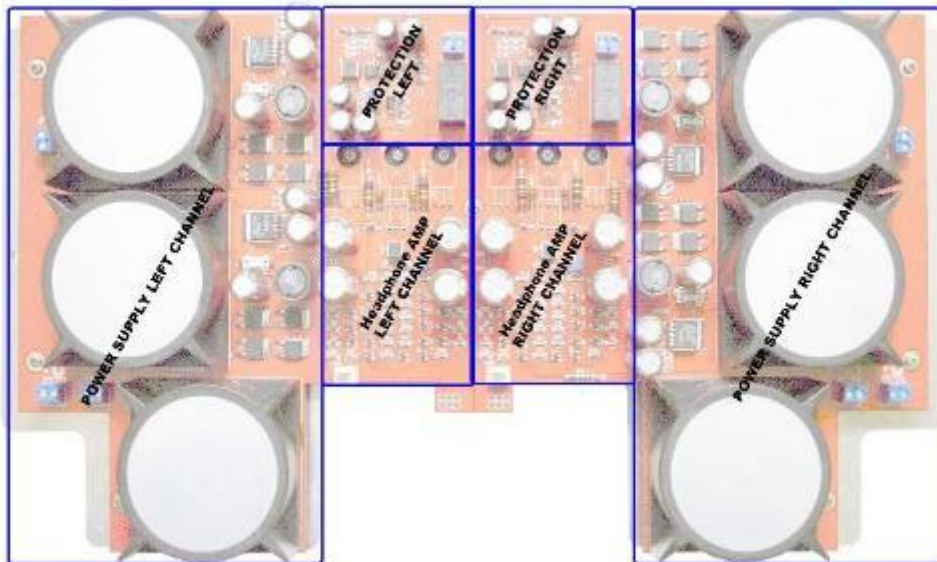
The final implementation of the SSD amp of the CanEVER Audio *ZeroUno* ₛₛD is the result of many prototypes and associated listening sessions. It incorporates years of experience in the design of amplifiers of any kind, whether tube or transistor based, push-pull or single ended etc.

Inside the cabinet of the *ZeroUno* ₛₛD there are two boards stacked above each other. First, there is the main DAC board, which is the one of the *ZeroUno* DAC.Over, there is the SSD amplifier board that includes the discrete Class A analog output stage. In between both boards there is a massive sheet of aluminium. The aluminium plate acts as a heat sink for the four transistors of the Class A output stage and shields the analog amp from the digital noise radiated by the DAC board, below.

The design philosophy of the output stage for the *ZeroUno* ₛₛD is very similar to the **CanEVER Audio LaScala PowerAmp**.

The output stage is a Class A Single-ended Push Pull circuit with a high current audio line amplifier – capable of driving even low impedance power amplifiers.

In electronic is well known that using a feedback network, very low distortions can be reached.
While "feedback" seems to be simple and inexpensive to implement, it comes with a price: implementing "feedback" reduces the "natural sound."
Extended listening tests have proven that feedback loops tend to create certain "patterns" inside the reproduced music, which do not sound pleasant to the ears (better: the brain) of the listeners.

For this the feedback in the topology of the *ZeroUno* ₛₛD is avoided:
N-NFB: No-NegativeFeddbackTopology.
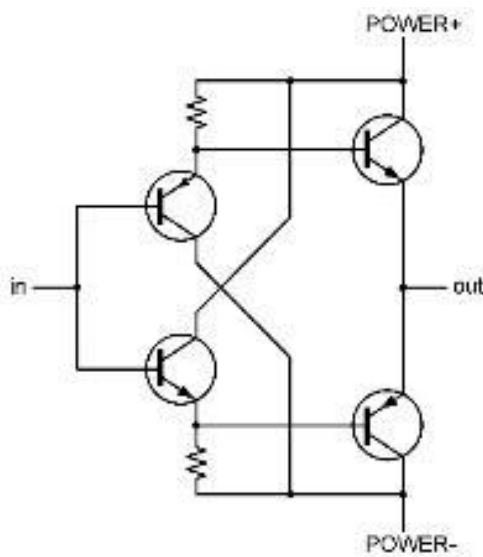
To care the matter of the distortion when a N-NFB is implemented, a special topology is implemented to reach the maximum "naturalness" of the sound reproduced.

A lot of effort was spent to setup the ***"super-linear"*** topology:
the concept is based on the crossing of the driving signals, so that distortions will be naturally cancelled when summed at the push-pull driver in the output stage.

The input topology is classic with a complementary JFET stage followed by a transistor acting as a driver and a transistor acting as power device.
The drivers and outputs transistors are crossed.

In this manner, the non-linearity of the JFETs and BJYTs are absorbed by a reverse non-linearity mode. This technique is not new and implemented with success in very low noise application requiring high linearity (satellites communications, radio telescope, nano technologies measurements).

The result reached is interesting because in a classic push-pull configuration only even harmonics are reduced/cancelled leaving only the odd one's present. With the crossed-driver topology (aka "reverse non-linearity mode"), and the selection of the components within 0.1%, the odd harmonics are reduced/cancelled, as well.
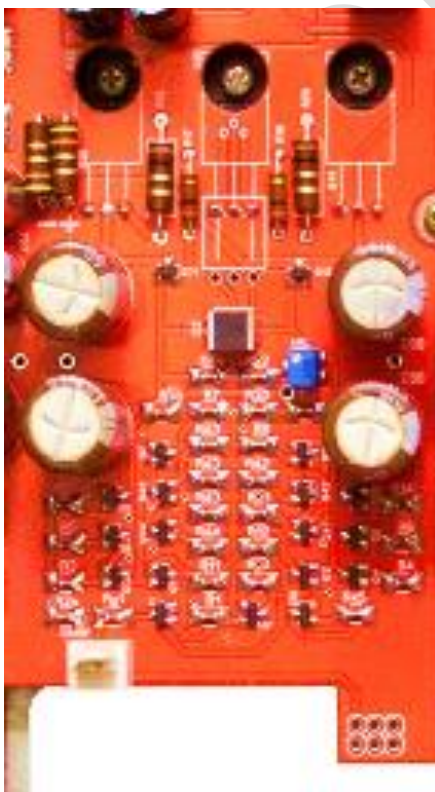
In the picture on the left, one channel is shown with the power transistors soldered at the backside of the mainboard.

The drawback of this kind of implementation, is the need for carefully selected JFET and BJT in pairs combined with high quality power supplies of laboratory standard.

The selection process starts from groups of 1000 BJT and FET, ending up at only 40 to 50 transistors suitable for the SSD amplifier.

All the solid-state devices are specific for audio use and not simple "industrial" components.

The power supply is completely dual-mono, with separated transformers for different power rails. In total six toroidal transformers are used to power the unit.

The picture at the top shows the power supply of one channel, only.

The output is protected against any DC current that might flow at the output in case of a fault. A double contact relay opens and protects the circuit, if needed (last picture on this page).

The circuit is also active when the *ZeroUno* ₛₛᴅ is powered on or off to protect the attached power amplifier from the transient noise of the power supply.

This circuit is not part of the signal path!

Conclusions:
a) Deleting the feedback loops and capacitors from the signal path let the sound become more "real" and relaxing.
b) implementing the crossed drivers of the **"super-linear"** topology, the stability and the linearity of the SSD stage implemented inside the *ZeroUno* ₛₛᴅ are astonishing even.

∞ *Power Supply*

The performance in any electronic unit is depending on a professional power supply!

The best output stage cannot perform on its peak performance level without a state-of-the-art power supply. The power supply of the SSD output stage of the *ZeroUno* ₛₛᴅ utilises four (4) dedicated toroidal transformers, which can deliver the needed current to drive both dual mono stages.

The rectifier module uses the last generation of spike noise free components followed by a double π filter. As a choke in the rectifier stage is a needed for better sound *ZeroUno* ₛₛᴅ uses two of them!

The capacity of the filter (choke) used is so big, that it represents quasi a regulated power supply without an active component in the power line!

In the *ZeroUno* ₛₛᴅ, the digital and analogue power supplies (16 in total) are powered individually by six (6) toroidal transformers - four (4) for the analog circuits and two (2) for the digital circuits.

Exclusive ground planes are used for the analog and the digital circuits.

All transformers sit in antimagnetic metal canisters using resin mix as damping material to avoid any kind of mechanical hum and vibrations.

Both the power supplies for the analogue and digital sections are split into two sections.

The first section is a low-noise power supply that:
- pre-regulates the voltages generating a very clean DC voltage
- isolates the second section from the domestic AC line
  reducing electric noise induced from there

As a result, the second level power supply is sourced by a very clean DC power and works in "quasi" battery mode.

The second section to power the *analog* stage, is made of four separate ultra-low noise power supplies and it sources directly the analog stage of the *ZeroUno* ₛₛᴅ. These ultra-low noise power supplies are built of discrete components only, designed around the AD797 operational amplifier to reduce the noise to an extreme low level.

The second section, to power the *digital* stage, is made of 13 separate ultra-low noise power supplies. Four of these ultra-low noise power supplies are built of discrete components only, still designed around the AD797 chip to reduce the noise to an extreme low level.

As the power supply is such an important part of the circuit, almost 60% of the time to develop the *ZeroUno* SSD was dedicated to the design of the power supplies, the correct signal path as well as to the paths of the power supplies and grounds.

Selected components used in the power supplies of the *ZeroUno* SSD make sure to avoid noise created in the rectifier stage. The diodes in use here are almost free of any "converting spikes", which usually have a negative impact on the sound quality of the audio signal.

To improve the performance of the power supply furthermore almost all capacitors used in the circuit are *aluminium organic solid polymer capacitor*s instead of electrolytic type.

In addition, for top noise filtering, there are 25 individual coupling inductors implemented in the power supply. This architecture is fundamental to keep the noise as low as possible. In many audio components this kind of noise is present, while affecting the sound in a negative way, creating harsh and cold sound textures.

Fig.8: The discrete ultra-low noise power supplies in details
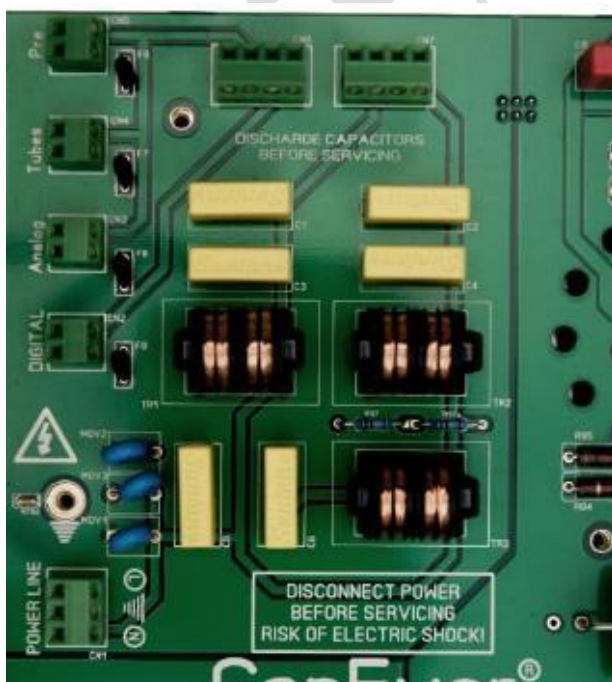
Last but not least a dedicated discrete EMI filter is part of the main power supply. This filter isolates the *ZeroUno* SSD from the mains power supply.

This filter blocks the digital noise created inside the *ZeroUno* SSD**,** which could otherwise affect the AC lines in the house.

It is not connected to the building ground (EARTH) so to avoid the pick-up of noises from the EARTH of the building itself.

Fig. 9: The mains filter power supply to isolate the ZeroUno SSD from the mains power network

∞ *SABRE³² DAC Chip and firmware*

The *ZeroUno* ₛₛₐ and the *ZeroUno* ₐₐᴄ use exactly the same main board.

Fig. 10: The DAC circuit and the USB bridge board; SABRE³² chip behind the USB bridge board.

The chip used in the DAC section is the ESS Technology SABRE³². This chip incorporates in total eight individual DACs in dual differential coupling. But the SABRE³² is not only a DAC! It is one of the most advanced industrial digital chips available today, working with 32 bits math, including 8 pairs of DACs with selectable resolution, IIR filter, FIR filter, de-emphasis filter, notch filter, 8 channels 32 bit volume control, patented jitter reduction algorithm and an 8 channel SPDIF multiplexer.

Although the SABRE³² is a very powerful component, it comes from the factory documented for a standard configuration only. This leads to a situation, in which many DACs, using this chip, make use only of the "default" standard configuration. The result often is a sound reproduction, which does not show the real performance level of the SABRE³².

To make full use of the complete SABRE³² feature set, it needs sophisticated engineering skills. For the *ZeroUno* ₛₛₐ exactly the same firmware as of the *ZeroUno* ₐₐᴄ is implemented.

So, the special and complex firmware developed to let the SABRE[32] runs at its full potential is included in the *ZeroUno*$_{SSD}$ too. The core implementation is a two channel DAC based on four paralleled pairs of differential DACs. Based on the patented internal jitter reduction module of the SABRE[32] the *ZeroUno* $_{SSD}$ reaches a very low level of jitter.

The key feature of the *ZeroUno* $_{SSD}$ is the smooth and natural sound without any loss of the rhythm e.g. using the human voice and unamplified natural instruments as the test benchmark. The special internal configuration of the SABRE[32] chip used for the *ZeroUno* $_{SSD}$ eliminates artefacts in the digital domain, which usually affect the quality of sound. Those kinds of distortions are more or less part of digital audio gear since the introduction of the CD in the early '80´s and the *ZeroUno* $_{SSD}$ is developed mainly to avoid them.

The firmware of the *ZeroUno* $_{SSD}$ is stored inside a separate memory chip fitted in a socket on the board mounted behind the front plane. This offers the opportunity to upgrade the firmware easily.
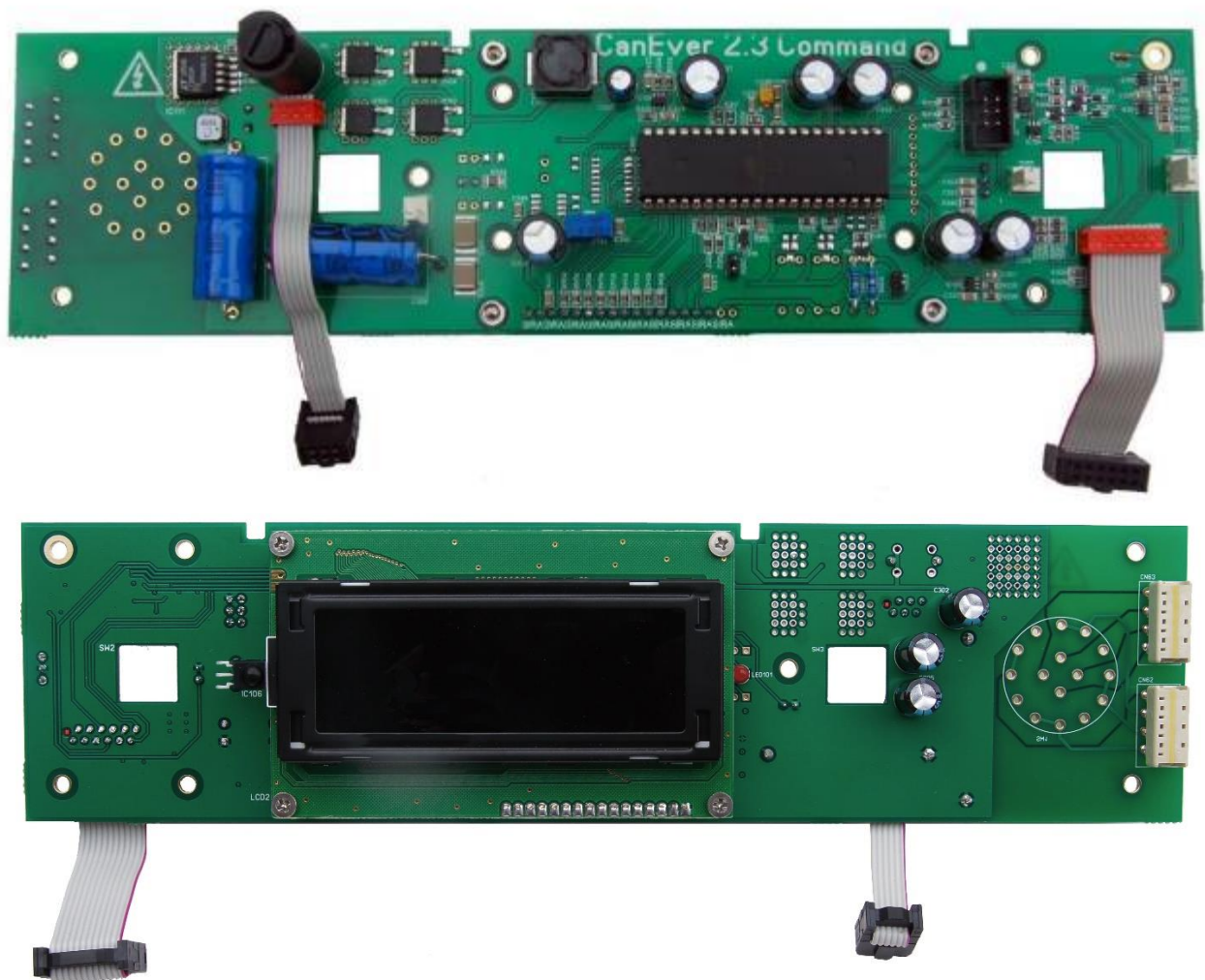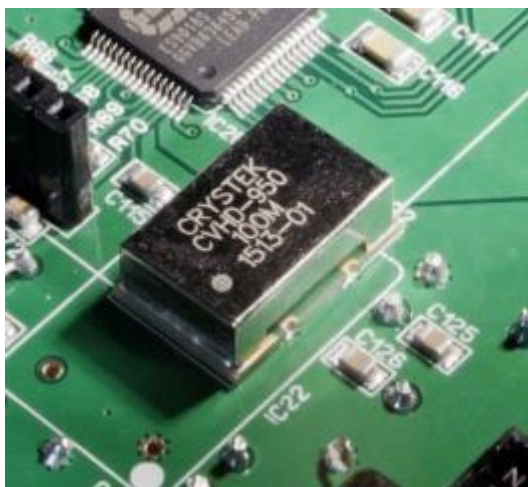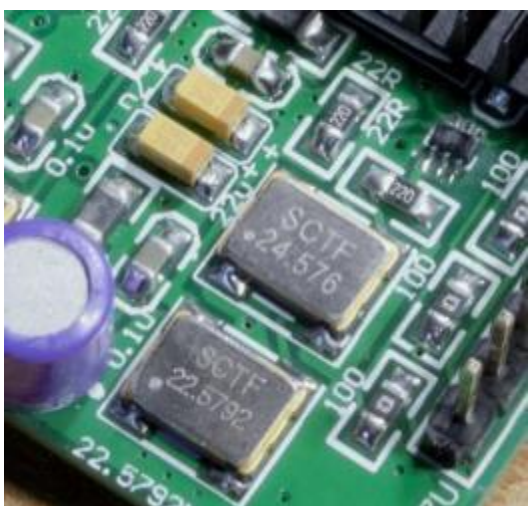

Fig. 11. The front panel with the microprocessor chip where the firmware is stored.

∞ *Clocks*

For precise clocking, the digital part of the *ZeroUno* SSD uses an ultralow phase noise and low jitter voltage-controlled crystal oscillator. This 100MHz oscillator works as main clock to make sure, that the DAC works at maximum throughput and synchronizes the whole system.
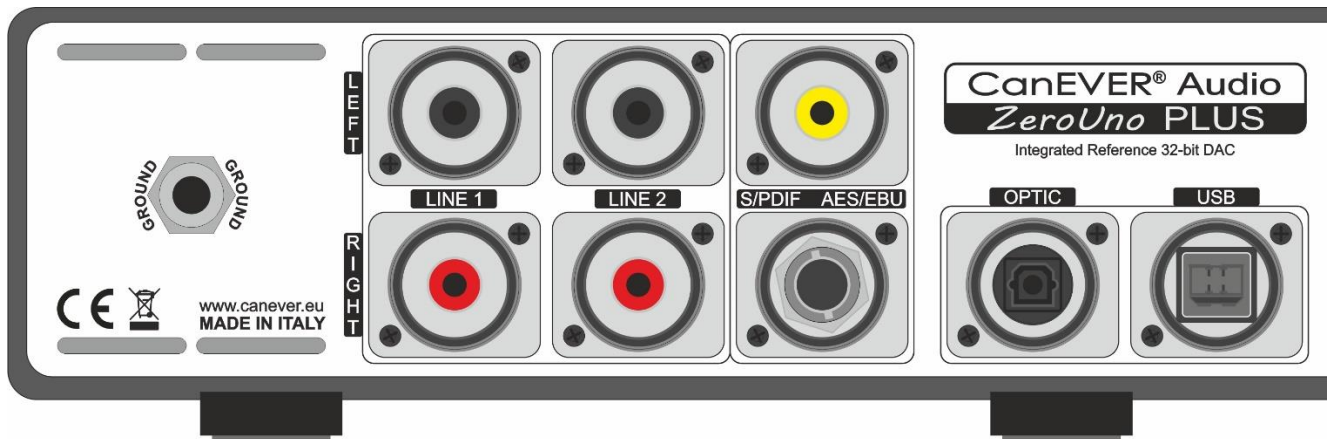

Another two low noise oscillators control independently the sampling rate of the two PCM "families" of input signals:

- 44,1; 88,2; 176,4 and 352,8 kHz
- 48; 96; 192 and 384 kHz

The DSD the sampling rate "families", which the DAC locks, are:

- 2,822; 3,072 MHz - DSD64
- 5,644; 6.144 MHz - DSD128

∞ *Analog & Digital Inputs*

The *ZeroUno* ₛₛₒ offers two analog inputs: LINE 1 and LINE 2.

The user can assign an individual name for these inputs corresponding on the type of equipment, which is connected to the individual input. Every time an analog input is selected, the assigned name will presented in the display on the front.

The names of choice for the analog inputs are:
* Tape
* Phono
* Tuner
* Line 1
* Line 2
* AUX 1
* AUX 2

The individual input names can be selected from the SETUP menu!

The digital inputs are:
* 1x RCA, 1x XLR (AES/EBU) and 1x TOSLINK for S/PDIF signals
  (optional: 1x BNC instead of the XLR input)
* 1x USB Audio 2.0 port for a direct connection to a computer or a network bridge / streamer
* Integrated Official, full features, MQA CODEC

All the S/PDIF digital inputs have a galvanic ground insulation from the connected components.

Each input channel can be activated or muted. So the user can toggle between only those input channels, which are actually connected to a source. Or, if the user wants to compare the sound quality of two different inputs (e.g.: analog records vs digital sources), he can mute all input channels despite those two, which he would like to compare.

∞ *USB Chip*

The USB interface is located in a separated module mounted above the SABRE[32] to reduce the length of the signal path to a minimum. The firmware is stored in a dedicated flash memory, to allow easy future upgrading, if necessary.

The USB module is NOT powered through the connected computer by the standard and usually dirty 5V power lines of an USB cable! Instead, a dedicated ultra-low-noise power supply inside the *ZeroUno* ₛₛD powers the USB receiver separately. Furthermore, a dedicated 1 Farad Super Cap buffers this power and acts almost like a pure battery power to the USB receiver chip.

USB signals demand high processing speed and efficiency, robust bit perfect audio streaming and flexible multi-format audio connectivity. To insure this, the *ZeroUno* ₛₛD uses in the USB input board a chip of the xCORE-200 *multicore* family, the XMOS XU216-512.

Unlike conventional microprocessors with only one CPU that handles the audio signal, the XU216-512 microprocessor has got inside 16 CPUs to execute multiple tasks parallel in real time.

By the dedicated *ZeroUno* ₛₛD firmware this 16 CPUs are optimised for handling audio signals, offering:

- the XMOS Hi-Res 2 AUDIO platform
- very low response latency
- high-performance real-time processing
- MQA codec

All these features ensures a bit perfect transfer of all audio data.

The USB interface together with the standard stereo 2-channels XMOS driver is 100% USB Audio 2.2 compliant and support signals up to 384 kHz in PCM mode as well as DSD64 and DSD128 in DoP mode. The driver for the Windows® operating system works in ASIO or WASAPI mode. No additional driver is needed for Mac users, because the ZeroUno SSD is 100% compatible with the Mac OS and it´s built in Core Audio.

It is integrated the Official, full features, MQA (Master Quality Authenticated) CODEC.

The USB interface of the *ZeroUno* ₛₛD is ready to support the native playback of DSD64, DSD128 and DSD256 files.

As soon as XMOS will release the standard ASIO driver for the native DSD formats, this driver can be used with the *ZeroUno* ₛₛD as well.
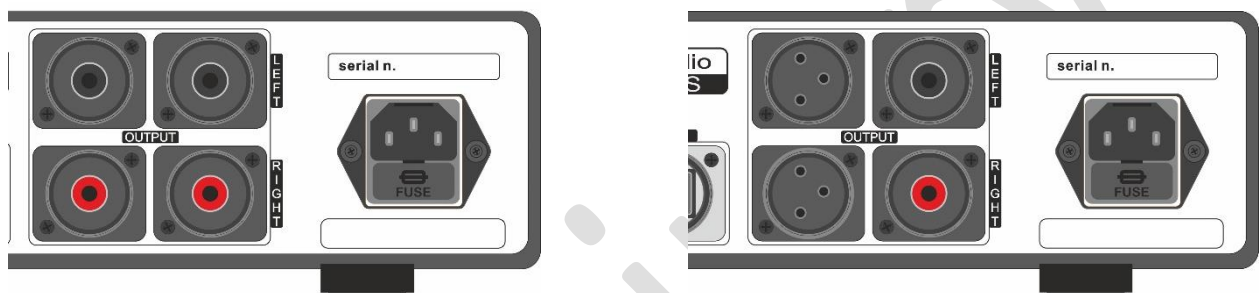
∞　*Digital File Formats*

The *ZeroUno* ₛₛD can play almost all the music formats being commercially available today, whether they are in PCM or DSD/DoP format.

PCM: 44.1kHz, 48kHz, 88.2kHz, 96kHz, 176.4kHz, 192kHz, 352.8kHz, 384kHz.
DSD/DoP: DSD64; DSD128

It is integrated the Official, full features, MQA (Master Quality Authenticated) CODEC.

∞　*Outputs*

As standard configuration the *ZeroUno* ₛₛD is equipped with 2x RCA unbalanced outputs.
Optional is possible to implement 1x RCA unbalanced outputs + 1x XLR true balanced outputs

Both couple of outputs can be used at the same time. This is useful for bi-amping and to connect a subwoofer if any.

Suggested input impedance of the power amplifier should be not below 600ohms.

The Voltage swing at the outputs, balanced and unbalanced, is 7.0Vrms / 20Vpp for the analog inputs and 4.2 or 8.4Vpp (to be specified at the time of the order) for the digital inputs.
For the digital inputs standard is 8.4Vpp voltage swing at the outputs.

∞ *Remote Control*
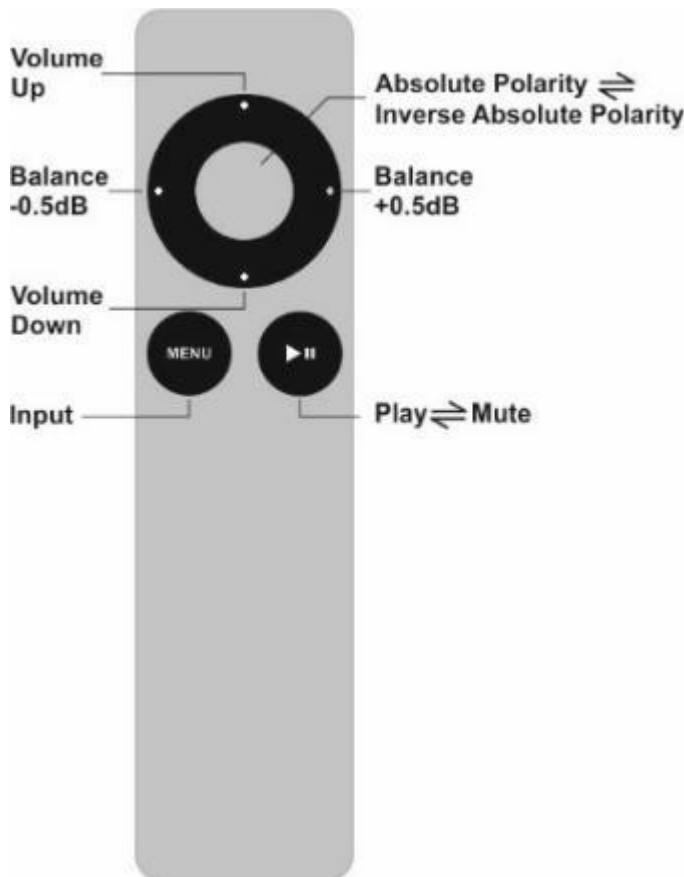
A remote control, which comes standard with each unit, gives access to most of the functions of the *ZeroUno* ₛₛ from a distance. Different from most other DACs on the market, the RC offers in addition to the function "*volume up/down*" buttons for "*balance left/right*" level adjustments! A "*phase*" button for changing the absolute polarity of the music signal and a "*mute*" button for reducing the volume complete the functions on the RC. All those options assist the customer to adjust the sound in a very comfortable way right from the listening position.

To switch between the different input channels, the user has to push the "MENU" button. The name of the selected input then is shown for 5 seconds in big letters at the display.

The Remote Controller coming with each *ZeroUno* ₛₛ has been paired already with the receiver inside the DAC in the factory by selecting one of 256 possible pairing codes.

In case of interference with the RC´s of other electronics in the household, the preselected RC code can be changed at any time.

To pair the RC, first move the RC close to the *ZeroUno* ₛₛ (about 1 m) and PRESS any BUTTON at the RC.

To pair the RC, press the SETUP button at the front of the *ZeroUno* ₛₛ for at least 2 seconds to enter the SETUP MODE, release the SETUP button. PRESS and KEEP PRESSED the INPUT button. PRESS again the SETUP button.

∞ *Display*

For optimal user control the *ZeroUno* ₛₛ𝒹 has a large display located in the centre of the front plate. In *PLAY* mode this display shows the selected input, volume, level, balance and absolute polarity.

Once a digital input signal is detected, the lock is displayed followed by the sampling rate.

As an option, the sample rate of the incoming digital data stream can be shown at the display in large letters. This feature is activated by setting the related parameter in the SETUP menu.

In SETUP mode the display shows all possible parameters selectable by the user and their related values.

When pressing the volume or balance buttons (+/-) at the remote control, the display presents the level in large digits for easier reading the display information from a distance. The same happens, if the user presses the MUTE/PLAY or the PHASE buttons. After 5 seconds, the display switches back to the default mode. Then again, the display shows all selected values in standard size together with all other data about the selected input and the active signal.

The brightness of the display can be set to various levels (50% 60% 70% 90% 100%).

After a defined time (e.g. 10s / 20s / 30s / 40s / 50s) of no user interaction via the Remote Controller or the buttons at the front of the DAC the display turns off. Based on individual settings in the SETUP menu, the display could stay ALWAYS ON as well, if preferred by the customer.

If the MUTE function is activated, the display will show MUTE in big characters continuously without any timeout until the MUTE function is turned off again.

∞ *Absolute Polarity Listening*

As during the recording, the mastering and the production process the absolute polarity of the music data is changing many times, the final digital master file can be stored in inverted polarity. As some listeners are very sensitive to this fact, the *ZeroUno* ~SSD~ gives the customer the option to change the absolute polarity of the music file by pushing the round toggle switch at the remote control.

After pressing the toggle switch, the display shows
   "PHASE+" (absolute polarity) or
   "PHASE-" (inverted absolute polarity)
in large letters for 5 seconds.

∞ *SETUP Menu*

The *ZeroUno* ~SSD~ comes completely configured by the factory for top performance!

To give the customer maximum flexibility to configure the unit to according to his personal taste, the SETUP mode is implemented. To enter the SETUP mode the customer has to press the SETUP button at the front for a minimum of 2 seconds.

Then the following list of parameters is ready for change:

PARAMETER	VALUE
Balance	range from 5.0dB left to 5.0dB right in steps of 0.5dB
Level	range from -22.0dB left to +17.0dB in steps of 0.5dB
Active Inputs	to active or exclude the INPUTs
Name	assign name of analog source connected (e.g. Tape, Tuner, Phono)
Phase	absolute polarity vs. inverted absolute polarity
LCD Brightness	display brightness: 50% / 60% / 70% / 90% / 100%
LCD Time Out	display timer: 10s / 20s / 30s / 40s / 50s / always on
Sampling Rate	show / hide (in large digits for 5 seconds)

For each parameter its value is visible at the display.
Rotating the right knob changes the parameter values.
To select the next parameter the SETUP button needs to be pressed shortly.
If no button is pressed or the right knob is not turned within a period of 10 seconds, the *ZeroUno* ~SSD~ automatically stores the values shown at the display and switches back to the PLAY/MUTE mode.
A countdown running on the second row of the display assists the user during this process.
All selected parameters are stored in a no volatile memory, so that the setup information is not lost after powering off the unit.
To RESTORE the factory values the SETUP button at the front panel of the *ZeroUno* ~SSD~ must be pressed for at least 10 seconds.

∞ *Cabinet*

The engine of a car can exhibit the maximum performance only, if it has a frame, which can manage the vibrations. This is a mechanical law to follow not to lose power of the engine. The engine in our case is the DAC chip with its 16 power supplies plus the tube buffer and its power supply. The frame in our case is the cabinet, which has to be deaf and rigid without compromises.

It is important to understand, that the cabinet is an "active" part of the *ZeroUno* ₛₛD.

The cabinet of the *ZeroUno* ₛₛD is made of a combination of aeronautic aluminium and sheets of stainless steel joined together to create a rigid, light and vibration free structure. Moreover, the cabinet has a coating of acrylic resin, which further dampens the structure and avoids vibrations. While the cabinet is acoustically "dead", it shields the electronics inside from electromagnetic interference (EMI) from outside as well.

∞ *Conclusion*

Although the *ZeroUno* ₛₛD is offering high performance technical data, it is impossible to judge it´s value based on these only. The result of the management of the input signals in the *ZeroUno* ₛₛD is a natural, warm, not harsh and a very dynamic sound, which is not polished to exhibit the last possible details, but to *let the music play*…

Looking at directly heated triode based tube amps (e.g. 300B, 2A3 or 211 and 845) or tube amps in general one can make similar observations. From a pure engineering point of view, there is no reason to prefer a SSD amplifier over a standard preamplifier. Most of the technical measurements are even voting against a SSD solution. However, if we do not leave it up to the instruments alone to qualify such an amp and instead we use our ears to listen and feel our emotions, the picture in many cases can change a lot!

Have fun with the *ZeroUno* ₛₛD!