CanEVER AUDIO®

Technical Description

about the

CanEVER Audio® Olimpico PowerAmp

or

How to design the “perfect” Amplifier

Index

Introduction

The "perfect" amplifier is basically impossible to design, but with the required engineering skills gained from a strong background in vintage amplifier design AND a deep knowledge of recently developed components as well as modern circuits, it is possible to get very close to an amplifier which works *almost* perfectly.

Fig.1: The *ZeroUno PLUS – a Tube Preamp with integrated DAC introduced in 2017*

CanEVER Audio, with its smart engineering approach, has already proven that introducing highly competitive products in the overcrowded market of High-End Audio is possible. The *ZeroUno DAC*, introduced in 2016 and the *ZeroUno PLUS*, shown for the first time at the High-End Show in Munich 2017, are perfect examples of this. Both products are a combination of a high-quality DAC including full MQA decoding *and* a preamp, with an intricately designed tube output stage working as a current source! While the *ZeroUno DAC* is a preamp accepting input from digital sources only, the *ZeroUno PLUS* comes with a top-class analog preamp built in, in addition to the *ZeroUno DAC* circuit.

Fig.2: The *Olimpico Power Amp* in two Cabinets for Power Supply and Amplifier

The *CanEVER Audio Olimpico PowerAmp* is one of the few audio amplifier designs, which consequently follows the most important results in research about audio amplifiers in engineering history. It is the result of over 30 years of research and experience gathered in the design and building of amplifiers based on single ended, push-pull and hybrid circuits, using tubes and/or transistors.

First of all:
the *CanEVER Audio Olimpico PowerAmp* is a TRIODE VOLTAGE AMPLIFIER followed by a CURRENT MOSFET CURRENT STAGE!

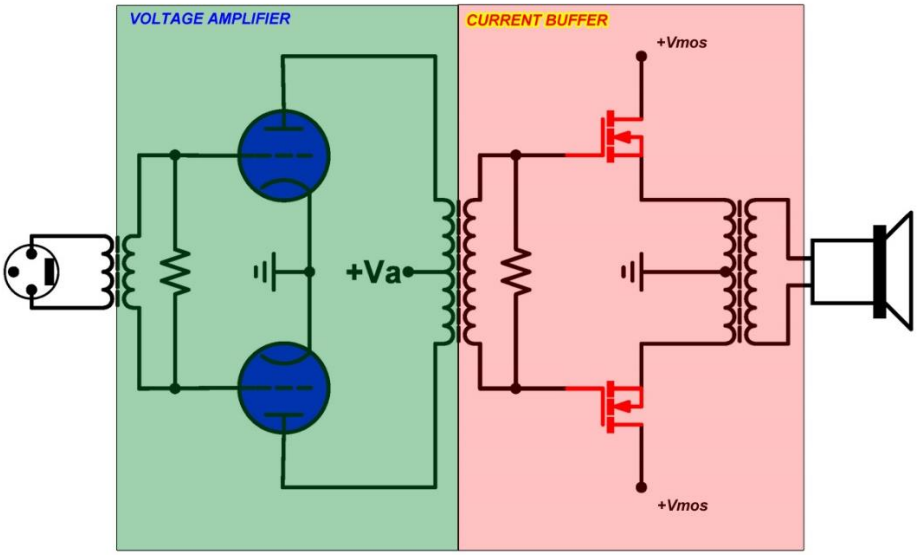

Fig.3: The basic Circuit of the *Olimpico Power Amp* (one channel)

Why is this important?

The triode voltage amplifier is responsible for the voltage swing and the damping of the signal at the output.

The MOSFET current buffer is responsible for the interaction with the loudspeaker impedance, avoiding irregularities at the load of the triode stage, with the impedance itself. So, the voltage amplifier is loaded with a very high impedance to preserve the sound quality.

To design the "correct" amplifier, it is important to understand how the load connected to the amp is working. The load of an audio amplifier is a loudspeaker. Each driver inside a loudspeaker follows the laws of physics – not the "ideas" of more or less talented people designing amplifiers. These laws of physics "command" any kind of speaker driver to move as a function based on the CURRENT of the input signal. This means, that the movement of the cone is directly proportional to the applied CURRENT.

How does this affect the sound of my loudspeaker?

It is very important to understand, that a loudspeaker does NOT represent a pure resistive load to the connected amplifier. In fact, the loudspeaker represents a complex load called IMPEDANCE. This impedance is dramatically irregular, with maxima and minima along the band of frequencies that the loudspeaker is radiating.

Once the output VOLTAGE of an audio amplifier is proportional to its input signal, coming from the various audio sources in an audio system, this VOLTAGE has to be "converted" into CURRENT to drive the speaker. The IMPEDANCE CURVE (impedance vs. frequency) of the loudspeaker influences this "conversion" strongly. Especially when this impedance becomes very low. In many modern speakers, the impedance can get as low as 2 Ohms!

Even for a non-engineer, it is easy to understand that under these conditions, the movement of the loudspeaker cone will become "corrupted". The result is ALWAYS a colored sound radiated from the speaker. There is no escaping it!

This situation changes completely, if the loudspeaker is driven by current!

In this case, the output CURRENT of the amp is directly proportional to that of its input signal and makes the cones of the speakers move in direct proportion to the applied CURRENT. The cone is moving proportionally to the original audio input signal, no matter what crazy "roller coaster" function its impedance curve is riding.

The result is a clean sound representing the original audio signal and not "modulated" by the impedance of the loudspeaker.

There is only ONE correct implementation of an audio amplifier and this is an amplifier with a CURRENT OUTPUT. One of the very rare amplifiers on the market today following this design principle is the *CanEVER Audio Olimpico PowerAmp*!

In the initial design phase of a power amplifier, choosing which type of audio circuit to implement is one of the most important and basic decisions, that needs to be made. For CanEVER Audio, it was clear from the beginning: Class A mode was essential in order for the sound of the amp to be as natural as possible. To reach a clean sound - free from any distortions - the decision to use a fully symmetric design was the only choice possible. To obtain the best performance in channel separation and power handling, the power supply and the amp itself are designed in a dual-mono configuration, in which the power supply and the amplifier come in two separate cabinets.

Other important aspects of the *Olimpico PowerAmp* design are the absence of coupling capacitors in the signal path as well as any kind of feedback loops.

The Power Supply

The *Olimpico PowerAmp* is the directly brother of the *LaScala Power Amp*, the top in the *CanEVER Audio* product line.

The Power Supply is the heart of any power amplifier and to rich the high demand of power, instead of a classic power supply like in the *LaScala* proposal, an advanced 'high frequency' power supply technology, specially tailored for audio use, is at the base of the *Olimpico PowerAmp.*

Fig.4: The Power Supply of the *Olimpico Power Amp*

Usually the 'high frequency' power supplies are powerful, light, fast, efficient but not directly suitable for the audio use because they are designed for the industry.

In *CanEVER Audio* we started from years of experience in the design of switching power supplies and a hybrid solution is adopted. A switcher working at high frequency is followed by a filtering section directly derived from the *LaScala* Power Supply solution.

The approach is innovative and the benefits are those of a switching power supply, fast, light, powerful, compact, precise, stable, protected, and the benefits of a linear power supply, clean, smooth, without any residual or irradiated noise.

The whole power supply is shielded in a 2 mm thick solid aluminum container used also as heatsink, and then all the electronic parts are drowned into antivibration resin, everything is sealed and should work also under the sea.

Fig.5: The switcher at the base of the *Olimpico Power Supply*

The switcher is preceded by a sophisticated mains input filter, with a CLC topology, that isolates and cleans all the potential noise coming from the mains electric plant, and, not less important, any emission of the switcher if any.

Then, the switcher is followed by the same active CLC filter designed for the *LaScala Power Supply*, able of exhibit the same performance of a capacitor bank of 470.000uF.

The Power Supply complaints all the emission standards, including the European Electromagnetic standards, actually the most rigorous in the world.

The Power Supply works at 50.000 Hz, 1.000 times higher than the 50Hz, the main frequency, and this is the key point that let all the transformers and inductors used become 1/10 of the standard size.

The mains filter, the switcher, actually the aluminum brick in fig. 4, and the output filter section are finally enclosed in a still container to increase the whole noise isolation.

The Power Supply can source up to 550Wrms, in continuous mode.

The weight is “only” 7.4Kg against the 32Kg of the *LaScala Power Supply*.

How is the *CanEVER Audio Olimpico PowerAmp* working in principle?

In a nutshell: This amp is a *push-pull amplifier* based on two "branches" of *single ended pure class A amps* for each audio channel, simply combining "the best of both worlds" in terms of circuits for audio amplifiers.

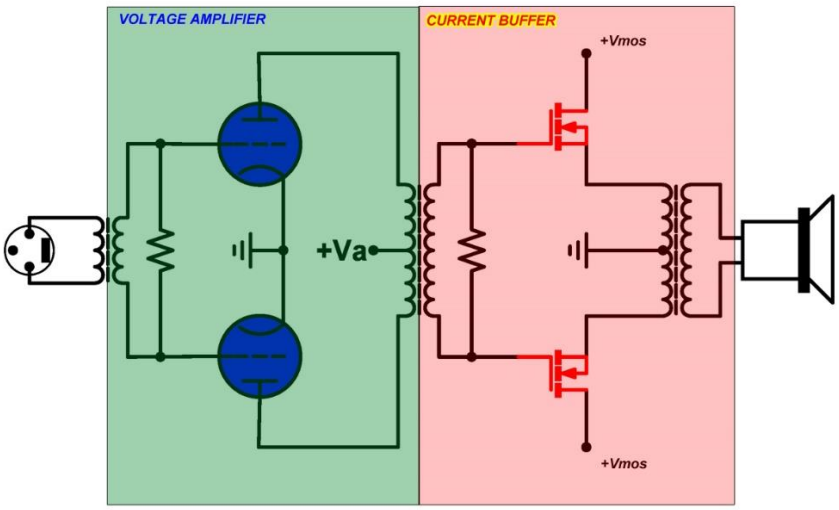

Fig.8: *Olimpico Power Amp* (one channel)

Input Transformer (Phase Splitter) + Voltage Amp (Triode / Push-Pull) + Interstage Transformer + Current Buffer (MOSFET / Push-Pull) + Output Transformer

Directly connected behind the XLR input connectors for each channel, you can find a first transformer working as a phase splitter to create the two "branches" of the signal feeding the voltage stage of the amp. This stage more or less consists of one double triode 6N6P per channel. As this first stage is working as a voltage amplifier, the following stage is doing the current amplification.

The current amplification inside the *Olimpico PowerAmp* works with a pair of last generation lateral MOSFETs, with a high linearity in the audio band. Using the MOSFETs as a current amplifier only avoid the driving complications of the MOSFETs in the classic configurations. In this way, the interface with the tube voltage driver is optimal.

The Interstage Transformer

The interstage transformer separates the voltage driver stage from the current output stage. As there is no coupling capacitor, the dynamics of the audio signal are preserved. This transformer is wound up on a 75% nickel double C core to use in audio applications. It works as a phase splitter to drive the output stage. The special bifilar winding scheme creates a perfect symmetry on its secondary side – in other words, the interstage transformer creates two signals as a "mirror image" of each other. This allows the use of one pair of IDENTICAL N-Type MOSFET transistors, different from usual push-pull configurations, where the mix of not perfectly matched n-type and p-type transistors are standard.

Because of the configuration of the MOSFETs, the interstage transformer only has to transfer a voltage signal and not any current. The result is a dynamic, transparent and natural sound.

The bandwidth of the interstage transformer is 75KHz ±1dB at 5Wrms.

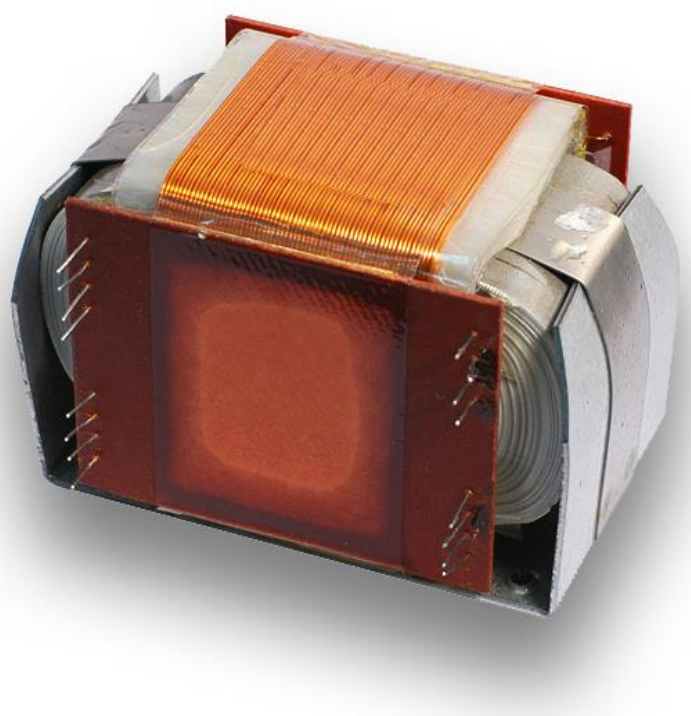

Fig. 9: *Olimpico* custom Interstage Transformer

Why is this Type of Interstage Transformer so important?

Usually push-pull configurations make use of two "complementary" types of transistors – "N" type and "P" type. Unfortunately, the specifications of those devices are NEVER exactly complementary! This creates some very "nasty" types of distortions in a push-pull amplifier.

As the interstage transformer inside the *CanEVER Olimpico PowerAmp* creates two "mirror images", it is possible to use two power transistors of exactly the same type. CanEVER Audio uses two lateral N-channel MOSFETs of the latest generation. This type of MOSFET does not need any kind of feedback for the thermal stabilization!

Class A Mode

As all stages inside the power amp are running in pure class A mode, no distortions are created in the crossover section. Specially designed BIAS control circuits manage the symmetry of the signals of the tubes and the MOSFETs. The result is a perfect symmetry in the processing of the audio signal, even if some SPECs of the active element are different. The BIAS for all stages is fix without feedback. The individual BIAS is independent from the power generated, the impedance of the connected loudspeakers and the processed audio signal!

A minimal number of parts in the signal path:

The *Olimpico PowerAmp* is made of two amplification stages only – one for voltage and one for current. Please note that there is NO CAPACITOR and NO FEEDBACK implemented in the complete signal path!

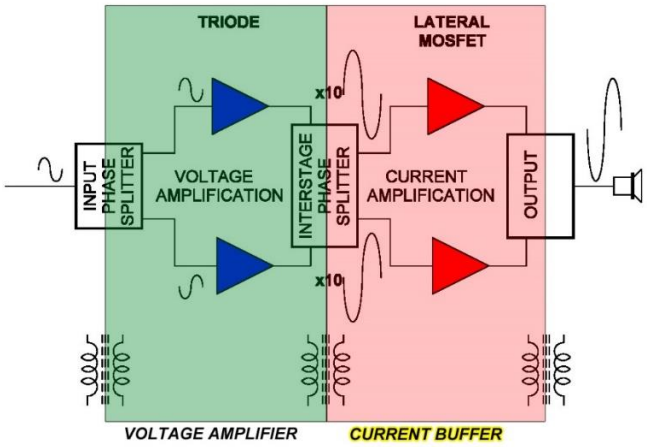

Fig.10: The Transformers inside the *Olimpico Power Amp*

The Output Transformers

While standard in most tube amps (beside OTL designs), there are only a few companies worldwide using output transformers, in power amps based on transistor circuits.

Most experienced engineers know the benefits of using these transformers - once skillfully designed and wounded – very well. However, to find a manufacturer skilled enough to produce them, with the same level of quality - especially with the high bandwidth needed - is not an easy task. Finally, the cost, weight and size prevent most companies from using such transformers.

The main purpose of the output transformers is their capability to “transform” the output impedance of the power amp to match with the impedance of the connected speakers. In tube amps, the output impedance of the circuit can be several hundred Ohms compared to the 4/8 Ohms of the speakers. In MOSFET based amps, there is still an output impedance of about 30/40 Ohms, which needs to be matched with that of the connected speakers.

Using an output transformer, the power transistors are loaded with a higher impedance than that of the loudspeakers. So, the power transistors work at a HIGHER VOLTAGE, but at a LOWER CURRENT with benefits in terms of distortion. Working at a lower current means less stress for the power supply and, as result of that, the rectifiers generate lower noise.

The output transformer substitutes the capacitor at the output, which is needed in almost all power amplifiers to isolate the power transistors from the loudspeakers.

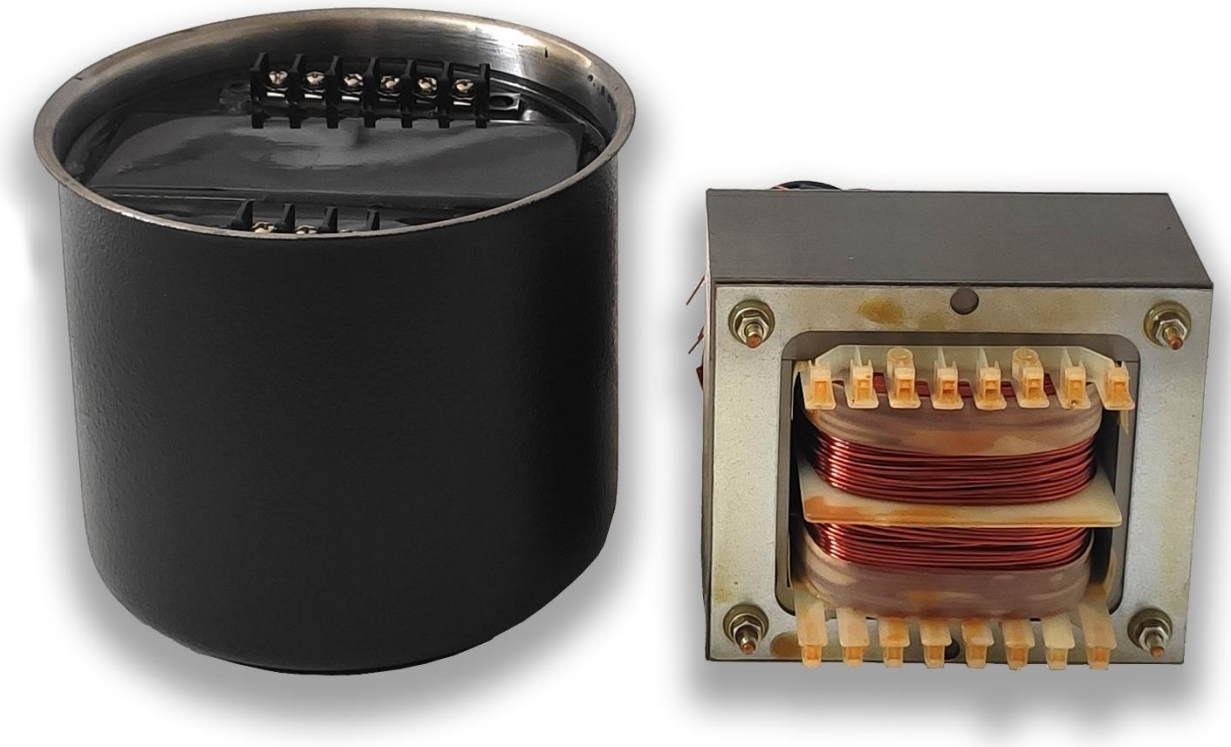

Fig. 11: *Olimpico* custom Output Transformer, potted and naked

The benefits for the sound are evident, because the sound energy transferred by a capacitor is less transparent than transferred by a transformer. The phase shift is also an issue to be taken into account and the matter was solved simply by designing the transformers with a bandwidth of a 75KHz ±0.5dB minimum bandwidth.

Other well-known implementations based on transformers are the step-up transformers for MC phono cartridges or all-inductors, no-capacitors RIAA preamplifiers like the famous *Vendetta Research* phono stage, designed by John Curl over two decades ago, or tube amplifiers where the output transformer is the key building block.

As result of the impedance matching, based on output transformers, the MOSFETs can work at a higher voltage and a lower current! The less current the circuit draws from the power supply, the less distortions are created by the switching diodes of the bridge rectifier.

Furthermore, the output transformers, in a push-pull design, as that of the *Olimpico PowerAmp*, effectively cancel any distortion created in the power supply by the design. This effect reduces the values needed for the filter capacitors in the power supply, which in turn, decreases the current needed for charging those caps, and leads to further reduction of noise created by this process.

Since the primary and the secondary windings of a transformer are not physically connected, no DC voltage can reach the output connectors of the amp. Therefore, a coupling capacitor, usually implemented at this point of the circuit to block DC from the outputs (even though having negative effects on the sound) is NOT necessary inside the *Olimpico PowerAmp*!

The bandwidth of the output transformer is 100KHz.

How to avoid overheating?

Besides the many benefits regarding sound, an amplifier running in pure Class A mode gets very hot! To ensure a long lifespan for the electronics and a stable running amp, is a true challenge for the designer. That is why most Class A amplifiers come with huge heat sinks, which in many cases still get very hot and are unappealing to look at. For the *Olimpico PowerAmp* the design goal was to use smarter solutions to reduce the heat from the amp.

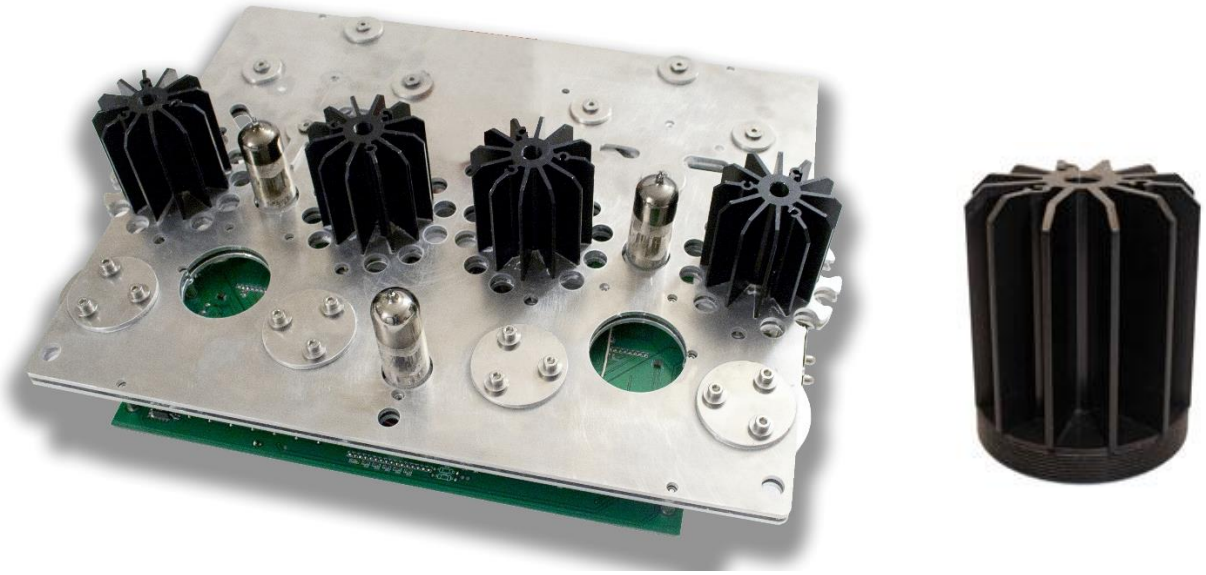

Fig.12: Heat Sinks on Top of the MOSFETs to cool the *Olimpico PowerAmp*

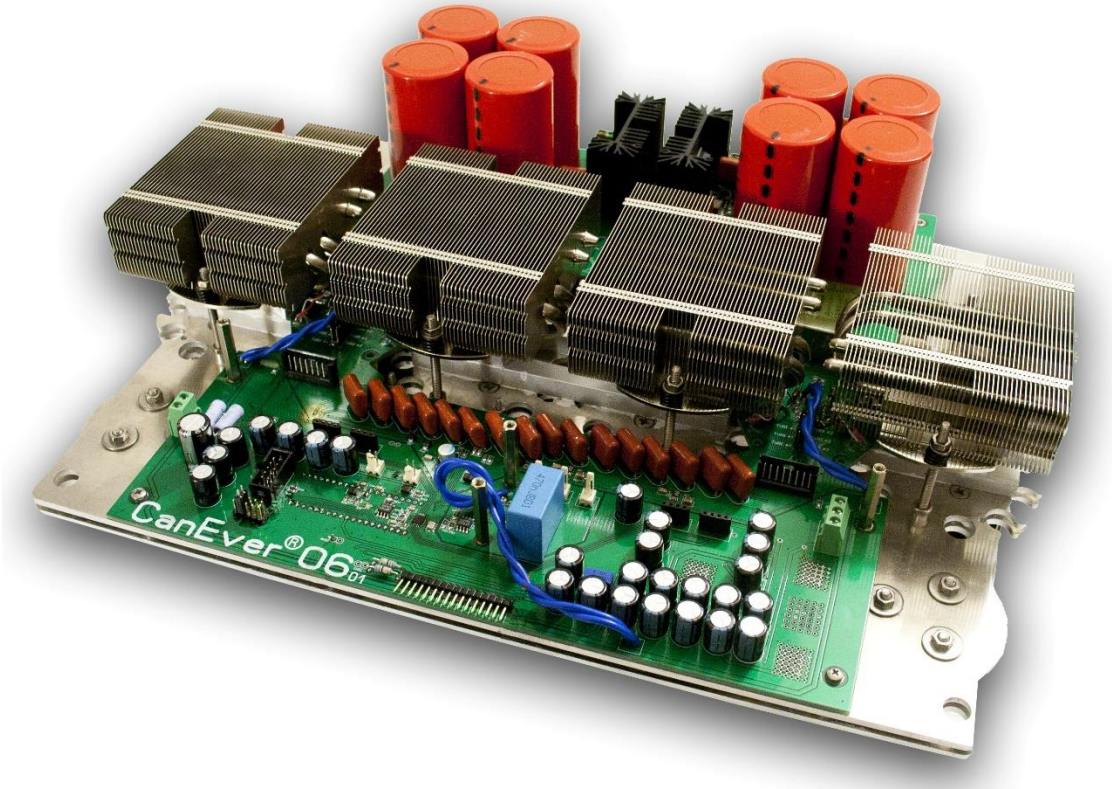

Fig.13: The MOSFETs glued to the Heat Pipes mounted upside down

The pictures above show a row of four heat pipes, including temperature controlled vans mounted from the underside, and four massive heat sinks mounted on top of the MOSFETs. Looking at the *Olimpico PowerAmp* from the outside, only the heat sinks on top are visible. The elegant style of the cabinet gives no sign that a massive Class A amp is working "under the hood"!

Following below are two pictures showing one of four heat pipes, which cool each of power MOSFETs.

The picture in the middle shows the heat pipe and the area where the MOSFET is glued to.

Fig.14: The Heat Pipes

The many narrow fins grant a very effective heat dissipation.

Fig. 15: The low speed Fans for the Air Circulation only
The Olimpico PowerAmp can work without the fans

The amplifier can work also with the fans powered off by setting the related parameter at the menu. The fans let only the air moves around the heatsinks. It increases the chimney effect.

With fans powered off the *Olimpico PowerAmp* works at 10°C higher temperature with a reservoir left of 35°C.

Conclusion

With the *Olimpico PowerAmp*, *CanEVER Audio* has once again proven its skills in offering extremely innovative products to the world of high-end audio. Thanks to the ability to combine well-known and proven engineering concepts with innovative ideas, *CanEVER Audio* has been able to create a product with amazing sound quality, which is able to compete with the best amps on the market today.

For further information, please visit our website www.canever.eu
or send us an e-mail, addressed to: sales@canever.eu

Specifications

Tubes	Driver 2x 6N6P (6H6n/6H6pi) matched pair Shunt Regulator 1x 6N30P (6H30n/6H30pi)
MOSFET	2x N-Channel Lateral MOSFET ECW20N20 matched pair
Power	60 Wrms / 140Vpp. (optional bridge configuration delivering 120Wrms / 280Vpp) Idle Power 600Wrms
Gain	20dB 6.5Vpp input voltage needed for the maximum power output
Bandwidth	75KHz -2dB
Input resistance	55 kOhm
Damping factor	> 1000
Amplifier size	41.5(W)x35(D)x24(H) cm
Amplifier weight	28.6kg
Power Supply size	20(W)x31(D)x15(H) cm
Power Supply weight	7.4 kg
Shipping weight	52Kg – wooden box 63x54x47cm
Cables length	158 cm (connectors included)
Cables weigh	0.8 kg

Description: Stereo power amplifier operating in class-A using only 2 Triodes and 2 MOSFETs each channel. Totally without feedback: without temperature feedback, without global feedback. Without any capacitor in the signal path.
Inputs: balanced XLR and unbalanced RCA selectable at the back.
Outputs: WBT Cu NextGen 3-way binding posts.

Warranty: 3 years, limited, transferable.

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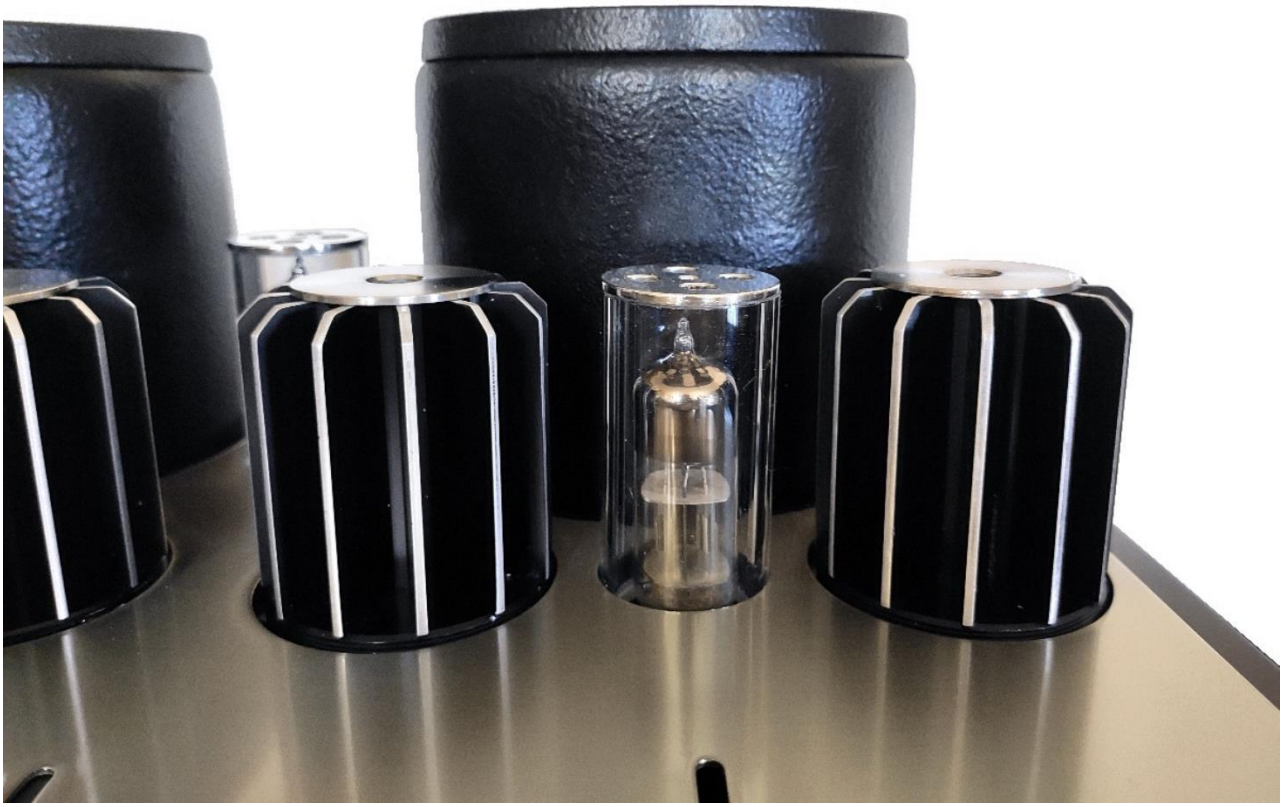
Current driving - The transconductance amplifier - Measurements.

Pictures Gallery

The *Olimpico* power amplifier – FRONT view

The *Olimpico* power amplifier – REAR view

The *Olimpico* power supply



The Triode driver stage (one channel) between the daisy heatsinks

The driver stages between the daisy heatsinks
The shunt regulator for the High Voltage Power Supply between the Output Transformer

The *Olimpico* – system view