

10-channel AES/EBU Amplifier Construction

by Bohdan Raczynski, February 2014

When I completed the construction the 5.2HT Analogue system in 2012 (described in http://www.bodziosoftware.com.au/Home_Theatre_Conclusions.pdf) I never anticipated, that I will be updating it to a digital version already in early 2014. Availability of AES/EBU amplifiers from miniDSP and AES/EBU digital sound card from Lynx Studio Technology, made it already possible to design and construct a state-of-the-art digital playback system, based on a standard PC audio server.

This paper describes the construction of a system described in this paper: http://www.bodziosoftware.com.au/Hybrid%20AES_EBU_Analogue_System.pdf, and this system includes the http://www.bodziosoftware.com.au/AES_EBU_24Bit_96kHz_System.pdf system as well.

There are changed to the original design idea. Here is what happened.

The original idea was to have all ICE_PWR digital amplifiers mounted at the back of the loudspeaker boxes. Now, when I counted the number of amplifier modules necessary to run the whole system (in it's full capacity it will include 7.2HT + BBM + CABS), the number of modules was 10.

Front-Left	1 module – 2in/2out
Centre	1 module – 2in/2out
Front-Right	1 module – 2in/2out
Side-Left + Side-Right	1 module – 2in/2out
Rear-Left	1 module – 2in/2out
Rear-Right	1 module – 2in/2out
Front Sub-Left	1 module – 1in/2out BTL (BBM)
Front Sub-Right	1 module – 1in/2out BTL (BBM)
Rear Bass-Sink-Left	1 module – 1in/2out BTL (CABS)
Rear Bass-Sink-Right	1 module – 1in/2out BTL (CABS)

With the amplifiers mounted at the back of loudspeaker boxes, I would have to flip 10 switches when turning the system ON, and do the same when turning the system OFF. The access to the rear of some of the loudspeaker boxes is restricted in my system. The centre channel loudspeaker, for example, is pushed under the entertainment unit and the rear side of it is not easily accessible. The same is true for larger subwoofers. See http://www.bodziosoftware.com.au/Home_Theatre_Updates.pdf

Next, installation of the amplifier modules would not be a trivial process, and involves disassembly of all loudspeakers, cutting square holes at the back, inserting additional LC output filters (if you need them), mounting the amplifiers, and re-assembling the loudspeakers. And how about 10 power cords to be connected somehow from various locations in the room?. Finally, AES/EBU extension cables are not cheap.

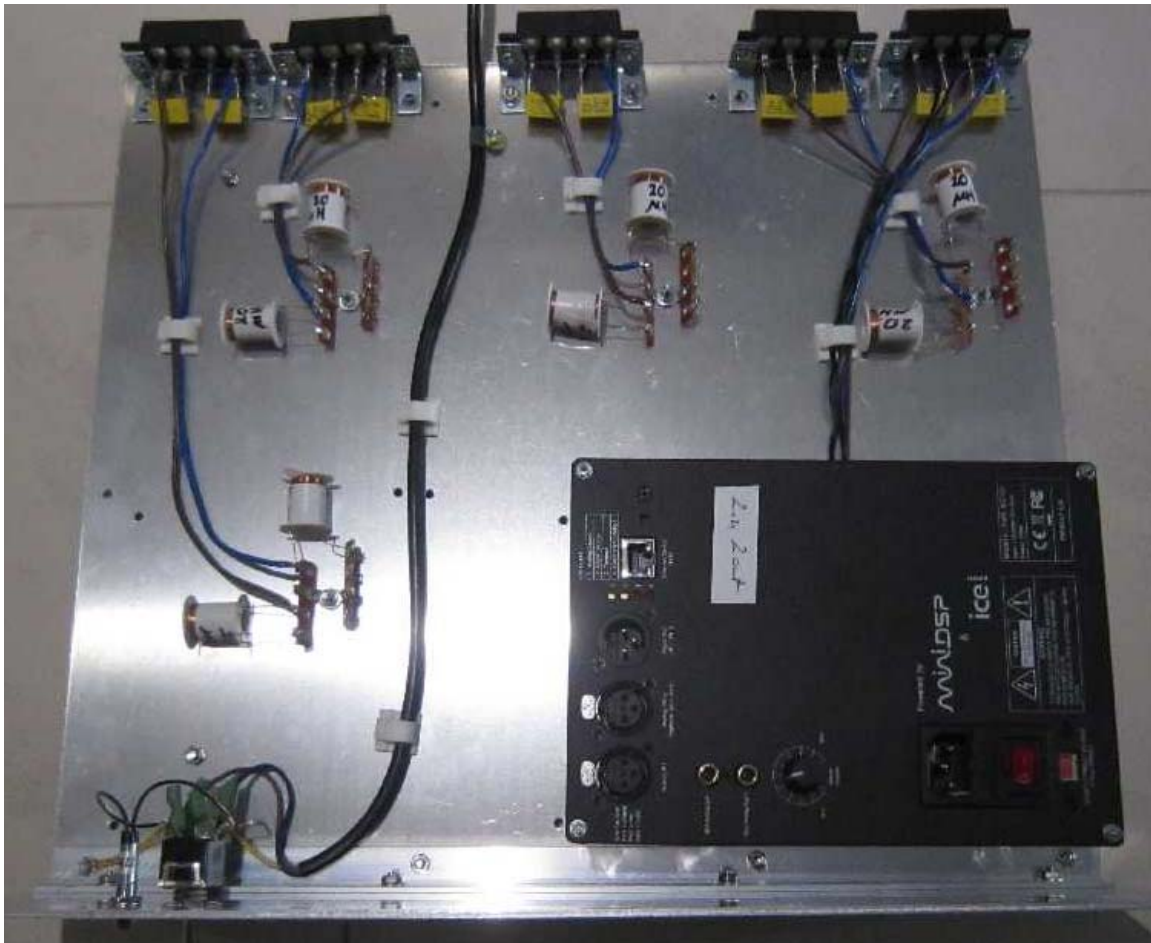
I think, that the excessive amount of cables floating around the room was the final “nail in the coffin” for the new idea. Given all the above, I settled on the same amplification idea as before – to have two multi-channel amplifiers shelved in the entertainment unit.

Therefore, there is one 2-channel AES/EBU subwoofer amplifier and one 10-channel AES/EBU amplifier for the current 5.2HT system. The subwoofer amplifier box has extra room allocated for inserting two more (1in/2out) modules for the rear bass sinks and one extra module (2in/2out) for the 7.2HT side channels.

Please note, that the side channels are 1-way, wideband loudspeakers. This is the trade-off you have to make, if you use CABS configuration. Without CABS, you can have side loudspeakers implemented as 2-way designs. This is the maximum of 16 channels provided by the LynxAES16 digital sound card.

Starting With The Chassis

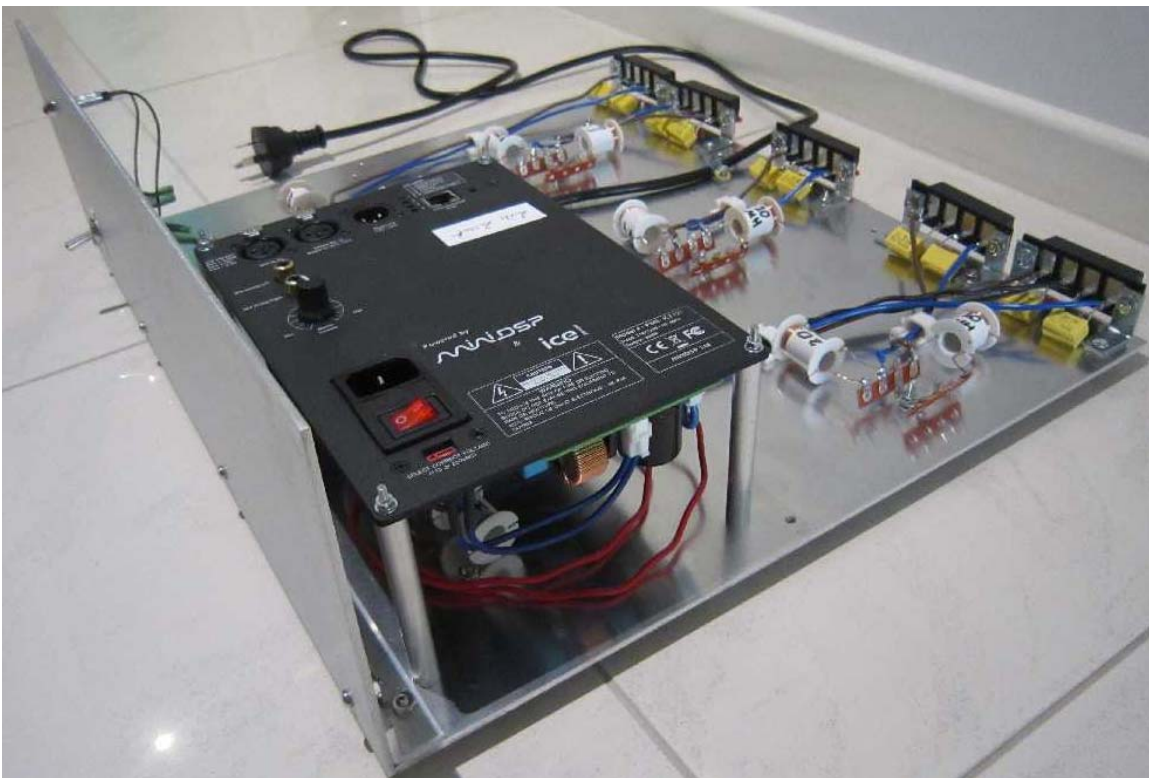
As before, the chassis is a simple 47cm x 42cm aluminum sheet, with a corresponding vertical front panel for mounting AC mains switch and “ON” LED – see below. The bottom plate has four rubber feet bolted to it.



Measurements of the residual 500kHz switching component at the output of the ICE amplifiers revealed the level of up to 4Vpp. Therefore I decided to implement additional LC filters to suppress this voltage further. I used simple LC filters with 20uH inductors and 150nH capacitors. The filters are mounted directly on the chassis bottom plate.



The ICE-PWR amplifiers have a vertical PCB connected to the main PCB. The vertical part extends 77mm away from the mounting plate of the amplifier, therefore, all amplifier modules are mounted on 80mm spacers - see below

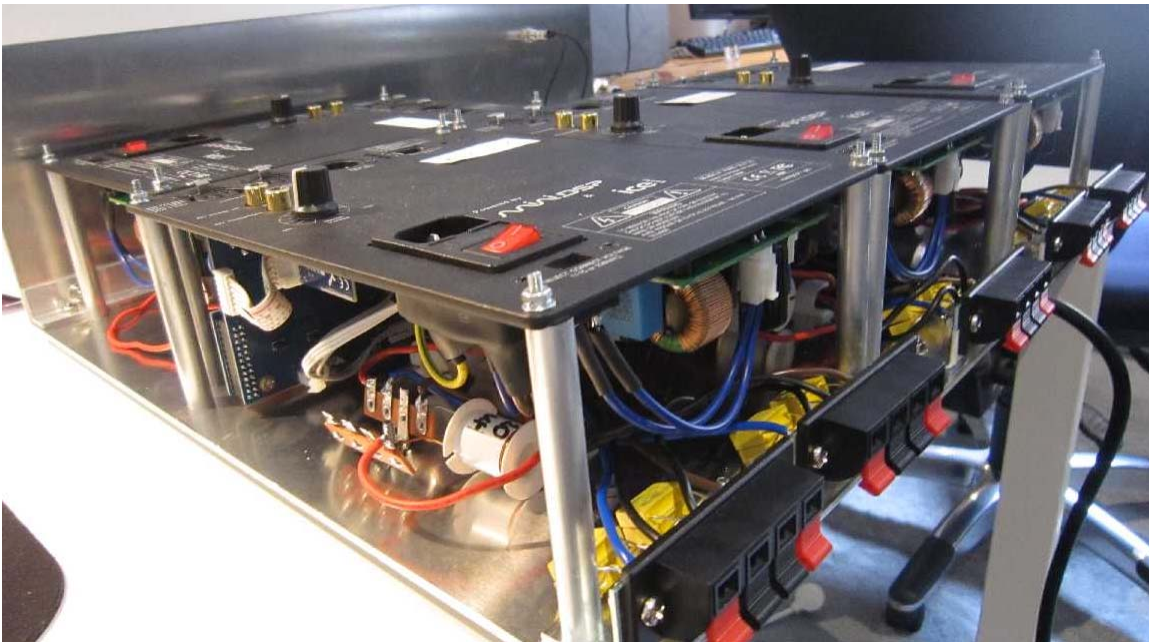


Mounting Of The Amplifier Modules

The 80mm spacers are simply long aluminum tubes cut to size by the local supplier. Inside each tube is a 100mm M3-size threaded rod, also cut to size from a longer specimen. Picture below shows 4 modules assembled already.

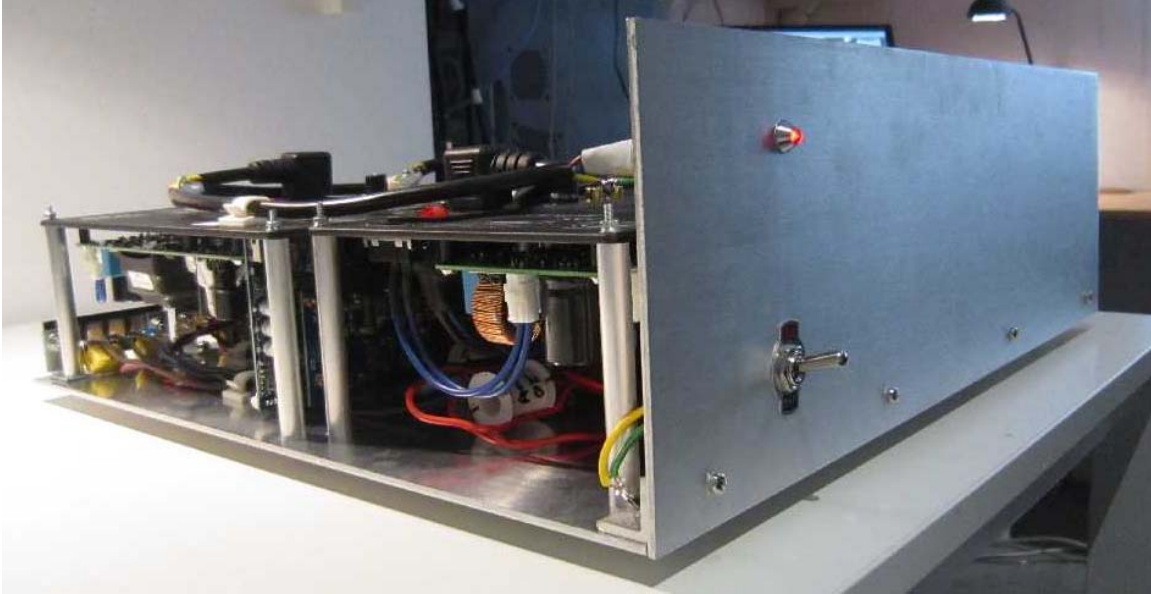


As you can see on the picture below, there is enough space under the amplifier modules to accommodate the additional LC filters.



Final Assembly

Even though the amplifier modules are mounted in the same enclosure, they are intact and unmodified. I have even used separate, custom-made AC power cord loom because the AC fuses are an integral part of the AC switch/socket assembly.



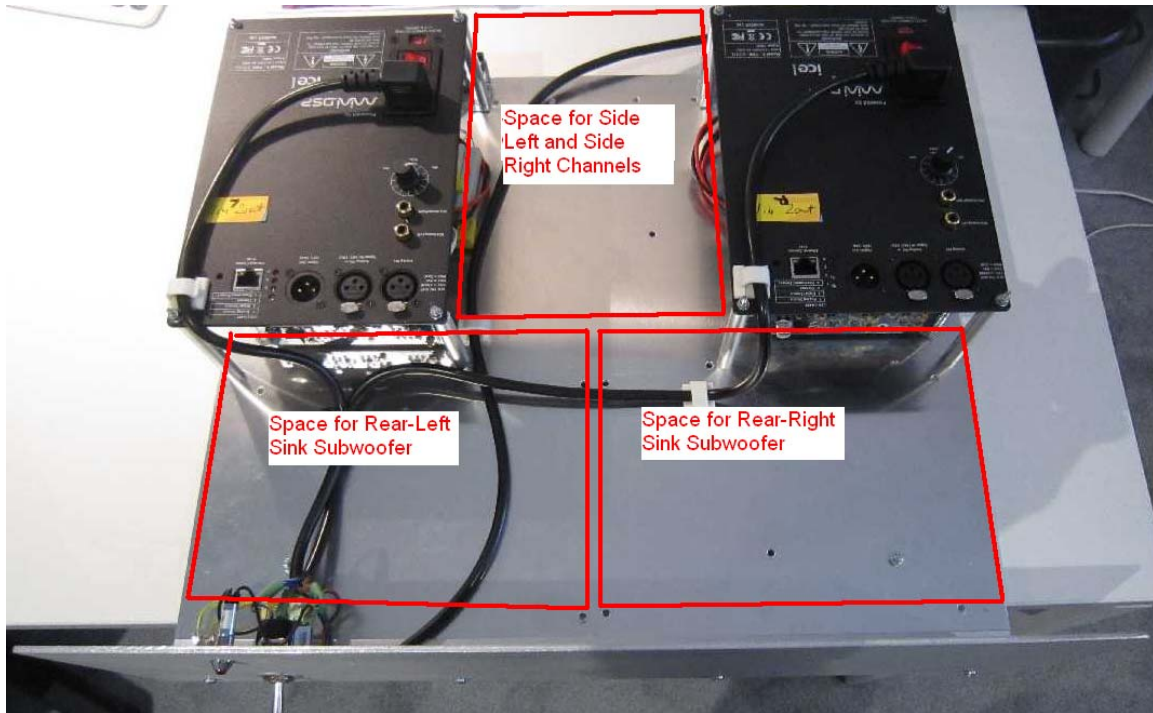
A custom-made AC power cord loom clearly visible on the picture below.



This is fully assembled and operational 10-channel AES/EBU amplifier. When using pre-cut aluminum sheets, spacers and rods, assembly time is about 12 hours.

2-Channel AES/EBU Subwoofer Amplifier Construction

Subwoofer amplifier chassis is designed to accommodate 7.2+BBM+CABS system. Therefore, there is enough room allocated for additional 3 x ICE power amplifier modules. The space will be filled when all loudspeaker boxes are completed. In the meantime, I run 5.2+BBM system. The subwoofer amplifier chassis has exactly the same dimensions as the 10-channel amplifier described above, and was constructed using the same approach therefore, I will limit the presentation to a couple of pictures, to show the final product.





Both amplifiers completed. Left – Subwoofer amplifier, Right – surround channels amp.

The ICEpower125ASX2 module specification is as follows:

Key Specifications

- 450W @ 1% THD+N, 20Hz – 20kHz, 4Ω, BTL
- 2 x 120W @ 1% THD+N, 20Hz – 20kHz, 4Ω, SE (both channels driven)
- 121dBA dynamic range (BTL-mode)
- 117dBA dynamic range (SE-mode)
- THD+N = 0.002% @ 1W (8Ω,1kHz, SE-mode)
- THD+N = 0.002% @ 1W (8Ω,1kHz, BTL-mode)
- 86,4 % total efficiency @ 250W, 8Ω
- CCIF Intermodulation distortion = 0.0009%, 10W, 4Ω, 18.5kHz/1kHz
- ±25V unregulated auxiliary power supply
- Selectable Mains 85-132V_{AC} & 170-264V_{AC}

Key Features

- Fully integrated audio power solution
- Rugged construction
- Thermal protection
- Over current protection
- Sound optimized soft clipping
- Suitable for CE approved designs
- EMI conforms to: EN55013
EN55020
EN61000-3-2
EN61000-3-3
FCC part 15-B
- Safety conforms to: IEC 60065 7th ed.
UL 60065 7th ed.

Please note, that there are two types of ICE PWR amplifiers used in this design:

1. 1in/2out for subwoofers in BTL mode
2. 2in/2out for the rest of the drivers – this is a special version for you to order from miniDSP.

This design achieves the following power/impedance configurations:

1. Four 250W/8ohm BTL channels – all 4 subwoofers
2. Three 120W/4ohm SE channels – all front 2x8” pairs of woofers
3. Nine 60W/8ohm SE channels – all rear + side drivers + all front tweeters.

CABS – Controlled Acoustic Bass System, as described in
http://vbn.aau.dk/files/62729248/LF_sound_field_control.pdf

BBM - Binaural Bass Management - AES Preprint 6628

Thank you for reading.

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