

INTERSTAGE COUPLED 5687 DESIGN

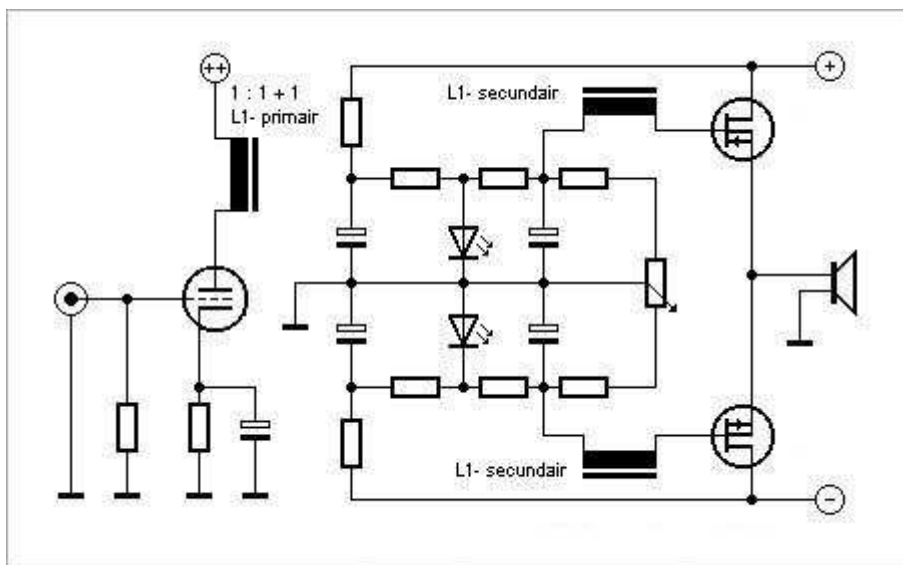
----- Hybrid amplifier
using an interstage transformer

This design is using a Lundahl interstage transformer, a 5687 driver tube and Magnatec Power Mos-Fets.

Idea came from several articles; though an article by Guido ten [NL] triggered me to start a project like this.

Ingredients for good sound?

Hybrid Amplifier using an interstage transformer



A hybrid amplifier revisited

This amplifier project was published in Electronics World + Wireless World (EWWW) March 2000. It was also published in Glass Audio.

Notice : This following article was originally written in Dutch and is translated using Word Translator '98®.

In my thoughts I had already built four hybrid amplifiers, however it never came to the point to build one. Begin this year I finally started with the development of this amp and the try out of my own hybrid amplifier.

This hybrid amplifier uses a 5687 tube, SCR coupling capacitors and Magnatec PowerMosFets. Result is extraordinary good. My Dynaudio loud speaker (10.5 litre basreflex, 17W75XL04 mid / low unit and a T330D Esotar unit) is really in love with this amplifier. Music like 'Get Here' by Oletta Adams and Neil Young's 'Cortez the killer' of the live 'Weld' cd are phenomenal. An other good example is jazz guitarist John Scofield with 'Dark blue' (Hand Jive cd). Besides that is my favorite classical piano music and my favourite music of jazz pianist Keith Jarrett reproduced in an extraordinary good way. I can state that the amplifier understands my music choice. So no reason to try another design.

However after reading an article by Guido Tent (Audio & Techniek No. 69 May / June 1999), it started to itch to try out this idea. This also because of an old transistor schematic I found some years ago (dated 1960; input stage, transformer as phase circuit and 2 N power transistors) and a patent dated back from 1998, I did read the article but didn't pay too much attention to it at that time but somehow it was still in my mind.

These ideas inspired me, because old schematics with currently obtainable components like transformers and semiconductors can lead to the required result. In the 30's and 40's many, many amplifiers were built with interstage transformers, also in the sixties they used interstage transformers in transistor amplifiers. In a Japanese magazine from 1995 I did find a design with an opamp, an interstage transformer and two N-Power MosFets.

After reading about those articles I had still some questions toward a design like this. An transformer? This component was in the past with great satisfaction eliminated? However the 'disappearance' of the coupling capacitors and the unique nature of the design has been my motivation to build this amplifier.

I have chosen for the following configuration. An 5687 tube, an Lundahl interstage transformer and Magnatec PowerMosFets. Because I had a number of 5687's tubes and because I have used the 5687 in my former hybrid (and this successfully), have I chosen for this tube. The Magnatec PowerMosFets are chosen this because I already used them in other projects and this also with good results. These PowerMosFets are special made for audio and are reasonably priced (\$ 17.50 each). The BUZ 900 has a TO-3 case and the BUZ 900P an TO-247. Also is there a version with two N-MosFets parallel in one case (and of course a version with P-MosFets, the BUZ900DP and the BUZ905DP), besides those Magnatec manufactures a N and P PowerMosFet in one (!) case (the MAG90X95). And what to think of the 500W version in an SOT-227 case.

Now was the problem which interstage transformer. The interstage transformers of Tango and Tamura are simply too expensive for a 'try out' like this. After a period surfing on the internet the choice was not difficult. An interstage of Lundahl was the best choice, this on behalf of the good specifications, obtainability and the price. The Lundahl have been ordered in Belgium, and were deliverable from stock. After receiving the transformers, I started quickly with the construction of the prototype. In the mean time emailed with Guido, not only about the hybrid but also about the well and woe of the DIYers in The Netherlands in general. I had also the opportunity to ask him about the in Audio & Techniek forgotten schematic. He was so friendly to send me this. It is skillful if you have already a begin of the possibility. In the enclosed Orcad drawing you can find the schematic as used / build / tested by me.

The original schematic by Guido was only put on 'paper' and is not actually build, with result that for example not was noticed that some components were incorrectly pictured and that one of the junctions of the secondary winding was wrong pictured.

Hybrid Amplifier according to Wim [Click picture for more details](#)

Building the amplifier I noticed that my design did oscillate and for this reason an RC network is placed. Another solution to eliminate the oscillation is to change the gate resistor from 249E to 1K5. The signal didn't change.

The secondary winding of the Lundahl has the thing that if unloaded a peak of 8 dB will occur at 30 kHz. With a resistor of 47K parallel to the secondary winding the best result is reached between distortion and damping / frequency response. The amplifier has now a peak of 0.5 dB at 20 kHz. Further it is progress is straight with the -1 dB point on 14 Hz and 45 kHz, what can be called an achievement for an 1:1+1 transformer. An effort to with an RC network parallel to improve the damping of the secondary winding, had no success. This all applies to the used Lundahl 1:1+1 interstage of the type LL1660. This trannie is obtainable in three various versions namely: a push-

pull version, a single-ended 18 mA version and a single-ended 10mA version. I have chosen for the LL1660/10mA.

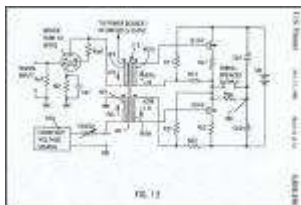
This interstage is wired according the connection alternative Alt U (please check update for this). Chosen configuration is suitable for use of single-ended to push-pull and a primary current of 18 mA. The 5687 is suitable to be used with this current. An alternative choice can be an interstage transformer of Border Patrol. This English company manufactures also an usable 1:1+1 interstage. Part number of this transformer is ITPP-860. I mention this company only, I have no experience with this product.

How does it sound? Noticeable is the good audibility and clearness of the sound. The low end is dry, punchy and tight. The music of for example my favorite pianist Keith Jarrett fascinates me.

Update: August 18, 2003. Lundahl did reconfigure the LL1660 to ALT V and offers now also a modified version of the LL1660 (the LL1660S), you might like to check out the Lundahl website for this. At the moment I did work on some different configurations and recently I did work on a version with two N-Power MosFets in the outputstage. It is called the CIC Power Amp [Circlotron Interstage Coupled]. Also in progress is a BTL output configuration with 4 Power Mosfets, this using tubes as the ECL82/6BM8, the ECC40, the 6BC4, the PC88 and the EC8010.

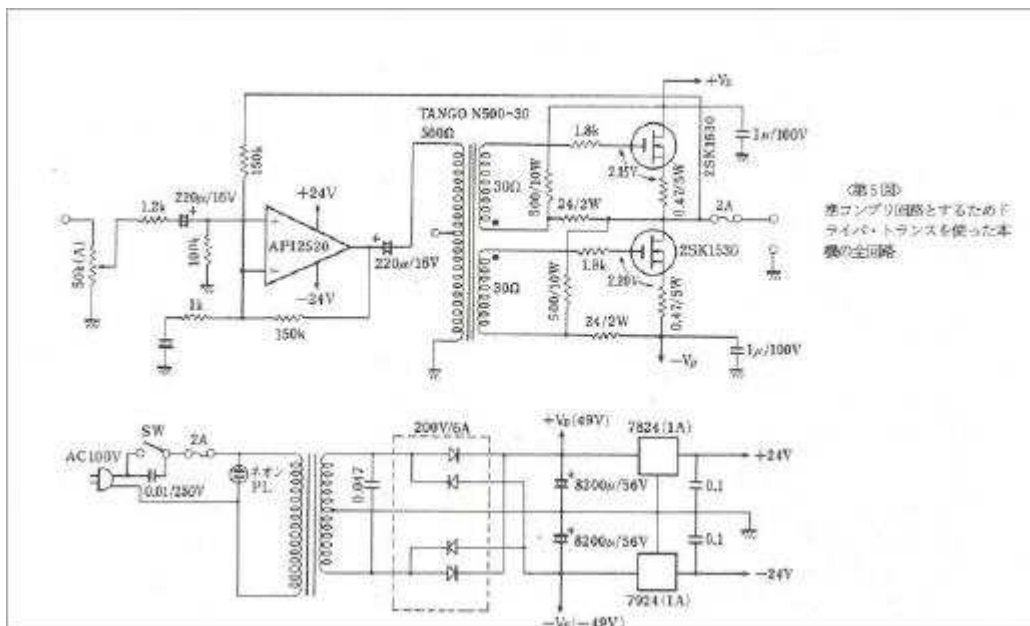
Above: left channel of the BTL Amp using a 1:1+1+1+1 interstage transformer; it is using the following components: an EC8010 tube, the Lundahl LL1660/18mA, 2 N and 2 P power MosFets in BTL configuration. Output into 8 ohm at 1% distortion is 70 Watts, this at +/- 23 Volt. This configuration measures better than the original version. For example, frequency measures upto 100 kHz and at 20 kHz at 10 W it measures half of the distortion of the original design. More to come.

Wim de Haan.



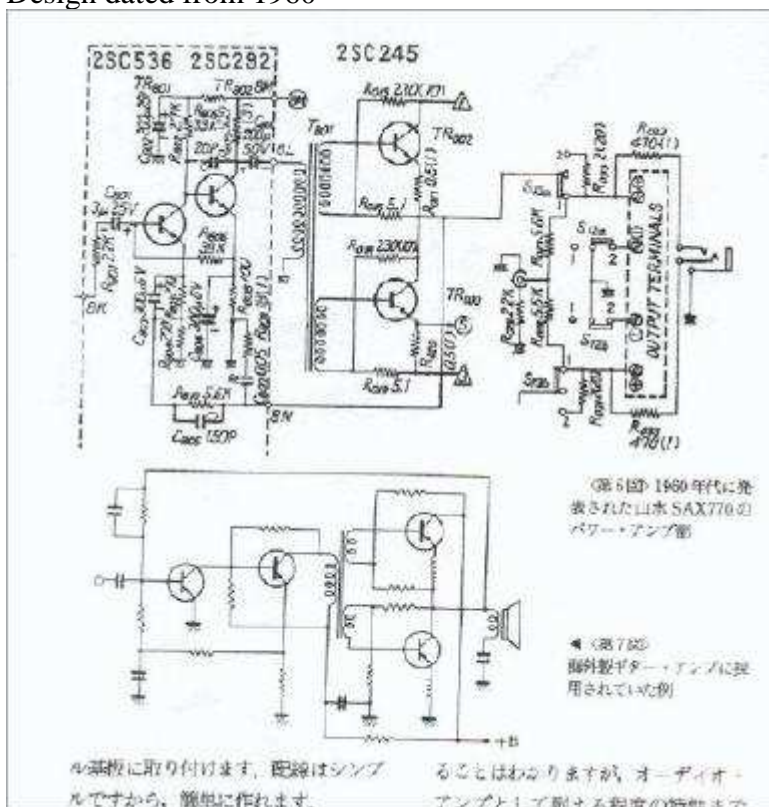
Patent Hybrid Amplifier [1998] Click picture for more details

Japanese design 1998



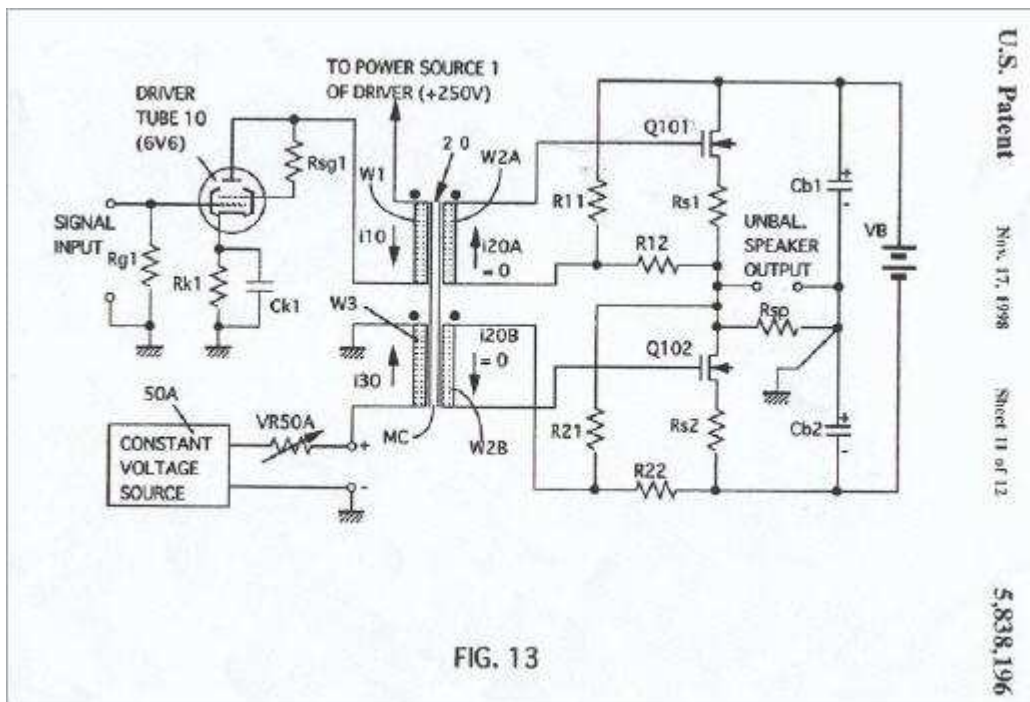
Design from Japan [1998] using 2 N-Power Mos Fets Click picture for more details

Design dated from 1960



Interstage design using transistors [1960] Click picture for more details

Patent Hybrid Amplifier



Patent Hybrid Amplifier [1998] Click picture for more details

Hybrid Amplifier [unknown]