

“The Albert”

It all started when as a young 12 year old in the U.K. I was visiting a local public dump with my Father (Albert) when I stumbled across an old Burroughs calculator adding machine from the late 60's -70's which had these amazing looking displays. After retrieving some of the display boards complete with driver IC's I brought them home and started to find out what they were and how they worked.

My interest in electronics had started when I was 9, I was given a magnificent Philips Electronic kit for Christmas and it was all downhill from there. I then got a Saturday morning job working in a HiFi shop in the local town and was given by one of the service guys a radio ham three more of these Nixie tubes to add to my collection from the previous scavenge together with another strange looking tube/valve which I later found out was a Dekatron.

Now skip 44 years a country and I find myself still in the electronic world but in Process Control Instrumentation and after a visit to a HiFi show in Toronto with a colleague I was very disappointed with the offerings on show with maybe only one decent sounding amp and maybe a couple of speakers.

Determined I could make something better I looked around for a suitable design ideas and as an avid reader of AudioXpress magazine was drawn to a couple of really clever and original designs. In Decembers 2011 and February 2012 were two such designs that immediately appealed to me the “Willow” preamp and “The 5002 Project” both by the same author Robert Nance Dee.

The “Willow” appealed on a couple of fronts namely the relay ladder acting as a potentiometer and the interesting front end using just a single FET and a buffer chip. The digital control nature grabbed my attention as one of my lines of business is the use of digital encoders and this had a couple being used!

The “The 5002 Project” just captured my imagination as it used the same HA5002 buffer chip but multiple paralleled together to produce outstanding specifications which put many at the HiFi show to shame.

Two things I have always mused about and feel very strongly are frequency response and slew rate and this design had them both! When I saw the square wave response in the article at 100 KHz I knew I had to build this. We always see amplifier manufacturers showing graceful sinewaves but real music is not like that and a square wave should be used as the benchmark, which I gather it is now being used.

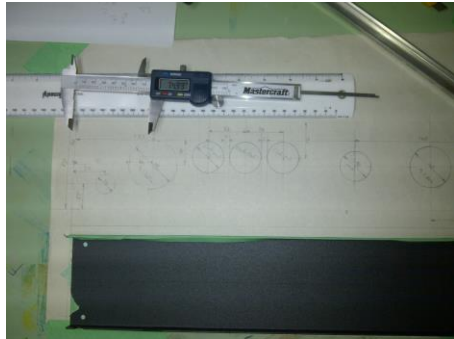
The last time I built an amplifier was when I was 17 it is currently connected to this very computer sounds amazing after all these years a Ben Duncan design using good old 2N3055's Class A.

This time however I was not going to etch my own circuit boards and it was going to look like a somewhat professional so I decided to plan this out very carefully.

The first thing I had to decide was how to incorporate the Nixies and the Dekatron without the microcontroller as my knowledge of programming them is nil. Not wanting to give up on using the Nixies and Dekatron I would have to design a control circuit to suit. I still had the original 74141's Nixie driver IC's recovered from the boards so that was the plan. The Dekatron I had no experience of driving it whatsoever but a quick Google search gave me circuits to try.

Following some of the spectacular build threads on the DiyAudio forum gave me a few ideas and I knew I wanted it in a 19" rack format so I found one on Digikey a Hammond one.

I quickly dusted off my old drawing board and quickly drew up a front panel after placing the knobs, Nixies, Dekatron, headphone and power button on it. With the placements sorted it was time to cut holes and start the project October 2012.



I had to figure out how to get the Nixies on the veroboard and came across someone on Ebay selling valve/tube sockets for the pins. This was crucial in getting them mounted and electrically connected and they worked just great.



Here you can see the pins poking through the veroboard

The next part of the circuit was rather involved and I will just say that not using a microcontroller certainly presented its problems. The volume encoder is a 128 count per revolution so the display will

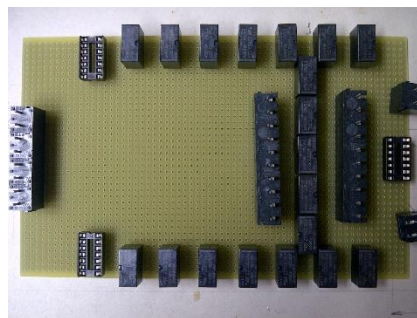
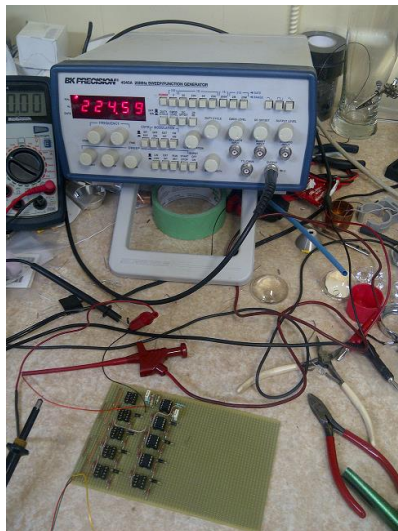
read 0 to 127. So I had to make the circuit count up to 127 and go no further and when returning back to zero go no lower than zero. With a little ingenuity and a sprinkling of diodes we made it happen it does not have the luxury of a memory so when it switches on it originally came up with random numbers but we made sure it returned to zero so it was dead quiet.

Moving on to the programme selector Dekatron this took approximately 8 months to get it right how I wanted it. I tried all different circuits to drive the ETL GC10 but it stubbornly refused to cooperate this left me with no alternative to source another one, again eBay to the rescue and this time I had to use an A-102 from Bulgaria. This one worked straight away and was driven perfectly by the encoder they appear to have been made for each other as the timing needed to make the neon glow move requires one pulse to arrive before the next quadrature in harmony! I needed to make a delay on relay so there is no annoying thump and so I created a small timing circuit that causes the Dekatron to spin and then stop at the number 1 position after switch on so it looks like its doing something and rather cool.

To supply voltage to the Nixies and the Dekatron it requires high voltages at least 300 for the Dekatron! I saw a really neat trick to utilise a second primary of a transformer 120 Vac to act as an isolated supply rather than simply paralleling them up provided you can still get the current you need on the secondary. I then used a voltage multiplier capacitor diode stack to generate over 600Vdc as the supply droop when the Nixies are drawing about 1.5mA each caused the Dekatron to malfunction. For both the Nixies, Dekatron and relay logic and control circuitry a separate transformer and power supply was used.

Having had logic gates filling my head for months I took a break and decided to build the power amp board next and see if indeed the frequency and slew rates were really what they were purported to be.

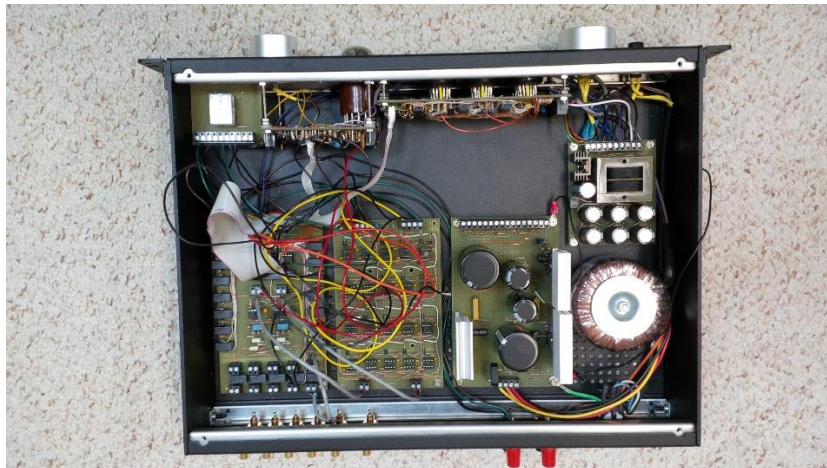
I again chose to build this on veroboard (more of this later) here you can see a mock up and this is the frequency 225KHz at which the response starts to suffer a little attenuation due to the capacitance of my wires etc.



Having got the power amp fully populated and tested I moved on to the preamp board this is where all the magic happens and is simply an R2R ladder using relays. For the volume control and the programme selector Rotary encoders are used 128 count and 16 count.



I start everything by placing the components on the board to get an idea of how much space we have for things and hopefully we do not run out of room. Here you can see the amplifier starting to take shape.



So clockwise from the top left hand corner we have the Headphone output and time delay relay speaker output board followed by the Dekatron driver and programme selector and the Nixie volume board. (Note the ribbon cable that feeds the R2R, Programme and Preamp Board). The final 600 DC power supply board, unmodded Toroidal transformer, Mark 1 of the final power supply board , the power amp board minus the heatsink and finally the preamp and programme board.

So the testing began music was input into the first channel and the volume control was turned up the relays making a wonderful clicking sound in unison with the changing digits of the Nixies a thing of beauty. Music was being played through some cheap headphones and I noticed some graininess and after about 5 mins of listening one of the earpieces started to get rather warm. I immediately switched the amp off but it was too late the voice coil had overheated!

So puzzled by this strange phenomenon I then quickly made a couple of dummy loads (note to self never connect a new amp to headphones before a dummy load test) and tested again. My old Telequipment scope on across the load showed nothing I could see but it definitely got warm somehow. I then took the power amp out of the amplifier and drove it direct from my signal generator and it was fine. Connecting it back to the power supply in the amp things got warm again. I checked the power supply with my scope but could not see ripple or anything maybe a bit of noise but nothing. The supply was nothing more than LM1084 variable 5 amp regulators that I have used for many years in other projects.

So prodding about on the PSU I noticed oscillations on the adjust pin of the LM1084 but only when loaded with 100mA or more the frequency was about 20MHz or so as my scope could not really see it clearly. Thinking the layout of the veroboard PSU was somehow causing this, I then totally rebuilt and placed more capacitors around the device so Mark 2 was born this was then tested again and it appeared to be a little bit better. Again music was played through this time through ear buds and guess what the same thing happened destroyed earbuds.

Thinking that both the power amp and the preamp were oscillating I rebuilt them both on ground plane veroboard and connected it up to the power supply the same problems. I was truly disappointed.

I had now lost a bit of the excitement building this and decided to leave it alone and come back fresh.

6 months passed as I have other hobbies that take over in the spring and summer months Mountain Biking but that's another topic.

Chapter 2 The Final Build

Trying various layouts of the LM1084 I could not stop the oscillations and as the Buffer Chips have high slewrates over 1000v/uS they happily will amplify the oscillations all day long.

I also discovered that the 38Vdc that was being generated by a voltage doubler to supply the FET and nothing else had chronic amounts of ripple on it and since my transformer was just two 0 to 18vac windings I was stuck.

Diyaudio to the rescue! I had seen a thread that mentioned being able to add a separate winding to a toroidal transformer and decided to give it a go. I bought some magnetic wire of the gauge required for the current drawn maybe be no more that 200mA put 10 turns on and measured the ac voltage. It turned out I needed only 120 turns to generate 36 volts and then using the circuit mentioned below I had a variable 38 Vdc on a separate winding.

I then came across a website <http://www.acoustica.org.uk/> a gentleman by the name of Martin Clark had come up with a really clever circuit for using two LM1084's with one being a pre regulator. After building this circuit up and testing it with a couple of modifications that I will post on another thread on DIYAudio I had the quietest and most stable power supply I have ever built. As luck would have it in the

last 6 months my boss had purchased a second hand LeCroy GHz oscilloscope and gave it to me to test out and find out how it worked, with this magnificent scope I was able to see all the spurious oscillations and tune the power supply capacitors to eliminate all noise and ripple!

So Mark 3 Power supply was built and installed and this time dummy loads were used and with the LeCroy clipped to them and voila we had no oscillations and no noise that I could see.

So I gingerly connected the amp to a couple of cheap speakers a sound bar off my old TV that had died and we had music and no temperature issues at all.

I then moved the amp to its final resting place in the family room to use with my main listening speakers and switched on. I was completely blown away by the sound the bass was just staggering and I could not tell if the amp was on even if I put my ear to the speakers!

I quickly got my favourite CD's out and started to listen I was shocked literally some of the CD's were outstanding I was hearing things in them I had never heard before and then others were just appalling.

The designer did caution people that this is a very revealing amplifier especially the FET front end and as they say rubbish in rubbish out.

So you would think that would be the end of the story but no I soon realised that all CD's are not recorded at the same volume level so I found myself having to continually get up from my listening position and adjust the volume so I decided I had a little bit more room left in the case for a remote control and as you can see in the final build the inclusion of the wireless remote control. I had to go wireless due to the fact I had not made provision for an infrared diode in the front of the case and to disassemble the whole thing was too much work.

So there you have it the "Albert" in its final form performing beautifully and allowing me to really enjoy music and listen for hours on end.



Does it end there? I'm afraid to say no, I have now caught the DIY bug and am preparing as we speak to build the F6 from Nelson Pass with a twist so that will be the subject of another build.

Hope you enjoyed reading of my exploits.

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