tynemouth software blog

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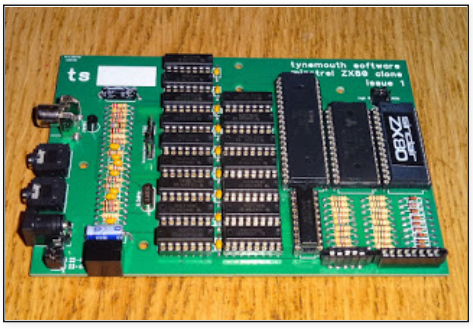
Sunday, 10 May 2020

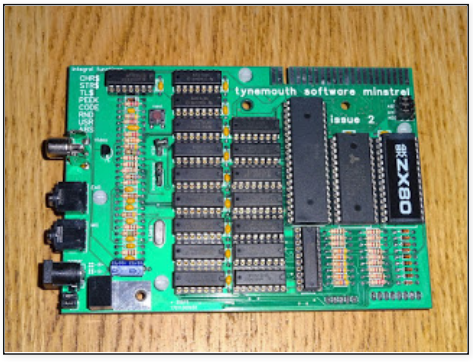
What is a Minstrel?

In the build up to the launch of the Minstrel 4th and the reopening of my Tindie store last week, I made a few changes to the existing Minstrel line up, so I thought it would be good to answer a few of the questions about that, starting with What is a Minstrel?

Minstrels are a series of Z80 based computer kits in the same shaped board as a ZX81. The first of these was launched in 2016, the Minstrel 1, a clone of the ZX80 design. It was only produced in small numbers, a sort of proof of principle (so they must now be worth at least $1M each). Could I make something that size which worked as a ZX80 computer, but was able to fit into a ZX81 case and use it's keyboard?



That was soon followed by the Minstrel Issue 2 (I dropped the 'Issue' bit later on, and just refer to that is the Minstrel 2 now). This added a back porch circuit to the video output to make it more usable, and also an edge connector for ZX81 expansions. That was still pretty much the ZX80 design, other than the RAM and ROM were switched for currently available chips, giving it 16K or RAM and multiple ROM options.



Due to a mixup by the PCB manufacturer, one batch of Minstrel 2 boards arrived in blue, and that has sort of stuck. I have kept green boards available in small numbers, but there are only a few left, the Minstrel 2 is only be available in blue now.

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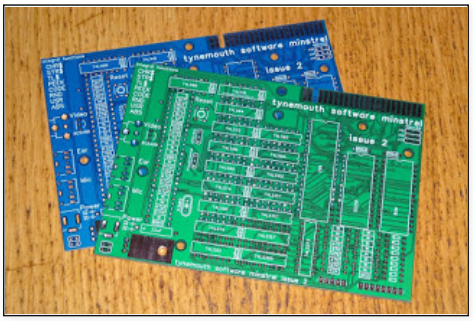
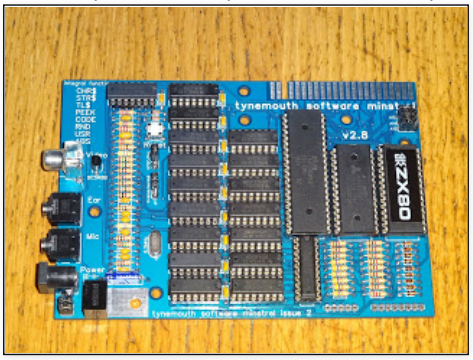
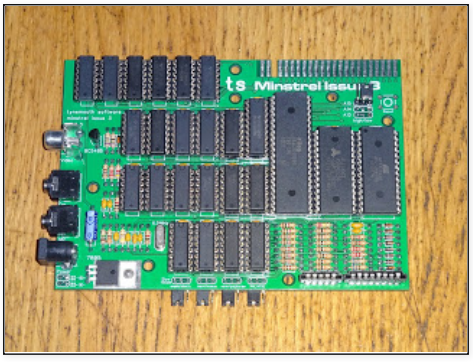


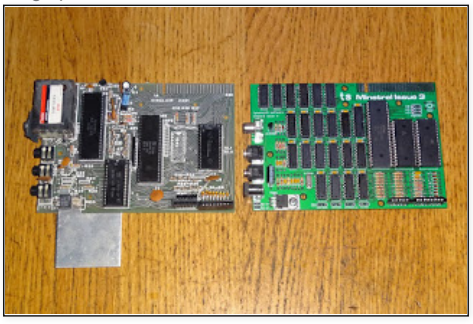
The Minstrel 2 has been refined a few times over the years, the latest being the Minstrel 2 V2.8. That includes a slight change to the composite video output to match that developed for the Minstrel 3.



The Minstrel 2 still follows the ZX80 design, so could only run some ZX81 software, as it lacked the 'slow' mode where it could run code in the gap at the top of the screen, instead of having to stop drawing the screen altogether when it wanted to run code.



In 2019, after quite a bit of work, I launched the Minstrel 3. That added the 'slow' mode, but also deviated from the original design quite a bit to make a more modern interpretation of the ZX81 design, less reliant on analogue properties of digital chips than the ZX80 design, and added 32K of RAM set up to work with high resolution graphics.



The board was still in the ZX81 form factor, and was now an ideal replacement for a dead ZX81 or simply to preserve a working one and replace it with one with extra RAM and composite video output.

Labels

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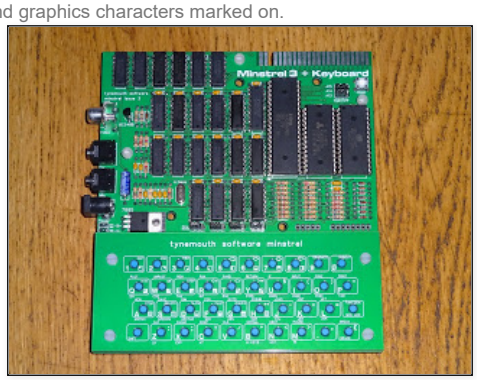
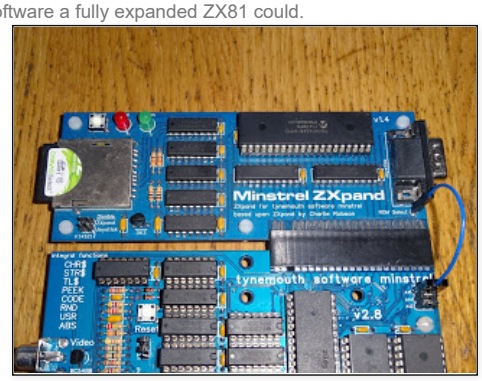
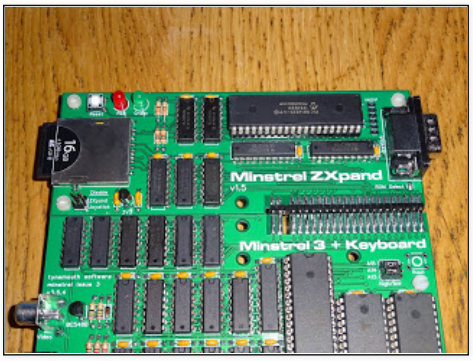
As well as the ZX81 case option, the Minstrel now had it's own keyboard, and a keyboard overlay PCB with all the keywords and graphics characters marked on.



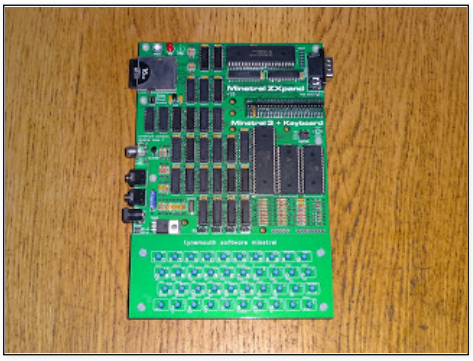
That made a nice standalone system built with all modern parts, but was still compatible with the ZX81 and could run all the software a fully expanded ZX81 could.



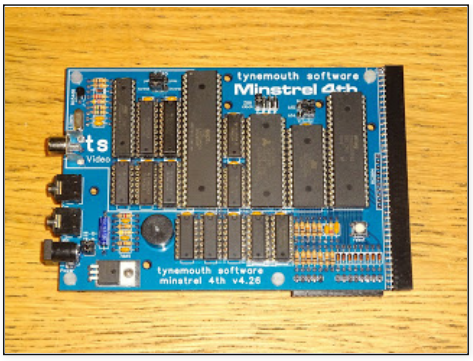
To make all that software easier to load, I produced a special version of Charlie Robson's ZXpand, with only the bits necessary to make it work on the Minstrel 2 or 3.



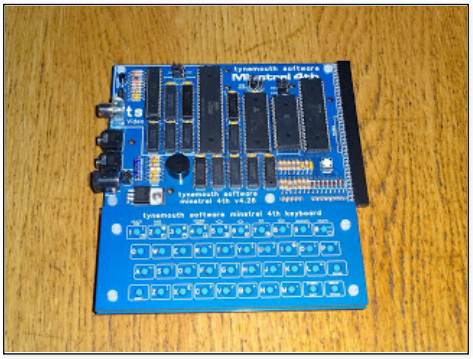
You can fit an edge connector, but I think it makes a more stable and better looking system if soldered on using a pin header.



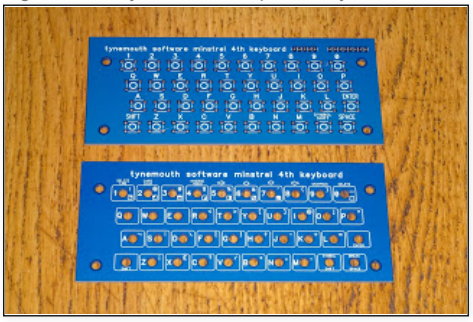
The next in the series was the Minstrel 4th. This followed similar principles to the previous Minstrels, Z80 based, ZX81 shaped, all the upgrades, all modern chips. But this one was based loosely on the Jupiter Ace, and can run Forth and Jupiter Ace software.



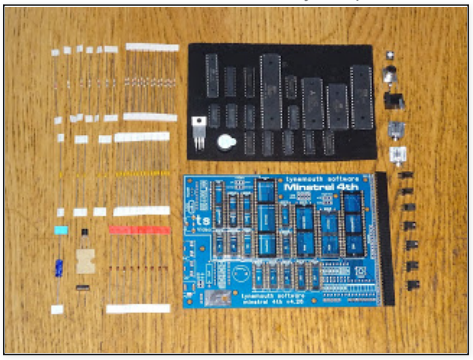
This one also added an RC2014 expansion bus (which is why it went blue again). The way the video circuitry is isolated in this design leaves the Z80, ROM and RAM running full time, unlike the ZX80 and ZX81 based designs that rely on the Z80 to run NOP instructions for most of the time whilst clocking through the video RAM. I had looked at adding this bus to the Minstrel 3, but most of the add ons would not have been usable.



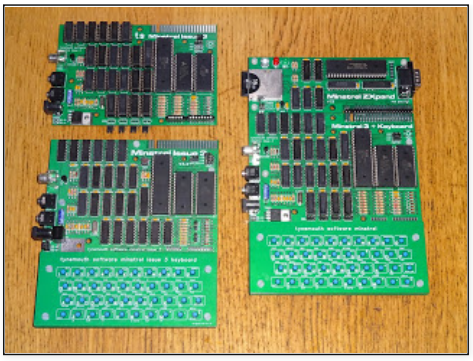
The Minstrel 4th can also be ZX81 shaped and fit into a ZX81 case, but again works best stand alone with it's own keyboard. This is almost the same as the ZX81 style used on the Minstrel 2 and 3, but the button row of keys is arranged differently, so it has a separate keyboard PCB.



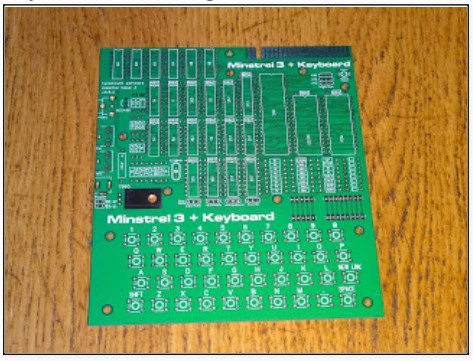
There used to be lots of options on my Tindie store, you could chose what type of keyboard connector, the voltage regulator, some or all IC sockets etc. and it got a bit complicated. Sometimes people would ask me what options to choose, other times it looked like they had picked them at random.



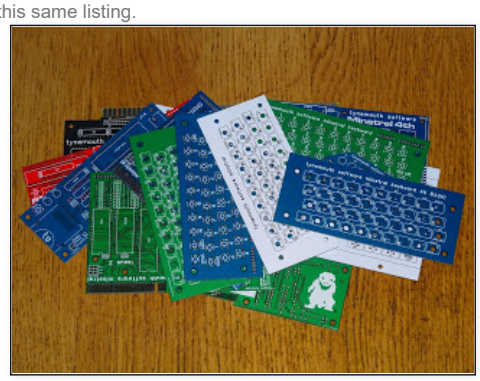
To simplify things, the Minstrel 2, 3 and 4th all have a similar set of options. You can order a kit of bits required to make the version which will fit in the ZX81 case, or you can order a standalone version with or without keyboard, and on the 2 and 3 with a ZXpand. Hopefully that should simplify things.



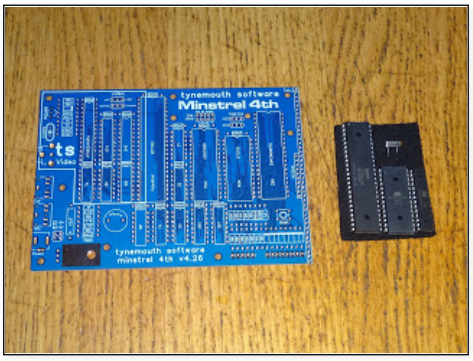
To make things easier to assemble, and stronger as stand alone systems, I have now merged the PCBs for the Minstrel 3 and it's keyboard to make a single board for the Minstrel 3 + Keyboard option.



I have also moved all the PCB only options to a separate listing (that makes the postage options easier as well as previously people could choose the 'put it in a card backed envelope with a stamp on it' when they had ordered a full kit with power supply etc.). I will also be adding PCBs from other things which are not available as kits to this same listing.



Also split out is the 'Partial kit' option, which includes the PCB and the difficult to find and pre-programmed parts.



So those are the Minstrels and the new options. You can order a Minstrel 2, Minstrel 3 or Minstrel 4th from My Tindie Store. If you have any more questions, let me know (as long as it's not the one about why it's called a Minstrel)*.

If you want to support this blog, you can donate via Patreon or Paypal, or buy something from my store.

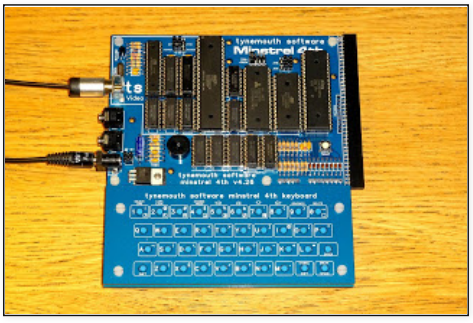
**Oh OK, why did I call it the Minstrel? Well, there was a ZX Spectrum clone called the Harlequin, and a Minstrel is a similar sort of medieval court jester type thing, but whereas the Harlequin is usually very colourful (like a Spectrum), the Minstrel is more black and white....*

Posted by Dave Curran at 13:42 Links to this post
Labels: Minstrel

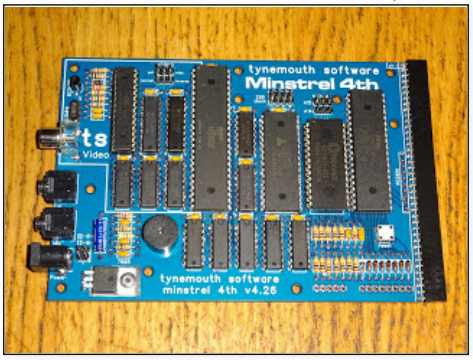
Monday, 4 May 2020

Minstrel Goes Forth

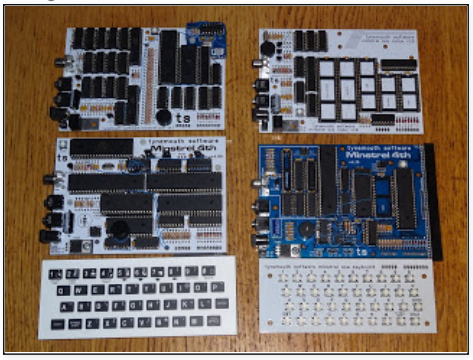
First there was the Minstrel 2. Then came the Minstrel 3. Now there is the Minstrel 4.....th.



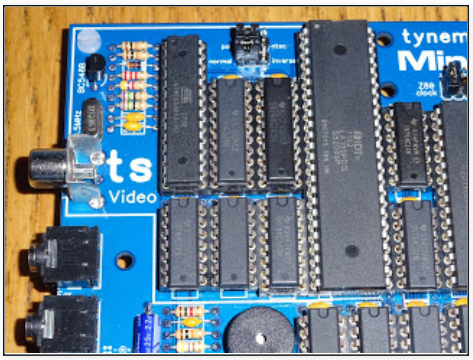
The Minstrel 4th is another Z80 based single board computer on a ZX81 shaped board, but this one is not compatible with the ZX80 or ZX81. This one runs Forth, and is compatible with the Jupiter Ace.



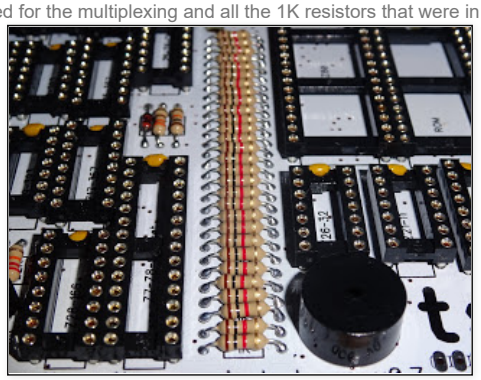
The Minstrel 4th started a long time ago as an attempt to build a Jupiter Ace clone. That didn't quite work, and was quite a challenge to fit into the 142x100mm form factor.



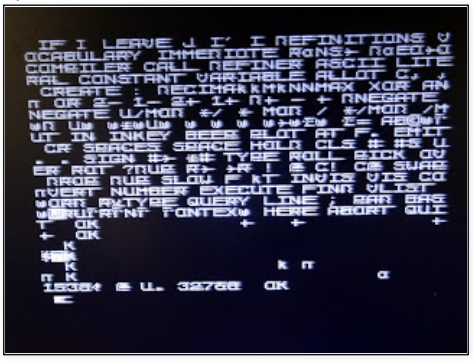
Several revisions passed as I tried some different approaches (long and detailed blog post to follow with all the gory details). With each revision I was trying to simplify the design, reduce the chip count and increase the capabilities.



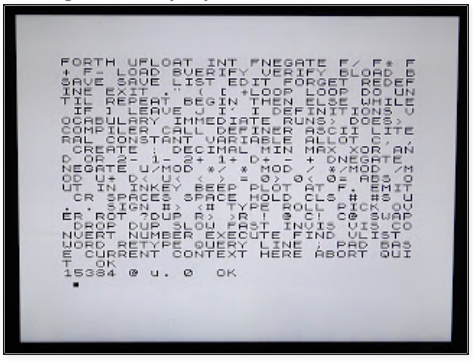
The main change is the way the video is generated. I have used dual port RAM (the big chip on the right) to remove the need for the multiplexing and all the 1K resistors that were in the original design.



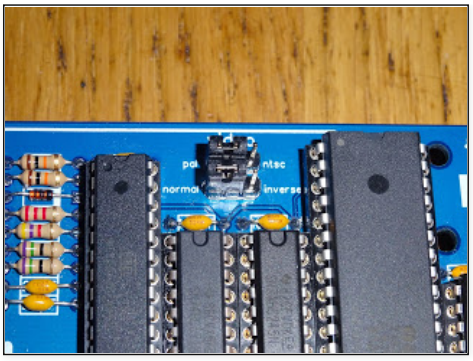
Yes, they look nice in a row, that that's not the point. I never got that version to work properly. The display was a bit fuzzy, and it would appear to be OK whilst it was working, but as soon as it stopped, the screen would be corrupted.



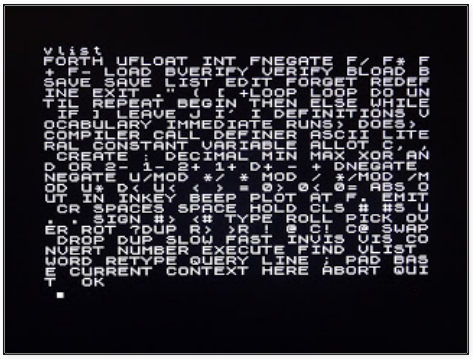
I redesigned the video circuitry in a much simpler way, without any 1K resistors. One concession though is the introduction of a microcontroller to do the counting. It's is just running a state machine counting through the cycles and generating the video sync and timing. Doing pretty much what a 6845 does in a PET. You might call that cheating. I don't. Anyway, I am the author. You are the audience. I outrank you!



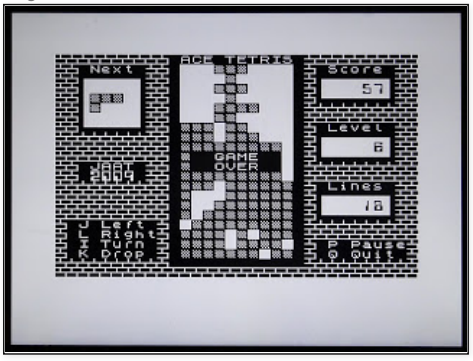
With that the picture is considerably improved and there is no display corruption. With the extra control of the timing, I was able to add a back porch signal. This was originally missing on the Ace, but was much less of an issues with it's black text on a white background. I added a jumper so you can select black text on a white background instead. There is also a PAL/NTSC 50/60Hz jumper rather than having to have separate boards like the Ace did.



The inverse option is there for those who prefer it, but I have found I preferred the black on white style as used on the ZX80 and ZX81, so that is the 'normal' setting. (see above statement about who's in charge here).

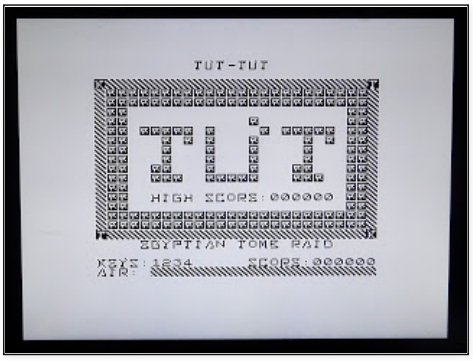


Other than that, the Minstrel 4th is able to run Forth and Jupiter Ace programs just like a real Ace would. And the video output looks great, doesn't it?

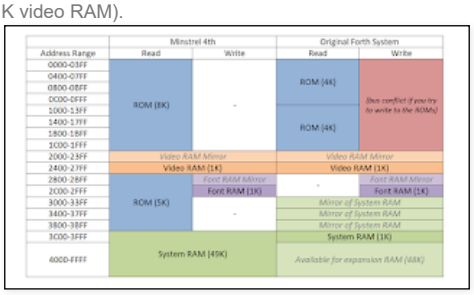


Loading files was a bit of a challenge, I'll go into that in more detail in the subsequent posts, but I spent ages going round in circles, and it turned out the problems I was having were down to the files and the programs I was using to get the audio out. Once I found the right combination, it loads fine every time.

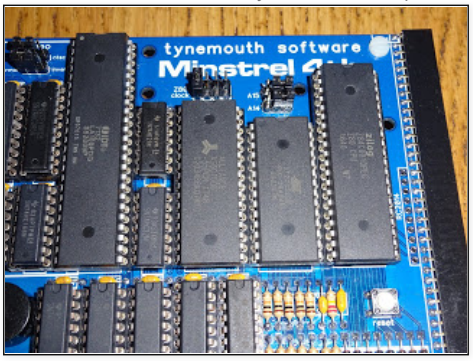
Thanks to George Beckett for providing me with work in progress versions of his Jupiter Ace port of Dave Stepenson's Tut-Tut. That's been good for testing the hardware along the way.



I have followed the Ace memory map, but filling in the gaps with more ROM and RAM. The ROM is now 13K rather than 8K, with up to four ROM images in a 27C512 EPROM. The RAM is now 1K + 48K system RAM (+ the 2x 1K video RAM).

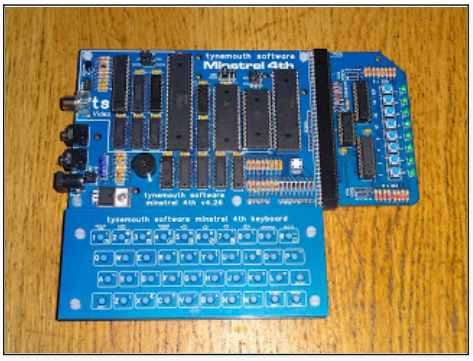


The Ace had an edge connector, but there weren't many add ons available, and these were mainly RAM packs. The Minstrel 4th doesn't need those as it already has the full complement of RAM.

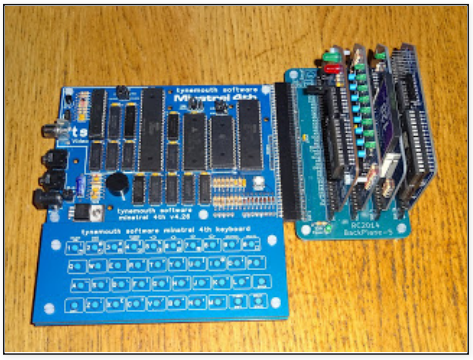


Unlike the ZX80 or ZX81, the Z80 isn't involved with drawing the screen. It couldn't care less. It just writes to the memory mapped video RAM (and can also write to the font RAM to redefine all 128 characters). You maybe able to make out the white border isolating the video section. All that is connected to that is power in, clock and interrupt out, and the left hand side of the dual port RAM.

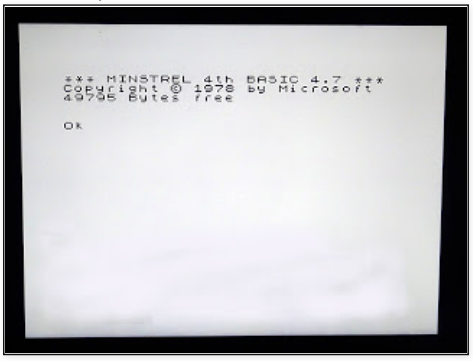
Other than that, it is a Z80 single board computer, which means the Z80 is free to run user code all the time, and can use any add ons that a Z80 can, so I thought why not give this an RC2014 bus connector, then it can use all the RC2014 expansion modules.



The Ace (like ZX80 and most of the other Sinclair machines) minimally decoded the IO, just using 'A0 is low', so even though it only ever accesses 0xFE, it ties up 0x00, 0x02, 0x04 etc. as well. That would limit things, so the IO is fully decoded on the Minstrel 4th to only use 0xFE. That leaves the other 255 IO addresses available for all manner of add ons.

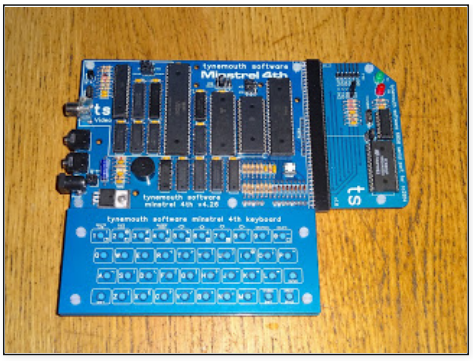


I have been looking at porting the NASCOM BASIC that was the starting point for the version used in the RC2014 and Grant Searle's Z80 SBC. It's not quite ready yet, so a new ROM image will be released once that is fully tested and bug fixed, you would then be able to select Forth or BASIC via the ROM jumpers. Anyway, I think it would be far more fun to see people struggling to get their heads around Forth before I give them an easier option.

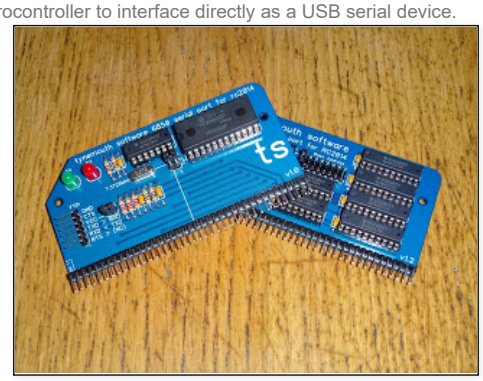


Although the Z80 needs to run at the original 3.25Mhz if you want to do Ace stuff (tape loading and beeps are speed dependent). 6.5Mhz is also available on board, and it runs fine at that speed. You can even load programs if you speed up the audio 2x. Neither of those speeds are ideal if you want to use a serial card, which normally need 7.3728Mhz to divide down to the standard BAUD rates.

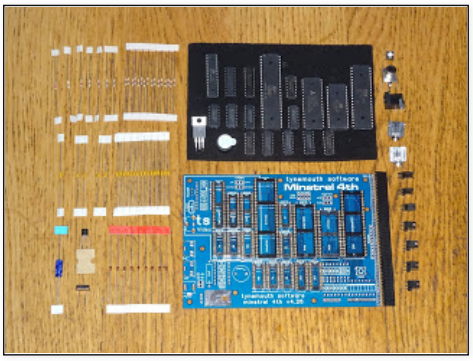
To get around that, I designed a new RC2014 serial module with a built in clock, so you can use that with the Minstrel 4th without need for an additional clock module. You can also run the Z80 at 7.3728Mhz if you want that extra boost.



I'm not keen on using new old stock parts, and I couldn't find a suitable UART that was still in production (since the WDC 65C51 is useless due to a bug that has been reclassified a feature, and I overlooked the Z80 SIO due to Zilogs mad part numbering scheme). So, I designed a serial board that didn't need a UART, and used a microcontroller to interface directly as a USB serial device.

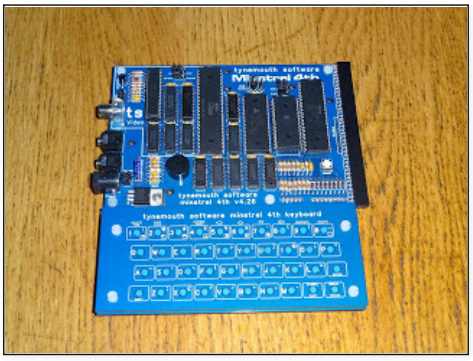


That's not available yet as I need another spin of the board, and it's getting a bit silly the number of chips it is using.



The Minstrel 4th and 6850 serial module with clock are now available in kit and assembled form from my Tindie store, which has now reopened. Postal options are a bit limited at the moment, and are likely to be a bit slower and be a bit more expensive, so please bear with me if you don't get your order within 24 hours.

To simplify the postage options, I have moved all the 'PCB Only' options into a single listing, so that can be set for letter postage. Everything else needs courier collection.



So that's the Minstrel 4th, I hope you like it.

May the 4th be with you.

If you want to support this blog, you can donate via Patreon or Paypal, or buy something from my store.

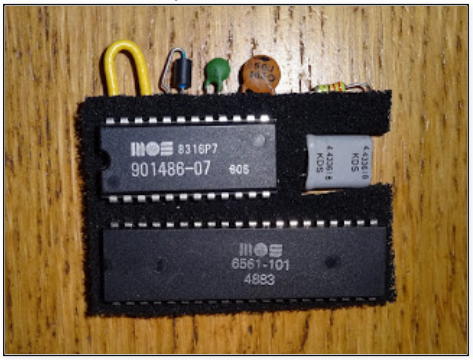
Posted by Dave Curran at 08:50 Links to this post
Labels: 4th, Minstrel, RC2014

Sunday, 26 April 2020

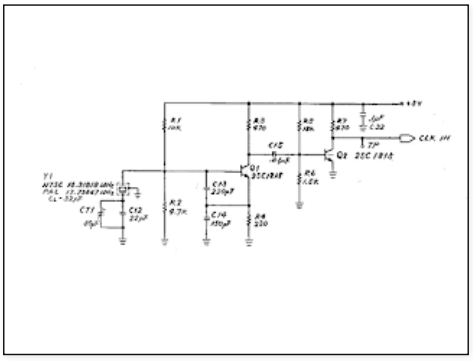
Commodore 16 PAL to NTSC switchable conversion

I was looking to test some upcoming game releases from The Future Was 8 bit, and I had a title for the Commodore 16 / plus 4. I like to test these on PAL and NTSC machines to make sure there are no issues. In the past I had converted a Commodore 16, but I couldn't locate it, so I converted another one.

I have some older post about converting a PAL VIC20 into NTSC. This required a change of a crystal, a ROM, the VIC chip and a few miscellaneous parts.

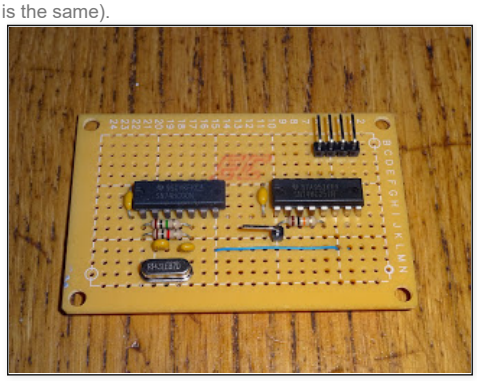


The TED series made this much easier. The only differences were the clock frequency and the KERNAL ROM. I think in the past I had fitted a crystal socket so I could switch between the 14.31818MHz for NTSC and 17.73447MHz for PAL.

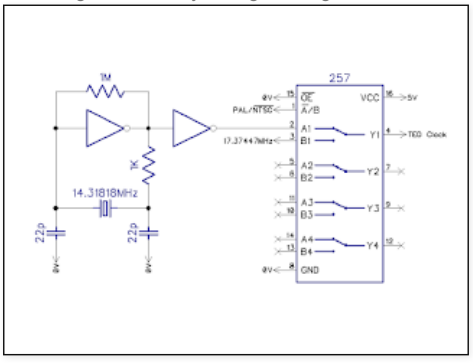


I thought I would try a different approach this time. The clock circuitry is all arranged neatly below the TED chip, along with some potentially useful test points.

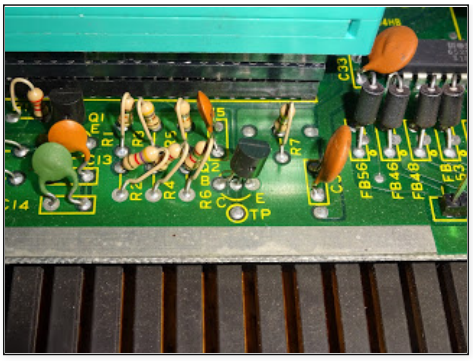
Rather than change the crystal, I went down the route of building a second crystal osciallator. The onboard one does the PAL frequency, so I just needed to built one that did the NTSC frequency. I build a fairly standard oscillator circuit around an inverter (I actually used a NAND gate as it made the layout easier, but the principle is the same).



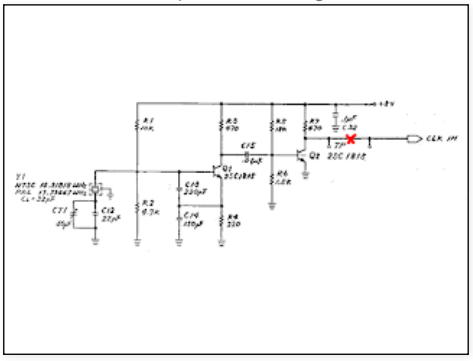
I also added a '257 multiplexor so I could switch between the two clocks signals without running them through a switch or jumper. A rough schematic just to give the general idea.



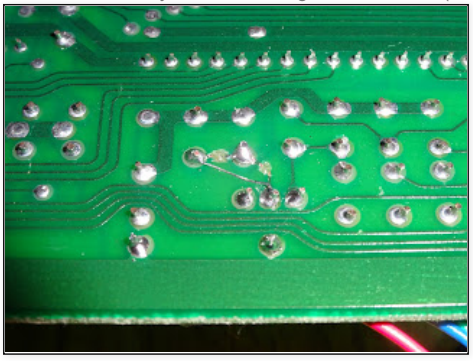
The plan was to disconnect the clock signal from the output of the existing clock circuit, and feed that into the 257 mux. The output of the mux would then into the TED chip.



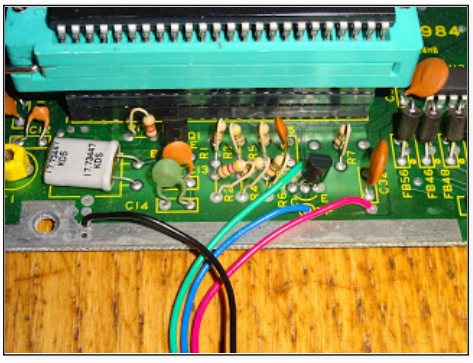
This is the board I am going to change, the transistor Q2 and resistor R7 on the right are the final stage of the original clock circuit, and TP is the test point with that signal on.



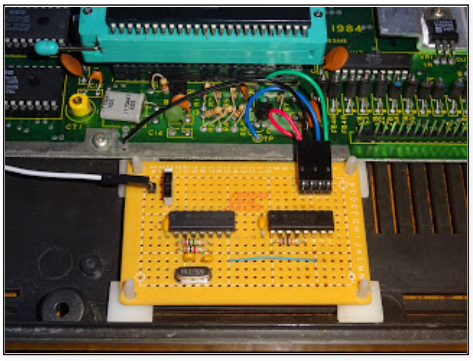
It didn't quite work out like that because the layout of the board meant I had to cut the link between the bottom of R7 and the collector of Q2 and rejoin them missing out the second (unmarked) test point.



I picked up the clock out (blue), clock in (green), ground (black) and 5V (red) at appropriate points and wired to a 4 pin header.



There was loads of space in the C16 case to mount the board, I wanted it close by to keep the clock wires short.

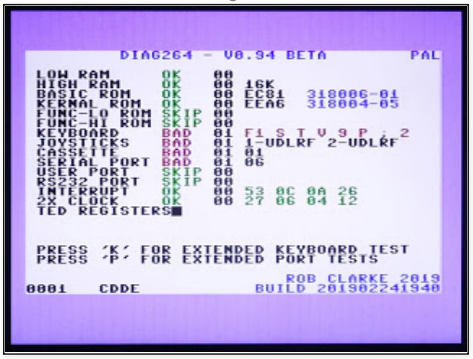


The white wire on the left is used to switch the ROM image. I burned a 27C256 with both the PAL and NTSC KERNALs in.

Time to fire up, I am using the DIAG264 cartridge from TFW8b.

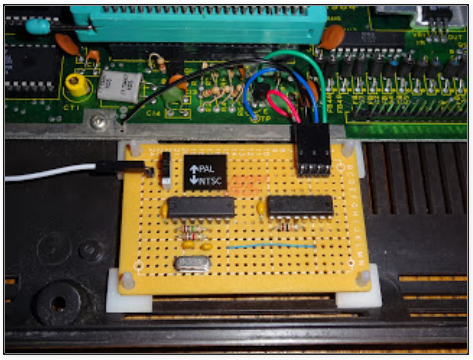
The refreshed version now comes in black and has a PAL/NTSC jumper.

First off, I will try the original PAL clock routed through the new board.

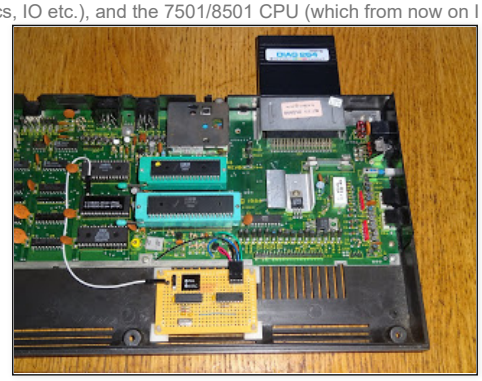


So far so good, this is an updated version of Diag264 by Rob Clarke. Time to give NTSC a go.

Excellent, that looks good to me. I also added a label to the mod board so I remember what this board does in five years time when I open up this Commodore 16 and stare confused at a bit of veroboard and a couple of chips on and wonder what I did that for.



So I am pleased I couldn't find the one I modified before, this has been a much nicer solution. This is my test board where I have ZIF sockets for the two most common chips to fail, the TED which is heart of the system (sound, graphics, IO etc.), and the 7501/8501 CPU (which from now on I intend to call Dougal).



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Posted by Dave Curran at 17:18 Links to this post
Labels: C16, Commodore, NTSC, TED

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