THE AMBER COMPUTER VDU PROJECT.

H. Holden. April. 2019. Updated Dec. 2020.

BACKGROUND:

Of the vintage small cathode ray tube VDU's or video monitors, the one that has impressed me the most, is the one manufactured by Zenith and used in IBM's 5155 computer.

The reasons are many so I will list them:

The monitor has an Amber colored phosphor, which is my personal favourite.

The raster geometry, beam focus (including corner focus) is excellent.

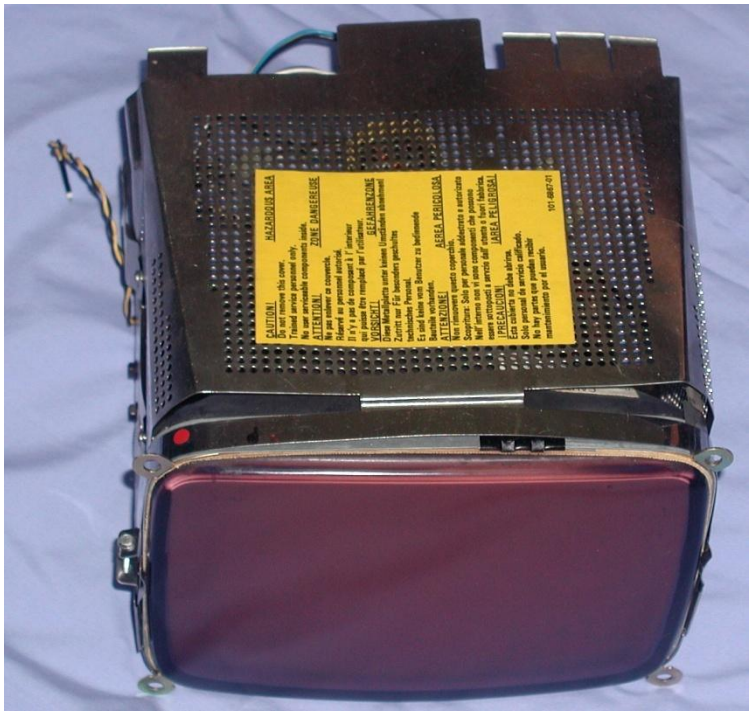
The monitor has a well designed video output stage with a bandwidth over 7MHz.

The monitor can display a 640 x 200 pixel array with very good definition.

The physical construction and circuit design is well executed and the circuitry is interesting too. For example the vertical scan oscillator is configured from two transistors wired up as a PUT (Programmable Unijunction Transistor).

Unlike some early IBM monitors, this monitor cannot be damaged by abnormal sync pulses because it has its own independent horizontal scan oscillator.

So I was please when some of these monitors appeared on Ebay as new old stock. So I bought two of them, with a plan to house them in some custom cases. The photo below shows how these monitors come as the “spare part” for the 5155 computer:



Housing & powering the monitors:

Recently I had built a disk drive unit for my SOL-20. The extruded aluminium case came from Takachi Japan and was a standard off the shelf product. Looking through their

stock list I could not find a housing that was correct for these monitors. In fact the one I put the disk drive units in would have been ok if one dimension (the width) was altered.

So I contacted the Takachi factory and they kindly obliged by manufacturing two cases for me with that dimension altered. In addition, they milled the large rectangular hole in the front panel for me. (It's a big job doing this perfectly by hand and I learnt my lesion cutting the large rectangular holes for the 5.25" disk drives in the previous project).

The photo below shows one of the finished monitors sitting next to the disk drive unit, as one can see, the cases are the same except for the width:

These cases are extruded aluminium and have a tough coating applied at the factory. The front and rear panels fit in grooves in the extrusion.

The Engineering Task:

I would be responsible for cutting all the holes in the rear panel and finding a way to secure the Zenith monitor inside the housing. I decided to go with a technique I have used before: “The Endoskeleton Technique”.

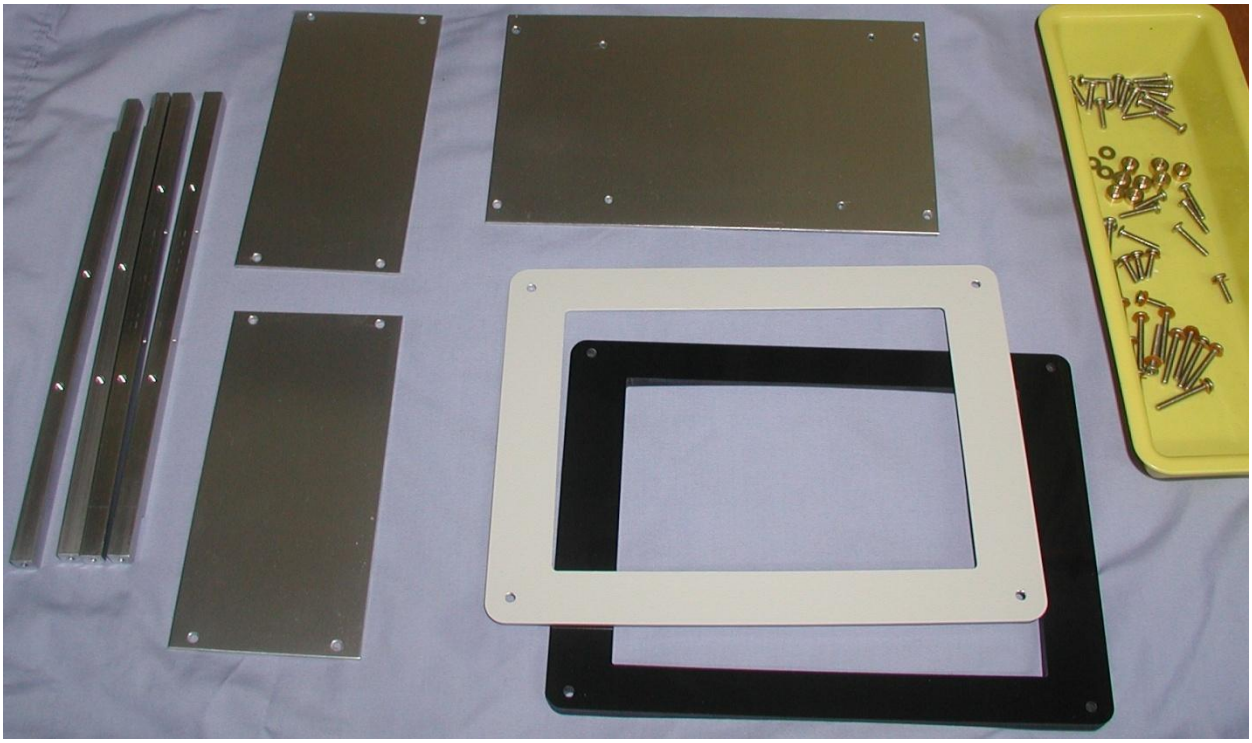
The idea is that the front and rear panels are secured together by long aluminium bars and create a self supporting internal sub-structure or skeleton upon which everything is mounted. This way the outer case, like a skin, is kept completely free from any objects in the case, and merely acts as a “Clam Shell” to wrap around the completed unit.

The first job was to organise an interface between the curved face of the CRT (which has close to a 700mm radius of curvature) and the flat front panel. To this end I had a local plastics company CNC machine one for me that is made out of 10mm thick black Acrylic. This is very suitable product, because when it is cut by the CNC router, it leaves a matte or “flat black surface” perfect for the task.

The photos below show the interface “gasket” to call it that:

The next task was to make 8 metal bars (10mm square aluminium). This was a long process done on my small hobby lathe and drill press. There are a total of 40 holes (for

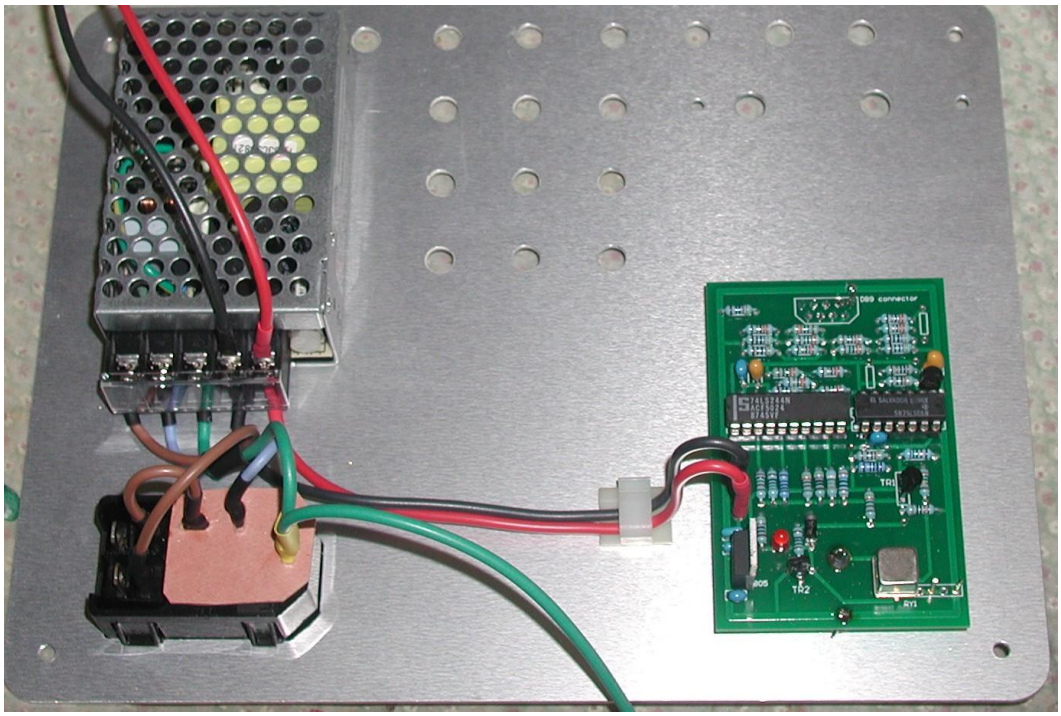
two monitors) that required drilling and tapping with 6-32 UNC threads (I always use coarse imperial threads in aluminium and avoid metric). There were also aluminium panels, three for each monitor required. The photo below shows some of these mechanical components. (All the screws are stainless steel).



I also machined brass spacers with a small flange for the CRT mounts. Fortunately, the Zenith CRT has a mounting clamp system pre-fitted to the CRT's bulb perimeter:

I drilled holes in the rear panel for ventilation. (The bottom case cover has pre machined ventilation slots).

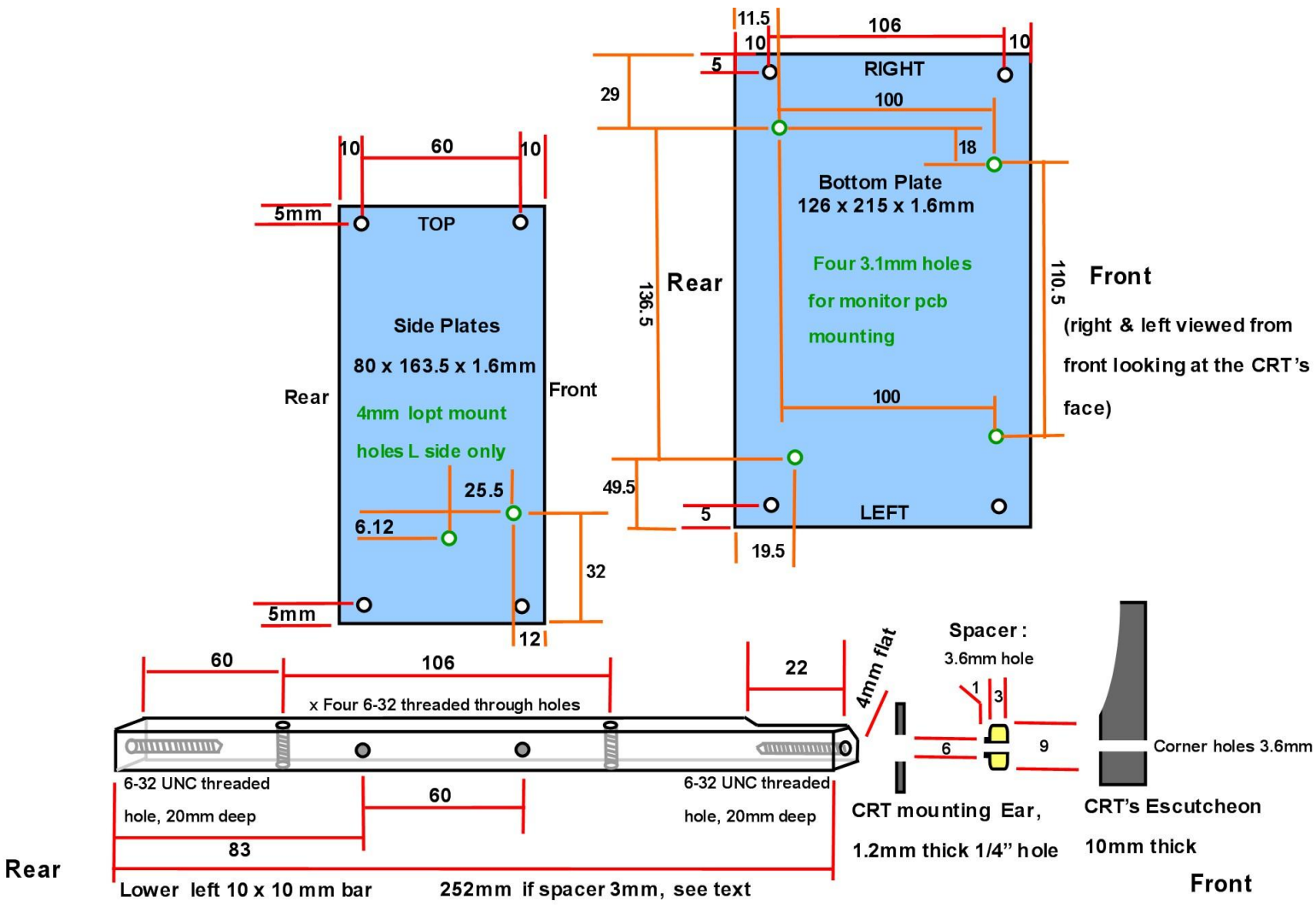
A Meanwell switch-mode PSU was used to power the monitor. I used a standard IEC power inlet adding extra insulation and making sure there are good separate Earth connections to all the metalwork in the unit, including the outer case. Takachi provide a fixing point for that with a countersunk screw in the side fittings that secure the out case together.



One thing that helps with the finish of the unit is to paint the cut edges of the holes. So I mixed up some matching paint and did that, also the cut edge of the large rectangular hole for the CRT was painted too.

I designed the pcb above to mount directly on two connectors: a BNC for the video input and a 9 pin D connector so the monitor could accept the output from a computer's CGA card. The circuit there auto-detects the presence of CGA's vertical sync pulse and switches the monitor onto a composite video signal constructed from CGA's RGBI signal lines and the H & V sync pulses.

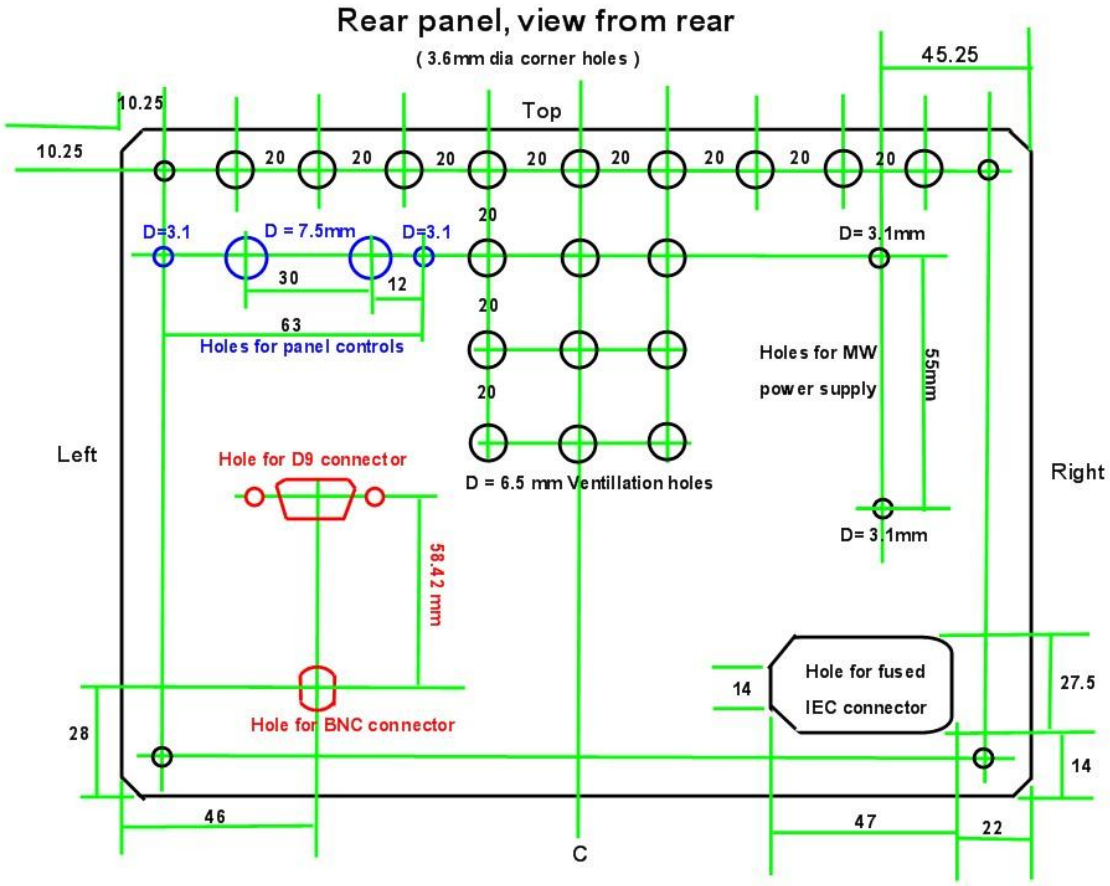
Dimensions:



There are four 10 x 10mm aluminium bars. The lower two are identical except for the position of the 22mm long flat to allow for the rounded corner of the CRT's perimeter. Each bar has two 6-32 end holes tapped 20mm deep and four full thickness 6-32 threaded holes. The upper bars are the same except they do not have two of the 106mm spaced threaded holes. When tapping deep holes in aluminium, it pays to regularly remove the swarf and keep the tap well lubricated and use a taper then a plug tap after that. I prepared these bars with the help of my mini-lathe.

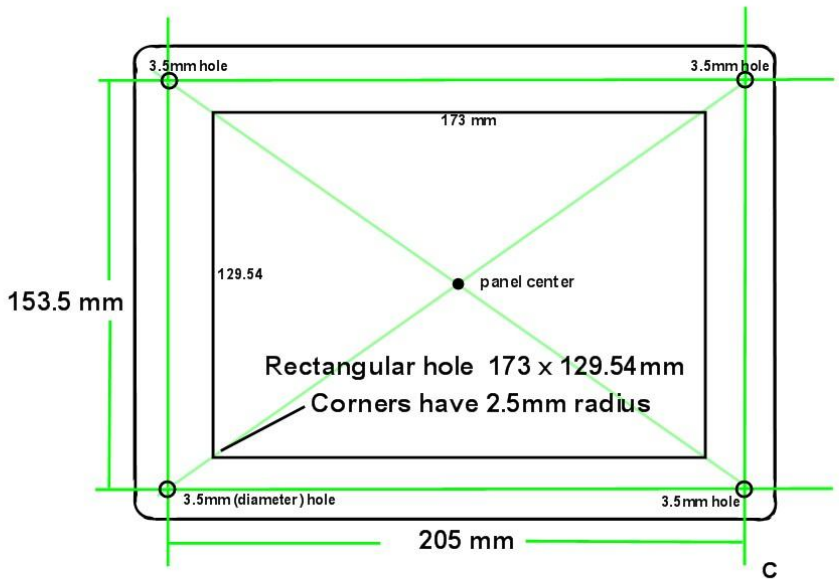
One of the two 163.5 x 80mm side plates (the one on the left hand side viewing the VDU from the front) has two 4 to 4.5mm holes to mount the Lopt.

The exact length of each bar depends on the brass spacer thickness. On some of these Zenith CRT's the metal mounting ears were not in the same place on each corner with respect to the CRT's faceplate. Good enough for mounting the CRT in a plastic cabinet, but for a precision fit in this enclosure a 1mm error has to be compensated for with the brass spacer to get a perfect fit with the escutcheon and at the same time have the total spacing of the front and rear panels exact so it will slide into the external housing.

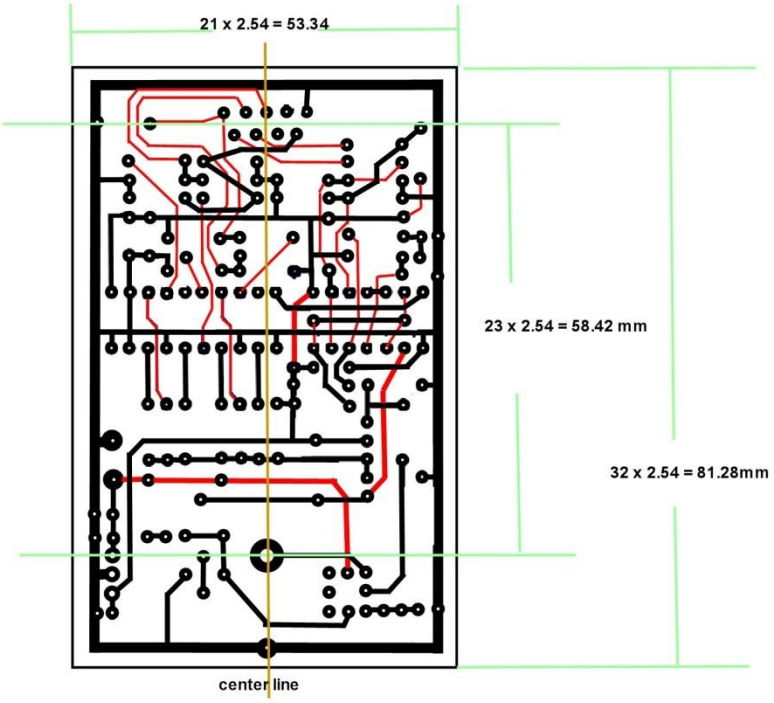


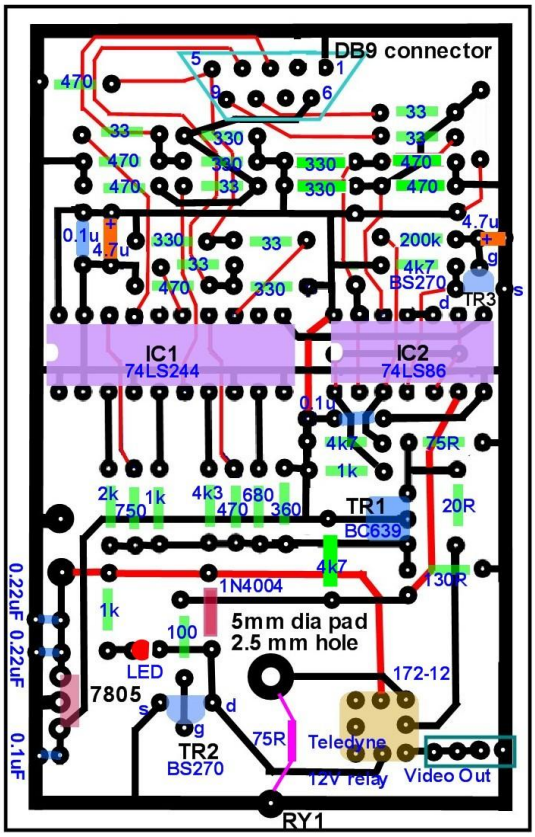
It is important to create clean holes. This can be done by drilling them in 0.5mm steps and removing the bur with a 90 degree CS tool. Also the panel must be protected with plastic to prevent marks. The rectangular holes were cut by drilling and filing. Takachi will machine these for a customer too and make the bars, but I chose to do this part myself.

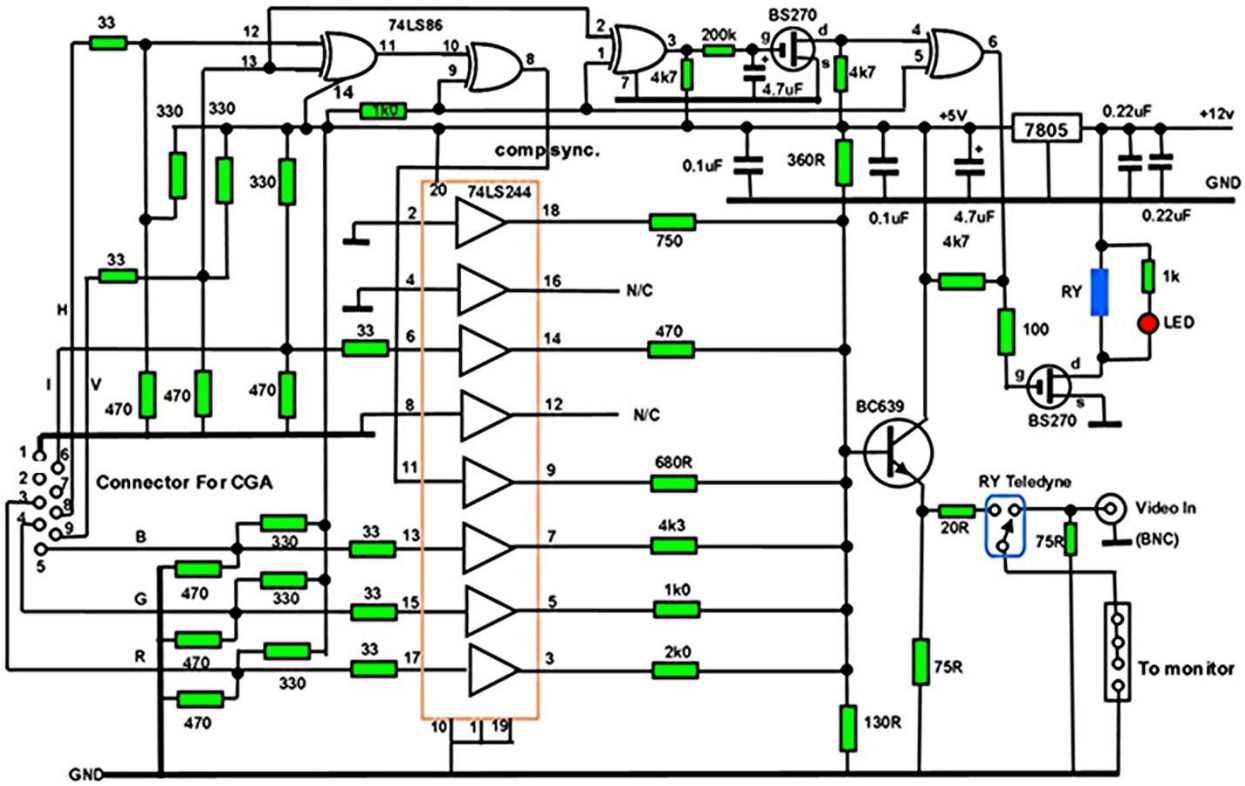
The front panel though was milled by Takachi and it is difficult to get perfection in a large rectangular hole by hand and have it exact match the milled CRT spacer:



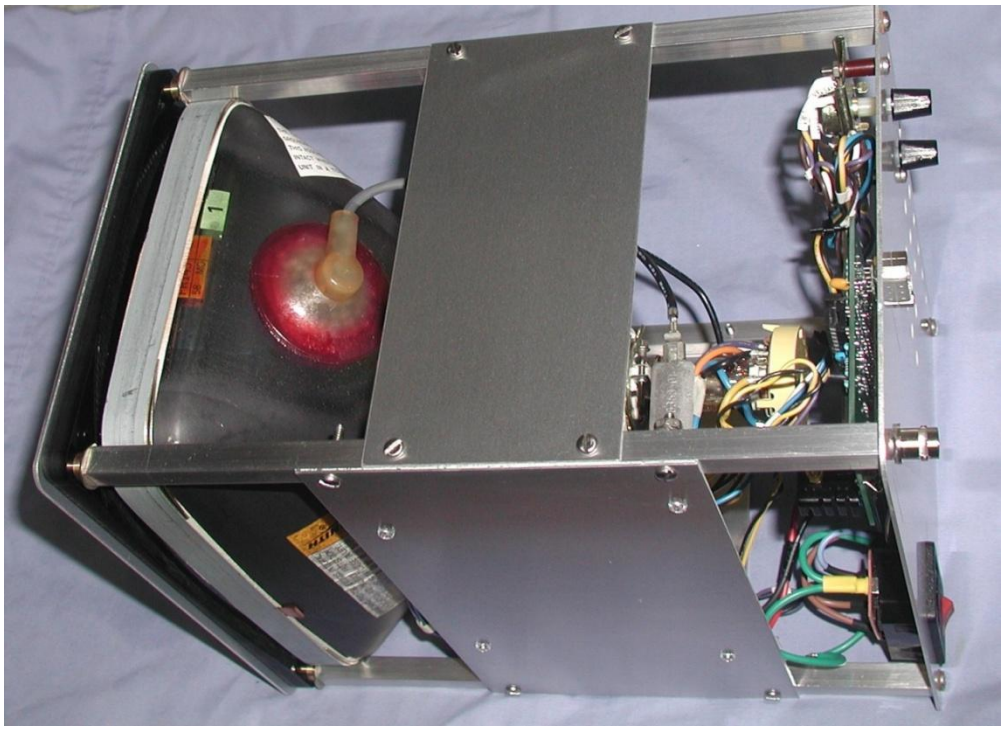
The PCB:

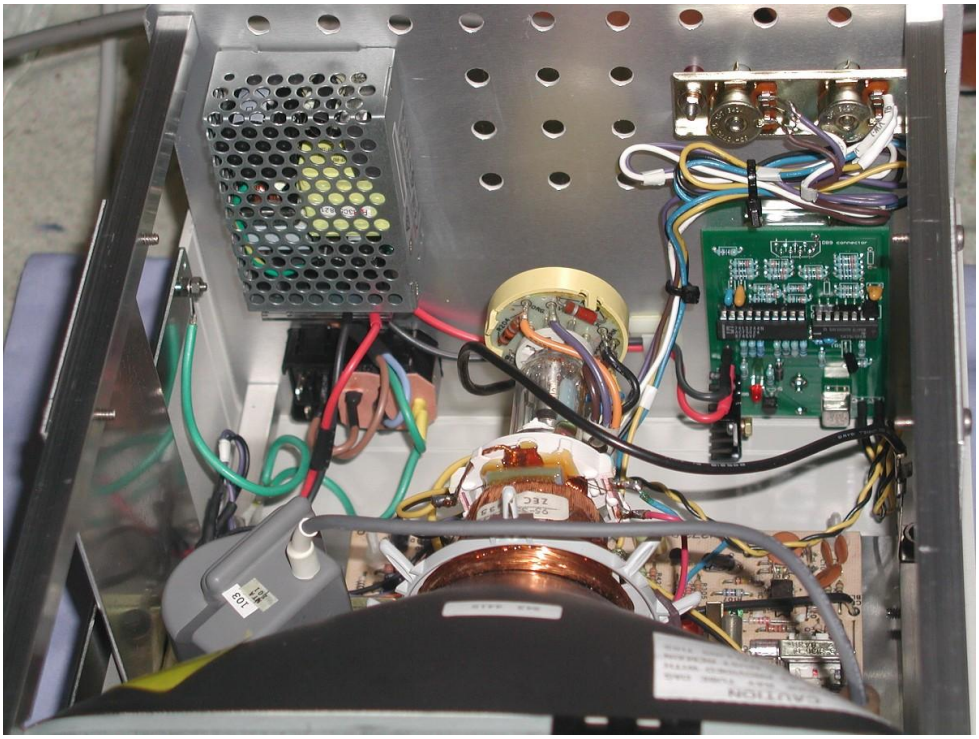



DB9 connector
IC1
74LS244
IC2
74LS86
TR1
BC639
TR2
BS270
TR3
BS270
7805
LED
1N4004
5mm dia pad
2.5 mm hole
172-12
Teledyne
12v relay
Video Out
RY1


74LS86
74LS244
BS270
BC639
7805
comp sync.
Connector For CGA
RY Teledyne
Video In
(BNC)
To monitor
GND
+5V
+12v
N/C
N/C

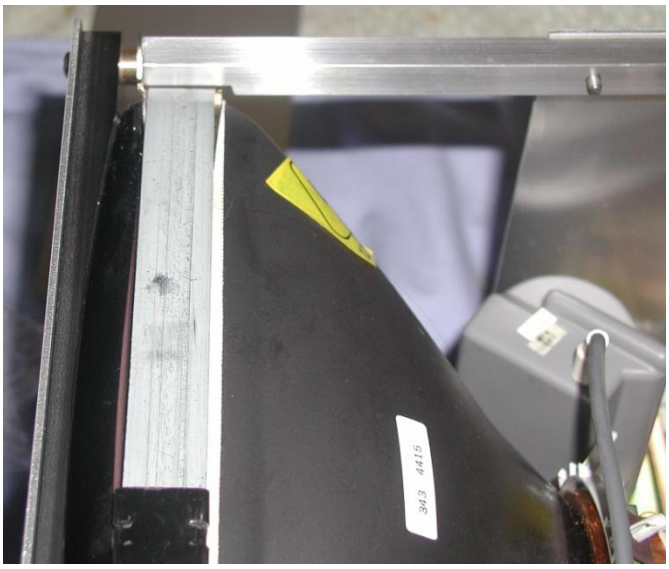
The photo below show how the monitor's pcb was re-mounted on one of the aluminium plates (using nylon screws and 10mm long phenolic spacers). The pcb's mounting holes have tracks running far too close to them to mount with metal screws or spacers. Originally they were mounted on push fit nylon spacers.





The photo below shows the rear panel of the assembled monitor and the feet used. These machined aluminium feet are a Takachi accessory and they have an O ring fitted in them and are secured by 4mm metric machine screws:

The photo below shows that the 10mm bar has a small flat created across one corner near the CRT mount:



Monitor Performance:

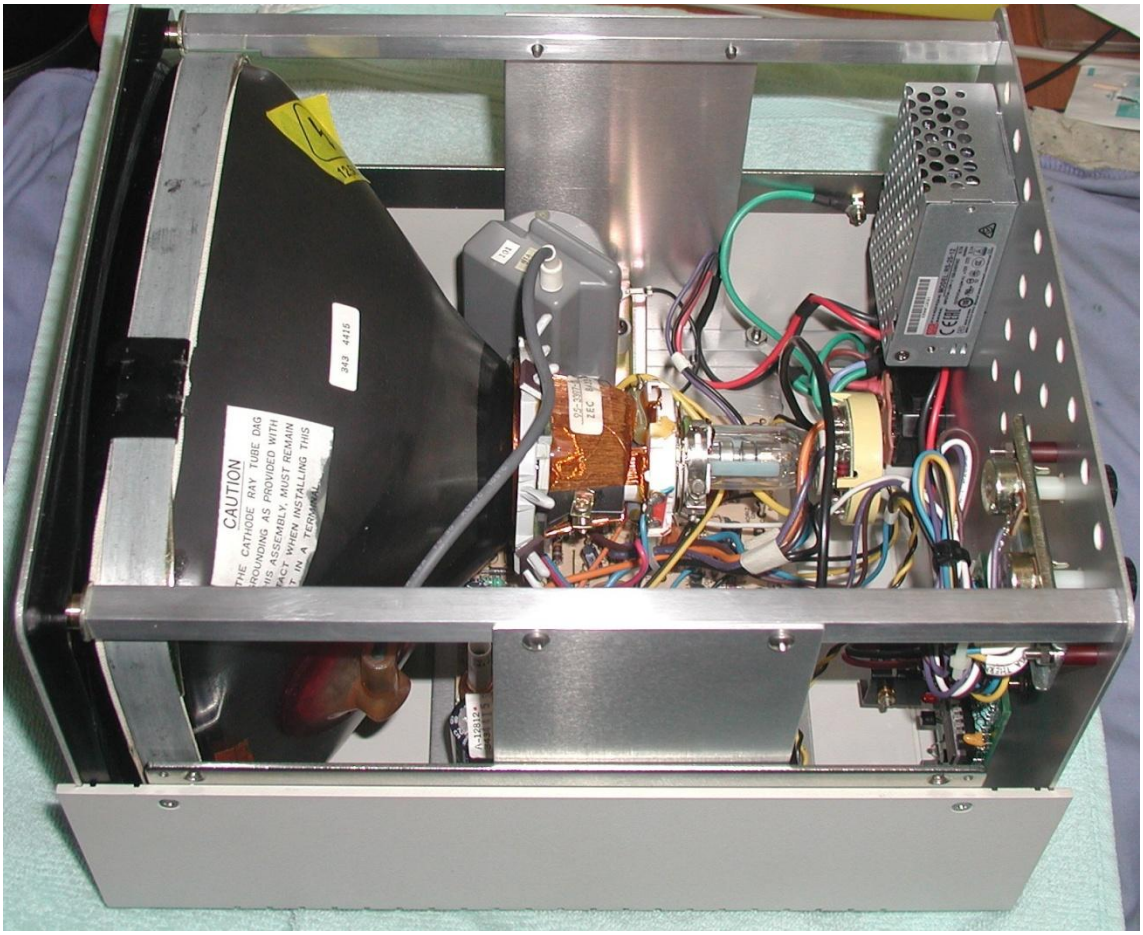
As noted for this Zenith monitor it is generally excellent, so it was well worth the time and effort to house these monitors well. The photo below shows a close up of the screen, due to exposure effects of the camera, it makes the image look softer than it really is:

The photos below show two monitors running off the IMB5155 with a .gif picture image from the PICEM program:

Update Dec. 2020. Third VDU made:

Since the nos 5155 Zenith VDU's were still available on Ebay, I decided to buy one more and manufacture a third unit. Since I labelled the first two A & B, I named the third one Omega, as it is likely the last one I will build as it is a time consuming task.


OMEGA


CAUTION


BRIGHTNESS
CONTRAST
CGA IN
230V F-1A
VIDEO IN

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