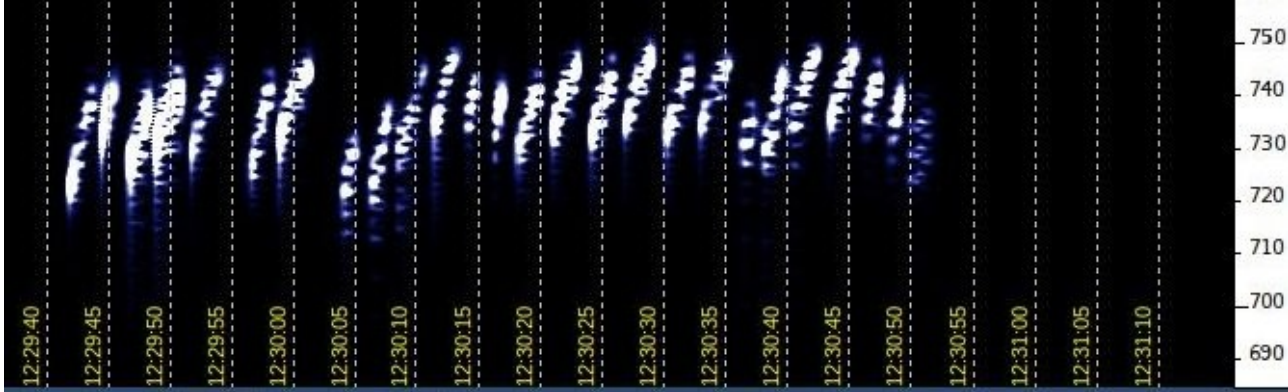


EMTX Chip Analysis

Hans Summers, G0UPL, 6-Jul-2020

EMTX, 10W output vs 5W output

This is a trace using Argo QRSS3 mode, speed Fast. It shows around 30Hz of chirp but this does not really show the very fast chirp in the first few milliseconds, which is audible by ear but does not show up in the FFT.



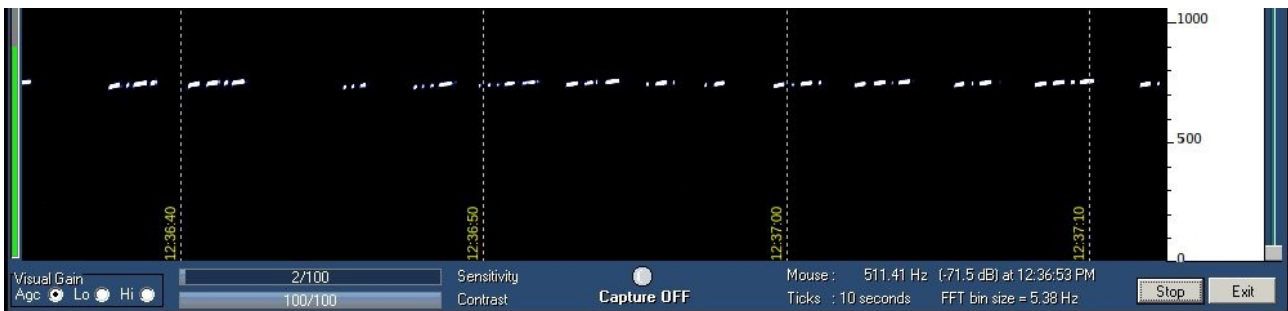
Here is the same thing from the 5W output recording:



You can see that certainly, at 5W the chirp is much less pronounced. It is difficult to hear by ear too, but as I said, I could detect it.

Now another way of looking at it, here is Argo's CW (NDB) mode with Slow speed setting; notice the compression of the Y axis. So chirp is less easy to see.

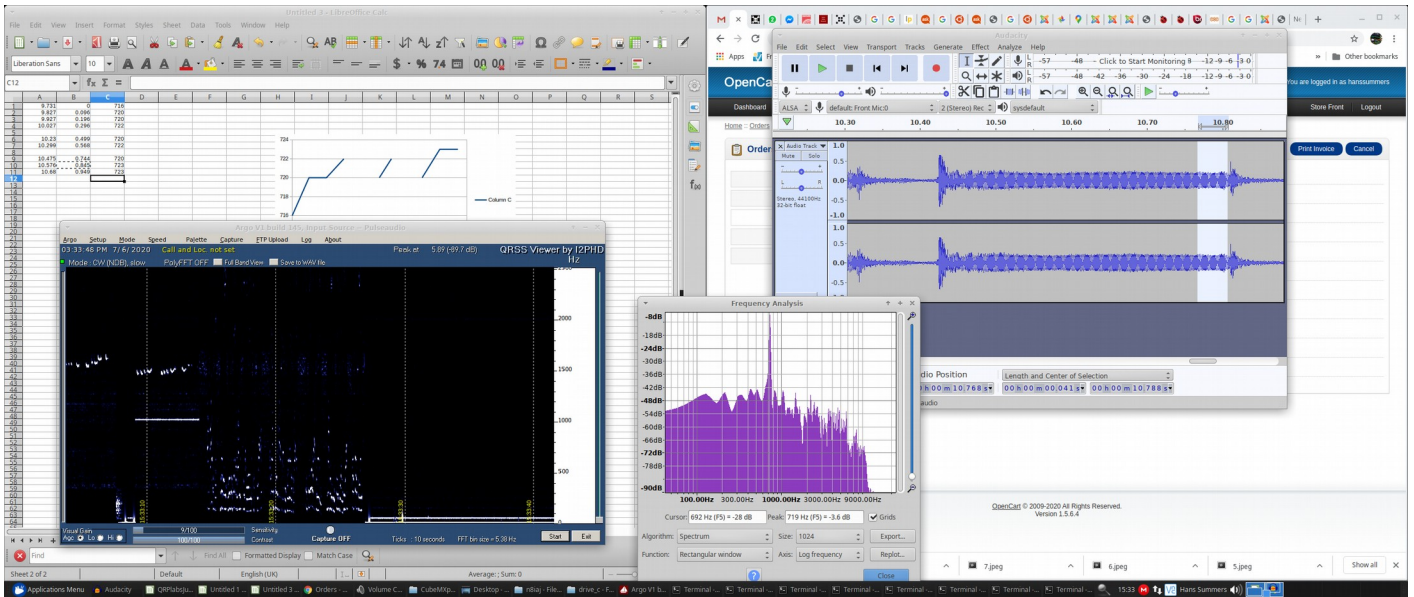
In the 10W EMTX recording, below, you can still clearly see the rising frequency during the transmission of a Morse character:



See below, at 5W the EMTX looks much straighter, you can still see some chirp at the commencement of the transmission but as I said, I think it is quite difficult to identify by ear!



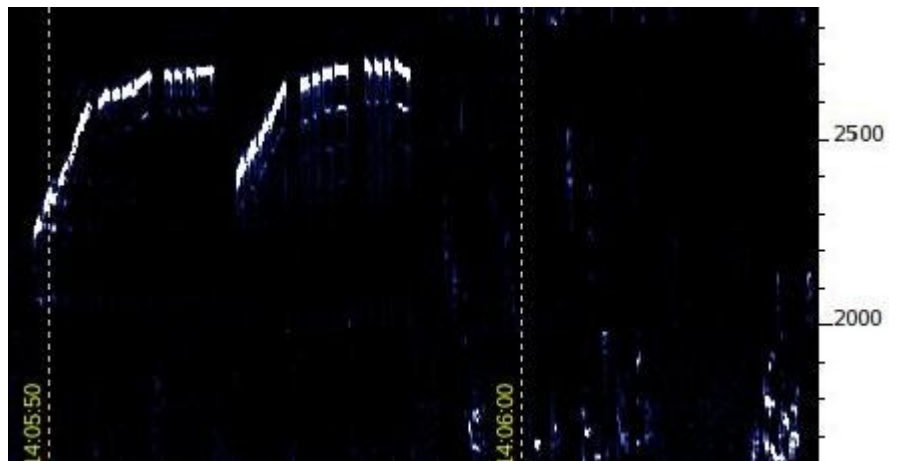
In yet another attempt to analyze it a different way, I tried making an Audacity recording. Then I selected a few milliseconds of the recording and ran the FFT tool to identify the frequency. I repeated this at various times after the start of the key-down and tried to plot it in a spreadsheet. Below is a screenshot from my computer. It was quite hard to measure consistent results with this method, and very time consuming, so I quit.



VK3YE implementation

VK3YE's first implementation uses an HC49/4H crystal which is the most common type we see nowadays; a low profile crystal with HC49 footprint but only $\frac{1}{4}$ the height. The crystal inside is very small.

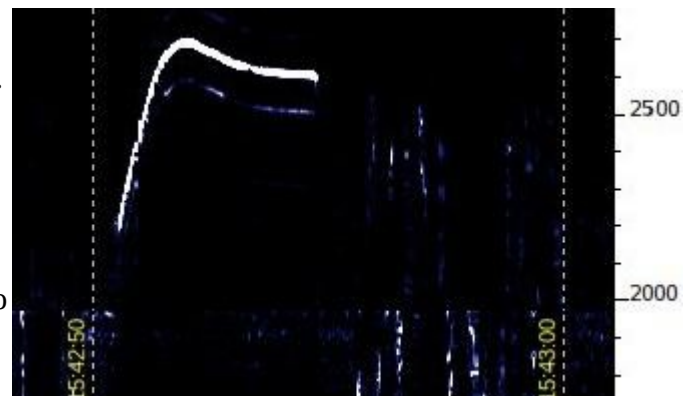
The first picture shows VK3YE's first key-downs in his video and you can very clearly see a huge drift from key-down.



The next traces shows his key-down from the part in the video where he shows the current consumption on a DVM.

This is a nice trace because it is possible to measure the chirp amount quite precisely, at 510Hz from key down to peak.

Also interesting is that the chirp shows a peak then starts to decrease in frequency again.

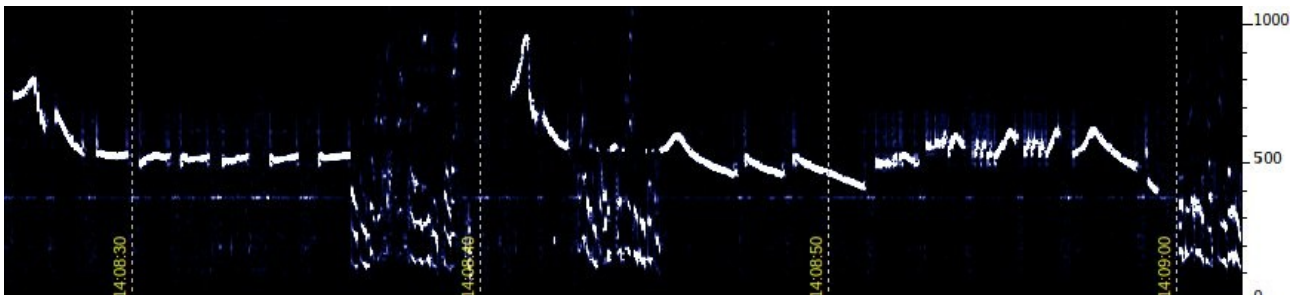


Two possible explanations for this:

1) The frequency drift is not dominated by one component, rather, it has contributions from several components for example, the crystal and the capacitor (or maybe transistor); perhaps they heat at different rates and have different temperature coefficients which combine to produce this shape.

2) Common cheap AT-cut crystals follow a cubic function of frequency vs temperature; the two points of zero gradient depend on the angle of the crystal cut. In my experience most common crystals show a zero gradient of frequency vs temperature at around 45C. If that is the case, then the curve would show the crystal reaching 45C in a time of only 4.3 seconds. So it is quite rapid heating that causes this drift.

This is VK3YE's CW transmission... quite horrible!



Next VK3YE tried a much larger HC6 crystal, which is also what you use in your EMTX. The following trace is his CW and a prolonged key-down at the end.



The "height" of this chirp is 272Hz and it takes 12.6 seconds to cover that frequency range. This is therefore a significant improvement over 510Hz in 4.3 seconds. But it is not exactly a massive change!

With the single HC6 crystal, the VK3YE implementation is still very far from the results you obtained. Which makes me think the crystal is not the problem here. Maybe the capacitor as you said, or the transistor.

Overall I feel your EMTX, properly built, seems to have surprisingly excellent and adequate chirp performance; and I agree with your observations:

"However the circuit is so non-critical to work that will work in many alterations, but do not expect the performance I got if not built properly. The vk3ye video is a classic example of how circuits get bad reputation if they are not built properly."

It will be very interesting to see how my implementation compares :-D

I'm not sure I have many (or any?) HC6 style crystals for 40m :-/ Anyway I do have a large number of crystals and I can compare them and how they affect chirp.

73 Hans G0UPL