Application Note for SoftRock v6 10 September 2006

Using a SoftRock v6 as a DSP back-end for an Yaesu FT1000/1000D

By Steve Ireland, VK6VZ

There has been some strong interest in using a Softrock as a digital signal processing back-end to an FT-1000/FT-1000D, connected before the 8.215MHz 2nd IF crystal filter.

A month or so ago, Tony KB9YIG built up a v6 SoftRock for me to experiment with my FT1000 as an IF signal processor, in order to see how well this worked in practice. I am a very keen 160m weak signal CW DX operator and the idea (inspired by Alex VE3NEA) was to have a very sensitive bandscope that could 'see' weak signals appearing across the CW portion of 160m at sunset/sunrise times, coupled with the ability to use this function on the other lowbands and to have a complimentary transmit function.

It would also enable me to compare the FT1000's famous analog receiver (with 500Hz crystal filters in both the second and third IFs), plus a brilliant audio peaking filter, plus IF shift and width) with the Softrock backend, which was to use *Rocky* and *KGKSDR* software with digital filtering that is variable down to several tens of kilohertz.

Some of you will be aware that Phil VK6APH and myself write a monthly column in the Radio Society of Great Britain's *RadCom* magazine about software defined radio and we are intending writing one on using SoftRocks as digital back ends in this manner in the near future.

The crystal Tony used for the FT1000 8.215 MHz IF application was a 11.0 MHz crystal, used with 1/3 sub-harmonic sampling. The center frequency is about:

3* (11.0 -0.003) / 4 = 8.248 MHz, i.e. 33 kHz above the IF frequency.

The modified SoftRock v6 is used with a M-Audio Delta 44 soundcard that can sample at 96 kHz, so the IF tuning with the SoftRock is from 8.2 MHz to 8.296 which gives excellent coverage of the FT1000 2nd IF passband. The soundcard runs from a Pentium IV personal computer, with a clock speed of 3.4GHz

For those who are interested in converting a SoftRock v6 for this kind of application, I think Tony still has a few more of the 11 MHz crystals and the associated components.

Tony's completed SoftRock was mounted in a diecast aluminium box by me and then Phil VK6APH worked out how to interface it to the FT1000 and modified the latter. Phil had to drill a hole in the rear of the case of the FT1000D in order to get the IF out, since there were no spare RCA sockets that were easily accessible – which may put a few people off.

PLEASE NOTE THAT THE SURGERY TO THE FT1000 WAS QUITE DIFFICULT TO PERFORM AND REQUIRED THE USE OF A VERY FINE POINT SOLDERING IRON. IT IS NOT FOR THE INEXPERIENCED OR FAINT HEARTED AND

REQUIRED THE SUBTLE SKILLS OF DR FRANKENSTEIN (VK6APH) AND NOT THOSE OF IGOR (VK6VZ). IT IS POTENTIALLY A REALLY GOOD WAY TO BREAK YOUR BELOVED/EXPENSIVE FT1000.

Neither VK6VZ or VK6APH except any responsibility for any damage caused as the result of attempting to carry out/carrying out this modification!

To power the SoftRock we used the 13.8V available at an RCA socket on the rear of the FT1000.

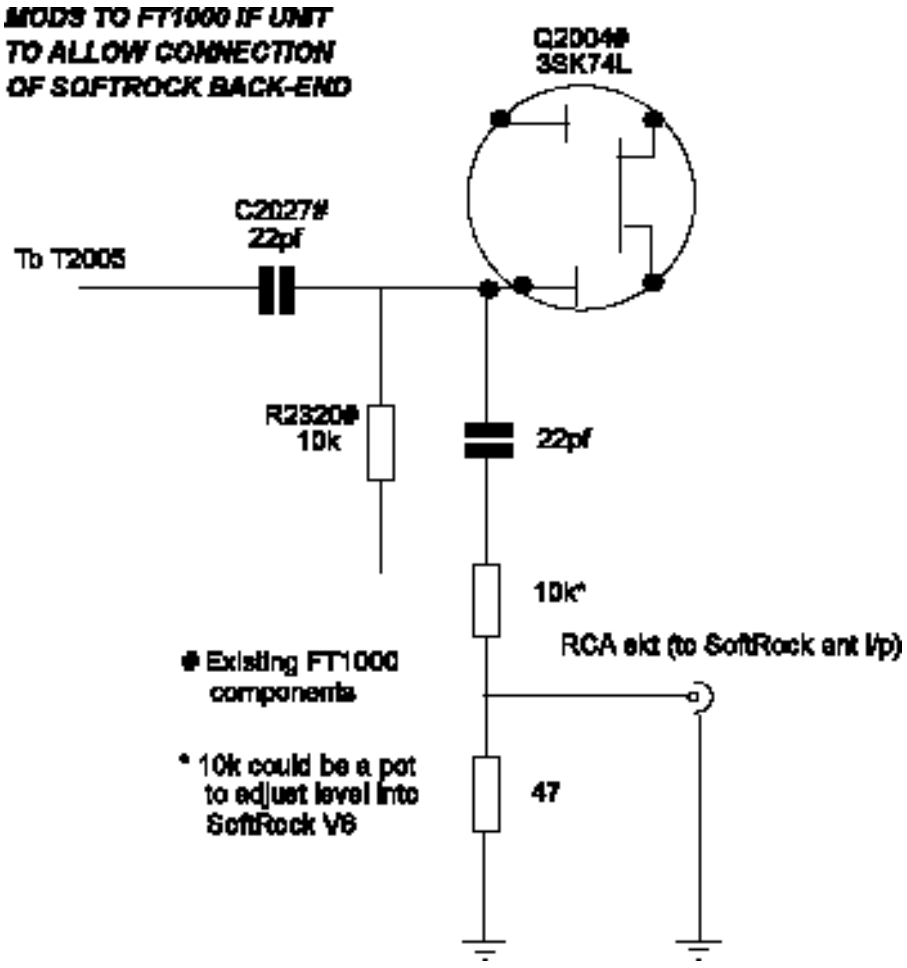
In essence, Phil got the IF output (for the SoftRock) from the FT1000 by 'tapping' a buffer amp (Q2004) that feeds the noise blanker at a low impedance point (one of the gates, to be precise) with a 22pf capacitor, following this with a 10k/47 ohm attenuator – see the diagram nearby.

With the antenna socket of the Softrock connected to the new FT1000 IF output, the SoftRock connected to the PC's sound card in the usual manner, a resonant antenna connected to the FT1000 and the latter tuned to the centre of the 40m band, this level of attenuation gave a noise floor on the *KGKSDR* bandscope of about 10dB above the base line noise (on the *KGKSDR* bandscope) when there was no antenna connected to the FT1000.

Note this measurement was taken with the noise blanker of the FT1000 switched on, as I generally run with this on at all times on the lowbands when using the FT1000 in stand-alone mode.

If the FT1000 noise blanker is switched on (probably owing to where the IF tap is placed) this has an effect on the signal level going into the SoftRock, effectively cutting it down in comparison to when the FT1000 noise blanker is switched off. In short, the gain adjustments in *Rocky* and *KGKSDR* /SoftRock signal levels are quite different in practice to when the FT1000 noise blanker is switched on and when it is switched off.

The SoftRock v6 can be overloaded with signal from the FT-1000, so care needs to be taken to adjust the gain of the SoftRock in *KGKSDR* and *Rocky* so that this does not happen.



Conclusions

The preliminary results are just terrific - we tested the FT1000/SoftRock combination on 40m and could see +/- 30kHz from the frequency that the FT1000D was tuned to, using *Rocky* or *KGKSDR* as our bandscope.

Given the narrow nature of the section of 160m where CW operation takes place (1800KHz to 1835kHz) this enabled us to easily see all of this part of the band at once.

The SoftRock backend also gives a useful second receiver for the FT1000D. You can see on the *Rocky* or *KGKSDR* bandscope where the main FT1000 receiver is tuned, since the 8.215MHz crystal filter leaves a 'suck out' in the passband (i.e. in the form of a depression in the level of the trace) on the *Rocky* and *KGKSDR* bandscopes.

In *Rocky*, we set the LO frequency to 0 in the Settings dialog (many thanks to Alex VE3NEA for this advice), while in *KGKSDR* we had to set the LO frequency to 0.001KHz because it wouldn't accept a 0KHz LO. We also found that in *KGKSDR*, the bit depth needed to be set to 16-bits for acceptable performance.

I have only had a few hours to play with the new setup, but can say conclusively that a weak SSB and CW signals are much more readable/more comfortably readable listening through the SoftRock/Rocky or KGKSDR/Delta 44 than through the analog filtering of the FT1000. As the FT1000 receiver is widely regarded as one of the best lowband weak signal receivers, owing to its excellent cross mod performance and filtering, this says a lot for how far digital filtering and processing has come.

I found *KGKSDR* is the best software to use for SSB for this application, whilst *Rocky* is the king for weak signal CW. I was 'seeing' and then copying several 160m CW signals from the USA that were barely audible at sunset today on the SofRock back-end – I never would have found them by tuning up and down the band on the FT1000.

What people should understand is that the bandscope that you get from *Rocky*/*KGKSDR* etc is able to see signals that you can hardly hear (and in some cases, not hear). Apparently, those bandscopes used in the current generation of HF transceivers seem fine at seeing strong signals, but not weak ones…

Frankly, the results are so good from the FT1000/SoftRock combo and it appears such an aid to an active DXer and contester like me, that until I used the combo to win a major contest, it was very tempting to keep it a secret ;-). The only downside so far is that SoftRock acts as a monitor receiver when I transmit and I can hear myself coming out the speaker delayed by a few hundred milliseconds, which is terribly distracting (!).

As a result, I need to find a way to mute the SoftRock when I transmit, which shouldn't be too difficult.

It would be appreciated if people didn't email me directly for further information, as my salt mine job often requires 12-hour days at present and my kids need the small amount of time I have outside this. As I learn more, I will (of course) post it on the SoftRock 40 reflector.

Phil VK6APH and I will write up a general piece on using software defined radios in this manner for RadCom magazine, which should appear in our column around the end of this year.

Vy 73

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