Modified Build of Elecraft KAF2 Audio Filter for the K2

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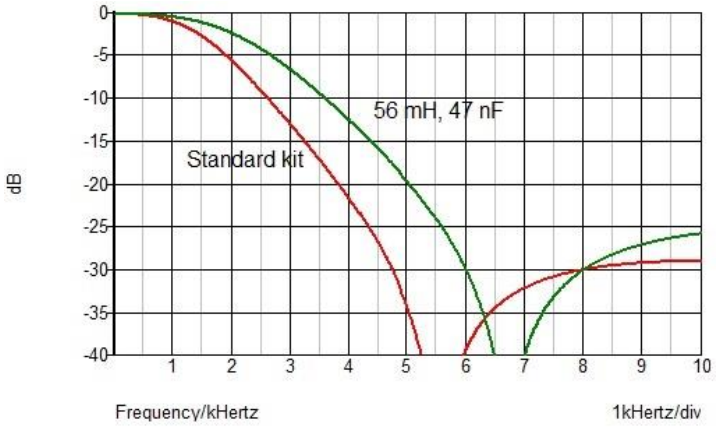
Elecraft offers an optional audio filter for the K2 transceiver. When using my K2 on CW, I found a couple of minor shortcomings that it was desirable to improve:

(1) There was quite a bit of high pitched hiss on the audio with the AF gain turned up, as needed on a quiet band, and
(2) On a busy band, such as during a contest, the IF filter rejection well away from the desired frequency was not as much as I would like.

The hiss was not really very noticeable on SSB. The KAF2 audio filter might cure these ills as it includes a low pass filter for hiss reduction and two selectable stages of narrow audio filtering. But as I looked into it, I found some conflicts with my operating interests:

(1) The low pass filter, which is always engaged (unless you take the top off the rig and flip a switch), appeared to have a significantly smaller bandwidth than stated in the KAF2 manual, when modelled using SPICE. It looked ideal for CW, possibly ok for SSB (particularly the wider band option mentioned in the manual), but not really usable for WSJT digital modes.



(2) Modeling of the narrowband filter stages showed that they (especially the AF2 setting) were really too narrow for most contest operating.

I decided to add the KAF2 but with modified component values to provide reduced hiss and some modest additional filtering, but with wider bandwidths than the original design. After spending some time simulating various options in SPICE, I ended up with the following changes, which are suitable for a preferred received audio pitch and sidetone setting of about 550 Hz.

- Low pass filter not installed (L1, L2 pads jumpered, C1, C2, C3, C4 not installed)
- R3 changed from 470 Ω to 8.2 kΩ
- R4 changed from 47 kΩ to 15 kΩ
- R5 changed from 100 kΩ to 33 kΩ
- R6 changed from 180 kΩ to 82 kΩ
- R7 changed from 470 Ω to 1.8 kΩ
- R8 changed from 510 kΩ to 220 kΩ

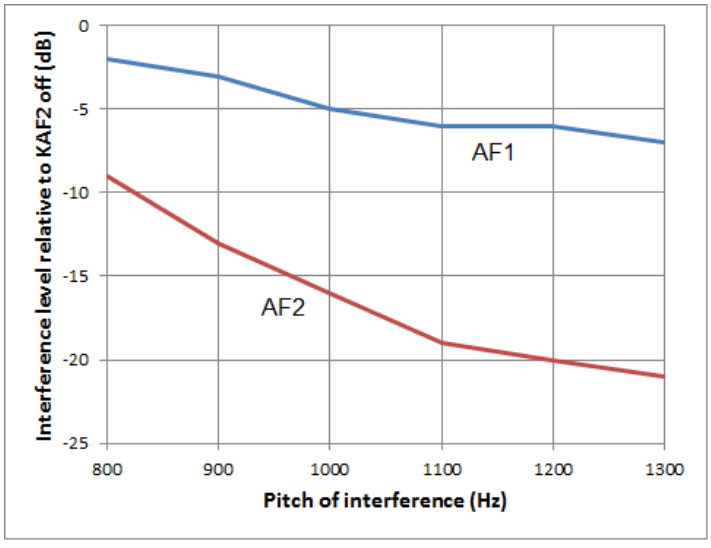
The capacitors in the bandpass filter sections remain unchanged. The tuning range of the first filter (AF1) is rather narrow. It probably would have been best to change to value of the R1 potentiometer to something larger and not to increase R3 as much, but a pot to fit the board was much more of a procurement challenge than fixed resistors, so I didn't try.

I may, in the future, try to redesign the low pass filter section for wider bandwidth to help the far-out rejection of the crystal filter, but for now I think I will leave it alone. In the AF OFF state the frequency response is intended to be essentially unchanged from what it was without the KAF2 installed but an initial measurement indicates that there is about 1 dB of extra rolloff between 1 kHz and 500 Hz with the KAF2 switched in (but in the "off" state), which may indicate a need to increase C12 and C13. Whether it matters for wideband digital modes like FSK441 is still to be determined. I did design in just a bit more gain than the unmodified KAF2, as I use the K2 as an IF on VHF bands quite a lot, where most signals in this area are quite weak and noise levels are low, making a higher overall gain useful.

On the following pages are plots of the spectrum obtained at the rear speaker jack in CW mode with the crystal filter set for nominal 600 Hz bandwidth and the antenna disconnected. These were generated using Spectran software. The spikes on the left side of each plot are just leakage of 60 Hz (and its harmonics) into the audio line from the K2 to the computer sound card. The reduction in hiss going from the KAF2 off state to "AF1" setting on the K2 can be quite pronounced to the ear in some situations, while the additional selectivity of the "AF2" setting seems useful for much HF CW operating.

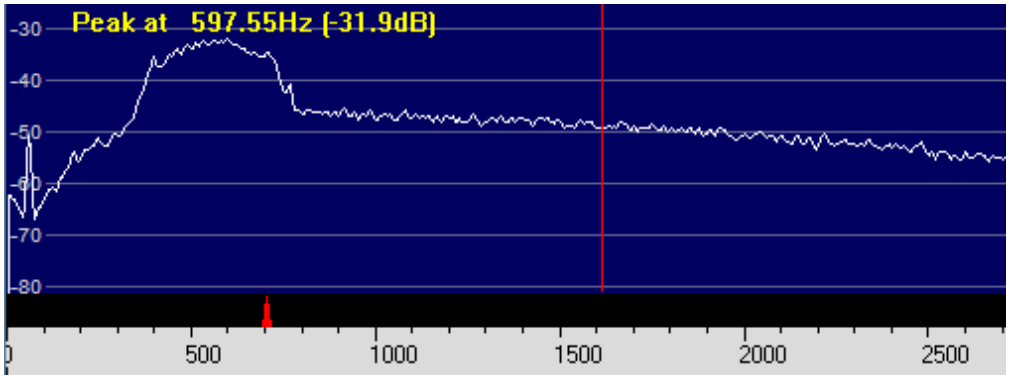
With the preamp off the level of the hiss at 2 kHz is reduced by a very noticeable 12 dB or so (relative to the desired signal) using AF1 and by about 15 dB more using AF2 (not so obvious to the ear). With the preamp on, the RF stages dominate the noise more than with the preamp off and the hiss reduction is not as obvious, but it is still significant to the ear at times.

The following is a plot of the measured reduction of the level of a high pitched CW interference signal resulting from switching the KAF2 to AF1 or AF2. This was measured using Spectran, with the 600 Hz crystal filter bandwidth setting, preamp on and AGC off. Above 1.3 kHz, the measurement was difficult due to low interference signal-to-noise ratio.

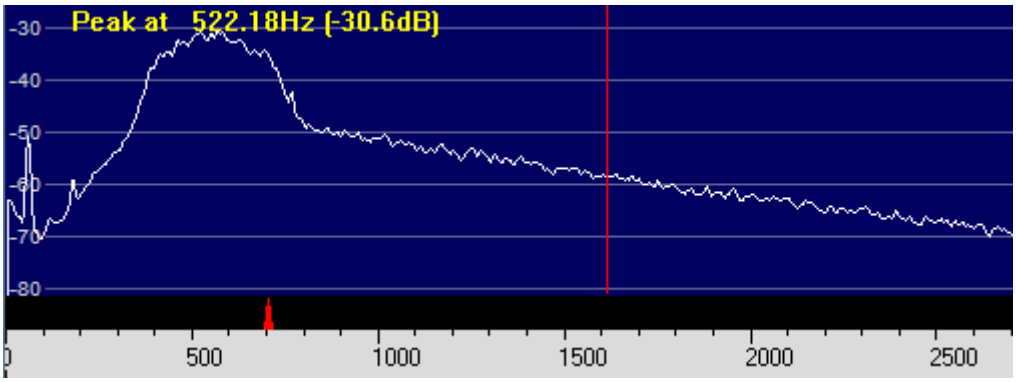


I have not confirmed in practice that my model of the KAF2 low pass filter is valid. If anyone has spectrum plots using the OP1 (SSB) filter with and without the standard KAF2 low pass filter only (not AF1/AF2), I would be quite interested to see them.

Preamp off, KAF2 off

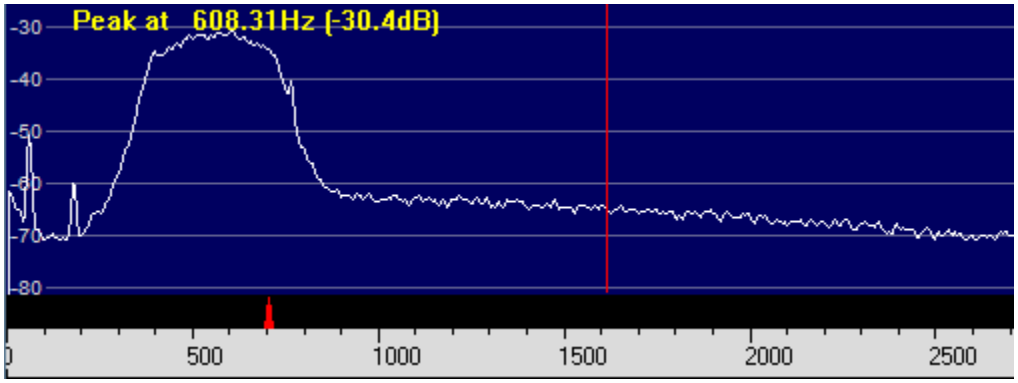


Preamp off, AF1

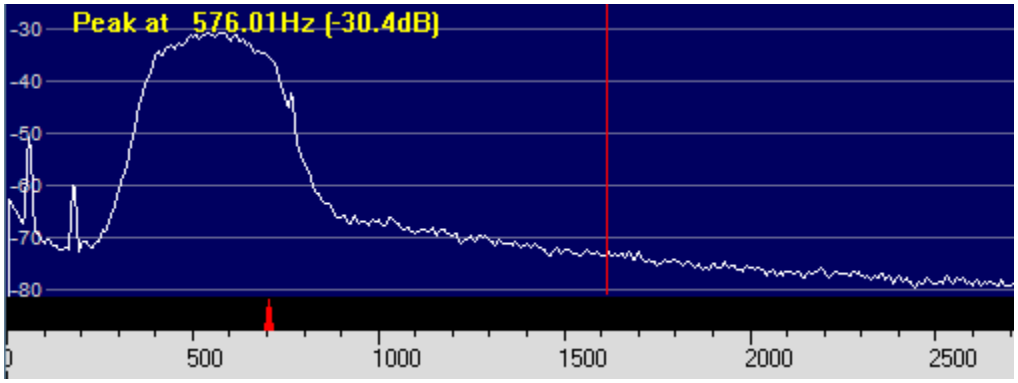


Preamp off, AF2

Preamp On, KAF2 off



Preamp On, AF1



Preamp On, AF2