Adding a Collins Mechanical CW Filter to the FT-817

Bob Wolbert, K6XX

Adding a Collins mechanical filter to the Yaesu FT-817 is simple and straightforward, and will save money compared to purchasing the factory version. The Collins 526-8634-010 "Low Cost Bandpass Mechanical Filter" is a seven resonator low profile 455kHz filter that easily fits in the space allotted for the external filter on the FT-817 main PC board. Required components are the filter, two capacitors, four resistors, and a small piece of perfboard. I wish to thank Chuck, W6CAM, who provided the technical expertise and extra filter for this project.

Interface Circuit

Achieving the best possible performance from a mechanical filter requires matching signal level and input/output impedances. The 526-8634-010 filter specifies 2kΩ and 30pF input and output terminations. Components inside the 817 present approximately 2.2kΩ resistive termination, so for proper matching, we need a resistor/capacitor network on both ends of the filter. Isolating the board capacitance and equalizing the loss through the two different filter paths (WIDE—the stock ceramic SSB filter, and the NARrow path—using the new mechanical filter) is accomplished with resistive attenuators. W6CAM recommended total attenuation of –3dB, a value that works extremely well in the FT-817.

Given the required termination, existing internal FT-817 values, and the –3dB required equalizing/isolating attenuation, we develop the circuit of Figure 1. Both resistive attenuators are set to provide 1.5dB of attenuation and a 2kΩ resistive termination as seen by the filter looking "out". Standard resistor values of 470Ω and 8.2kΩ are very close matches to ideal.

The 30pF of required termination capacitance on each end is provided by 27pF capacitors. This assumes about 3pF of stray capacitance exists on the final layout.

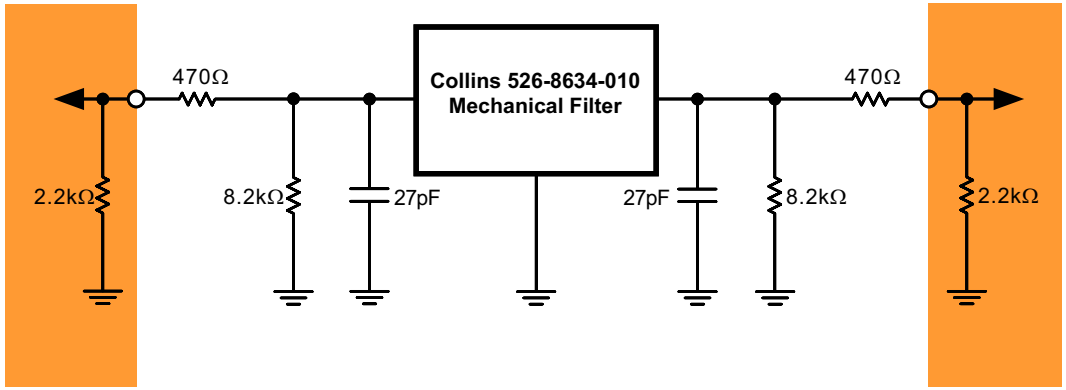

Figure 1. CW filter circuit schematic

Mechanical vs. Crystal

Mechanical and crystal filters have different characteristics.

Mechanical Filters

- Lower Passband ripple
- Lower Passband Attenuation
- Somewhat smaller for given performance
- Center Freq. from 100kHz to 600kHz

Crystal Filters

- Better Shape Factor
- Center Frequencies from <100kHz to >20MHz

In high performance applications, crystal filters are generally preferred because of their better skirts; 500Hz bandwidth 455kHz crystal filters often feature better than 2:1 shape factors between their –6dB and –60dB points, whereas the mechanical filter is only about 3:1.

The passband response of the typical mechanical filter is typically less than 0.5dB, and is guaranteed less than 3dB. I haven't found guaranteed specifications for the passband ripple of crystal filters, but some samples exhibit over 5dB of peaks and troughs. This makes tuning signals more difficult.

Implementation

Figure 2 shows the board area allocated for the filter. Measurements were made with calipers calibrated in mils; however the measurements don't seem to get any "rounder" when converted to metric units. With the radio's front panel facing you, the top pin on either row is the active input/output. All other pins are grounds.

The filter is mounted on standard 0.100" pitch perfboard. The filter pin spacing is not 0.100", however, and neither are the interface pins in the FT-817, but with rotating the filter slightly and spreading the pins a bit, the perfboard solution works "good enough". Mount the filter near the center of the perfboard, with the capacitors on the opposite side of the board, directly across the pins. The resistors are mounted on the same side as the filter, and their leads are pulled back through the perfboard again. This assembly is pushed onto the FT-817 interface pins with the mechanical filter inverted. Crimp or solder the leads to the interface pins.

After replacing the top cover, enable the filter by selecting the CW Filter option of Menu System item 38 "**OP FILTER**" (press and hold the "F" key until the menu system appears, turn SEL until menu 38 appears, then turn the main tuning knob until the display reads **CW**. Exit this menu by holding "F" again, tune to your band of interest, select CW mode, and select the narrow filter (momentarily press "F", turn the SEL knob to the **IPO ATT NAR** menu and press C). Note the narrow filter must be separately enabled for each band and VFO (A/B) by using the operation menu (the momentary "F" menu only). It is simpler than this description makes it sound, really...

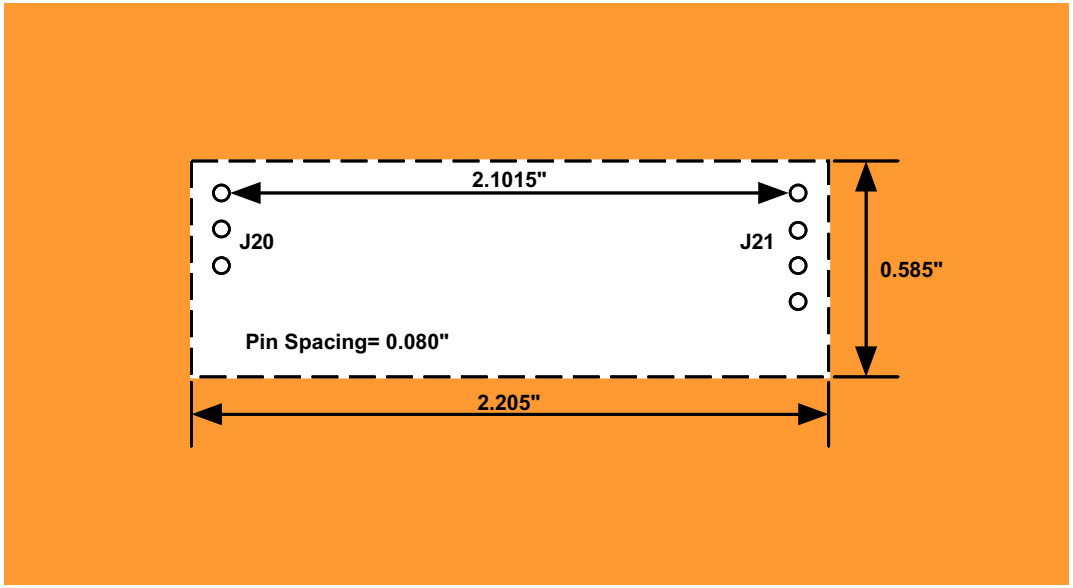

Figure 2. FT-817 main board layout showing reserved area and pin spacing for the accessory filter.

Mechanical vs. Crystal, cont.

Mechanical filters are supposedly more rugged than crystal filters, and are specified to sustain 100 G shocks. I have no comparable crystal filter data, however.

On on-the-air tests between the Collins 526-8634-010 and a Yaesu 250Hz bandwidth filter clearly demonstrated these characteristics in the FT-817. The mechanical filter had poorer strong signal selectivity but a "cleaner" in-passband tone. Overall, my preference is for the crystal filter. Unfortunately, it is too large for the 817; testing was performed with the top cover removed.

PC Board Layout?

No PC board layout is (yet) available for this project. If you have the wherewithal, please lay out the board for us! The FT-857 and FT-897 use the same filter boards, but implement a coding scheme where the PC board itself communicates it presence and its filter bandwidth to the rigs microprocessor by grounding certain pins. The rig responds by adjusting its BFO injection frequency. You might as well add this coding to your filter so it may be used in the other rigs, since filters without this coding may require IF Shift to center the passband—and regardless of what the manual state, IF Shift is NOT remembered between operating sessions.

The code for each of the three Yaesu optional filters is shown below, with 1 = open circuit and 0 = ground:

ODF2	OFD1	OFD0	Filter
1	0	0	300Hz
1	0	1	500Hz
1	1	0	2.3kHz

All other combinations are apparently ignored. See Figure 3 for drawings.

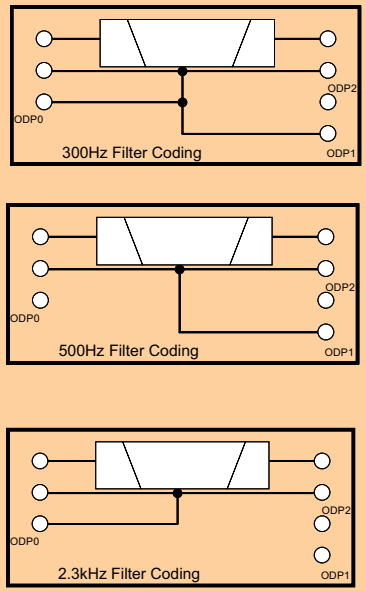

Figure 3. CW Filter Coding (Optional on the FT-817)

V2.00 2 March 2005