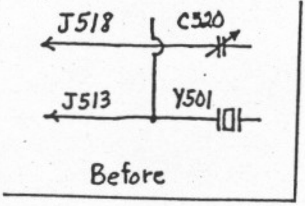
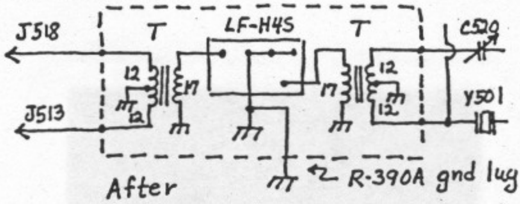
M76-6-1

R-390A Filter Mod 2

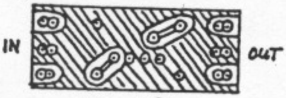
Dallas Lankford
12 I 94, rev. 18 I 94



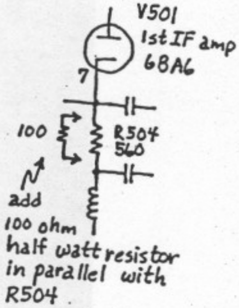


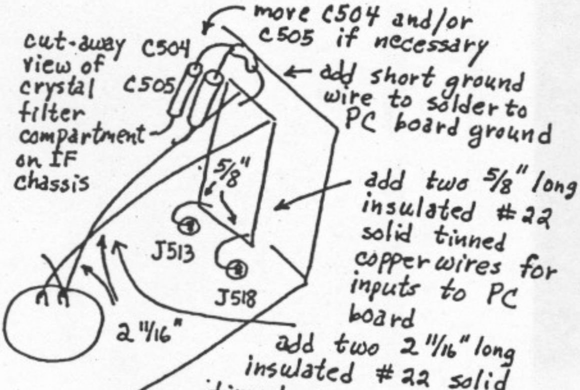
T = 24 turns, center tapped, and 17 turns, #26 enameled copper wire, on Amidon FT-50A-75, toroid wrapped with Teflon tape

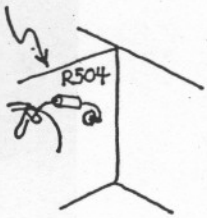
PC Board Layout
(bottom view)



5/8 x 1 9/16







add two 2 11/16" long insulated #22 solid tinned copper wires from crystal filter lugs to outputs of PC board (original inputs to crystal filter ran from J513 and J518 to these lugs)

LF-H4S ceramic filters are available from Kiwa Electronics, Attn. Craig Siegenthaler, 612 South 14th Avenue, Yakima, WA 98902, (509)-453-5492 for about $15.

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Several things caused me to rethink my R-390A torsion filter mod. First, I never liked the idea of modifying the RF chassis because any repairs or adjustments to the mod require removal of the RF chassis, a time consuming process. Second, any changes to the mod, such as developing a noise blanker, would be difficult for the same reason. And third, trouble-shooting the RF chassis could require removal of the mod, which, again, would be difficult.

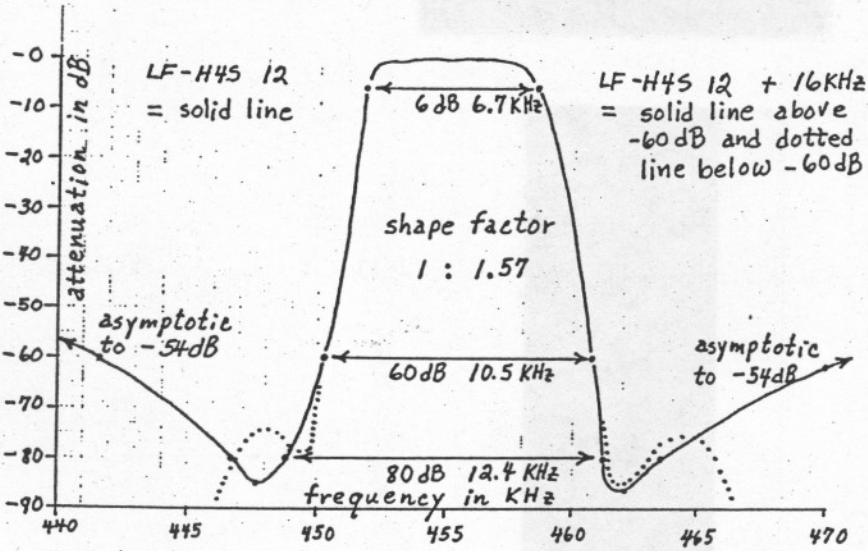
A much better place for adding such filters is at J518 and J513, where the 455 KHz output of the 1st IF transformer (on the RF chassis, following the last mixer) enters the IF chassis. But when I did the first filter mod, I did not know the output impedance of the 1st IF transformer, so I could not develop suitable impedance matching for filters which might be installed at that point. Subsequently, I read in the Collins R-389/R-390 Engineering Report that the output impedance of the 1st IF transformer was 1000 ohms. Except for tube differences, the R-390A last mixer, 1st IF transformer, and following crystal filter appeared to be similar to the R-390 circuits. So assuming a 1000 ohm output impedance for the R-390A 1st IF transformer, I developed impedance matching broadband transformers for 2000 ohm source and load filters, implemented my design, and found that it worked as well as my first filter mod. This mod, called mod 2, is shown above.

There is not much available space in the crystal filter compartment of the IF chassis, so I decided to use a tiny LF-H4S ceramic filter. The total number of parts required was four: the filter, two broadband matching transformers and a PC board. Everything fit neatly on the tiny 5/8 by 1 9/16 inch PC board. As with the first mod, there is considerable loss with this mod. And like the first mod, signal loss was restored by adding a 100 ohm half watt resistor in parallel with R504 to increase the gain of the 1st IF amp.

As with the first mod, and for the same reasons, close-in (within ±100 KHz) dynamic range of the R-390A is improved for non-crystal filter bandwidths, with more improvement as signal spacing becomes closer. For one RF chassis, the 20 KHz spacing ICP3 at 1.6 MHz was improved from -12 dBm to +2 dBm. For another RF chassis, the improvement was even greater, to +10 dBm. Apparently there is considerable variation in the potential ICP3 improvement from one RF chassis to another. A third RF chassis was tested, and the improvement in ICP3 was to +2 dBm. So it seems that +2 dBm is typical of the ICP3 improvement

It appears feasible to use a Collins torsion filter for this mod, but a larger PC board, more parts, and a different mounting arrangement would be required. For these reasons, a torsion filter was not used.

The measured attenuation characteristics of a typical LF-H4S ceramic filter are shown below. The solid line is for a stand-alone LF-H4S measured in a carefully constructed test fixture with BNC connectors and RF tight input and output chambers. An LF-H4S installed in an R-390A and cascaded with a 16 KHz bandwidth R-390A filter is shown by the dotted continuation below the -60 dB attenuation points. Above -60 dB attenuation there was no difference between the stand-alone LF-H4S and the installed LF-H4S cascaded with the 16 KHz BW R-390A filter. As can be seen, there is remarkably little signal leakage around the installed LF-H4S filter despite the rather long (2.5") leads from the output of the LF-H4S matching transformer to the input of the crystal filter. I had considered using miniature coax in place of these two open wire leads, but these measurements demonstrate that there would be little gained by using miniature coax. My ultimate plan is to remove the 16 KHz BW filter anyway, and to use the 8 KHz BW filter cascaded with the LF-H4S, in which case the humps on each side of the LF -H4S notches will be eliminated by the 8 KHz filter skirts. As can be seen from the graph below, the stand-alone attenuation of the LF-H4S filter leaves something to be desired below about 447 KHz and above about 462 KHz, namely, the attenuation comes back up from deep notches to about -54 dB. However, when cascaded with other filters, as is done in this R-390A mod, the attenuation characteristics of the LF-H4S below about 450 KHz and about about 460 KHz are of little concern because the folowing filter takes over. When you use the 8 KHz R-390A BW in combination with the LF-H4S you get an outstanding 6 KHz nominal BW. Gone are the annoying 5 KHz hets which you normally get with the R-390A 8 KHz BW when tuning the SW bands. The 4 KHz and 2 KHz R-390A BWs perform about the same as before. In every way this mod is as good as the previous mod using the 6 KHz Collins torsion mechanical filters. Actually, it is better, because it is simpler to implement, and no alignmant is required other than adjusting the R-390A 1st IF transformer for maximum signal with a stable signal tuned to the center of the LF-H4S passband.



The toroids must be mounted upright (as opposed to flat) on the PC board; otherwise the finished PC board will not fit into the available space. The transformer lead lengths should be kept as short as possible to minimize signal leakage by reradiation. The 5/8 inch length of the wires from J513 and J518 to the PC board and the 2 11/16 length of the wires from the PC board to the crystal filter are the lengths of the insulation, not counting additional wire length for making connections to lugs and the PC board. The input wires should be soldered to J513 and J518 first, then the PC board slipped onto those two wires and soldered. The input wires are curved into a semicircle so that the bottom of the PC board is directly above J513 and J518. Then the output wires are soldered to the crystal filter lugs, and the remaining connections to the PC board are made.

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R-390A Filter Mod 3

Dallas Lankford, 1 I 95

If you have done my "Collins Torsion Mechanical Filter For The R-390A" mod (DX News Vol. 61, No. 2 - Oct. 11, 1993, pages 23-27; or Hollow State Newsletter No. 30, pages 2-8, for HSN contact Ralph Sanserino, P.O. Box 1831, Perris, CA 92572-1831 and include SASE for info sheet), or have done my improved and simpler "R-390A Filter Mod 2," (to appear in DXN, DXM, and HSN), then my latest R-390A filter mod may be just the thing you have been waiting for.

The purposes of the previous two R-390A filter mods were to establish a 6 KHz BW as the widest BW for the R-390A and at the same time to provide a 6 KHz bandwidth for the R-390A, to increase the R-390A close-in 3rd order intercepts for all non-crystal filter bandwidths, and to protect the R-390A mechanical filters from excessive RF levels due to very strong nearby signals.

The disadvantage of those mods is that the 8 KHz and 16 KHz BW positions of the front panel BW switch provide the same 6 KHz BW. Wouldn't it be nice, I thought, if the 16 KHz mechanical filter were replaced with a 3 KHz BW filter? That would provide 2, 3, 4, and 6 KHz bandwidths for such a modified R-390A, which would be as many bandwidths as a DXer could reasonably wish for. The down side here is that the bandwidths would not be in sequential order, but I just wasn't up to the task of shifting the 8 KHz mechanical filter to the 16 KHz position, the 4 KHz filter to the 8 KHz position, and then installing the 3 KHz filter in the newly vacated 4 KHz position. Anyone who has fiddled around with the R-390A mechanical filters in the IF subchassis knows that such a project would not be a weekend project.

For a 3 KHz filter, I decided to use one of Kiwa Electronics (Craig Siegenthaler, 612 South 14th Avenue, Yakima, WA 98902, phone (509) 453-5492) CLF-D2-K filters. Putting this 3 KHz ceramic filter into an R-390A IF subchassis in place of the 16 KHz mechanical filter turned out to be a toughie. Two problems were encountered: reducing signal levels into the ceramic filter (the ceramic filter has much less loss than R-390A mechanical filters when properly impedance matched), and signal leakage. To equalize signal throughput, a resistor divider network was used ahead of the ceramic filter; see the "After" schematic below. To eliminate signal leakage, a flange was fabricated from 0.015 inch copper sheet (copper gutter stock, available at sheet metal shops), tinned, and assembled with two etched PC boards so that the ceramic filter input and output pins were isolated from each other by the flange. The flange was made approximately the same size as an R-390A mechanical filter flange, so that the ceramic filter assembly could be bolted (just like an R-390A mechanical filter) into the vacated 16 KHz IF subchassis hole. The flange, with ceramic filter passing through it, also acts as an RF barrier to help shield the input and output impedance matching transformers T1 and T2 from each other.

As can be seen from the "Before" and "After" schematics below, the 16 KHz mechanical filter was removed with C507 (51 pF) still attached to the mechanical filter pins. The other 51 pF fixed value (silver mica) capacitor was left in situ, attached to the lugs of C571, the output 50 pF variable ceramic trimmer.

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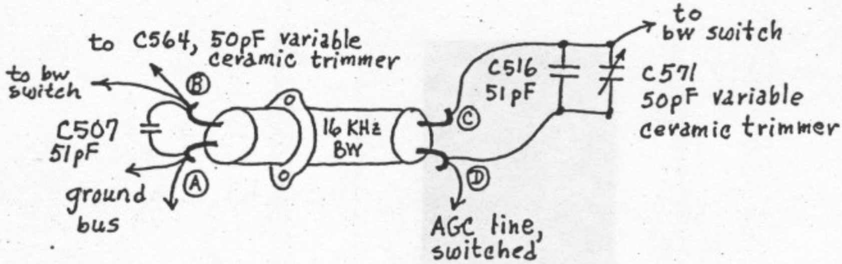
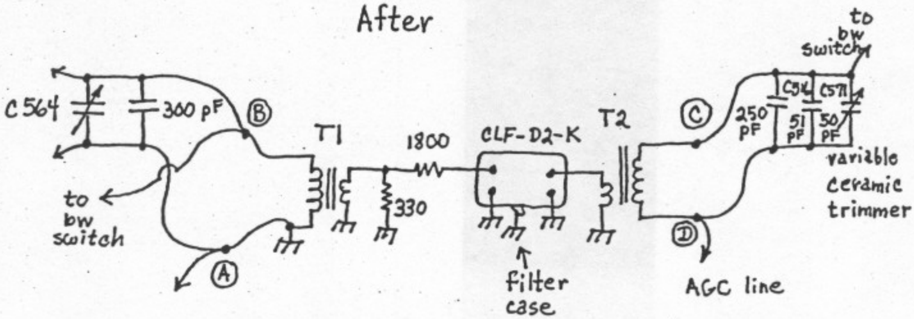
This is the "natural" way to remove a mechanical filter from an R-390A IF subchassis in preparation for doing a filter mod using tuned primary impedance matching transformers, as I did. Consequently, a 300 pF silver mica capacitor was added (in parallel) to the lugs of C564 (the input 50 pF variable ceramic trimmer) to permit the primary of T1 to be tuned to resonance at 455 KHz using C564, and a 250 pF silver mica capacitor (actually 180 pF paralleled with 62 pF) was added (in parallel) to the lugs of C571 (the output 50 pF variable ceramic trimmer) to permit the primary of T2 to be tuned to resonance at 455 KHz using C571; see the "After" schematic below.

Before



After



T1 = 64 3/4 : 3 3/4 turns # 26 enameded copper wire on Amidon FT-50-61

T2 = 64 3/4 : 8 3/4 turns # 26 enameded copper wire on Amidon FT-50-61

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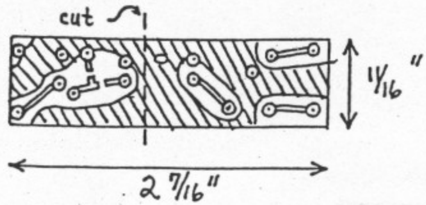

A PC board layout of the filter mod is given at left. The PC board was etched, and then cut along the dashed line. The short part extends below the IF chassis, and the longer part extends above the chassis. The ceramic filter was soldered to one of the PC board pieces (it does not matter which one), and then the unsoldered end of the ceramic filter was "Chinese puzzled" through a small rectangular hole in the flange, after which the ground plane of the PC board with filter attached was soldered to the flange. Next, the other PC board piece was inserted onto the unsoldered ceramic filter pins and then soldered at the pins, and along the ground plane and flange boundary. Finally, the remaining parts of the filter were soldered to the completed PC board and flange assembly, the completed assembly was mounted in the vacant mechanical filter hole, the remaining wires were attached (points A, B, C, and D on the schematics), and the 250 pF and 300 pF fixed silver mica capacitors installed at the lugs of the variable ceramic trimmers. To simplify installation, small pins about the same size as the mechanical filter pins were press-fitted and soldered to the two pairs of PC board pads at each end of the PC board. To conserve space, 330 ohm and 1800 ohm surface mount resistors were used (the PC board is laid out for surface mount resistors).

To align the ceramic filter input and output transformers, the variable ceramic trimmers C564 and C571 must be adjusted. Set the bandwidth shaft to the 16 KHz position, remove the mechanical filter cover (if not already removed), and with the R390A tuned to a steady signal (one of the 100 KHz calibration points will suffice), adjust C571 (the top trimmer) for maximum signal. To adjust C564 (the side trimmer), tilt the IF subchassis so that C564 is accessible through one of the circular cutouts in the side panel.

During testing of the filter mod, it was observed that signal levels through the ceramic filter slowly decreased for about an hour or so while the R-390A came up to operating temperature. This problem was traced to a "drifty" C516 (the 51 pF silver mica capacitor across the pins of the variable ceramic trimmer C571). Replacement of C516 cured this problem.

The inductance of 64 3/4 turns of # 26 enameled copper wire can vary considerably from one Amidon FT-50-61 toroid to another, so it may be necessary for you to vary the value of the 250 pF or 300 pF capacitor (or both) to permit T1 and T2 to be tuned to resonance at 455 KHz. If you do not get two peaks for two different settings of the variable ceramic trimmers C564 and C571 when you adjust them, that is an indication of failure to achieve resonance, in which case you will have to tinker with the value of the 250 pF or 300 pF capacitor (or both).

Is this filter mod worth the effort? Probably not. In fact, this mod is very close to, if not, an "emperor's new clothes" mod because I have yet to find a listening situation where the 2 KHz or 4 KHz BW does not work about equally well. At best, I would not expect to find more than one or two DX situations per month where this mod makes any observable difference. And as for making something hearable that was not hearable before, it'll never happen.