Heathkit SB/HW Crystal Filters.

Heathkit used two different physical sizes for the filters in the SB/HW transceivers, receiver/transmitter pairs, and SWL receivers.

The larger sized filters are:

Part no.	Model no.	Type.	Bandpass at 6 db – 60 db		Used in.
404-200		SSB	2.1 kHz.	5 kHz.	SB-100, 300, 400
404-201		AM	3.5 kHz	14 kHz.	"
404-202		CW	400 Hz.	2.5 kHz	"

Smaller sized filters are:

404-283	SBA-310-2	SSB	2.1 kHz.	5 kHz.	SB-301, 310, 401, 101
404-284-1	SBA-301-2	CW	400 Hz.	2 kHz.	" "
404-285-1	SBA-301-1	AM	3.75 kHz.	10 KHz.	" "
404-314		AM	5 KHz.	15 kHz@50db	SB-310, 313 only
404-328	SBA-310-1	SSB	2.1 kHz	7 kHz.	SB-310, HW-100, 101 only
404-548		CW	400 Hz.	2 kHz.	SB-104, 104A only.

Be careful of the last one, the 404-548 CW filter. It will ONLY work in the SB-104, 104A because its center frequency is different, 3395.700 Khz, from all the other CW filters.

There are TWO AM filters: the 404-285-1 is the "Deluxe" AM filter. It was used in the ham rigs. The 404-314 AM filter was only used in the SWL receivers.

In my opinion, the so-called "Deluxe" AM filter is still too narrow for maximum fidelity, and the 404-314 AM filter does a better job.

So, on to building an AM filter…or any filter you desire for that matter. Below is Jan Maldups' e-mails to Eddy Swynar, compiled and arranged by Ken Gordon W7EKB.

The AM filter.

The Heathkit AM filter, Part no. 404-314 consists of the following parts:

2 each part no. 404-306 crystals, 3393.7 kHz.
2 each part no. 404-307 crystals, 3396.8 kHz.
2 each part no. 28-3 phenolic capacitors, 0.56 pF.
1 each part no. 20-130 dipped mica capacitor, 12 pF.
1 each part no. 40-814 slug-tuned, center-tapped coil, 115 uH. (This adjusts the bandpass center frequency)
1 each part no. 85-157 printed circuit board.

A verbal description of the schematic for all the filters follows:

Starting at the upper left-hand corner, the IN terminal, draw a line horizontally to the right to the first 3396.8 kHz. crystal also lying horizontally. Draw a 0.56 pF capacitor in parallel with it. Continue on horizontally to a 3393.7 kHz crystal, also lying horizontally. The other lead of this crystal is the OUT terminal.

Back at the IN terminal, draw a line vertically downward, then to the right to a 3393.7 Khz. crystal. Position this crystal in parallel below the first crystal/capacitor combination. Continue on to the right to a 3396.8 kHz crystal. Position this crystal in parallel below the second crystal above. Connect the remaining lead of this crystal to the OUT terminal. Draw a 0.56 pF capacitor in parallel with this 3396.8 kHz. crystal.

From the junction of the two crystals in paragraph one, draw a 12 pF capacitor down to the junction of the two crystals drawn in paragraph two above. Draw a center-tapped coil in parallel with this capacitor, and connect the center-tap of the coil to ground.

The circuit board used in the AM filter, the center-tapped coil, the metal housing, and the base-plate, are all identical to the ones used in the SSB filter. Therefore, you can take a SSB filter apart using a propane torch. The SSB filters are much more common than the AM filters, and cheaper, so you can use these parts to build your new AM filter.

The "large" sized filters all use the standard HC-6/U crystals, while the "small" filters use the "flattened" HC-6/U crystals. The "small" filters are the same height, depth, and pin-spacing as the "large" filters, but they are not as "thick".

There are some differences between the "large" and "small" filters, although they all have identical input and output impedances, 2000 ohms, and insertion loss, -4db. The bandpass shape factor is slightly better in all of the smaller filters than in the larger ones. Their insides are slightly different also. However, they are directly interchangeable, although you will have to drill new mounting holes to do that.

You can use the larger, HC-6/U crystals inside the smaller filters (SB-102 style case) as they will fit fine.

The original 404-314 AM filter is in the smaller sized case.

The value of 0.56 pF for the parallel capacitors was arrived at by cut-and-try at Heathkit, but all 404-314 filters use exactly the same values of capacitor and the filters were not tweaked individually. For a home-built filter, you will probably have to tweak the capacitors for best bandpass response, because the crystals you use will probably have different capacitances than the Heathkit original crystals. The slug-tuned coil adjusts the center-frequency of the bandpass.

The CW filter.

The schematic diagram for the CW filter is identical with that for the AM filter. The top left crystal is 3395.450 kHz., and the top right crystal is 3395.150 kHz. The bottom left crystal is 3395.150 kHz., and the bottom right crystal is 3395.450 kHz. Both 3395.450 kHz. crystals have the 0.56 pF phenolic capacitor in parallel with them, identical to the AM filter. However, the mica capacitor in parallel with the adjustable, center-tapped coil is 47 pF for the CW filter. Both the circuit board, and the adjustable center-tapped coil (115 uH) are identical to those in the AM filter.

The specifications for the CW filter crystals are:

Effective series resistance:	25 ohms maximum
Load capacitance:	34.5 pF.
Frequency tolerance:	+/- 50 Hz.

SSB Filter.

The smaller Heathkit SSB filter 404-283 uses two center-tapped toroid coils with two parallel ceramic trimmers instead of the center-tapped adjustable coil and parallel fixed capacitor.

At this point, we do not have a schematic diagram for the 404-283 SSB filter, but, if you are going to take one apart to build an AM or CW filter (or RTTY filter), you can easily enough reverse-engineer it to make your own schematic.

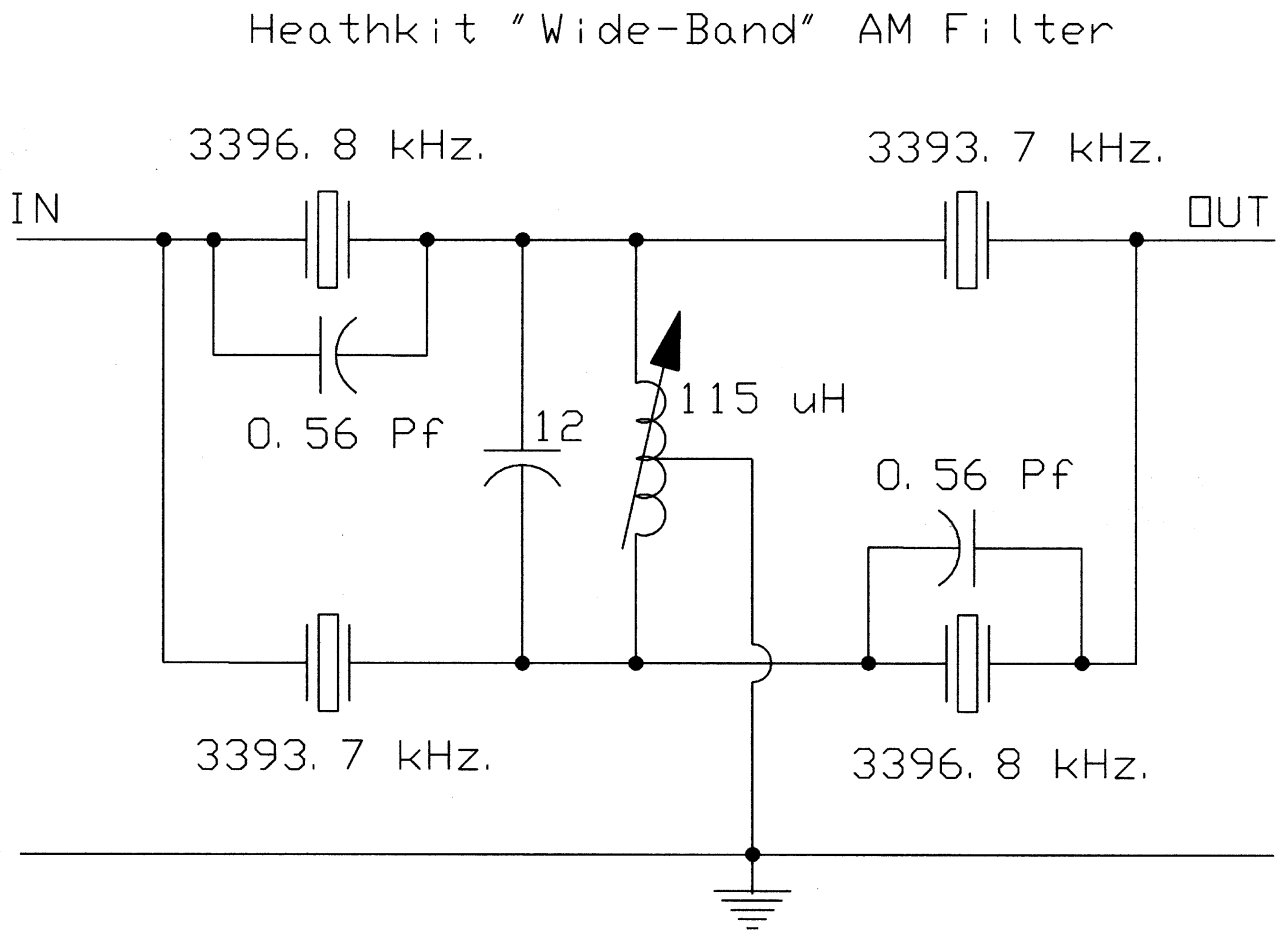
It is possible that the two "center" crystals, of the six crystals in the 404-283 SSB filter, which are 3393.960 kHz., and 3395.100 kHz, set the outer limits of the bandpass curve and make the sides steeper.

The older Heathkit 404-200 SSB filter is a bit different from the 404-283 filter. We have taken one labeled "Heathkit PT NO. N-404-200", made by the "James Knights Co., Sandwich, Ill, Crystal Filter" apart. This filter contains 6 crystals, two center-tapped toroids, two 4.5 – 20 pfd ceramic trimmers, a 15 pfd, N330 10% disk ceramic capacitor, and a 39 pfd N330 10% disk ceramic capacitor. We have not yet measured the inductance of the center-tapped bifilar-wound toroids, but we will do this as soon as possible, and will post the info here.

The frequencies of the crystals are: 2 Ea 3395.220 Khz, 2 Ea 3393.520 Khz, 1 Ea 3395.080 Khz, and 1 Ea 3393.940 Khz.

The schematic for the N-404-200 filter is shown below the one for the AM filter.

Here is the schematic for the AM filter:



Shown below is the SSB filter, Heathkit PT NO N-404-200.