Tuning Instructions Notch Filter

Manually Tunable Notch Filters from Wainwright Instruments can be tuned by tuning each resonator – either by screwdriver or by knobs. You can choose this tuning option.
**Please note: non-tunable filters can only be re-adjusted, tuning them to a different frequency can damage the filter.**

To tune one of Wainwright Instruments' tunable notch filters, you need a network analyzer, where both channels (transmission and reflection) can be seen.
This is very helpful, the transmission channel is essential! It would be best if you can also display the other channel (reflection), which shows you the return loss. This helps you while fine tuning the filters.

You need to connect the filter to the analyzer and set the start and stop frequency in a way, so that the actual curve and the expected new curve can be seen.
Setting markers is strongly recommended. Please use the test report of your filter for settings. (supplied with the filter) The marker of the new center frequency is an additional help.
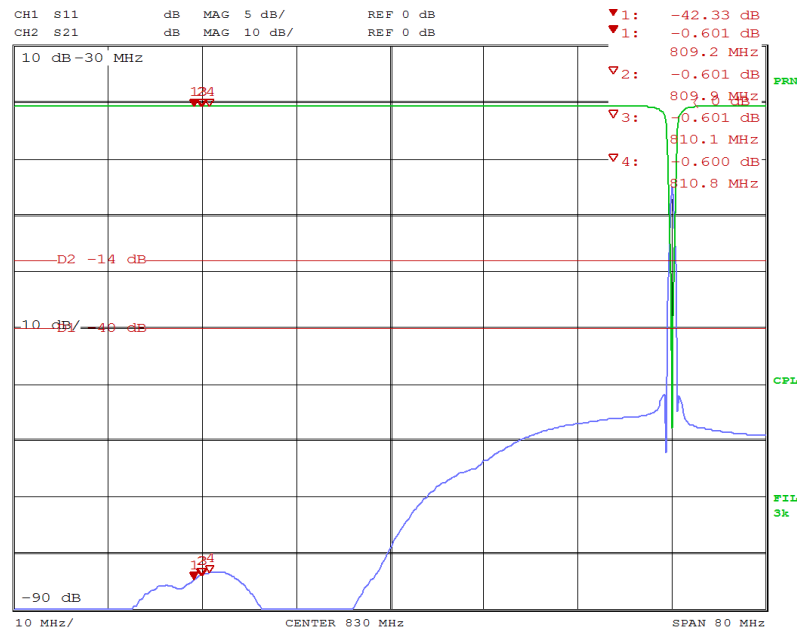
Figure 1: Notch Filter tuned to high end, new markers can be seen

For better understanding we explain the tuning for a filter with 5 resonators. More or less resonators are also available – depending on bandwidth, frequency, attenuation and steepness of slopes.

It would be best if you start by tuning resonator 3 (tuning a notch- or band reject filter should always start with the resonators in the middle and go (alternating the sides) to the outer ends, even if it is not that critical with notch filters)

Tune the resonator by turning the tuning screw or knob in a way that a little notch in the transmission curve will wander from the old notch to the new frequency.
Tune the resonator, until the little notch will be at your new center frequency. (turning clockwise will shift it to a lower frequency, turning anti-clockwise will shift it to a higher frequency)
If you hear screeching noises - this should be avoided by turning the resonator slower oder faster.
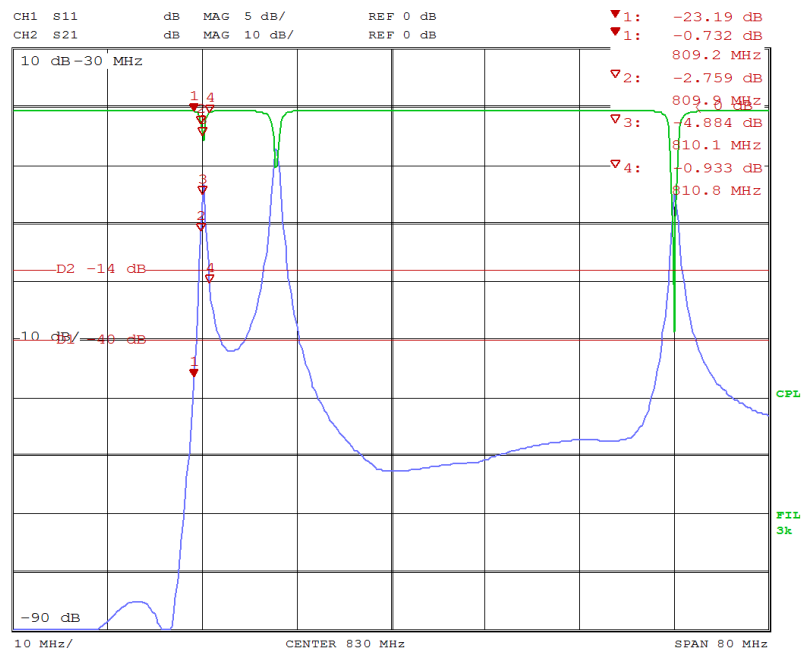
Figure 2: Resonator 3 tuned to new frequency,
resonator 4 is on its way

Then do the same with resonator 4. The result should be a curve with a notch which is a bit bigger than before.

Continue with all of the other resonators – put them all to your new center frequency.
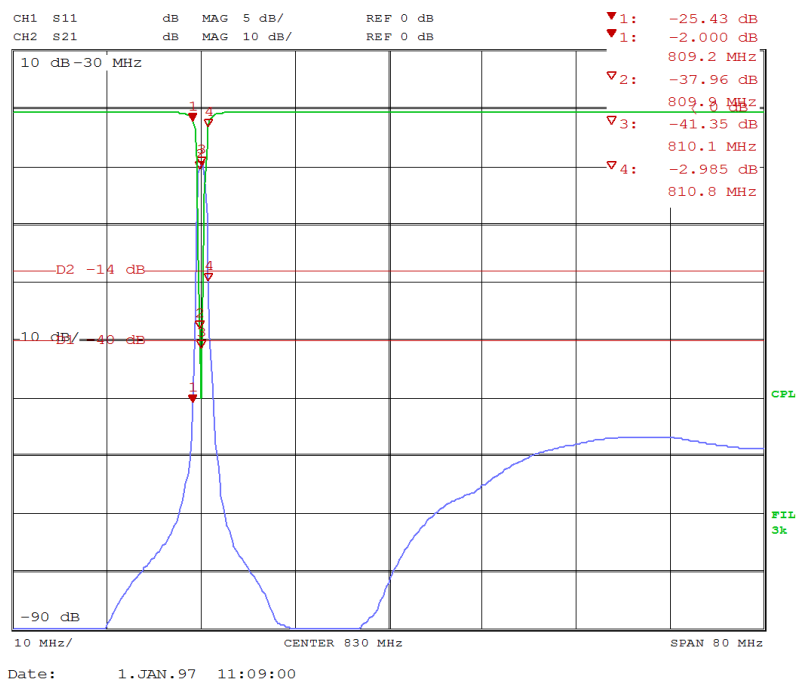
CH1 S11   dB   MAG 5 dB/   REF 0 dB   ▼1:   -25.43 dB
CH2 S21   dB   MAG 10 dB/   REF 0 dB   ▼1:   -2.000 dB
                                                     809.2 MHz
10 dB -30 MHz   ▽2:   -37.96 dB
                                                     809.9 MHz
                                               ▽3:   -41.35 dB
                                                     810.1 MHz
                                               ▽4:   -2.985 dB
                                                     810.8 MHz
D2 -14 dB
10 dB/ -40 dB   CPL

                                                          FIL
                                                          3k
-90 dB
10 MHz/   CENTER 830 MHz   SPAN 80 MHz
Date: 1.JAN.97 11:09:00

Figure 3: All Resonators tuned to new frequency

Now we would recommend changing the settings of your network analyzer.
Set the center frequency to the center frequency of your new notch and choose an appropriate span – depending on filter and notchwidth it can vary. 10 or 20 MHz could be a good value.
It's time to do ome fine adjustment on the resonators you have already tuned to your new frequency. Try placing them exactly on the center frequency.
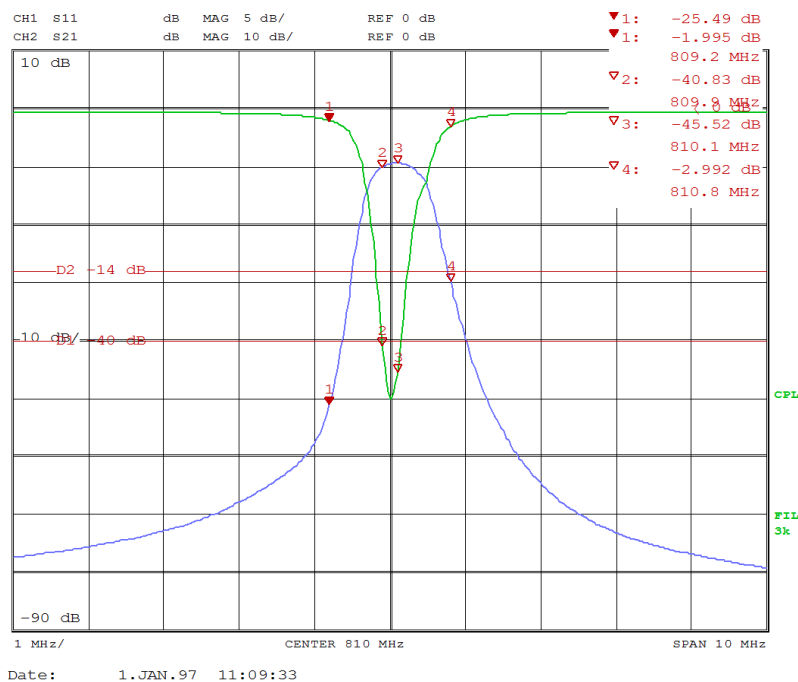Now your new curve should look good, but it might not have enough return loss.

CH1 S11   dB   MAG 5 dB/   REF 0 dB   ▼1:   -25.49 dB
CH2 S21   dB   MAG 10 dB/   REF 0 dB   ▼1:   -1.995 dB
                                                     809.2 MHz
10 dB   ▽2:   -40.83 dB
                                                     809.9 MHz
                                               ▽3:   -45.52 dB
                                                     810.1 MHz
                                               ▽4:   -2.992 dB
                                                     810.8 MHz
D2 -14 dB
10 dB/ -40 dB   CPL

                                                          FIL
                                                          3k
-90 dB
1 MHz/   CENTER 810 MHz   SPAN 10 MHz
Date: 1.JAN.97 11:09:33

Figure 4: All inner resonators tuned to new frequency,
*Reject Attenuation and Returnloss are not perfect*

For final adjustments you would need to display the reflection channel also. If you cannot display it, you will probably also be fine, you might have a return loss of just close to 14 dB at the passband corner frequencies instead of 14 dB minimum for example.

On a notch filter all resonators are basically at the center of the notch, forming one big notch. Now if you happen to experience that the return loss is not as good as it should, or if you want the most perfect filter, you might want to consider „playing" a bit with the exact standings of the resonators.
If you watch the retun loss and tune of the resonators just a little bit, you might see its impact on the return loss. If you do you can just scatter the little notches within the big notch so that the return loss looks good. There is no definite way to do this, every filter might be a bit different.

Good luck!

And remember – we are always here to help you.
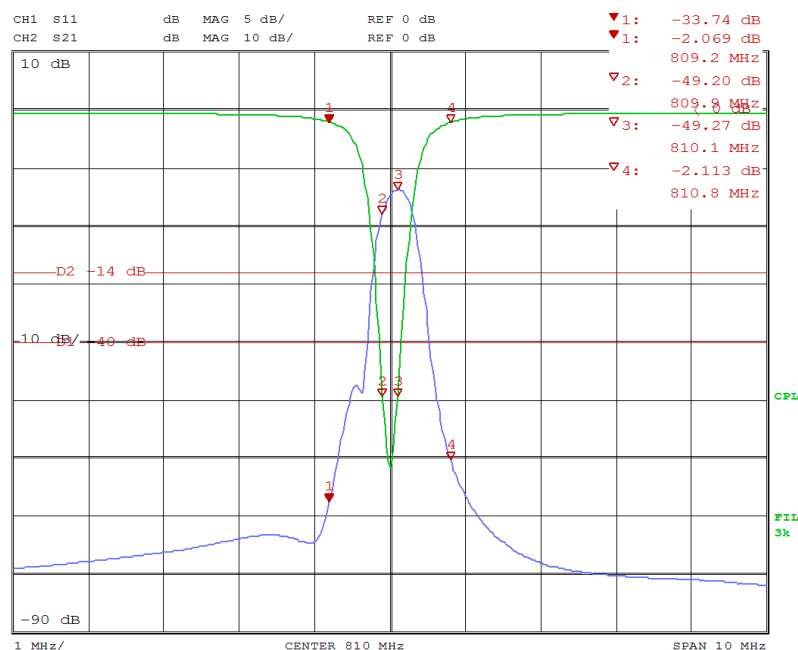
Figure 5: Fine Adjustments have been made, Return Loss is very good.