Keysight DSOX1102G FRA for 8.83MHz SSB Filter

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When DSOX1102G was initially released it had very underwhelming FRA. Later firmware version 01.20 significantly improved the FRA.

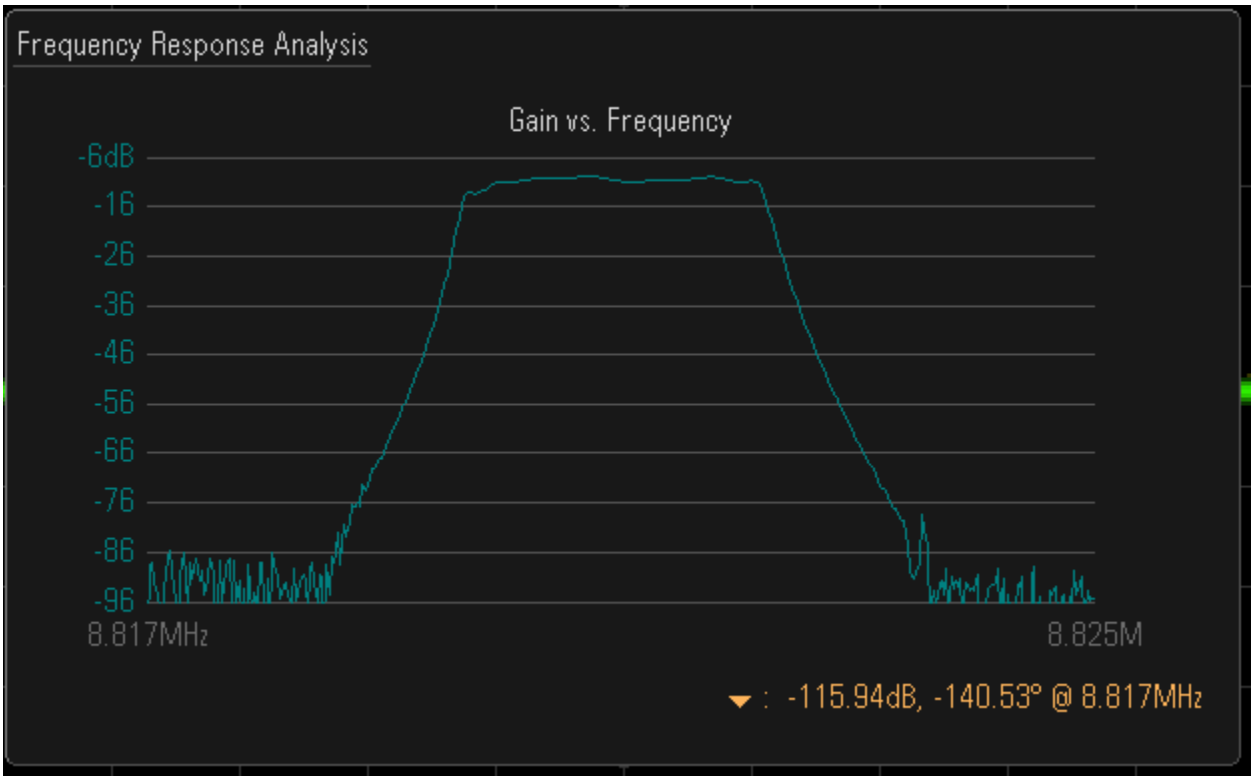
It is interesting to see how good the FRA is using practical example of the SSB filter for the standard IF of 8.83 MHz.

As can be seen from the plots below, actual filter center frequency is closer to 8.821 MHz.

Maximum frequency scan points, allowed by the scope, is 1000. However, the FRA is slow, so it is reasonable to use 400 points. For the start frequency of 8.817 MHz and the end frequency of 8.825 MHz, the frequency resolution is 20 Hz.

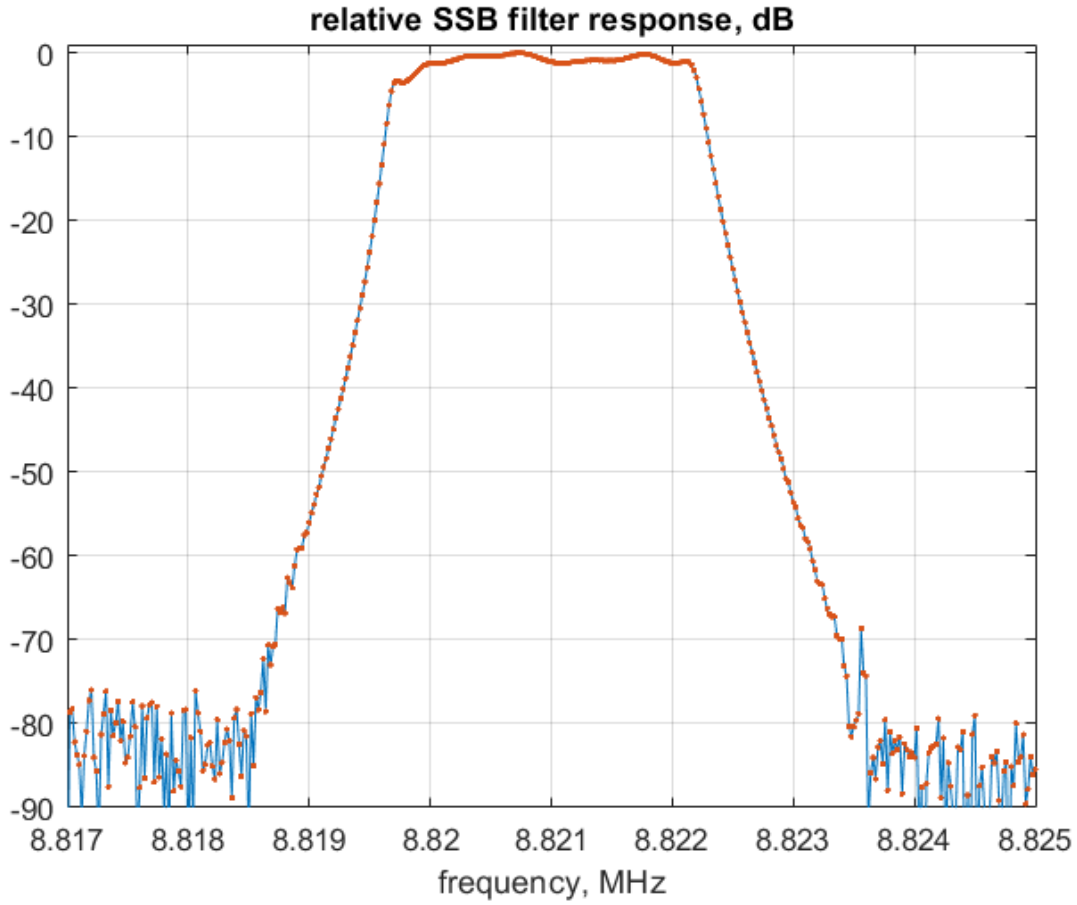
First, I show the FRA result captured from the scope screen.

It looks that Keysight did not expect that such narrowband filters would be tested, so the amplitude response plot on the scope screen is not very pretty:



Neither scan points nor frequency grid are shown on the scope screen.

To get better plot, I downloaded FRA data to PC, and used PC to make better plot:



Here the sample points are shown by red, and the blue line connecting them is just the guide for an eye.

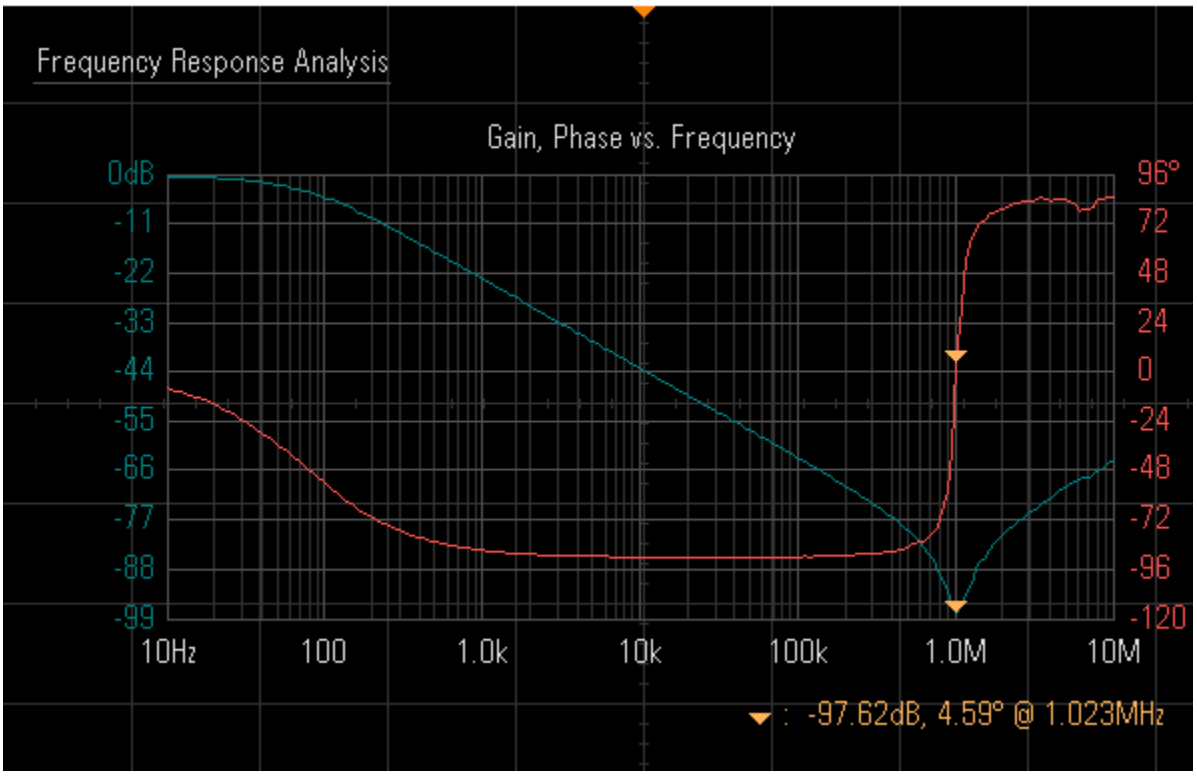
We see that there is nothing but noise below –80 dB.

In theory signal/noise ratio can be improved by increasing FRA WaveGen voltage. For the crystal filter used, maximum input voltage is specified as 1 V rms.

Yet, to get the best possible results, I set the FRA WaveGen voltage to 4 V pk-pk. So, it looks that for this filter the S/N ration cannot be further improved.

Maximum DSOX1102G FRA WaveGen volage is 12 V pk-pk.

It is interesting what can be obtained with such large voltage. To see that, I made trivial RC filter consisting of 1 K resistor and 2.2 film capacitor, and run 200 frequency points scan between 10 Hz and 10MHz:



We see that about 95 dB drop of response at the resonance can be observed.

But, of course, obtaining response of the crystal filter is more interesting.

One may ask question:

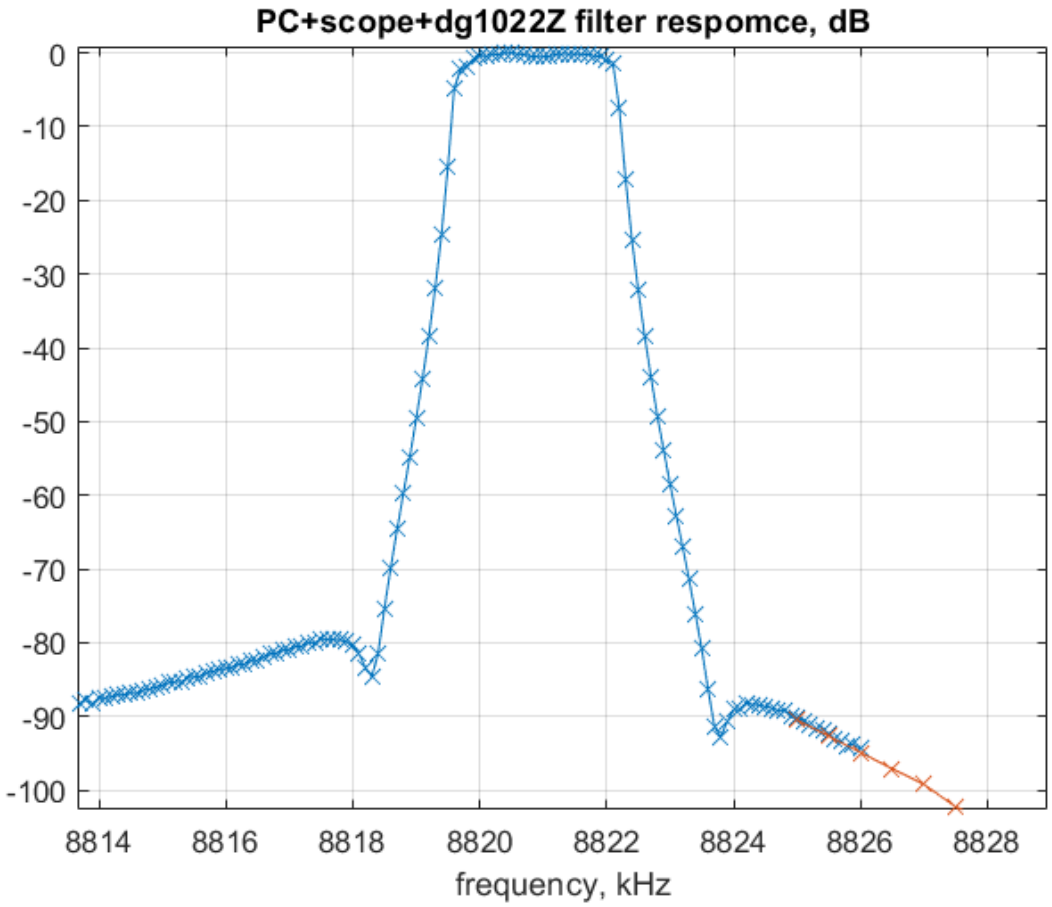
Can DSOX1102G be used to get the filter response with much lower noise?

And the answer certainy is “yes”.

Instead of using DSOX1102G WaveGen, I provided signal from low-noise Rigol DG1022Z waveform generator. To make it safe for the crystal filter, I reduced input amplitude to 2V pk-pk.

I controlled both the scope and DG1022Z by PC. PC also was responsible for averaging of the downloaded scope waveforms and for calculating of the amplitude of the response by FFT.

This way noise level is reduced below 100 dB relative to the maximum of the filter response:



Here blue crosses show data points obtained by averaging 10 scope waveforms, and the red crosses require averaging of 100 scope waveforms by PC