

**Measurement of a 6 cavity duplex filter of brand Procom and type DP2/6S equivalent to DP2/S6H
I suppose the S indicates (Special) because it is manufactured with BNC connectors.**

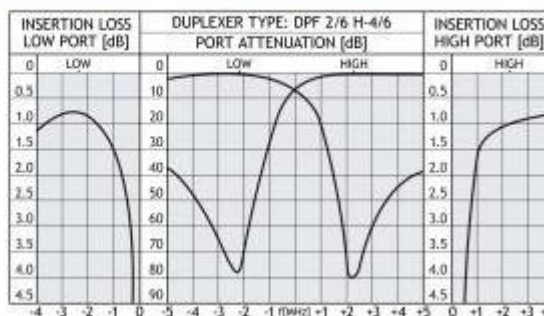
Preface:

The aim of the measurements is to prove the argumentation in the document issued, with the name "Why VNWA2 and VNWA3 does not show correct attenuation of high and lowpass filters", to be found via the link http://www.hamcom.dk/VNWA/Why_VNWA2_and_VNWA3_does_not_show_correct_attenuation_of_high_and_lowpass_filters.pdf

The filter used for the test is seen below:

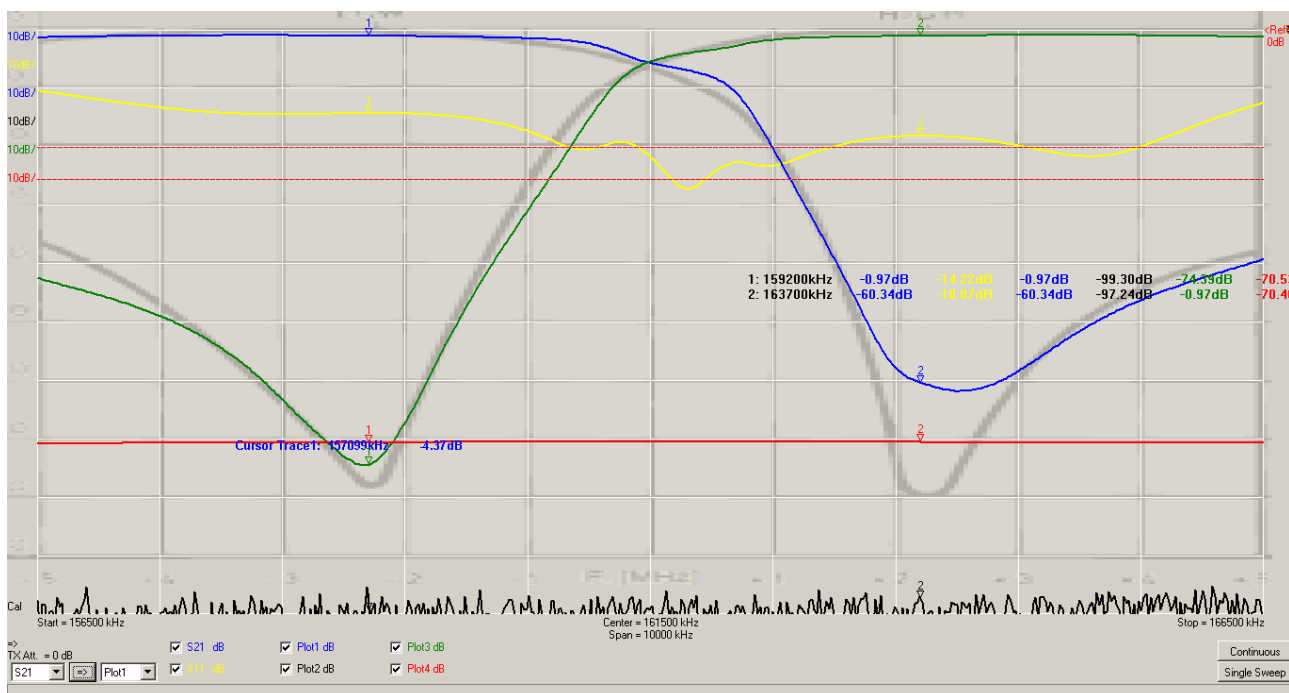
<http://www.procom.dk/products/filters-50-mm-cavities-resonators/112-175-mhz/duplex-filters/dpf-2-6>

TYPICAL RESPONSE CURVES @ 4.5 MHz DUPLEX SPACING



Test condition:

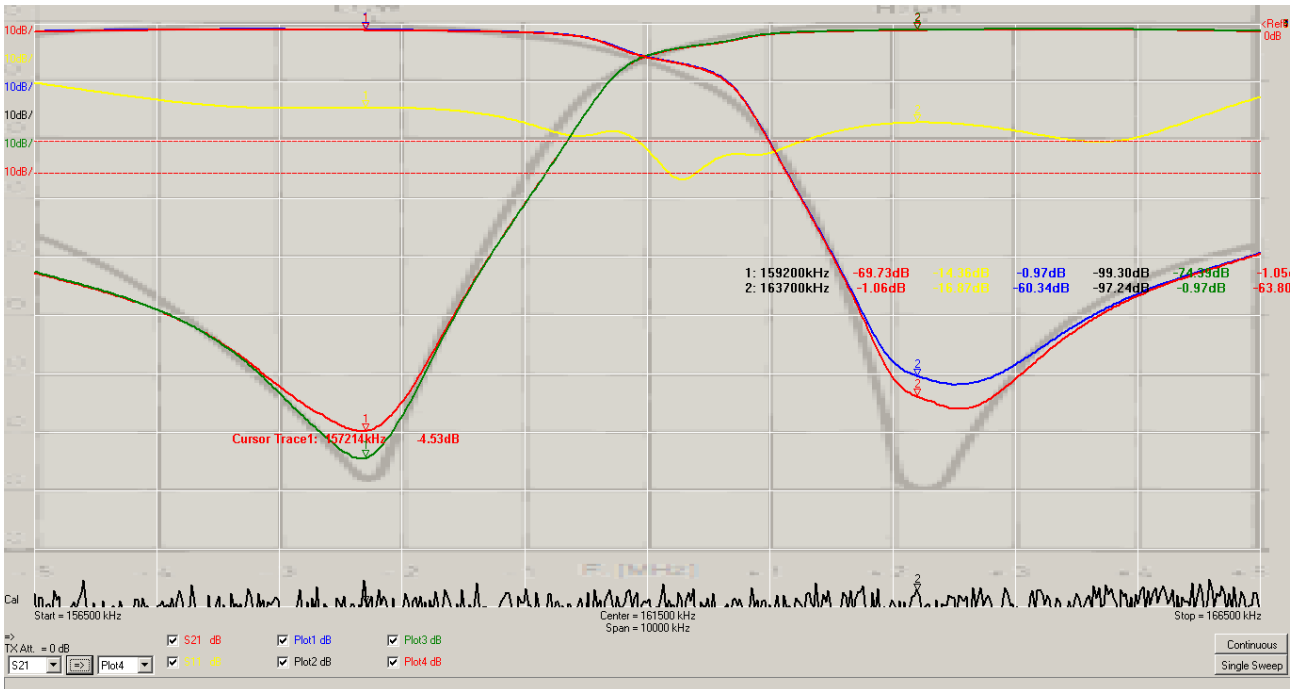
The actual measurements is performed for both of the two paths through the duplexer, the RX and TX path, with the Center Connector (antenna) connected to the VNWA TX port, and the VNWA RX port connected to either the TX or RX connector, with the unused connector terminated with 50 ohm.



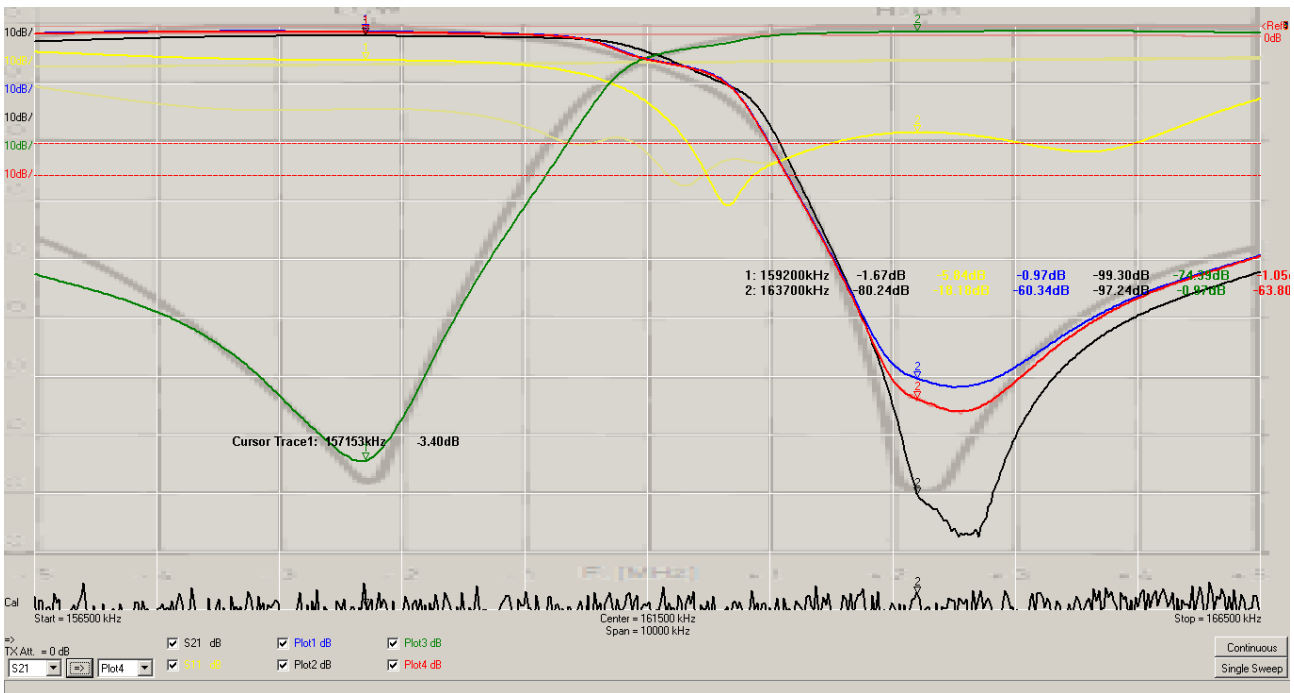
Above picture is when VNWA3 is in Auto x3 mode, which correspond to the default mode for VNWA2.

Manufacturers spec used as background picture as a light gray plot.

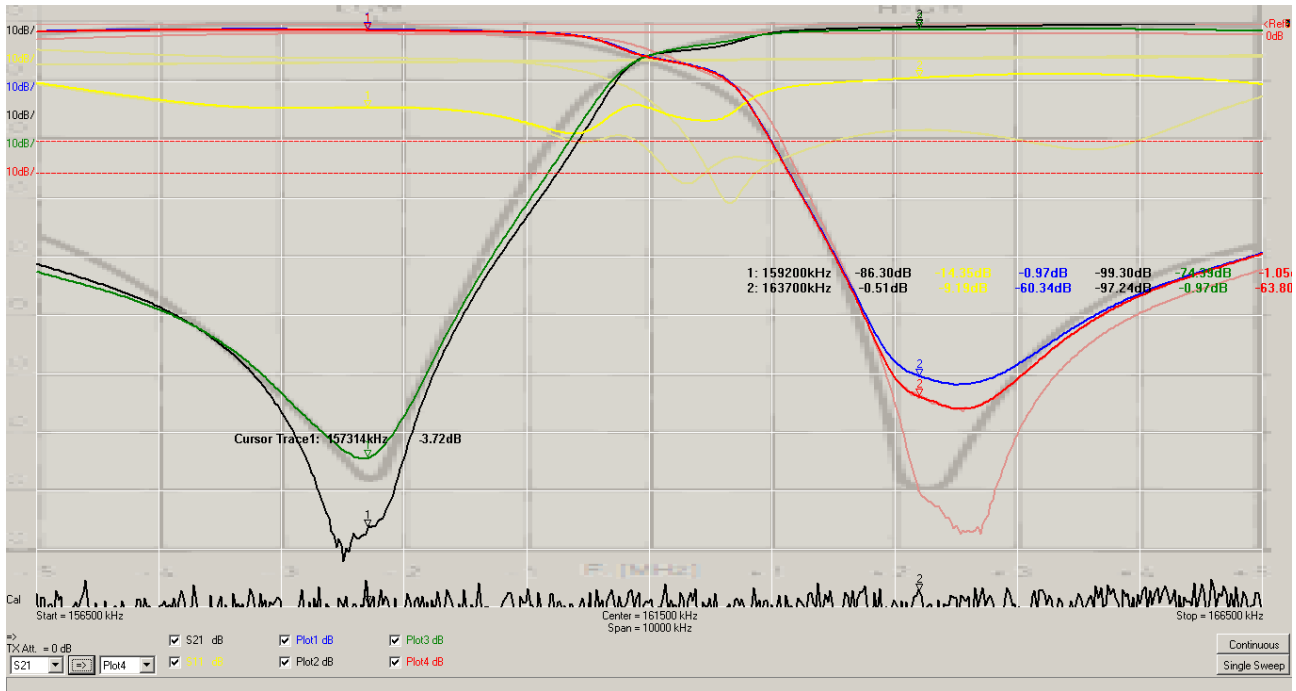
The Black Trace is the S21 Noise Floor with nothing conned to TX and RX test cables. Specs not fulfilled apparently, but below shall be demonstrated there are reasons.



Above picture is with the VNWA3 switched to Auto Auto mode, and both directions measured plotted as red traces. It is seen the result is poorer for the RX path and better for the TX path compared to the Auto X3 mode, shown as the green and blue trace.



Above picture is with a 2meter Lowpass filter placed in between the RX port and the duplex filter. The lowpass filter also fitted during S21 through and through match calibration. The only trace renewed/updated, ref. previous picture, is the S21 trace in black for the RX path and an improvement of 20dB seen.



Above picture is with a 2meter Lowpass filter placed in between the RX port and the duplex filter. The lowpass filter fitted also during S21 through and through match calibration. The only trace renewed/updated is the S21 trace in black for the TX path and an improvement of close to 20dB seen, when compared to the Auto Auto mode, and about 15dB when compared to the Auto x3 mode.

It is interesting to see that even in the area of low attenuations (the crossover range) the plots are slightly different by some small fractions of a dB.

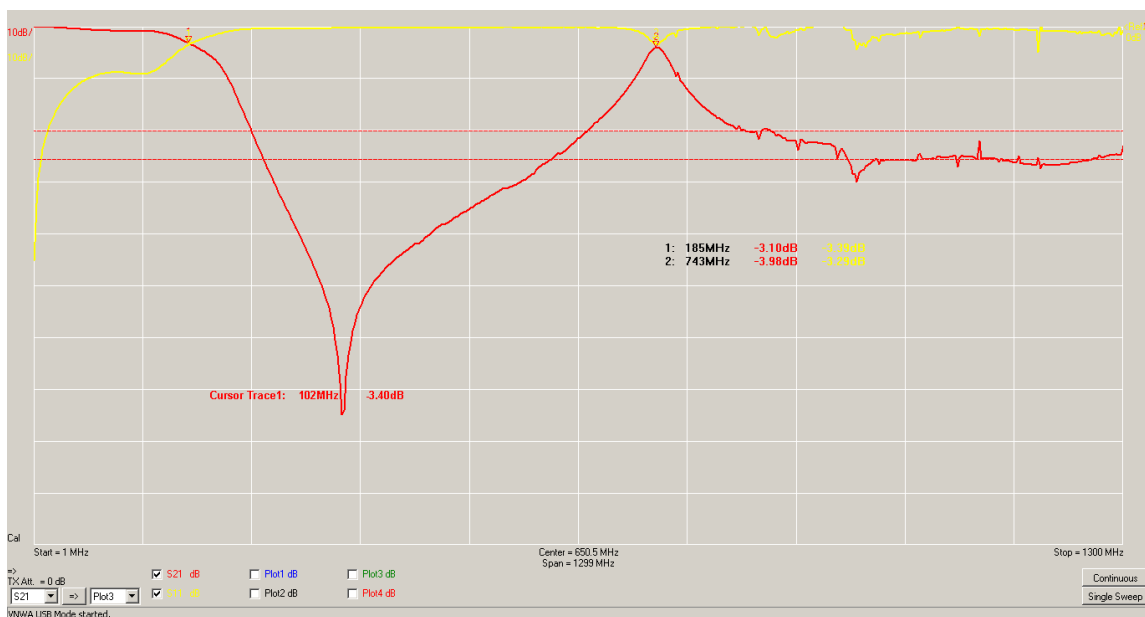
Please note the storage screen is enabled for above picture so the RX path visible also

The 2 meter lowpass filter:

Frequency response seen below, and made many years ago before I got myself a VNWA2.

The peak at 743 MHz I did not know the existence off, and I also wondered, at the time I made the filter, why it did not removed the TVI from my 2 meter station in the UHF TV band. The disturbed TV channel had a frequency close to the peak 😊.

In this context it is at 5. Harmonics of the center frequency between RX and TX path for the duplexer (crossover range) and may explain, why the measurements are deviating slightly in this crossover range when the 2 meter lowpass filter was included, and as mentioned above.





A wide sweep from 1 to 1300MHz of the duplex for both the TX (red) and RX (blue) path shows how the Harmonics/Aliases from the RF DDS of the VNWA will pass through the Duplexer, outside the Frequency range of interest for the duplexer's function, between marker 1 and 2.

Conclusion and final comments:

The argumentation made in the previous issued document (referenced in the beginning of this report) is thus proved.

To measure accurate attenuations for selective devices, like this Duplex filter, (which has little or no attenuation outside range of intended operation) it is important to include, at the least, an lowpass filter and at best a bandpass filter, with center and bandwidth suitable for the frequency range of interest, when measuring attenuation beyond some 40 to 50dB. (just a sensible rule of thumb, not proven other than being my best estimate).

I had not the option to see how the use of a bandpass filter would work out.

Note: Making measurement in the upper end of the frequency range might benefit from the use of highpass filters

The "grand message" is that as long we measure in a frequency range using a fundamental frequency from a signal generated by the RF DDS, well below the Nyquist limit, and that means in the Auto x3 mode up to 108MHz, where LO/RF multipliers are 10/9, then a 100 MHz low pass filter will probably do. From 108MHz to 576MHz where LO/RF multipliers are 20/19 then, when sweeping only this frequency range, a low pass filter of e.g. 500MHz will probably also do the job, but if extending to full frequency from 1 to 500MHz then 3. Harmonics (and aliases) of RF out, in the range 1 to 108 Mhz, will interfere, if these frequencies can pass the device under test (the DUT), while sweeping the 108 to 576MHz range.

It is therefore a challenge to carefully think through what might disturb measurements. One method, worth testing, is to run the VNWA with different fixed multiplication and compare the obtained result. That is why Tom Baier designed his VNWA software such, that the user has this option. USE IT and make you own "auto clock multiplier settings" saved to a file, and remember to use the Instrument State facility as well. Everything you finally find adequate for your test object incl. use of low/high and bandpass filters, calibrations, screen setting mode of operation, and so on, is stored when saving Instrument state, provided you use a descriptive name for the instrument state file, or you use the calibration and calibration kit manager to include comments, about all exterior parts used, such as VNWA RX / TX port male/female adaptor, test cables, calibration kit, filters and the like.

Happy testing.

Kind regards

Kurt de OZ7OU

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