Are tolerances in manufacturing BT filters going to affect our measurements?

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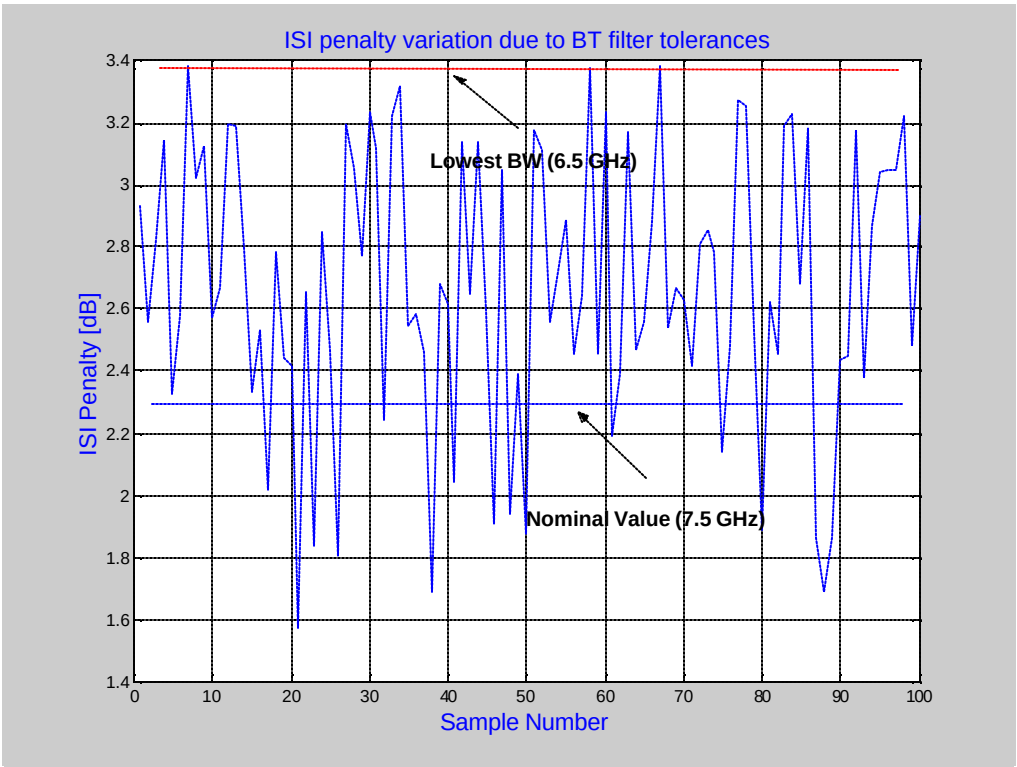
Instrument manufacturers follow the ITU specs for the BT filter transfer function tolerances. These tolerances allow up to 0.8 dB of variation in the transfer function from the nominal –3 dB value at the rated bandwidth. The table below summarizes the allowed tolerances, which follow the Industry Standard Bessel-Thompson reference receiver boundary limits (as provided by my scope manufacturer):

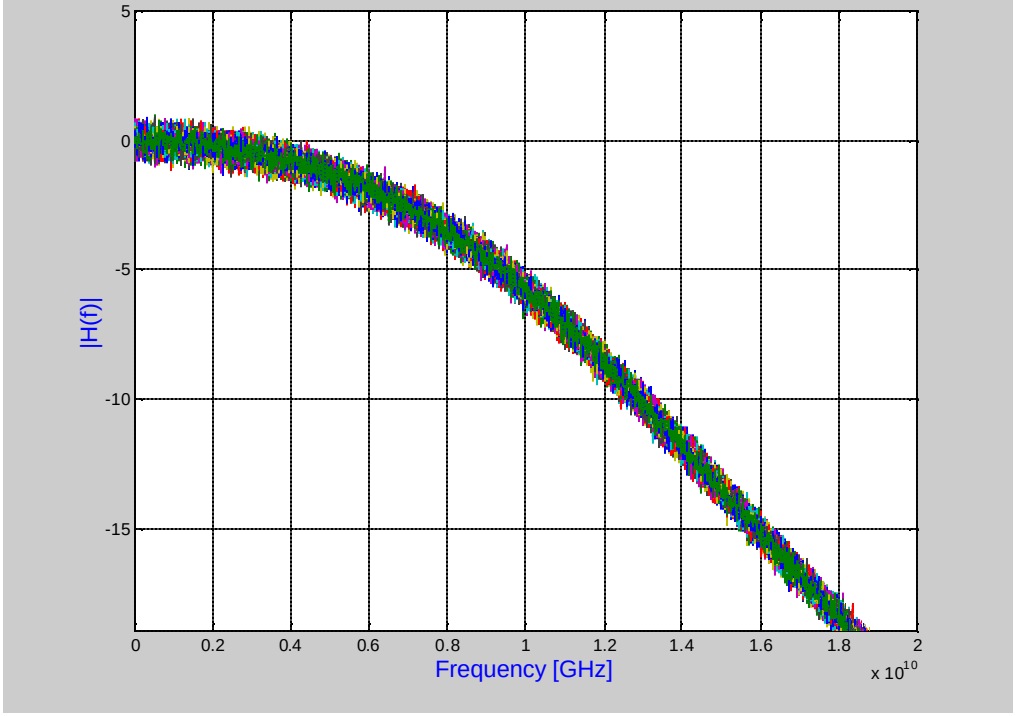
Frequency [MHz]	Tolerance [dB]
<7465	+/- 0.85
8958	+/- 1.7
9953	+/- 2.1
10451	+/- 2.4
11944	+/- 3
13437	+/- 3.5
14930	+/- 4

I performed a simulation of these variations by first generating the stressed receiver test signal and propagating it through a BT filter whose bandwidth varies. I used a 400 bit long pattern. I first simulated the nominal case, followed by the limiting cases for the upper and lower bandwidth. Then the ISI penalty calculated was calculated from the simulated signal.

After this, I generated random variation to the BT filter transfer function of up to +/- 0.8 dB and was added at each frequency. The random variation was Gaussian in nature, with 0 mean and standard deviation such that 3 sigma=0.8 dB. Initial simulations assumed that the TF values at each frequency were not correlated, although later correlation was used, but without affecting the results (Thanks to John Ewen for suggesting this). The sample size (total number of BT filter transfer functions) was 100.

The figure below summarizes the simulation results. It plots the ISI penalty from a sample of 100 filters with varying bandwidth. On the figure, the nominal case and the low bandwidth limit (high ISI) are also shown. The variation of the bandwidth of the BT filter on the low side generates significant increase (>1.1 dB) in the ISI penalty that the user would measure. On the other side of the variation, the effect is not as pronounced, although it is significant (0.6 dB). For your reference, all 100 BT filter TF are shown on the lower part of the figure.


ISI penalty variation due to BT filter tolerances
ISI Penalty [dB]
Sample Number
Lowest BW (6.5 GHz)
Nominal Value (7.5 GHz)
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
0
10
20
30
40
50
60
70
80
90
100


|H(f)|
Frequency [GHz]
x 10^10
5
0
-5
-10
-15
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2