MWA Memo
MWA LNA and Beamformer Temperature Variation

Eric Kratzenberg
Haystack Observatory
9/30/2009

Introduction

The variation in gain and delay over temperature is measured over the range 20-80degC for a low gain delayline board, 7 meter cable, and LNA. Plots are also shown for just the delayline board alone.

Description

The low gain delayline board, 7m cable, and LNA were place in the oven and the temperature was raised to approximately 80degC. The low gain board uses the SGA-4263 as the first amp rather than the higher gain SGA-4563. Since the oven did not have temperature control it was allowed to cool slowly and measurements were taken approximately every 10 degrees. Both the air temperature and the cpld board temperature were monitored and were within several degrees of each other for each measurement. A balun was used to inject a signal from port 1 of the network analyzer and the amplitude and group delay of S21 was measured. Data was taken at three discrete frequencies, 101MHz, 202MHz, and 302MHz.

Figure 1 shows the gain variation, and Figure 2 shows the total group delay variation, over temperature for the case where no delay sections are inserted. Similarly, Figures 3 and 4 show the gain and group delay variation for the case where all of the delay sections are inserted. The variation in gain over temperature can be approximated by the term -0.05dB/degC.

Figures 5 and 6 are the differential gain and delay respectively. These are found by subtracting the 'all delay' from the 'no delay' datasets. For the gain plot, it shows what effect temperature has on the bypass filters, which are inserted into the signal path when the delaylines are switched out. The two longest lines use bridge-T filters to compensate for the frequency dispersion of the delaylines. The 2^{nd} and 3^{rd} delay lines use pi-attenuators and the shortest line uses a single resistor for compensation. At midband, the filters cause a rise of about 0.6dB in gain as the temperature rises from 20C to 80C. The delay plot shows that the differential delay over temperature varies less than +/-0.5ns.

Figures 7 through 12 are the same as 1 through 7 except that only the delayline board(low gain), without the LNA or the 7m cable, was used. As expected the gain slope was less but the differential gain variation was similar. It should be noted that the group delay measurement on the spectrum analyzer usually exhibits greater measurement noise for longer delays, presumably due to the larger difference between phase for each frequency point. Thus the differential delay shows a wider variation in Fig 6 than in Fig 12. There

was no attempt to use smoothing to average out the noise on any of the group delay measurements in this document.

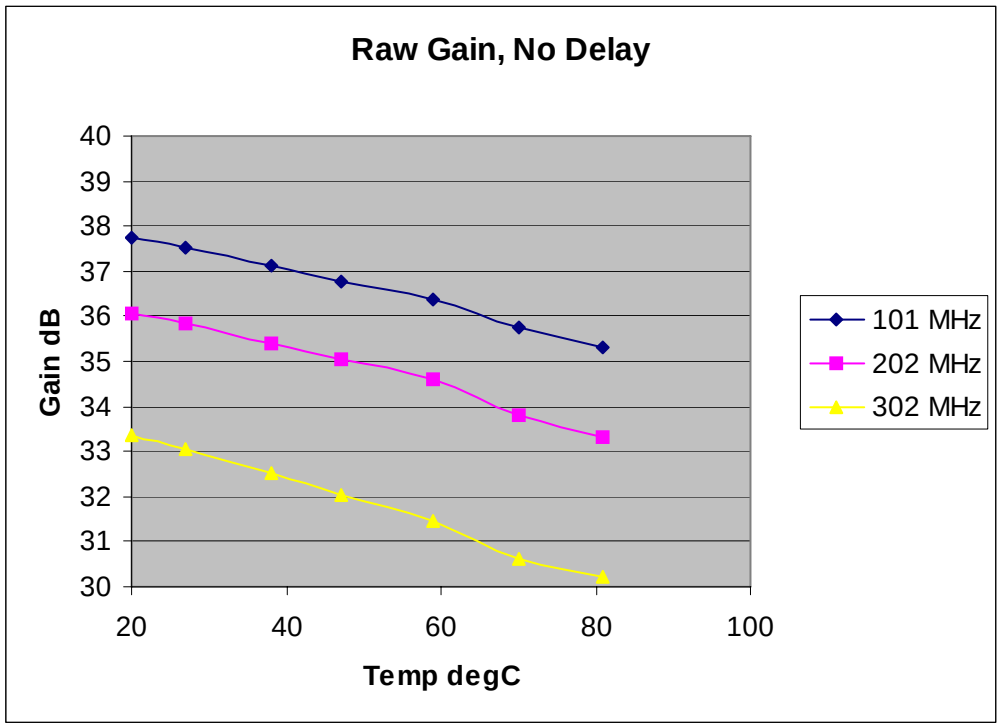

Figure 1. LNA+7mCable+BF.

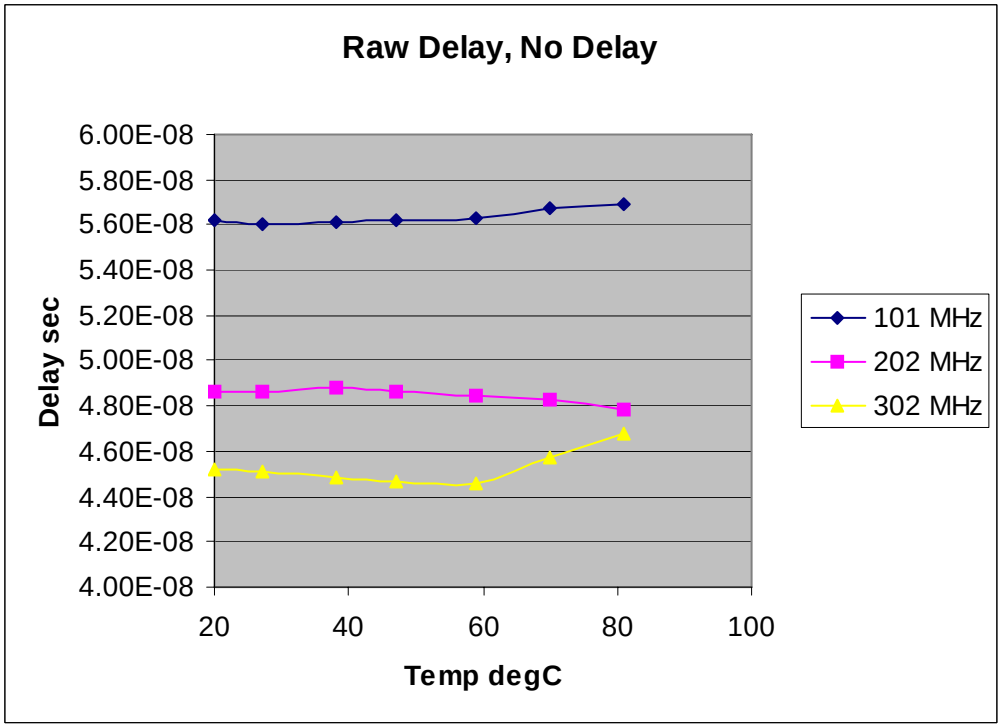

Figure 2. LNA+7mCable+BF.

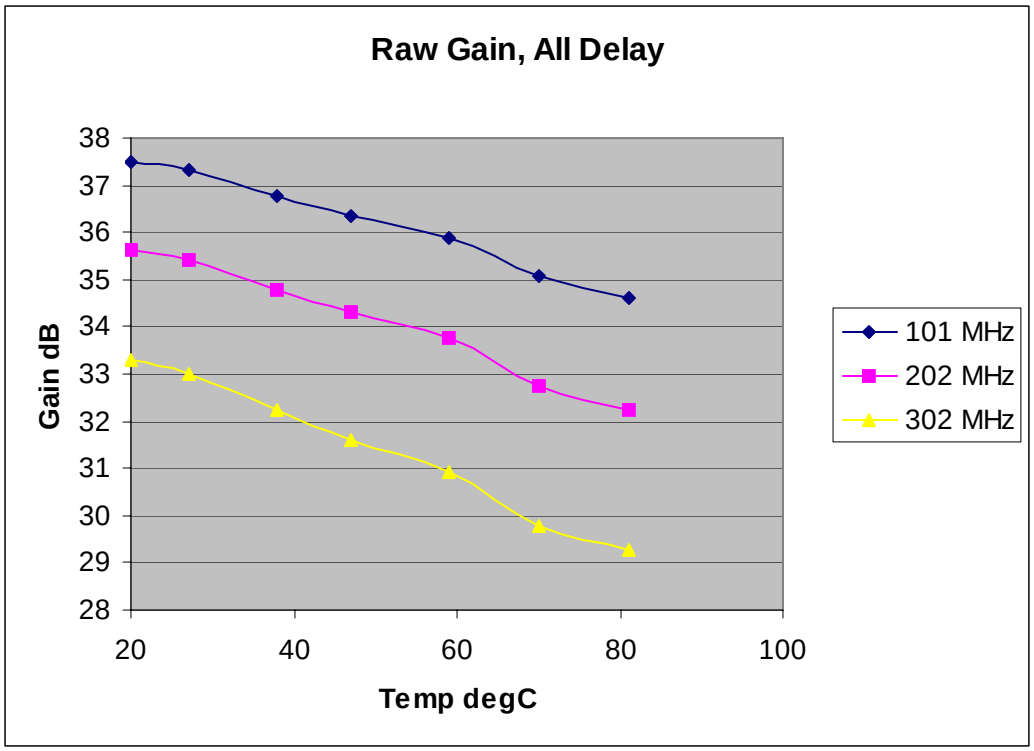

Figure 3. LNA+7mCable+BF.

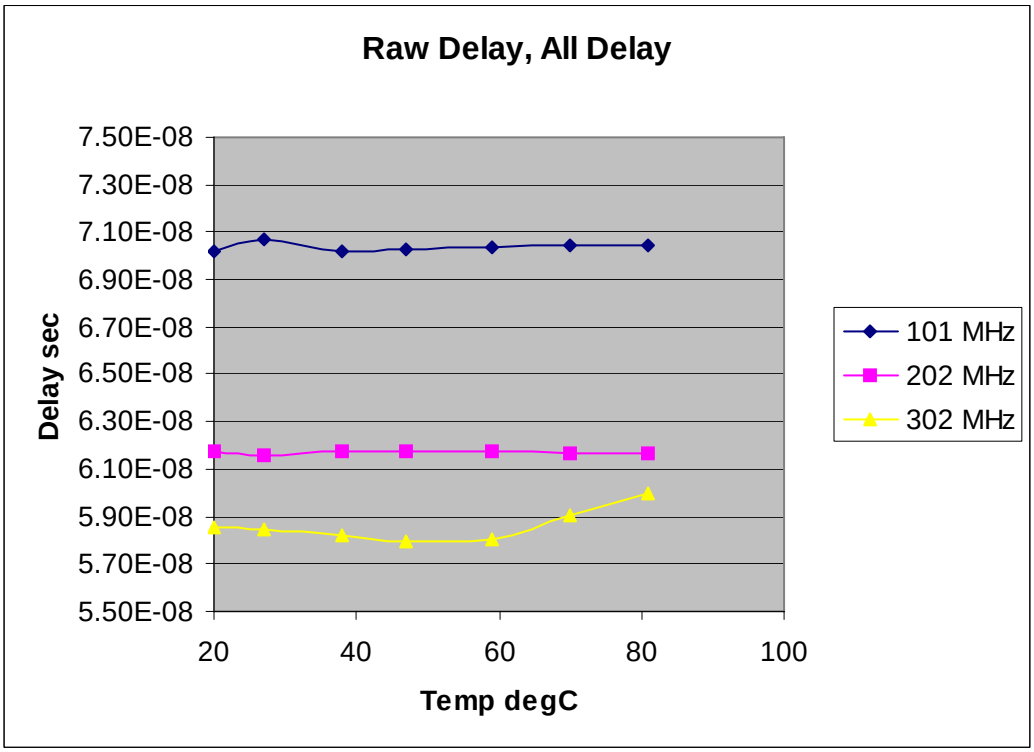

Figure 4. LNA+7mCable+BF.

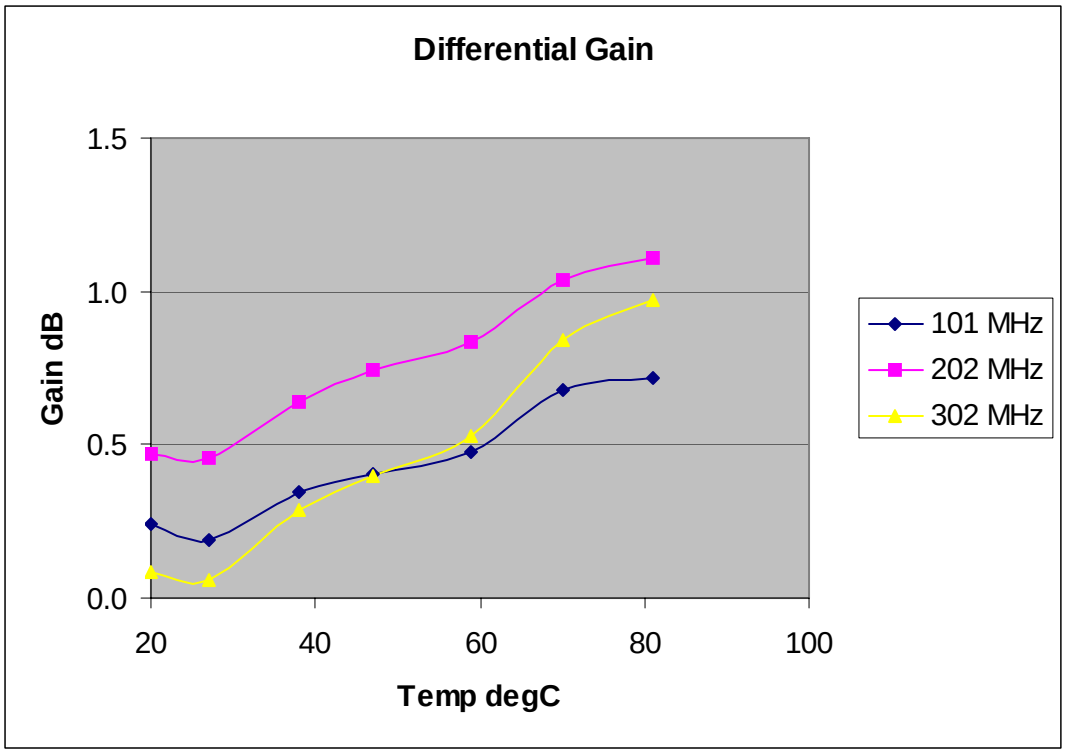

Figure 5. LNA+7mCable+BF.

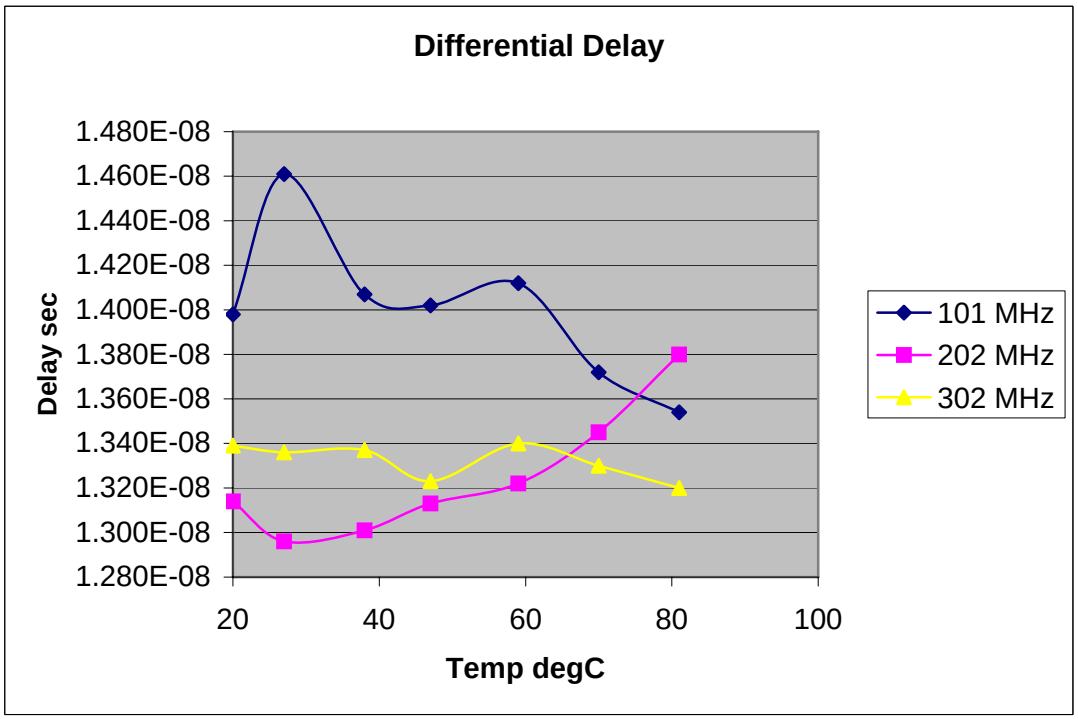

Figure 6. LNA+7mCable+BF.

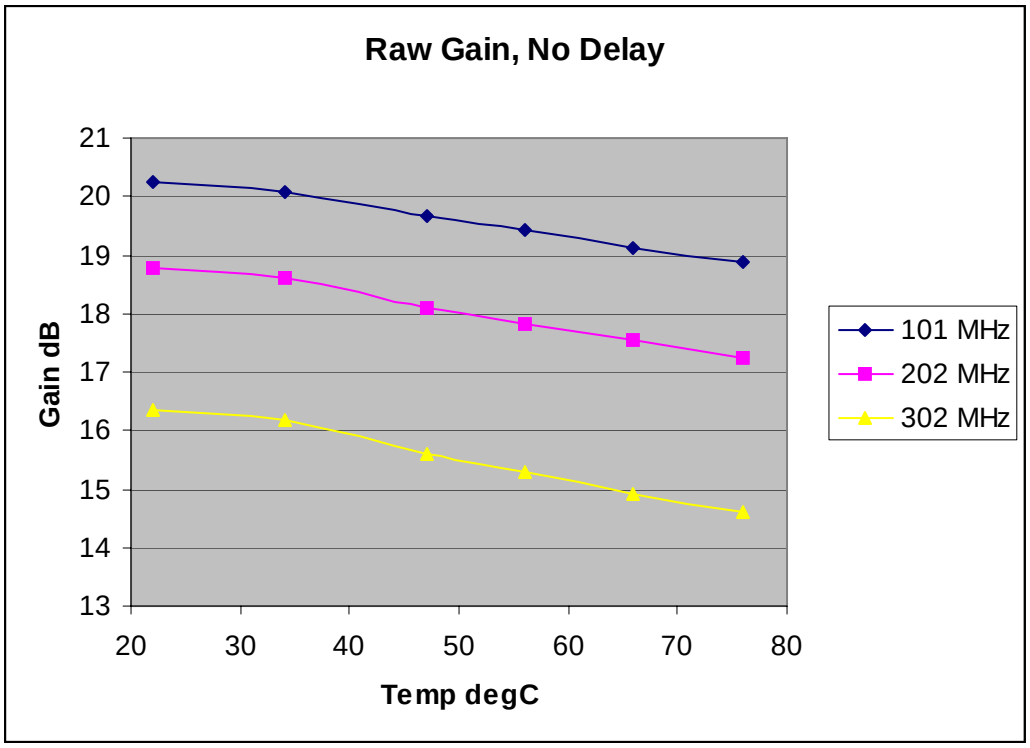

Figure 7. BF only.

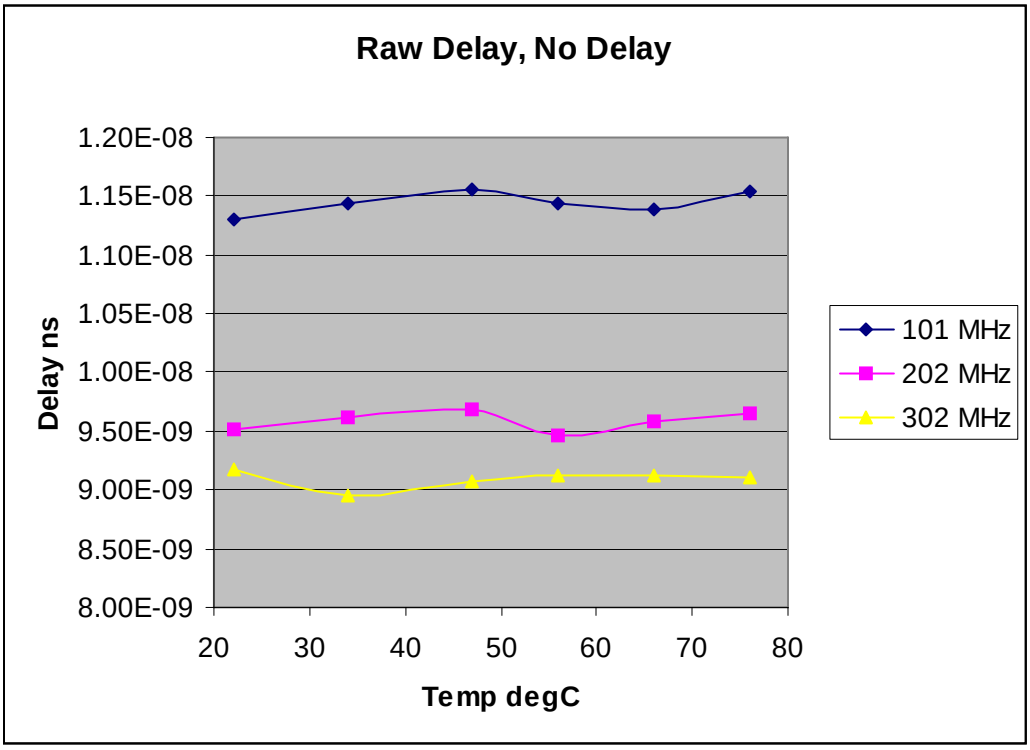

Figure 8. BF only.

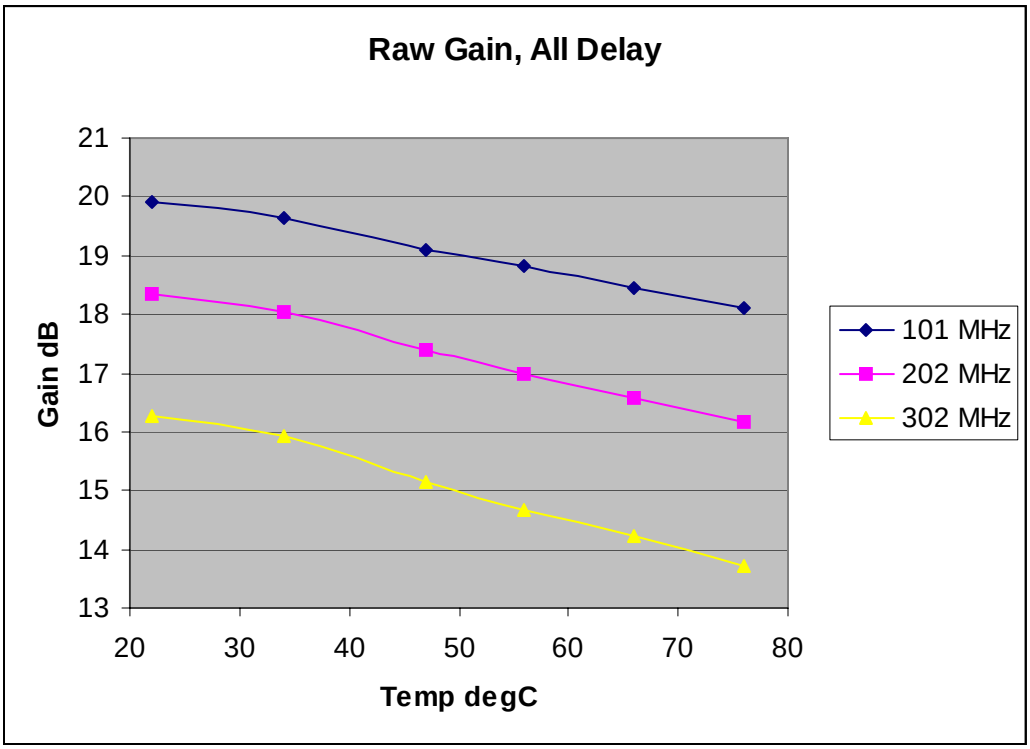

Figure 9. BF only.

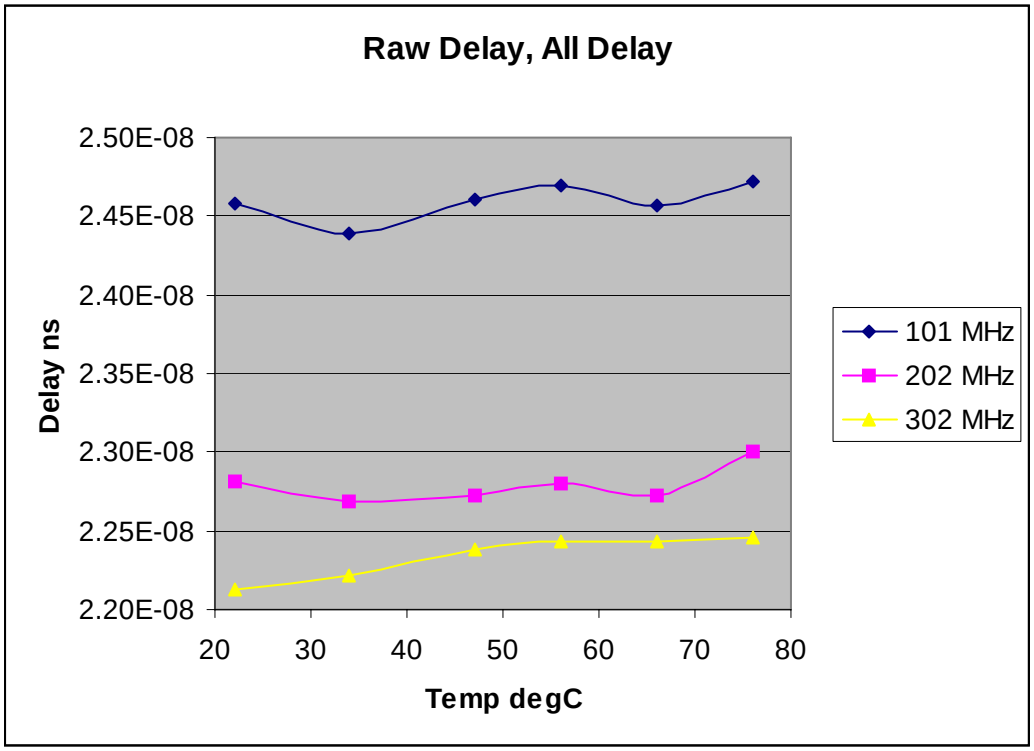

Figure 10. BF only.

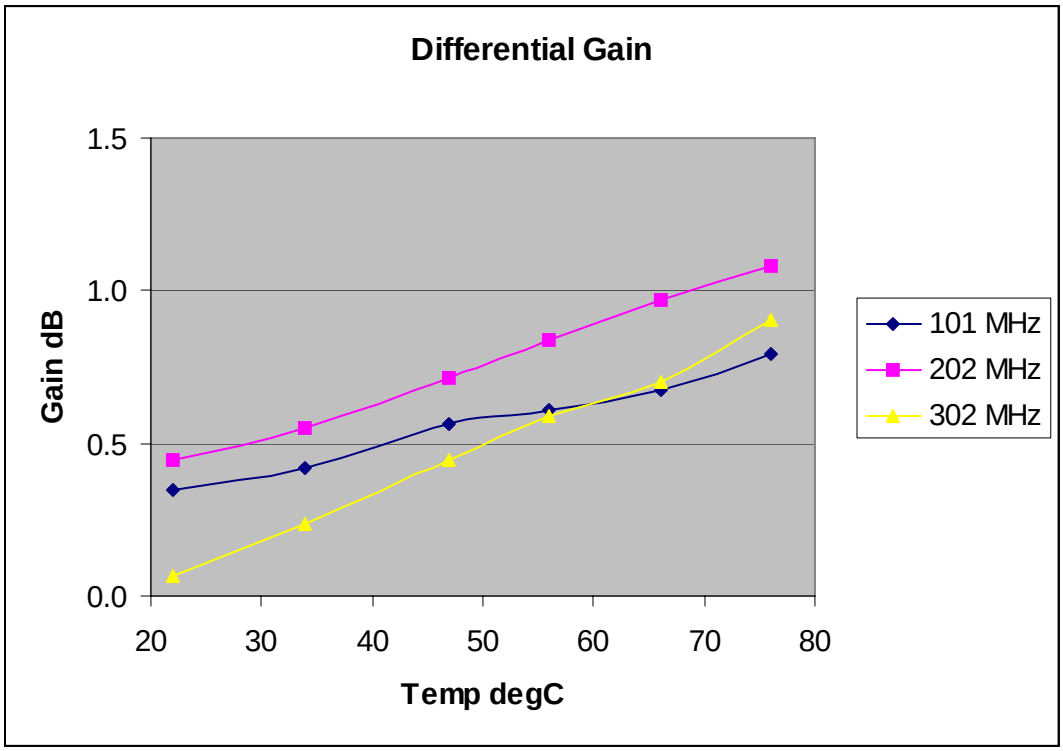

Figure 11. BF only.

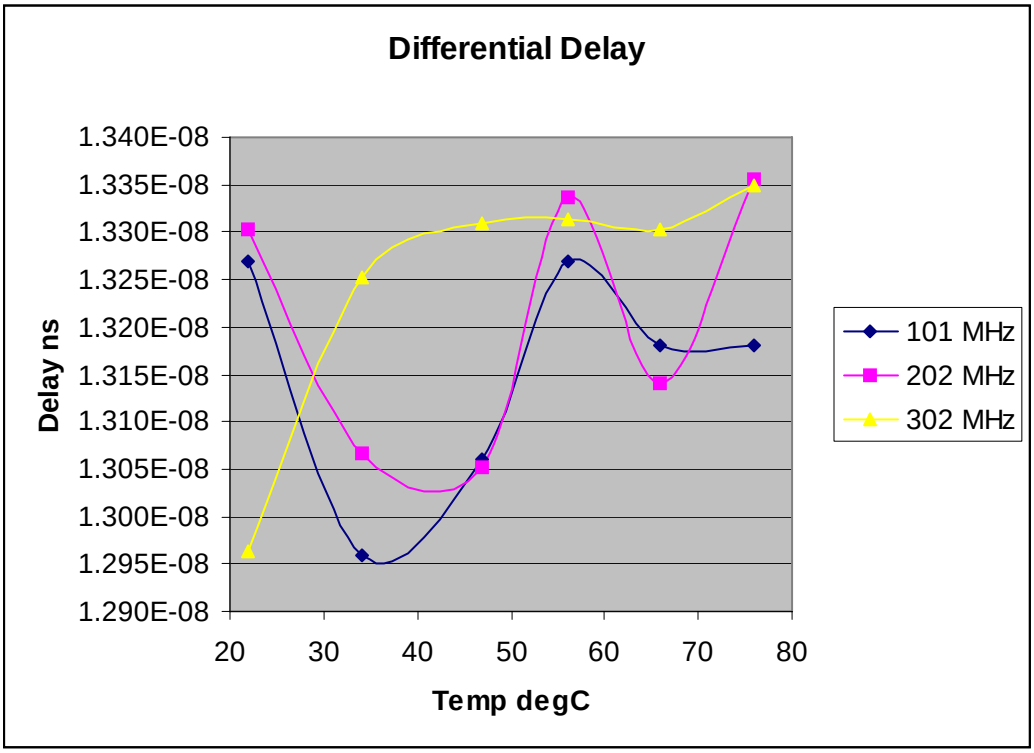

Figure 12. BF only.