MWA memo
MWA Dipole Variation

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Introduction

Variation in the MWA dipole response can cause un-expected differences in the Tile radiation patterns as well a differences in Tsys between elements. Causes of potential differences are investigated.

Input Capacitance

The circuit model can be modified to better approximate the measured data by adding 10pf of additional capacitance at the input of the LNA terminals. The plot below shows the change in amplitude response between 2pf (dotted blue line) and 10pf (solid blue line). The change in Tsys is shown between 2pf (dotted pink line) and 10pf (solid pink line) .

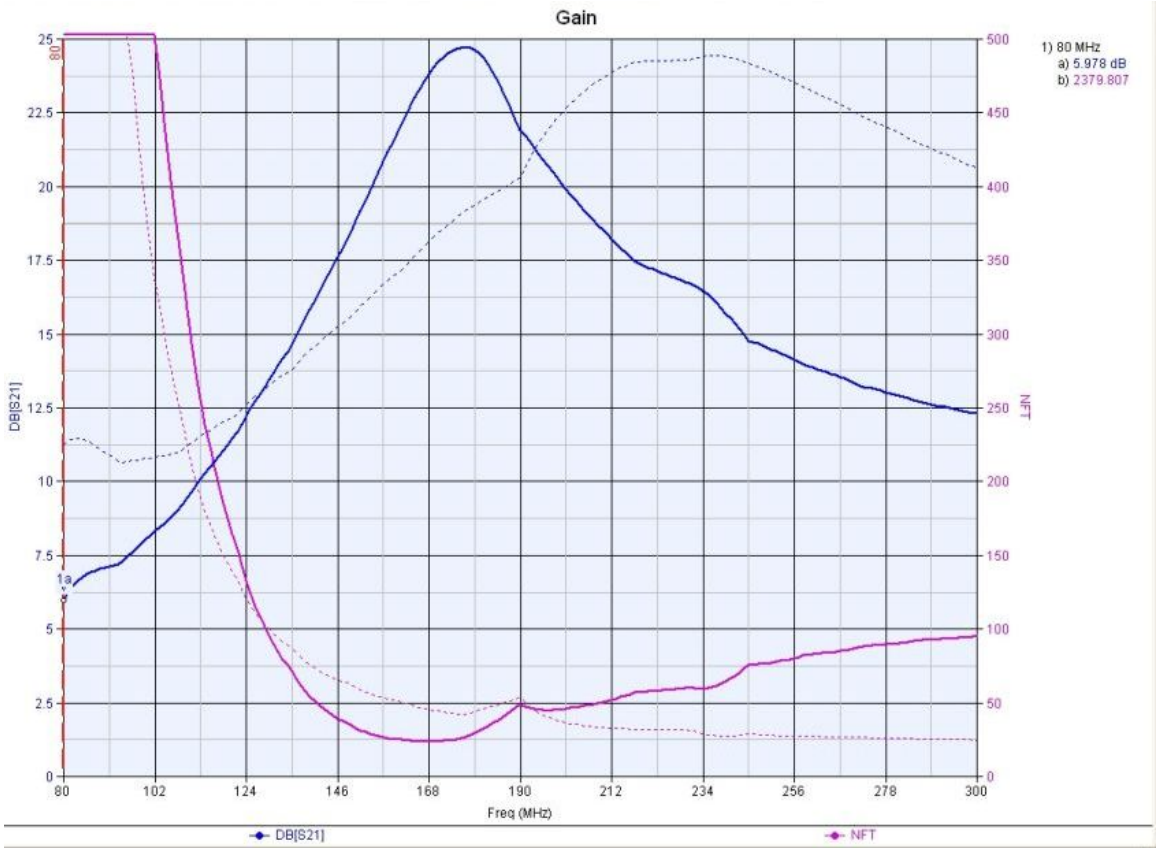

Figure 1.

The gain ‘peaks’ at a lower frequency. This peak with 10pf is much closer to the measure gain peak performed at the Lincoln Labs, see Lincoln Lab Anechoic Chamber Test Report Figure 3, which peaks at roughly 170MHz.

Tsys in the 10pf case rises from 25K at 150MHz to 100K at 300MHz. This also more accurately reflects the measured data in the T+V report.

This additional capacitance is currently not accounted for but some sources might be; protection diodes, element to LNA wiring, vertical orientation of the LNA circuit board. While variation in the response between elements should be accommodated by the RTS it is best to minimize it where possible.

Diode variation

10 of the 1n4148w-tp, which are the type used on the input to the LNA for lightning/static protection where tested by inserting them into a transmission line and observing the change in amplitude on a spectrum analyzer. The measured value was 0.8pf +/- 0.02pf, which is not a significant source of variation.

LNA variation

Phase of the forward gain was measured for four LNA boards, #708, #1, #3, and #5. The phase variation was less than 2 degrees across the 80-300MHz band for all the LNA’s, which is not a significant source of variation.

Wiring changes

The wires connecting the elements to the LNA were moved around to see how it affected the insertion phase on a network analyzer. Three cases were tried on the top (X polarization) circuit board. The effects were less noticeable on the Y polarization.

Reference: All the wires were moved close to the LNA board.
Case 1: All the wires were moved away from the LNA board.
Case 2: The excess length of the wires was pulled up out the top of the hub.

The difference in phase of the forward gain for each case is shown below;

Freq(MHz)	Case1(deg)	Case2(deg)
100	2.6	6.0
150	5.0	11.1
200	8.2	22.3
250	4.7	14.1

It is recommended that wires of the exact length be used to reduce the element to element variation due to the wiring.