VNA COMPARISON
TEKTRONIX TTR506A (TEMPORARILY IN LAB DEMO)
VS
ALIGELENT E5061A

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Description of Measurements:

- ➢ There is a new VNA available in our lab, a Tektronix TTR506A, and it was compared to the AGILENT E5072A, we have been using until now.
- ➢ The comparison consisted of the accuracy of the measurement of four attenuators (3dB-BW-S3W2+, 6dB-BW-S6W2+,10dB-BW-S10W2+, and 15dB-BW-S15W2+), after correction using the expectations for the open, short, and match (Male,85033E). The temperature at all moments was23.5±0.5◦C
- ➢ With measurements specifications as follows:

i. Power: 0dBm
ii. bandwidth: 100 Hz
iii. Max Frequency: 200MHz
iv. Min Frequency: 40MHz
v. AVG: 10 traces
vi. Points: 641
vii. Frequency Step (MHz): 0.250

- ➢ The steps in the testing at each VNA are:

i. Calibrate the VNA at its SMA port (with open, short, & match).
ii. Measure the S11 of the open, short, & match, AGAIN after calibration.
iii. Measure the S11 of the four attenuators.
iv. Repeat steps ii and iii for repeatability.

Images of VNA connections:

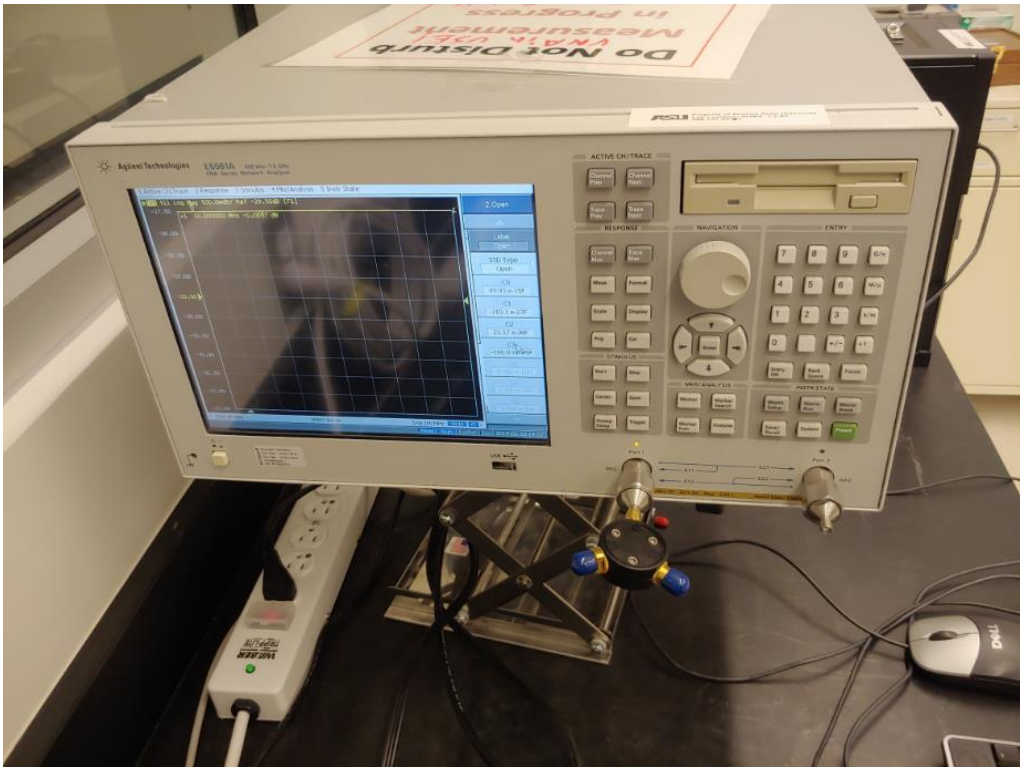

Figure1: Aligelent E5061A Calibration arrangement utilizing the male 85033E Calibration kit

Figure2: Tektronix TTR506A Calibration arrangement utilizing the male 85033E Calibration kit

Results:

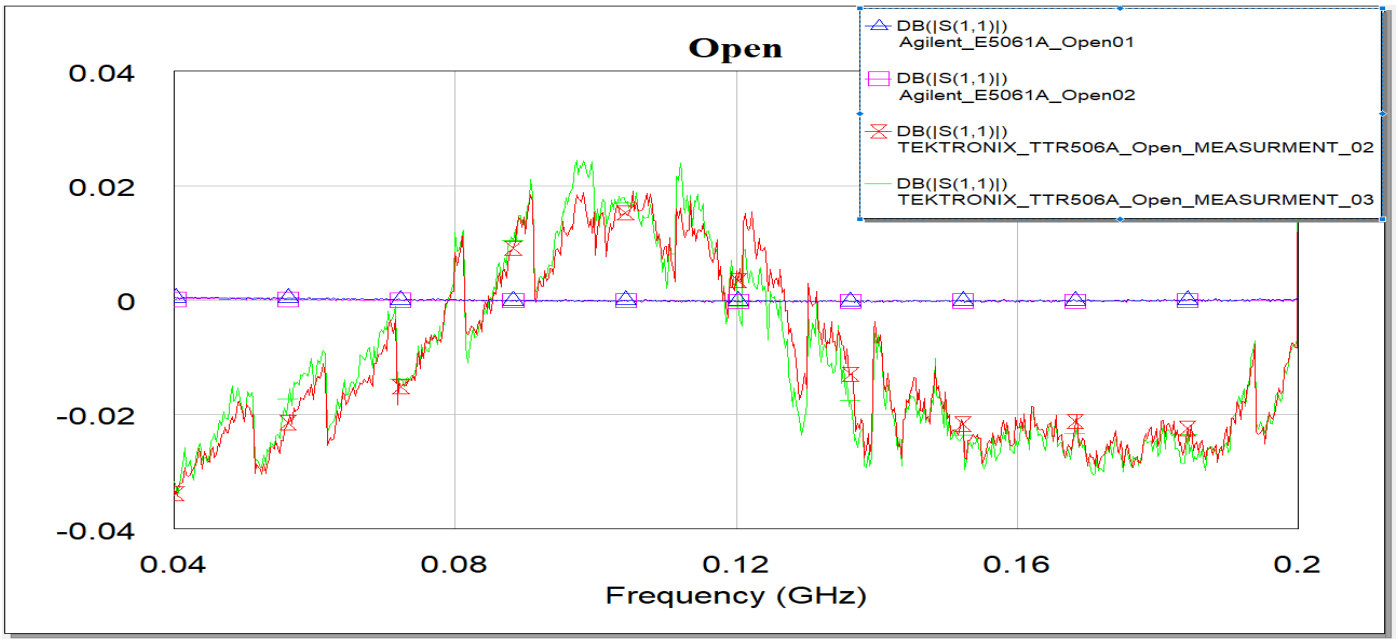

Figure3: Magnitude of the Open after calibration. Tektronix TTR506A measurement one red trace, Tektronix TTR506A measurement two green trace, Agilent measurement one blue trace, and Agilent measurement two pink trace. The difference in repeatability between the two VNAs with the same settings is favoring the Agilent E5061A VNA due to closer tolerances, consistent curvature, and less noise.

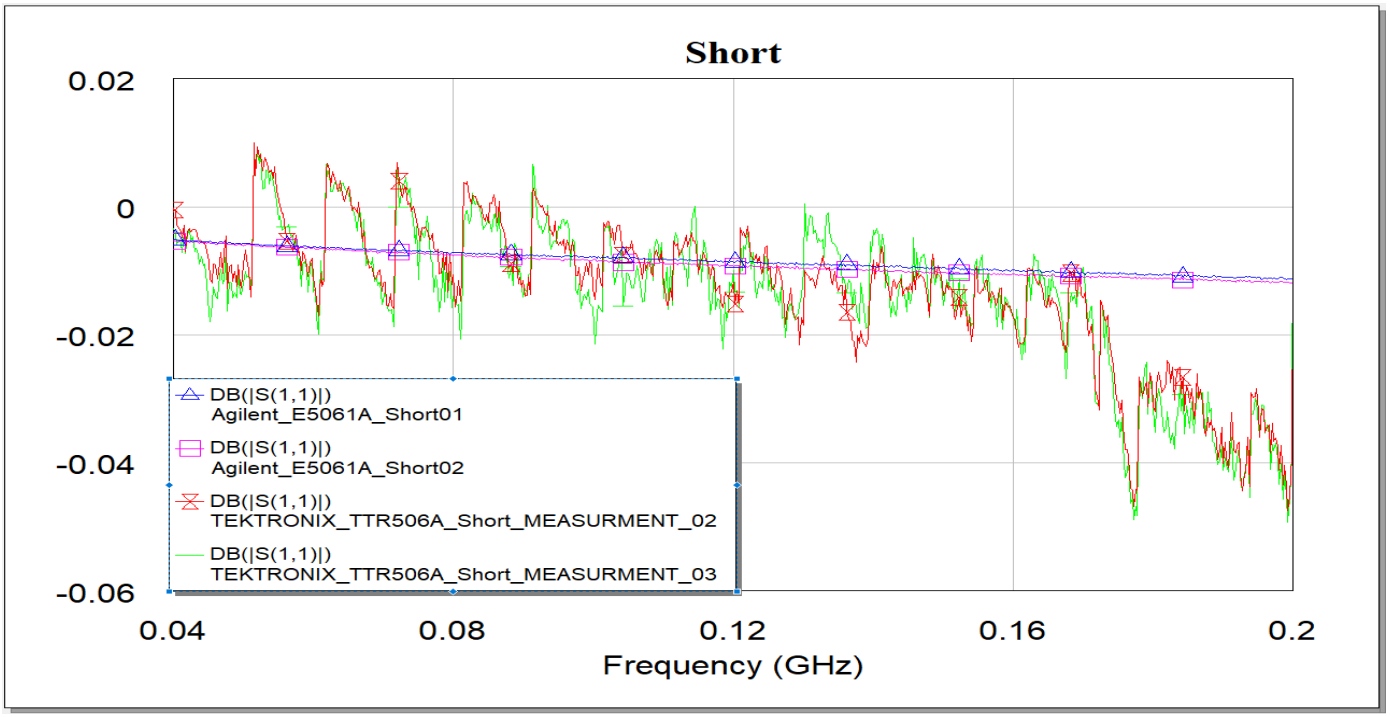

Figure4: Magnitude of the Short after calibration. Tektronix TTR506A measurement one red trace, Tektronix TTR506A measurement two green trace, Agilent measurement one blue trace, and Agilent measurement two pink trace. The difference in noise between the two VNAs with the same settings is favoring the Agilent E5061A VNA due to consistent curvature.

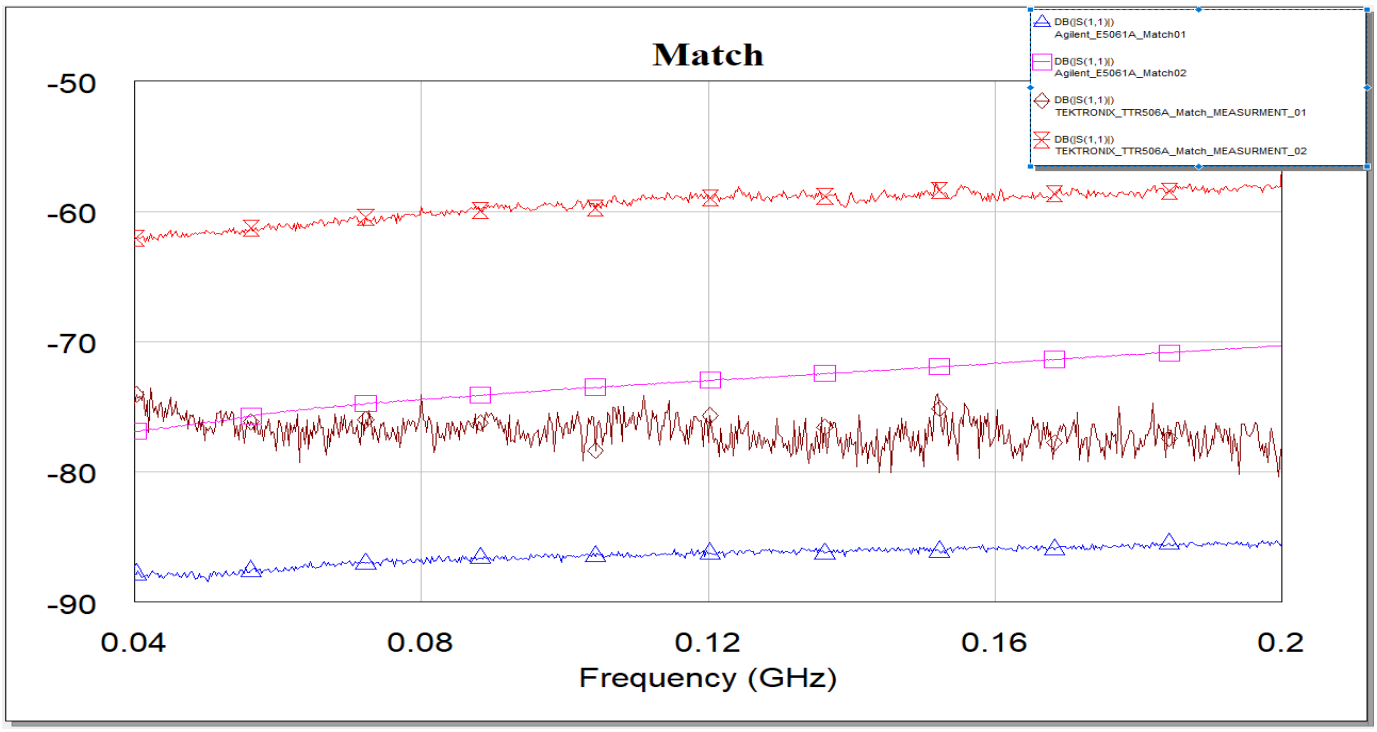

Figure5: Magnitude of the Match after calibration. Tektronix TTR506A measurement one brown trace, Tektronix TTR506A measurement two red trace, Agilent measurement one blue trace, and Agilent measurement two pink trace. The difference in repeatability between the two VNAs with the same settings is favoring the Agilent E5061A VNA due to closer tolerances, better curvature and less ripples.

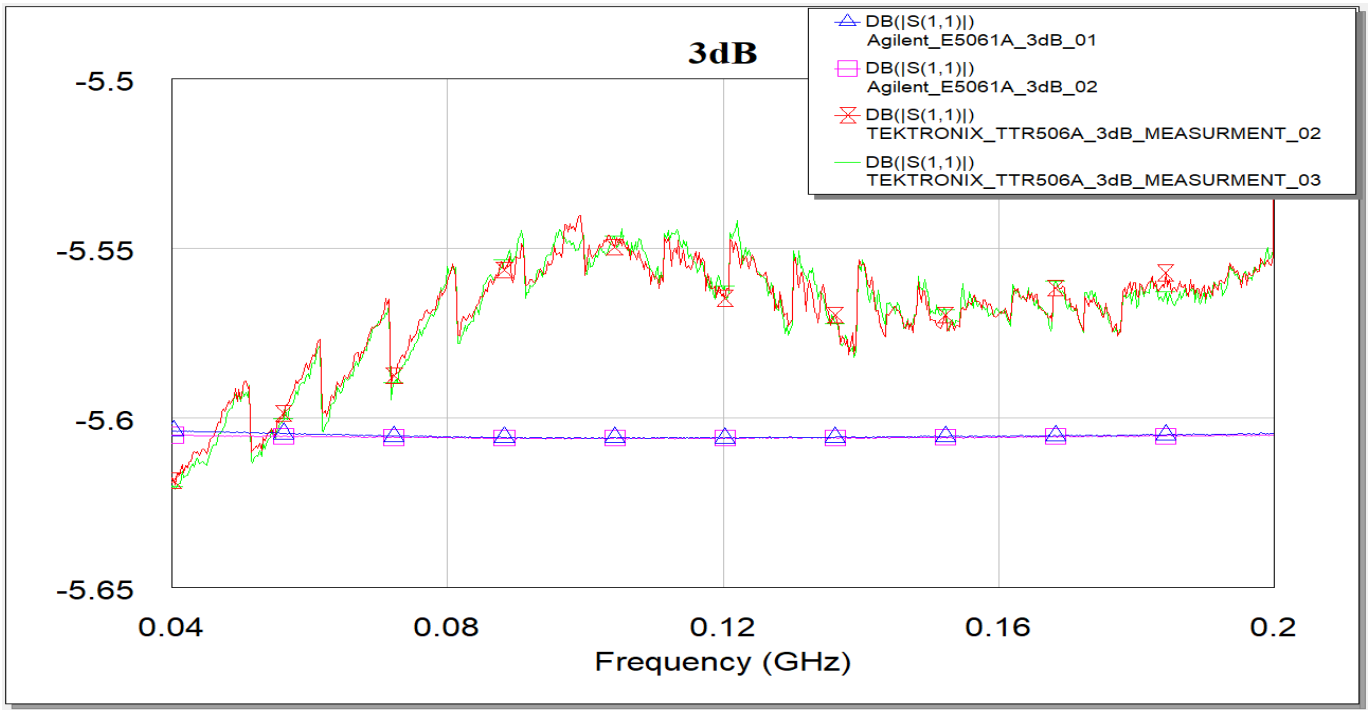

Figure6: Magnitude of the 3dB Attenuator after calibration. Tektronix TTR506A measurement one red trace, Tektronix TTR506A measurement two green trace, Agilent measurement one blue trace, and Agilent measurement two pink trace. The difference in repeatability between the two VNAs with the same settings are similar but the Agilent E5061A VNA is favored due to its consistent curvature which is more predictable.

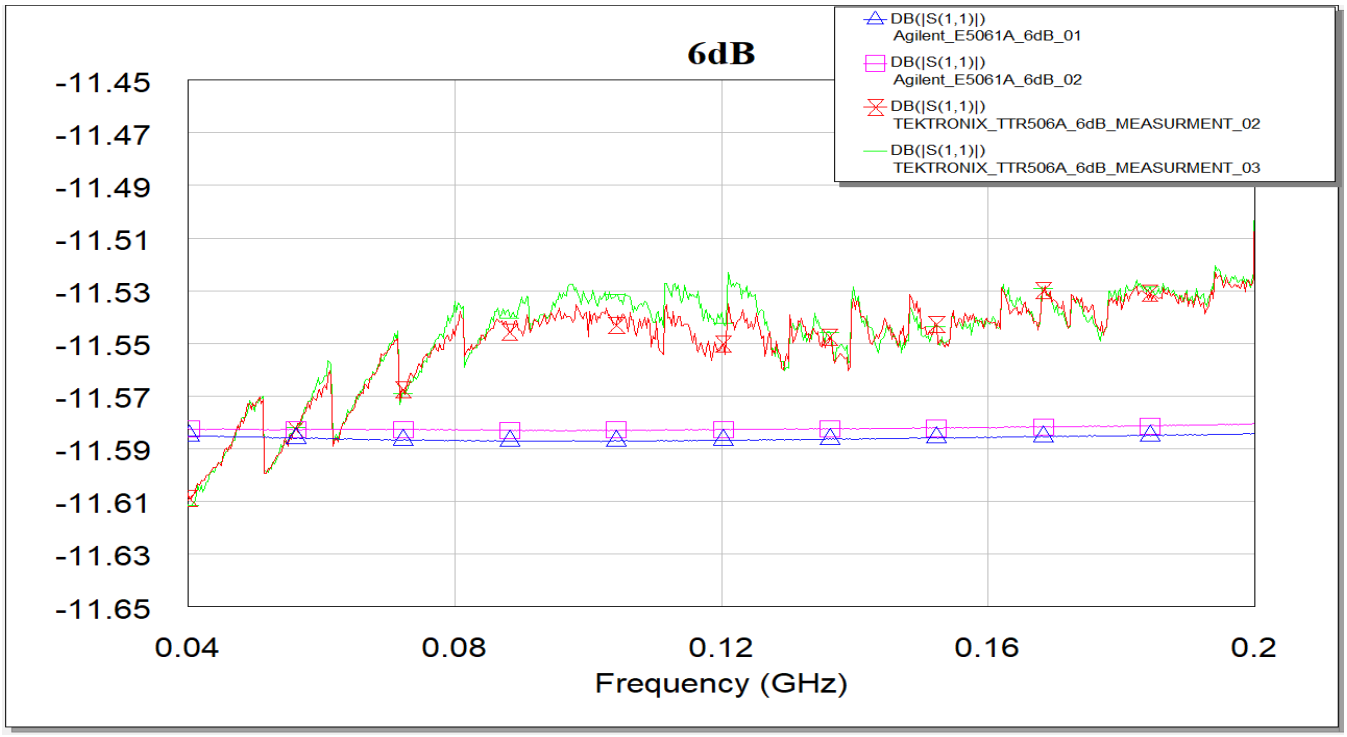

Figure7: Magnitude of the 6dB Attenuator after calibration. Tektronix TTR506A measurement one red trace, Tektronix TTR506A measurement two green trace, Agilent measurement one blue trace, and Agilent measurement two pink trace. The difference in repeatability between the two VNAs with the same settings are similar but the Agilent E5061A VNA is favored due to its consistent curvature which is more predictable.

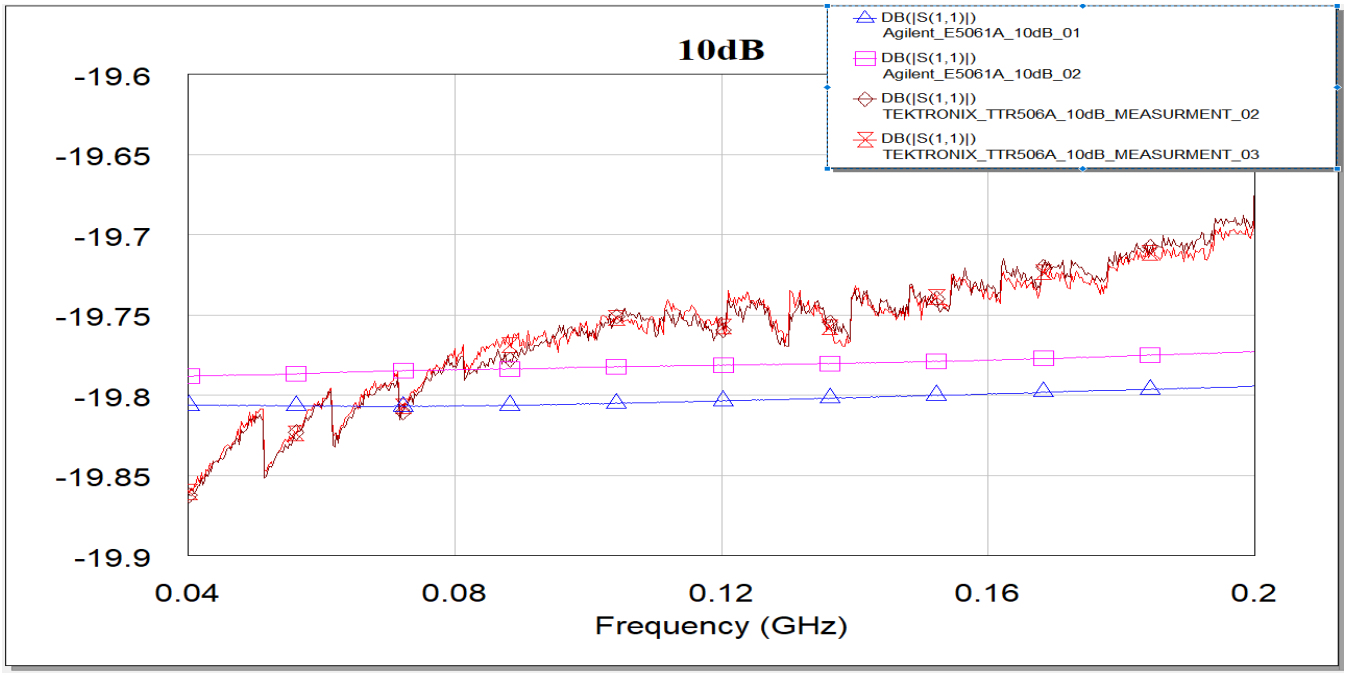

Figure8: Magnitude of the 10dB Attenuator after calibration. Tektronix TTR506A measurement one brown trace, Tektronix TTR506A measurement two red trace, Agilent measurement one blue trace, and Agilent measurement two pink trace. The difference in repeatability between the two VNAs with the same settings is favoring the Tektronix TTR506A VNA. However, the Agilent-E5061A has a consistent linear curvature with less noise that is more predictable.

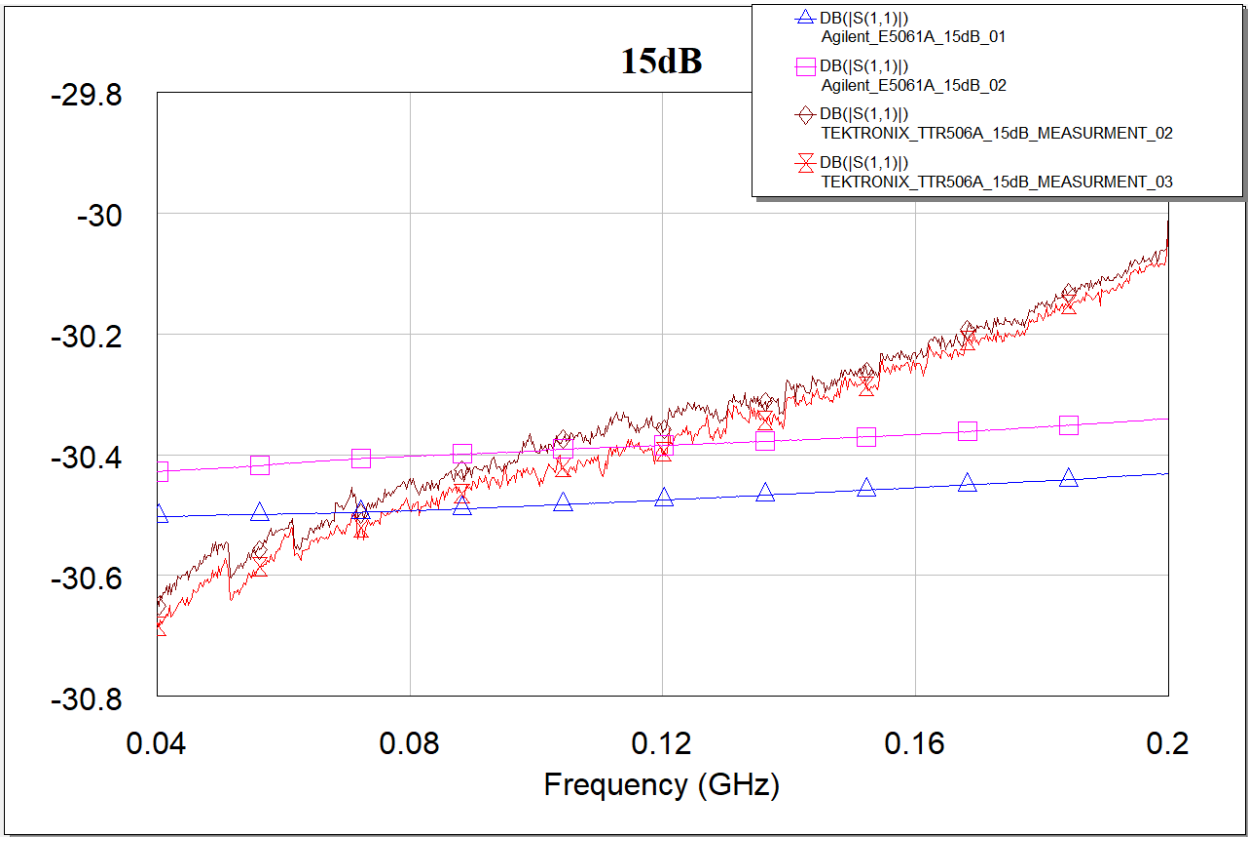

Figure9: Magnitude of the 15dB Attenuator after calibration. Tektronix TTR506A measurement one brown trace, Tektronix TTR506A measurement two red trace, Agilent measurement one blue trace, and Agilent measurement two pink trace. The difference in repeatability between the two VNAs with the same settings is favoring the Tektronix TTR506A VNA. However, the Agilent-E5061A has a consistent linear curvature with less noise that is more predictable.

Discussion:

- Originally each sweep of the Tektronix TTR506A VNA is significantly longer in comparison to the Agilent E5061A VNA. After communicating with Bryan at Tektronix the software does has an alternative mode for sweeping (Fast Mode) that reduces down the sweeping time.
- Both VNAs take between 15 to 30 minutes to warm up and stabilize. In comparison, the Tektronix TTR506A VNA is time consuming averaging 2 minutes per sweep with the fast sweep setting and 3:30 minutes per sweep with normal sweep settings. When averaging 10 sweeps per measurement the time to complete one measurement is over 20 minutes. However, the Agilent E5061A has an average of 10 seconds per sweep and takes a total time of 1:40 minutes to complete one measurement.

- The Tektronix TTR506A has better duplications of measurements only varying 0.1 dB from each repeated measurement (Most noticeable within 10dB, 15dB Attenuated measurements).

- The Agilent-E5061A has a consistent linear curvature with less noise making the measurements more predictable. When looking at each measurement the Agilent E5061A is noticeably less noisy. Although the Tektronix TTR506A is within its manufacture specification (0.008 dB rms trace noise) the Agilent E5061A has less noise thus giving us a consistent linear curvature.

- Due to the conflicting sweeping speeds multiple computers were used as a comparison using both normal and fast modes. The following Specifications of the computers used and sweep times are the following:

1. Asus G11DF – PROCESSOR: AMD® Ryzen 7 1800X OCTCORE 3.6GHz – RAM: 16GB – SSD HARDRIVE – Normal single sweep time: 00:03:28 – Fast single sweep time: 00:02:27
2. DELL OTPIPLEX5050 – PROCESSOR: Intel i7-7500 Quad-Core 3.6 GHz – RAM: 16GB – STANDARD HARDDRIVE - Normal single sweep time: 00:03:30 – Fast single sweep time: 00:02:30
3. Dell - PROCESSOR: INTEL Core i7-2600 OCTCORE 3.4GHz – RAM: 16GB – SSD HARDDRIVE
   - Normal single sweep time: 00:03:32 – Fast single sweep time: 00:02:33