Experiment #1 – VNA Calibration

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# EEL5439C RF and Microwave Active Circuits

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# **Experiment Objective**

The objective is experiment is to introduce students to PCM modulation through MATLAB simulation and by pre-built circuit to view PCM waveforms on the oscilloscope. The lab also provides students with a method of modulating and demodulating PCM signals.

# **2.0 Q&A**

1. A diagram of a circular object

   Description automatically generated with medium confidenceA diagram of a circle with numbers and symbols

   Description automatically generatedA diagram of a circular object with numbers and symbols

   Description automatically generated with medium confidenceA diagram of a circle with numbers and symbols

   Description automatically generatedA diagram of a circle with numbers and a blue dot

   Description automatically generatedA diagram of a graph

   Description automatically generatedYou can present S parameters using Smith Chart, X-Y graph (magnitude or phase, real or imaginary). It is your decision regarding which format to use. But the one you pick should help you explain the results clearly.

A diagram of a circle

Description automatically generatedA diagram of a circular object

Description automatically generated with medium confidenceA diagram of a circle

Description automatically generatedA diagram of a circular object

Description automatically generatedA diagram of a circle

Description automatically generatedA diagram of a capacitor

Description automatically generated

1. Why do you use TRL instead of SOLT calibration for the measurement? Point out your reference plane for each case on the picture. Which kind of errors if you use SOLT calibration? Can you use theory to compensate the errors? How?

I would use TRL over SOLT when the phase change due the DUT is important to the characteristics of the device. When using SOLT calibration, the reference plane is moved to the end the coaxial cable of the VNA, whereas, when using TRL calibration, the reference plane is moved to the start of the DUT.

1. Show how you determine the TRL standard length and maximum frequency range.
2. Show the calibrated responses of the through, line, and reflect using TRL cal. Comment on your results.
3. Graph the S parameters of the lumped elements using both calibration methods. Also extract the resistance, capacitance, and inductance value of each component. Please note that you need to also plot the component values versus frequency. Comment on your results.
4. Can you use the low-frequency capacitor for 1 GHz circuit? Why?
5. Does the RF choke behave like an open at 1 GHz? You will use it for your amplifier biasing.
6. Is the chip component performance good enough for 1 GHz applications?
7. The grounding vias will introduce parasitic inductance. How to minimize this inductance? (extra points: characterize the parasitic inductance using any full-wave simulation software such as momentum in ADS.)

# **3.0 Learned Objectives**

* PCM Modulation
* PCM Demodulation
* MATLAB Simulation
* Methods of PCM Modulation and Demodulation

# **4.0 Conclusion**