You are to determine the bandwidth of the following antennas: 0.024" (#28 awg) wire dipole, 1/8" wire dipole, ½" copper pipe dipole, bowtie, and helical antenna. Pictures of these are shown below. The dipoles and bowtie antennas were designed to operate at approximately 120 MHz where their length is $l \cong \lambda / 2$. The helical is designed for 900 MHz. As you would expect, the dipoles, will exhibit additional resonances at odd harmonics of the original half-wave frequency. (i.e. 120, 360, 600…). However, do not be concerned about these. We will measure the bandwidth at their lowest frequency. We will define bandwidth as the range frequencies where the SWR is less than or equal to 2.

1. For each antenna, use the Agilent/Keysight Analyzer to determine the frequency range where $SWR \leq 2$. Record the values of f_L, and f_U and the corresponding SWRs in your laboratory notebook. Note, the SWR should be approximately 2, but record its measured SWR value at f_L and f_U. *Sketch* the SWR graph too. To minimize any interactions, vertically position the antenna so it is perpendicular to the table or do the measurements in an open field.
2. Record all values, observations, and analyzer graphs in your lab notebook. You should take pictures of your antennas and include them in your final report.
3. For each dipole type, determine at what frequency it starts to behave as a traveling wave antenna. In other words, at what frequency does the SWR start to flatten out, and what value is this "flat" SWR profile?

Copper Pipe – 131.12 (upper) 113.7 (lower)
.024 – 124.5 – 111.5
⅛" – 111.5 – 116.75
Bowtie – 114.750 – 143.360
helical – flatten at 1.328 GHz