Notes for Lab 1

Additional information for Lab 1 (updated 2013-01-28).

Notes

- Try to bring a ruler or measuring tape and some tape that can be written on to the lab. This will let you mark distances on the benches.
- The detector and SWR meter have sufficient dynamic range that you should not need the 30 dB variable attenuator.
- Check the power supply current. It should read about 100 mA for an 8 V supply voltage.
- Turn on the transmitter's 1 kHz modulator and set the SWR meter for 100 Hz bandwidth. Set the SWR meter to use the 10 dB range (not the expanded range). Adjust the SWR meter's frequency control for maximum signal level. Check this setting periodically.
- Place a desk perpendicular to the lab bench and place the detector on this desk. Obtain signal strength readings at distances of 10, 20, 40, and 80 cm. Take a reading at 160 cm if your cables will reach that far. You will have to splice together two or three co-ax cables using BNC couplers to extend the range of the detector.
- Before recording each reading, make sure the two antennas are pointed directly at each other by orienting **both** *of them* for maximum signal level.
- Measure the signal strength using the dB scale of the SWR meter. If the meter goes out of range, switch the range. Record the range, the meter reading and the sum of the two.
- Repeat the measurements at the same set of distances.
- There may not be enough support stands for all students. You can use the short supports included in the Lab-Volt kit instead. You may actually prefer this to using the tall supports since it is difficult to get the tall supports to support the waveguide components securely.
- Data sheets for the Gunn oscillator, detector and antenna are available on the course web site. You may need these to answer the questions below.
- Section 3 is optional. Do it if you have enough time left at the end of the lab.

Pre-Lab Assignment

Answer the following questions and hand in your answers at the start of the lab.

1. What change in dB do you expect for each doubling of the distance between transmitter and receiver?
2. What is the wavelength of the 10.5 GHz signal in free space? For the 60 cm transmitter-receiver separation given in the lab instructions, what is the minimum distance (y) at which you expect the reflected signal to be 180 degrees out of phase with the direct path? What do you expect to happen to the signal level as the value of y is varied around this distance? As the value of y increases, when do you expect the reflected signal to again be in-phase with the direct path? Prepare a table showing the values of y for the first three maxima and first three minima.

Lab Report

Your lab report should include the following:

- for Section 1, a log-log graph (dB vs log of distance) showing your predicted values, both sets of measurements and a least-squares straight-line fit to your data. Many spreadsheets (Excel's "Trendlines"), numerical software (Matlab's `polyfit()`) and web sites (Wolfram Alpha's "linear regression" demo) will do the computations and plot the results.

- for Section 2, a table comparing the predicted and measured offsets (values of y)
- answer the questions below.

Questions For Lab Report

1. How do your two sets of measurements compare to each other? How do your measurements compare to your predictions? Do your measurements confirm your predictions?
2. How much power is being supplied to the transmitter at the recommended voltage and current? What is the oscillator's rated power output in dBm? In milliwatts? What is the oscillator's power efficiency?
3. What is the gain in dBi of the horn antenna according to the data sheet? What is the corresponding effective aperture in square meters? Based on the supplied E-plane antenna pattern, what is the 3 dB beamwidth in degrees?
4. What is the transmitted EIRP in dBm? In mW?