# Digital Communications Lab

## Lab #4

## Experiment

1. Use the function generator to produce a sine wave with a peak amplitude of 1 volt and a frequency of 10 kHz. Measure the amplitude and frequency of the signal on both the oscilloscope and spectrum analyzer, and see if all three devices (signal generator, oscilloscope and spectrum analyzer) agree on the amplitude and frequency of the wave.

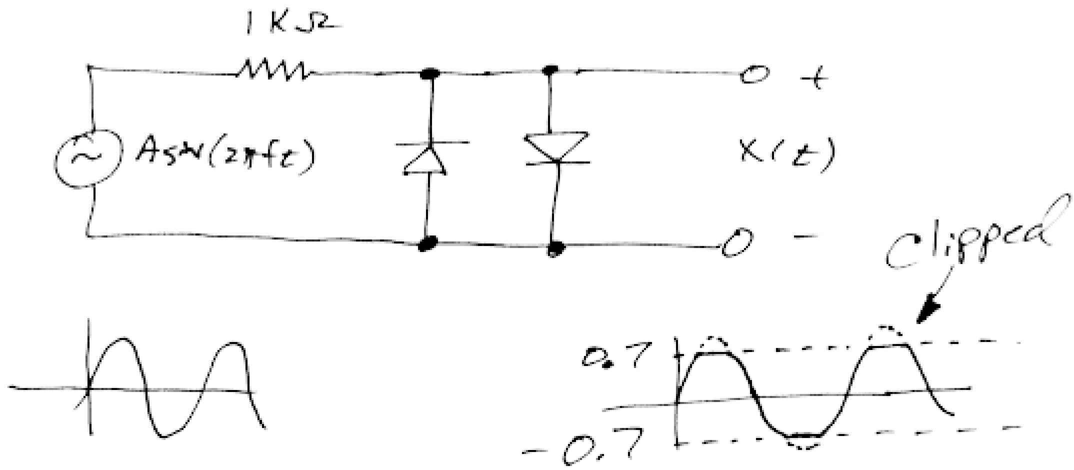
2. Calculate the average power of the sine wave from step 1, assuming it was put across a one ohm load. Don't actually put it across a one ohm resistor, just calculate the power if that voltage had been put across a one ohm resistor. For the rest of this lab, any time the power of a signal is mentioned, it will be assumed to be the power if the signal was put across a one ohm load.

3. Use the function generator to produce a triangle wave with a peak amplitude of 1 volt and a frequency of 10 kHz. Verify it is correct by displaying the signal on the oscilloscope. Calculate the power of the signal.

4. Measure the triangle wave from the previous step on the spectrum analyzer. Determine the power of the term at 10 kHz, 20 kHz, and at many other multiples of 10 kHz. The sum of all these powers should add to the same number you got in the previous step.

5. Repeat the previous two steps with a sine wave. But unlike in step 1, this time look not only at 10 kHz, but at multiples of 10 kHz. Record the total amount of the power that is not at 10 kHz.

6. Ideally, a sine wave on a spectrum analyzer should have only a term at its fundamental frequency - the frequency the signal generator says it is producing. However the spectrum analyzer often finds terms at high frequencies, especially at odd multiples of the fundamental frequency. This is because the generator may not be producing an ideal sine wave. To see this effect more clearly, connect the circuit shown below

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iodes start conducting around 700 mV. If the input sine wave is less than 700 mV, it should go through the circuit unchanged. However once the peak voltage exceeds that level, the top of the sine wave will be flattened, or clipped. Generate sine waves with amplitudes of 100 mV, 700 mV, 1.5 V and 3 V. Pass these signals through the circuit above, and measure the amplitude of the first few harmonics (first few multiples of the carrier frequency) on the spectrum analyzer. Also look at the signals on the oscilloscope, and record what they look like.

7. Each frequency you measured in the previous step represents a sine wave at that frequency. Each of these sine waves has some power. Estimate the sum of the power in all the sine waves that are not at the fundamental frequency. The radio of this power, to the total power of the signal is called the total harmonic distortion, or THD. Find the THD, in percentage, for the four signals used in the previous step.