

* **Attach your pre-lab work to this report.**

**Rectangular Pulse waveform Duty Cycle D=1/2=50%**

* 1. Record the DC, and pulse amplitude from the time waveform. What is the total normalized power of the waveform?

**DC = 1 V**

**A = 2 V**

* 1. Record and sketch the spectrum from DC to 10 MHz using the Vrms linear scale. What is the ratio of the voltage of the fundamental to the voltage of the third harmonic? How does this compare to the theoretical value?



* 1. What is the ratio of the voltage of the third harmonic to that of the 5th harmonic?

* 1. Explain why we say the amplitude of the harmonics decrease as 1/n where n is the harmonic number using the Fourier series.
  2. Change the SA (FFT) vertical scale to 10 dB/DIV with 0 to 125 MHz span. Notice how the amplitudes of the harmonics decrease as 1/n at lower harmonics, and then decrease in amplitude much faster for higher n. Explain this effect.

**The signal generator has a bandwidth of 25 MHz, and is unable to produce much higher frequencies.**

* 1. Change the duty cycle from D=50 to D=50.1 and watch the amplitude of the 2nd harmonic. Should the second harmonic be present? Record the amplitude of the fundamental and the 2nd harmonic in Vrms. Compare the ratio of V2/V1 measured to what the theoretical ratio should be in your report. Hint: ratio of the C2/C1 coefficients.

|  |  |  |
| --- | --- | --- |
| harmonic | Measured | Calculated |
| 1 | 0.912 | 0.9 |
| 2 | 0.003 | 0.0028 |
| ratio 1/2 | 323 | 321 |

**Rectangular Pulse waveform Duty Cycle D=1/5=20%**

1. Find the power in the waveform from the scope as you did in 1)

**DC = .4 V**

**A = 2 V**

1. Sketch the FFT display. Be sure the DC term is shown. Determine what percent of the total pulse power is transmitted through a channel whose frequency response is that of a low pass filter with cut-off at 5 MHz (5 MHz does get through). This should be 1/ bandwidth. Hint: (Vrms n2)/<v(t)2>\*100
2. plot the percent of the pulse power for bandwidths from 0 Hz to 25 MHz. Remember that the power that gets through the channel is the summation of the squared Vrms values of each of the different signal components that are within the bandwidth, i.e. the DC term, fundamental, and in this case the 2nd, 3rd, and 4th harmonics. See the Mathcad program for additional help.

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**90% of the power is in the null bandwidth**

**Tektronix Spectrum Analyzer with Pulse waveform Duty Cycle D=1/2=50%**

1. Record the DC, and pulse amplitude from the time waveform. What is the total normalized power of the waveform?

**DC = 1 V**

**A = 2 V**

1. Record and sketch the spectrum from DC to 10 MHz using the Vrms linear scale. What is the ratio of the voltage of the fundamental to the voltage of the third harmonic? How does this compare to the theoretical value?



1. What is the ratio of the voltage of the third harmonic to that of the 5th harmonic?

|  |  |  |
| --- | --- | --- |
| Frequency | dBV | Vrms |
| 10 MHz | -1.6 dB | 0.8317638 |
| 30 MHz | -17.6 dB | 0.1318257 |
| 50 MHz | -47 dB | 0.0044668 |