

# Your Paper

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## Abstract

Your abstract.

## 1 Introduction

## 2 Loose Notes and Calculations

We used one signal generator (N9310A) with a wide range of allowed frequencies, while the other (83712B) with a lower frequency limit of 10 MHz.

We set the 83712B to run at 11 MHz and 1.5 dBm (justify??). This gave  $\Delta\nu = .05 \times \nu_{LO} = .55$  MHz. We set the N9310A to run at 1.5 dBm as well and, depending on the trial, either  $\nu_{RF} = \nu_{LO} + \Delta\nu = 11.55$  MHz or  $\nu_{RF} = \nu_{LO} - \Delta\nu = 10.45$  MHz.

When collecting data, we sampled at 32.5 MHz, which is more than double the Nyquist frequency. ?? why is this important and give a calculation of how far above the Nyquist this is

?? I didn't identify the sum and difference frequencies from observation!!

$$\sin(\nu_{LO} + \Delta\nu) = \sin \nu_{LO} \cos \Delta\nu + \cos \nu_{LO} \sin \Delta\nu$$

$$\sin(\nu_{LO} - \Delta\nu) = \sin \nu_{LO} \cos \Delta\nu - \cos \nu_{LO} \sin \Delta\nu$$

But these are not relevant, we want

$\sin(a) + \sin(a+b) = ?$ , right?

$\sin(\nu_{LO}) \sin(\nu_{LO} + \Delta\nu) = \frac{1}{2}(\cos \Delta\nu - \cos(2\nu_{LO} + \Delta\nu))$  by evenness of the cosine function and

$$\sin(\nu_{LO}) \sin(\nu_{LO} - \Delta\nu) = \frac{1}{2}(\cos \Delta\nu - \cos(2\nu_{LO} - \Delta\nu))$$

Why do the power spectra look the way they do. Upper sideband and lower sideband.

For the upper sideband, we can see spikes at almost the difference frequency (.575 MHz  $\approx$  .55 MHz). The other spikes are at 10.2 MHz? Why?

For the lower sideband, we see outer spikes at 9 MHz. The inner spikes are still at roughly the difference frequency...

First I need indices of maxima?

Recreate the original using Fourier filtering. I did NOT do this!!

Explain what you see.

## 3 Outline and To-Do

Major logic error: side-by-side captions are mutilated!

Rough outline:

argue what the Nyquist criterion is, based on results.

Symmetry \* \* Introduce correlation theorem \* Show ACF results

Observations and Data \* Include make and model of all equipment used. \* "Don't quote a number without the uncertainty and units." \* Introduce a hypothesis before each result, and justify each hypothesis with theory

Discussion on results for week 2, section 1

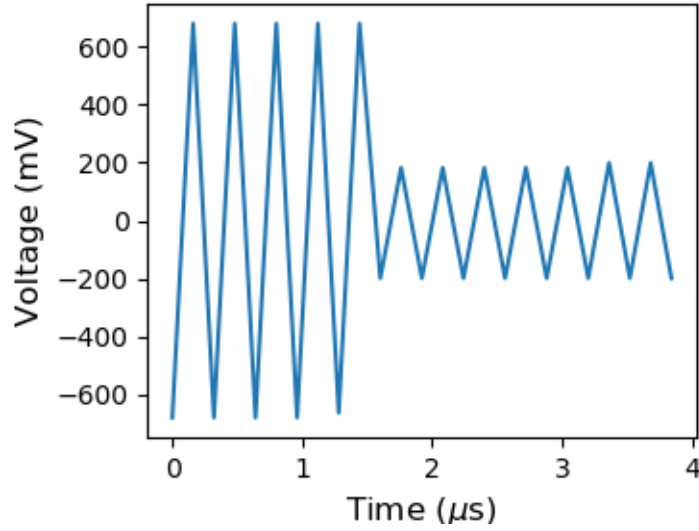


Figure 1: The oscilloscope displayed a constant signal throughout the period of data-taking. The data sampled from the pico sampler, however, reconstructs a signal with large aberrations in the first few microseconds.

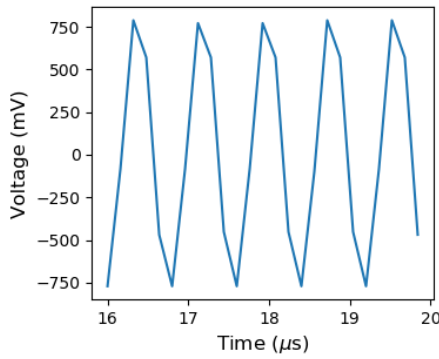


Figure 2:  $\nu_0 = .2\nu_s = 1.25$  MHz.

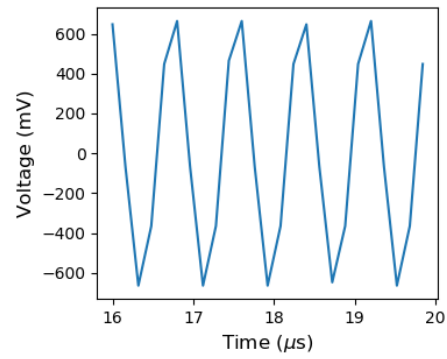


Figure 3:  $\nu_0 = .8\nu_s = 5$  MHz.

I need to include details about the equipment used, but how in-depth do I need to go? Current plan \* For most things, use model number and manufacturer \* When data analysis depends on a spec sheet, offer a brief summary of the specs to which you are referring to fine-tune your analysis

I need uncertainties on results but I do not yet know how to get these.

## 4 5

### 4.1 2

Without taking the spectrum, we want to perform visual analysis of the plots and find periods

Motivation

\* Pico sampler model, what sampling rate we used

\* We're using the ugradio pico sampler code

\* We're using the \_\_\_ signal generator

\* Define terms  $\nu_0$  = input frequency.  $\nu_s$  = sampling frequency.

Finally, we took the default 16000 samples for each signal. However, for the data analysis, we will be excluding the first 100 samples due to a peculiarity of the pico sampler which distorted these (1).

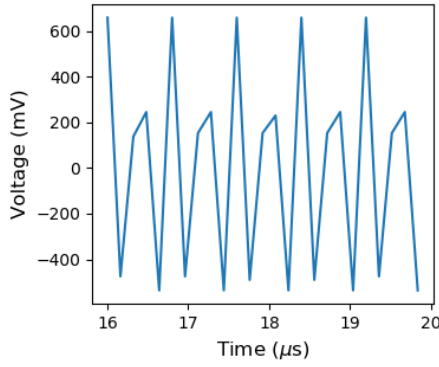


Figure 4:  $\nu_0 = .4\nu_s = 2.5$  MHz.

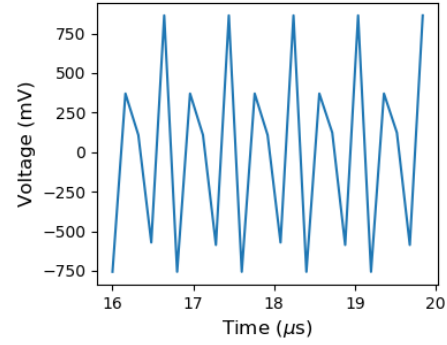


Figure 5:  $\nu_0 = .6\nu_s = 3.75$  MHz.

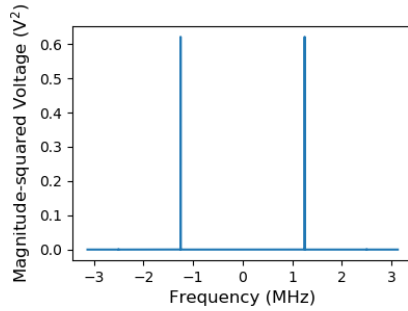


Figure 6:  $\nu_0 = .2\nu_s = 1.25$  MHz. Peak amplitudes at  $\pm 1.25$  MHz

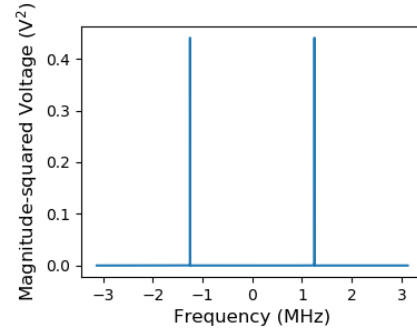


Figure 7:  $\nu_0 = .8\nu_s = 5$  MHz. Peak amplitudes at  $\pm 1.25$  MHz

We may begin inspection of the samples with a qualitative approach. Figure 2 shows a signal which repeats about five times in the span of about 4 microseconds. This gives us 1.25 cycles per microsecond, or 1.25 MHz, as expected. Figure 5 is not as obviously derived from a sine wave (the shape is distorted by the shrinking gap between  $\nu_0$  and  $\nu_s$ ), but we may still say that there is a repeating signal with slightly under five repetitions in a span of 4 microseconds. This would give us slightly under 1.25 MHz, which is incorrect; thus we have qualitatively demonstrated an aliasing effect.

## 4.2 3

Comments can be added to your project by clicking on the comment icon in the toolbar above. To reply to a comment, simply click the reply button in the lower right corner of the comment, and you can close them when you're done.

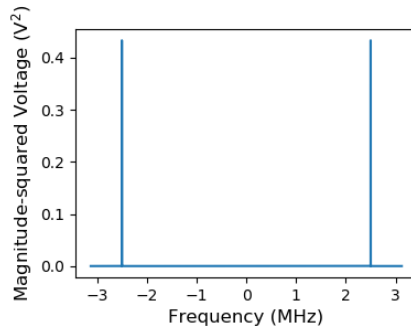


Figure 8:  $\nu_0 = .4\nu_s = 2.5$  MHz. Peak amplitudes at  $\pm 2.5$  MHz

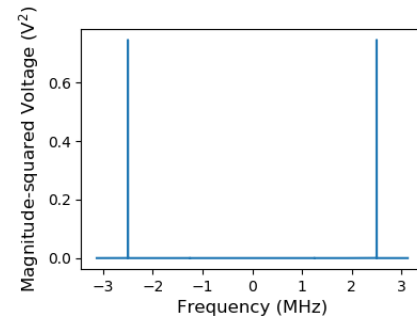


Figure 9:  $\nu_0 = .6\nu_s = 3.75$  MHz. Peak amplitudes at  $\pm 2.5$  MHz

Item	Quantity
Widgets	42
Gadgets	13

Table 1: An example table.

Comments can also be added to the margins of the compiled PDF using the `todo` command, as shown in the example on the right. You can also add inline comments:

This is an inline comment.

Here's a comment in the margin!

## 4.3 4

Use the `table` and `tabular` commands for basic tables — see Table 1, for example.

## 4.4 5

$\text{\LaTeX}$  is great at typesetting mathematics. Let  $X_1, X_2, \dots, X_n$  be a sequence of independent and identically distributed random variables with  $E[X_i] = \mu$  and  $\text{Var}[X_i] = \sigma^2 < \infty$ , and let

$$S_n = \frac{X_1 + X_2 + \dots + X_n}{n} = \frac{1}{n} \sum_i^n X_i$$

denote their mean. Then as  $n$  approaches infinity, the random variables  $\sqrt{n}(S_n - \mu)$  converge in distribution to a normal  $\mathcal{N}(0, \sigma^2)$ .

## 4.5 6

Use section and subsections to organize your document. Simply use the section and subsection buttons in the toolbar to create them, and we'll handle all the formatting and numbering automatically.

## 4.6 7

Noise.

# 5 7

## 5.1 1

You can make lists with automatic numbering ...

1. Like this,
2. and like this.

... or bullet points ...

- Like this,
- and like this.

## 5.2 2

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### 5.3 3

Single side band mixer is more difficult to perform.

## References

- [Gre93] George D. Greenwade. The Comprehensive Tex Archive Network (CTAN). *TUGBoat*, 14(3):342–351, 1993.