THE UNIVERSITY OF BRITISH COLUMBIA

Department of Electrical and Computer Engineering

**LABORATORY REPORT *TEMPLATE***



**LAB ASSIGNMENT 1**

**SPECTRUM ANALYZERS**

prepared by

Lab Group #

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in Partial Fulfillment of the Requirements for

ELEC 391 – Electrical Engineering Design Studio II

Date performed: 24 Jul 2018

Date submitted: 31 Jul 2018

# Abstract

*In the Abstract, you should summarize the objectives, methodology, results and major conclusions of the study in a single paragraph of between 100 and 250 words.*

*When describing what you did, you should write in the past tense.*

*When presenting your conclusions, you should write in the present tense (assuming those conclusions refer to something that is still valid, rather than something that might only be true when the data was collected.).*

*You should not give any information or draw any conclusions that are not also stated in the report.*

*Note that the following sample abstract is a summary of the objectives, the method, and the key results of this lab assignment. The reader is left with no doubt concerning the contributions and content of the lab report*

*Sample abstract: (264 words)*

*We have used an oscilloscope and a spectrum analyzer to measure: (1) selected square-wave and triangle-wave periodic signals, (2) the frequency transfer function of a Butterworth low-pass active filter and (3) the output of a frequency modulator to which a sinusoidal test signal has been applied. We have used the results to compare theoretical predictions to measured results and the strengths and limitations of the two instruments in the characterization of signals and systems. We make the following observations. First, while the power spectrum computed using Fourier theory is two-sided in frequency, noise- free, and ideal, the power spectrum measured by a spectrum analyzer is one-sided, corrupted by noise, and may be regarded as the result of frequency-domain convolution of the theoretical power spectrum with the response of the spectrum analyzer’s resolution bandwidth filter. Second, when used in conjunction with a variable frequency signal generator, both the oscilloscope and the spectrum analyzer can be used to measure the frequency response of a system. While the oscilloscope allows one to measure both the magnitude and phase response, it has a relatively narrow dynamic range. While the spectrum analyzer can only be used to measure the magnitude response, it has a much greater dynamic range and may be used to measure weaker signals. Third, if the modulating signal is a pure sinusoid, the spectrum of the corresponding frequency modulated signal consists of multiple carriers. The separation between the carriers is equal to the frequency of the modulating signal. The number of carriers in the spectrum increases as the maximum frequency deviation of the modulated signal increases.*

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# Glossary

|  |  |
| --- | --- |
| *Term 1* | *- definition of term 1* |
| *Term 2* | *- definition of term 2* |
| *Term 3* | *- definition of term 3* |
| *Term 4* | *- definition of term 4* |
| *Term 5* | *- definition of term 5* |
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# List of Abbreviations

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| *Abbreviation 1* | *- definition of abbreviation 1* |
| *Abbreviation 2* | *- definition of abbreviation 2* |
| *Abbreviation 3* | *- definition of abbreviation 3* |
| *Abbreviation 4* | *- definition of abbreviation 4* |
| *Abbreviation 5* | *- definition of abbreviation 5* |
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# INTRODUCTION

*The Introduction to your lab report should be written in paragraphs, without subheadings. You should include the following information in the following order:*

* *GENERAL STATEMENT OF THE FIELD OF THE INVESTIGATION: often a re-working of your title in which you clearly define the problem you are investigating; e.g., "This laboratory report presents an investigation of ....” or "This laboratory report is concerned with ....”*
* *OBJECTIVES: summarize the general objectives of the lab assignment.*
* *OUTLINE OF THE LAB REPORT: this is* ***always*** *the concluding sentence or section of your Introduction because it serves as a “road map” of what is to come; e.g., “This lab report is divided into the following sections....” (list them).*

*….*

*This lab report is divided into the following sections:*

*In Section 1, we compare the theoretical and measured power spectra of selected periodic signals including square waves and triangle waves.*

*In Section 2, we measure the response of a low pass filter using a variable frequency signal generator in conjunction with either or both a spectrum analyzer and an oscilloscope and consider the merits of the two approaches.*

*In Section 3, we determine how the frequency spectrum of an FM signal that has been modulated by a 1 KHz sinusoidal signal evolves as the maximum deviation of the FM signal increases.*

*Finally, we draw conclusions and offer recommendations.*

# POWER SPECTRUM OF PERIODIC SIGNALS

## Introduction

*In the Introduction to this Section, you should summarize the specific objectives of this experiment. In some cases, you might want to mention the specific issues that we ask you to address in your lab report.*

## Procedure

*In the Procedure section, you should:*

* *summarize (but not repeat) the instructions in the lab handout.*
* *include significant details of your work that aren’t described in the lab handout, including equipment serial numbers*

## Results

*In the Results section, you should:*

* *present the theoretical or numerical results that you obtained as a pre-lab assignment*
* *present the data that you collected in the lab (plus any simple data reductions) in tabular, graphical, or numerical form as appropriate*
* *graphs should be generated using MATLAB, then imported into Word*
* *equations should be typeset using Equation Editor*

## Discussion

*In the Discussion section, you should:*

* *summarize the results and their implications*
* *respond to the issues raised in the lab handout*

*Please read the lab handout carefully. Marks will be deducted if a particular issue is not addressed.*

# RESPONSE OF FILTERS

## Introduction

*In the Introduction to this Section, you should summarize the objectives of this experiment. In most cases, you will want to mention the specific issues that we ask you to address in your lab report.*

## Procedure

*In the Procedure section, you should:*

* *summarize (but not repeat) the instructions in the lab handout.*
* *include details of your work that aren’t described in the lab handout, including equipment serial numbers*

## Results

*In the Results section, you should*

* *present the theoretical or numerical results that you obtained as a pre-lab assignment*
* *present the data that you collected in the lab (plus any simple data reductions) in tabular, graphical, or numerical form as appropriate*
* *graphs should be generated using MATLAB, then imported into Word*
* *equations should be typeset using Equation Editor*

## Discussion

*In the Discussion section, you should*

* *summarize the results and their implications*
* *respond to the issues raised in the lab handout*

# FREQUENCY MODULATED SIGNALS

## Introduction

*In the Introduction to this Section, you should summarize the objectives of this experiment. In most cases, you will want to mention the specific issues that we ask you to address in your lab report.*

## Procedure

*In the Procedure section, you should:*

* *summarize (but not repeat) the instructions in the lab handout.*
* *include details of your work that aren’t described in the lab handout, including equipment serial numbers*

## Results

*In the Results section, you should*

* *present the theoretical or numerical results that you obtained as a pre-lab assignment*
* *present the data that you collected in the lab (plus any simple data reductions) ) in tabular, graphical, or numerical form as appropriate*
* *graphs should be generated using MATLAB, then imported into Word*
* *equations should be typeset using Equation Editor*

## Discussion

*In the Discussion section, you should*

* *summarize the results and their implications*
* *respond to the issues raised in the lab handout*

# WIRELESS SPECTRUM – AM AND FM BROADCAST BAND

## Introduction

*In the Introduction to this Section, you should summarize the objectives of this experiment. In most cases, you will want to mention the specific issues that we ask you to address in your lab report.*

## Procedure

*In the Procedure section, you should:*

* *summarize (but not repeat) the instructions in the lab handout.*
* *include details of your work that aren’t described in the lab handout, including equipment serial numbers*

## Results

*In the Results section, you should*

* *present the theoretical or numerical results that you obtained as a pre-lab assignment*
* *present the data that you collected in the lab (plus any simple data reductions) ) in tabular, graphical, or numerical form as appropriate*
* *graphs should be generated using MATLAB, then imported into Word*
* *equations should be typeset using Equation Editor*

## Discussion

*In the Discussion section, you should*

* *summarize the results and their implications*
* *respond to the issues raised in the lab handout*

# CONCLUSIONS AND RECOMMENDATIONS

## Conclusions

*The Conclusions section should briefly address each of the objectives presented in the Introduction section. It should summarize the results and discussion presented in the body of the report and briefly discuss their implications.*

*Your Conclusions section must not contain any information that you have not previously presented. All of your evidence must be presented in the body of the lab report.*

## Recommendations

*In some cases, there are limitations to the results that you obtained (due to limitations of time, equipment, or staff) and therefore limitations in the conclusions that you have drawn. In the recommendations section, you can acknowledge these limitations and suggest methods for overcoming them.*

*If your recommendations are strong enough, they could well be incorporated into the version of the lab assignment that we issue next term!*

# REFERENCES

[1]

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