

***Department of Electrical Engineering and Electronics***

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**Year 2 Project (ELEC222/ELEC273)**

**Short report**

**Declaration**

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Project Title:                                  Frequency  Downconverter

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# Introduction

Changing the frequency of an electromagnetic signal while preserving other characteristics, such as phase and amplitude of the original signal is a technique that has various applications in communications, radar and others. It is also used in the application of the UHF method for Partial Discharge (PD) monitoring in high voltage equipment to down-convert the high frequency RF signals obtained from UHF sensors into lower frequency signals. The resulting low-frequency signals can then be amplified and digitised using much cheaper and more widely available equipment. In this project, a frequency downconverter should be designed which can receive Ratio Frequency (RF) signal in the Ultra High Frequency (UHF) range from 300MHZ to 3GHz and convert RF signal to the Intermediate Frequency (IF) with the range of 10MHz – 200MHz. Furthermore, the input and output impedance of the circuit will be 50ohm, and it can interface with standard instruments.

# Objectives

The purpose of this project is to develop an ultra-high frequency downconverter by designing and testing electronic circuit as well as the PCB design. Practice the skills related to signal processing and condition monitoring of high voltage equipment. In addition, the electronic circuit will be simulated by using the software. Learn how to search information in the data sheet of the components. Know the basic usage and characteristic of Surface Mount Devices (SMD), as well as the difference between Surface Mount Devices and Dual In-line Package (DIP) components in the PCB design.

# Methodology

3.1 Basic Concept

The flowchart of the UHF downconverter basic concept will be shown below: 

Figure 1: UHF downconverter basic concept

The first band pass filter is used to extract the high frequency signal. After the amplification, the high frequency signal enters into the mixer and mix with the local oscillator to achieve a reduction in signal frequency, and the output is a product signal. Then the mixed product signals pass another band pass filter and amplify to get the required low frequency signal.

3.2 Development Procedure

1. Circuit design

2. Circuit simulation: The computer software will be used to simulate the circuit, and the expected results should be obtained before the PCB design.

3. PCB design: The layout software could be used to design the PCB including component placement and PCB routing.

4. PCB simulation

5. PCB test

# Deliverables and expected outcomes

The expected outcome is a printed circuit board which can accept UHF signals (300MHZ - 3GHz) and convert them to the Intermediate Frequency (IF) in the range of 10MHz – 200MHz.