

## ELC 3414 Electronic Design

# Lab 3: Half-wave Rectifiers

## Background

Your company has recently acquired a small start-up electronics firm who was developing a new half-wave rectifier technology. Your company often uses half-wave rectifiers in their products. Your boss, also an electrical engineer, wants you to investigate the trade-offs between your company's current half-wave rectifier design and the newly acquired design.

## Introduction

There are always trade-offs when designing electronic circuits. One of these trade-offs is determining whether to use *passive* or *active* components. Typically, active components will give a better response, but passive components are simpler, cheaper, and don't require a power supply.

## Objective

The purpose of this experiment is to compare the performance characteristics of simple and precision half-wave rectifier circuits. You are to consider such factors as frequency response, output accuracy, and dynamic range of the circuits.

## Procedure

### Part 1

Two half-wave rectifier circuits are shown in Figure 1. Compare the performance of these two circuits using the Agilent function generator to provide a sinusoidal input voltage for the following conditions:

Frequency Range:	100 Hz to 10 KHz
Input Voltage Range:	100 mV to 10 V (peak to peak)
Load Resistor Values:	100, 1000, and 10k $\Omega$

**Note: This means you want a representative sample of all possible combinations of these specifications (i.e. you measure over the entire frequency range at 100 mV and 100  $\Omega$ , then perhaps at 500 mV and 100 $\Omega$ , and so on).**

Identify the principal advantages and disadvantages of each circuit and discuss the general design tradeoffs and application limits for each. Also identify any equipment or measurement limitations that you may have encountered in performing the required tests. Suggest solutions for any such problems.

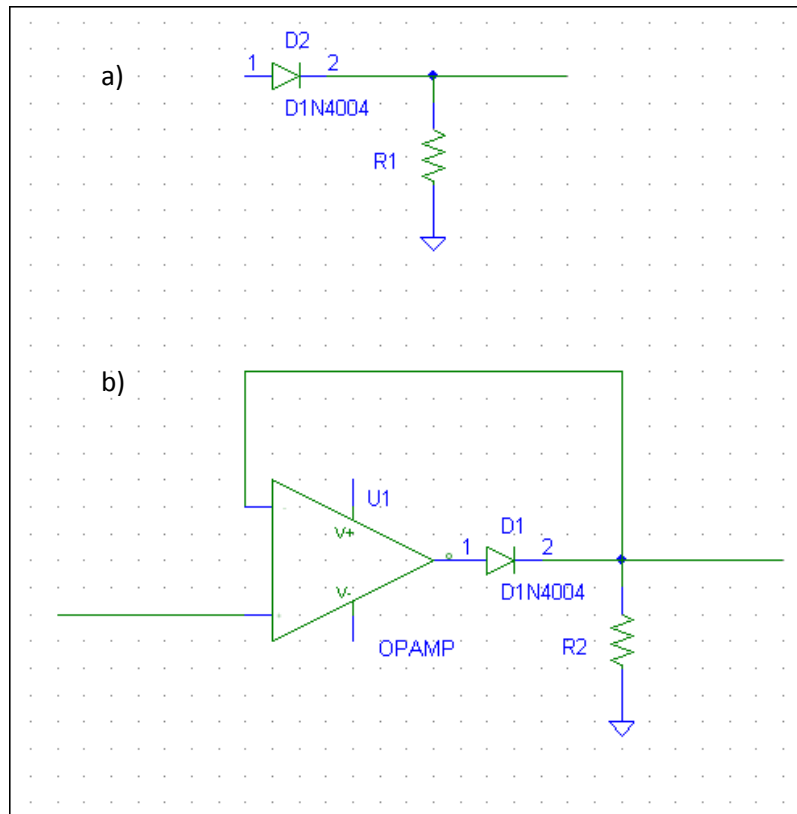


Figure 1. Two half-wave rectifier circuits.

## Part 2

After you have determined the principle limitations of the precision op amp rectifier circuit, design an improved circuit that mitigates the performance issues. Model both designs in PSpice. Construct a prototype of your new design and demonstrate its improved performance.

An improved design is available online, but you are not permitted to use this design since, hypothetically, you would be violating an existing patent for the circuit. Come up with your own improved design which you believe will not infringe.

## Deliverables

In total, you will have 3 lab sessions (i.e. 3 weeks) to complete this exercise.

### Due in 1 week:

Prepare a short report of your findings from **Part 1** for your boss. Include your discussion from the last paragraph of Part 1 (i.e. advantages, disadvantages, limits, etc) and any supporting data, figures, schematics, etc that is necessary. Submit one report per team and be sure to include both lab partners' names in the report.

*Remember:* Your boss has assigned you to investigate these two options for a half-wave rectifier because he wants to know when he should choose one over the other. Your report should explain your findings and help him decide which design to use under what conditions.

**Due date to be determined:**

Your final "report" will be a patent application covering your improved rectifier design. More details will be given in lab.