Stony Brook University

EEO335

Spring 2024

Infrared Transmitter and Receiver

Pete Mills
ID: 115009163

Professor
Gianluigi De Geronimo

March 23, 2024

Copy of Original Assignment

Assignment 6 – Infrared Transmitter and Receiver

This Assignment aims at verifying and expanding, with experiments and supporting simulations, your knowledge and understanding of the input stage of the infrared transmitters and receivers.

Please document each step with snapshots, pictures, and your observations. Please make visible on WaveForms the date and time fields (top left) and the serial number (bottom right) of your Analog Discovery. Also, please include this page.

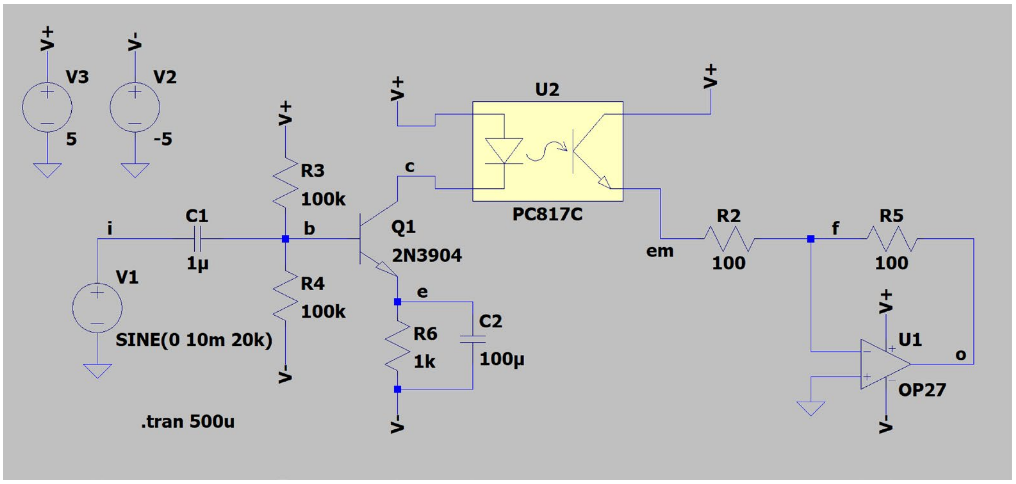

Figure 1

1) Using the simulator, design the circuit shown in Fig. 1 (the PTC817C can be found in the Optos library) (**30pts**)

a) simulate the response and calculate the gain

b) explain in your own words how the circuit operates

2) Build the circuit at (1) and experimentally reproduce the simulation by using the QED123 transmitter or similar and the QSD124 phototransistor or similar (**70pts**)

a) measure the response and calculate the gain

b) increase the input amplitude until you observe a visible distortion and report the value

Note: for maximum signal transfer consider placing the transmitter and receiver head-to-head

Overview

In this lab we explore the performance of optocouplers through experiments and simulations. We first design and simulate a circuit, then build and test it practically using specified components. Then, we measure responses, calculate gains, and note observations. This assignment aims to reinforce understanding while providing hands-on experience with infrared transmission systems.

1 Using the simulator, design the circuit shown in Fig. 1

a)

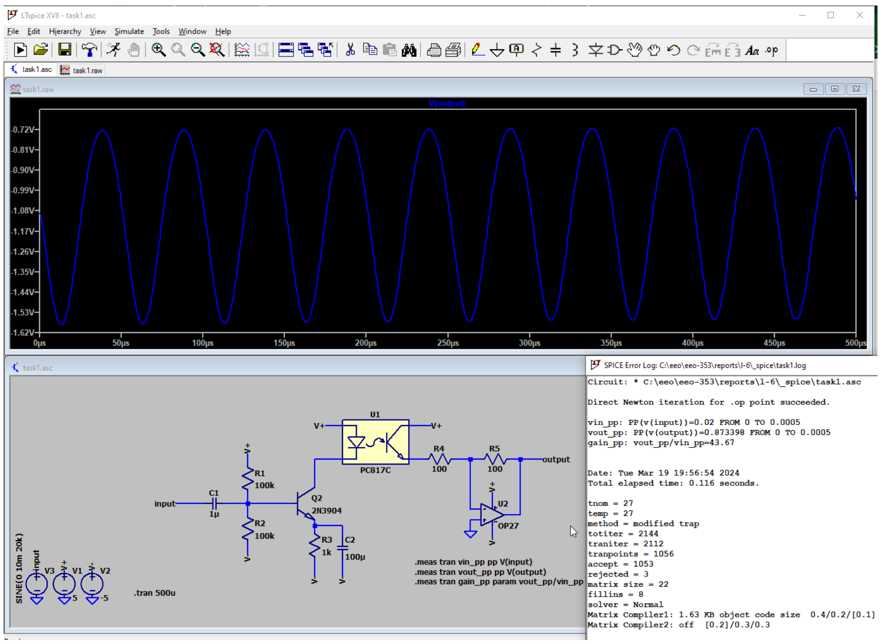

Figure 1: The simulation reveals an output gain of ≈ 43.7

b)

This circuit is an optically coupled transmitter/receiver circuit. There is no electrical continuity between the input and the output, yet a signal can still be transmitted.

First, I will describe the transmitter portion of the circuit. Capacitor C1 removes any DC voltage on the input signal and passes only AC signal. R1 and R2 are equal and thus provide a balanced bias to the input of Q2. R3 limits current in the IR LED transmitter of U1 and C2 filters the signal at the emitter of Q2.

For the receiver portion of the circuit, the IR light emitted by the transmitter in U1 falls on the 'base' of the receiver/NPN output of U1. In this way you can see that the IR light modulated from the transmitter to receiver can transmit a signal. This output is fed to U2 which is configured as an inverting amplifier configuration. With R4 and R5 being equal, it is understood the gain in U2 will be -1.

2 Build the circuit at (1) and experimentally reproduce the simulation

a)

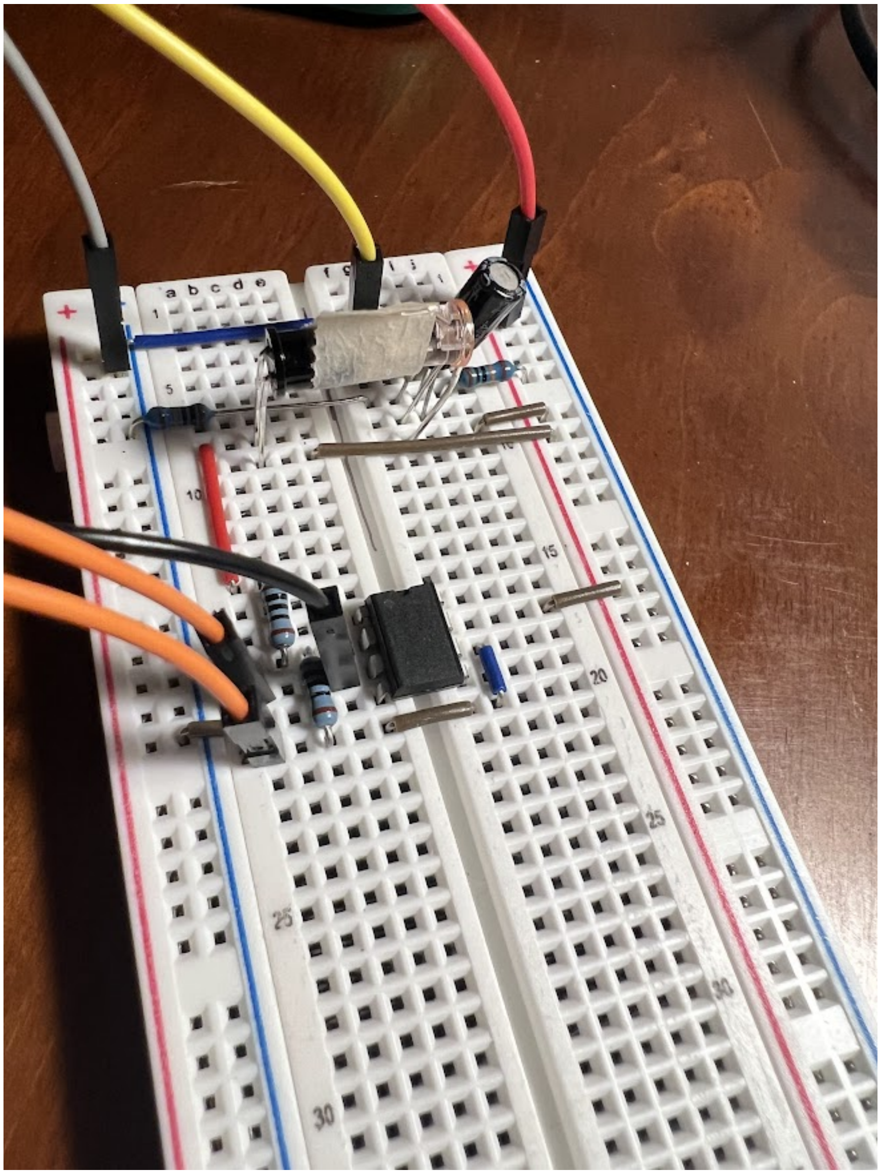

Figure 2: Experimental circuit with IR transmitter and receiver placed head-to-head.

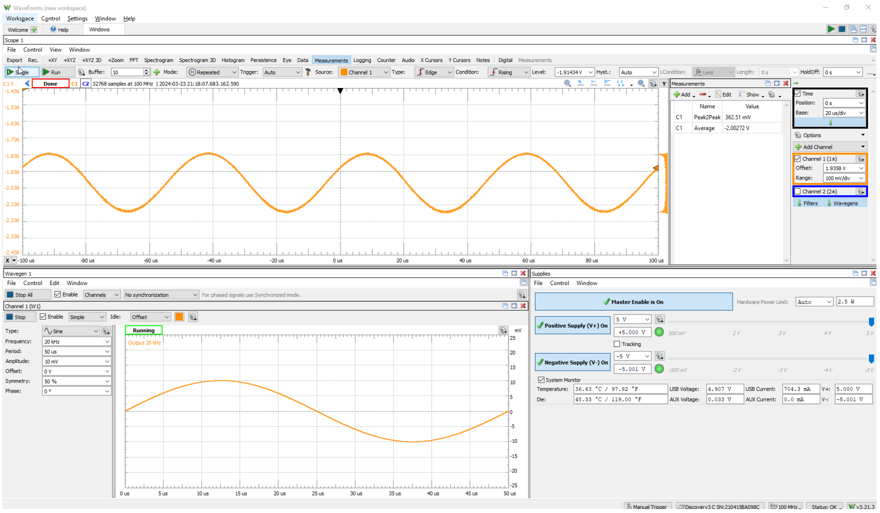

Figure 3: Experimentation reveals a system gain of ≈ 18. This is lower than the simulation, however the components in the simulation are also different to the ones used in the experiement and have different parameters leading to different gain.

b)

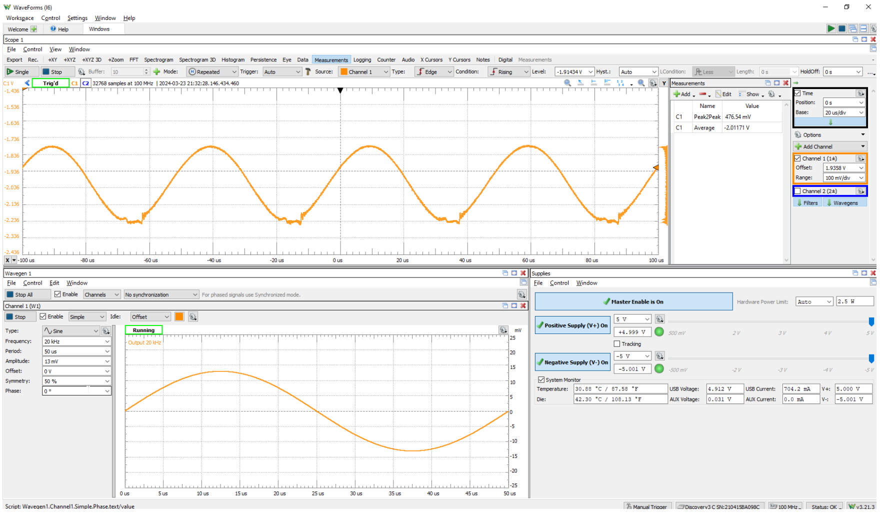

Figure 4: Noticeable output distortion occurs when the input signal reaches just 13 mV