ECE 342 Optical Link Project

LAB 1: PHOTODETECTOR AND TRANSIMPEDANCE AMPLIFIER MODULE

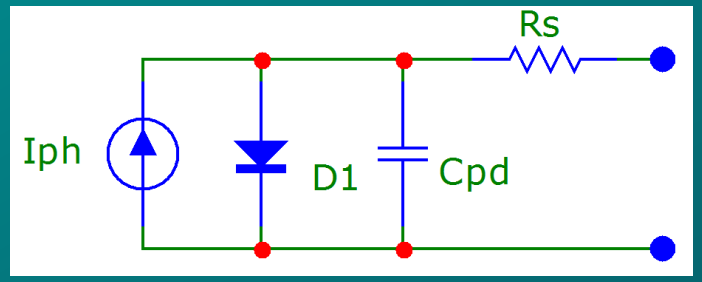
Function in the Optical Link Project

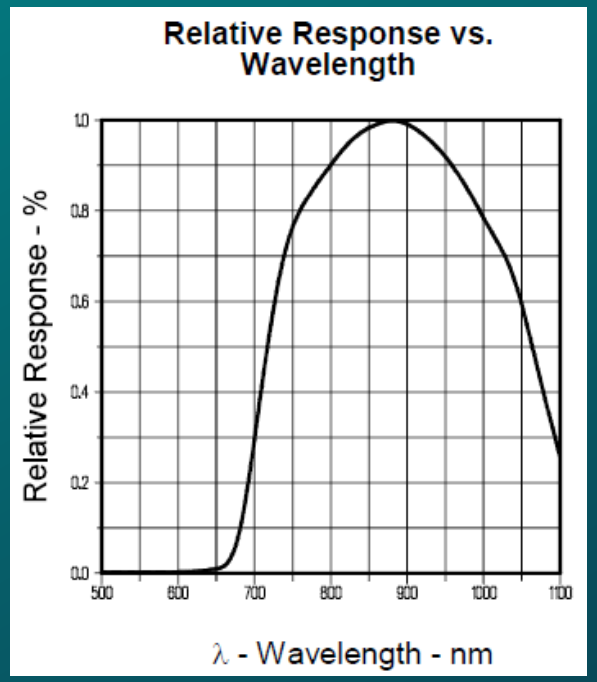
- The first stage in the receiver detects the optical signal and converts it into an electrical signal
- A photodiode will detect the optical signal, and generate a proportional current signal, on the order of a few nA
- The current signal must be converted to a voltage signal and amplified

Task Objectives

- Investigate the performance of light emitting diodes (LEDs) and photodiodes
- Choose a suitable LED and a suitable photodiode for the optical link
- Design, construct and test a transimpedance amplifier with a 3 dB cut-off frequency of 40 kHz

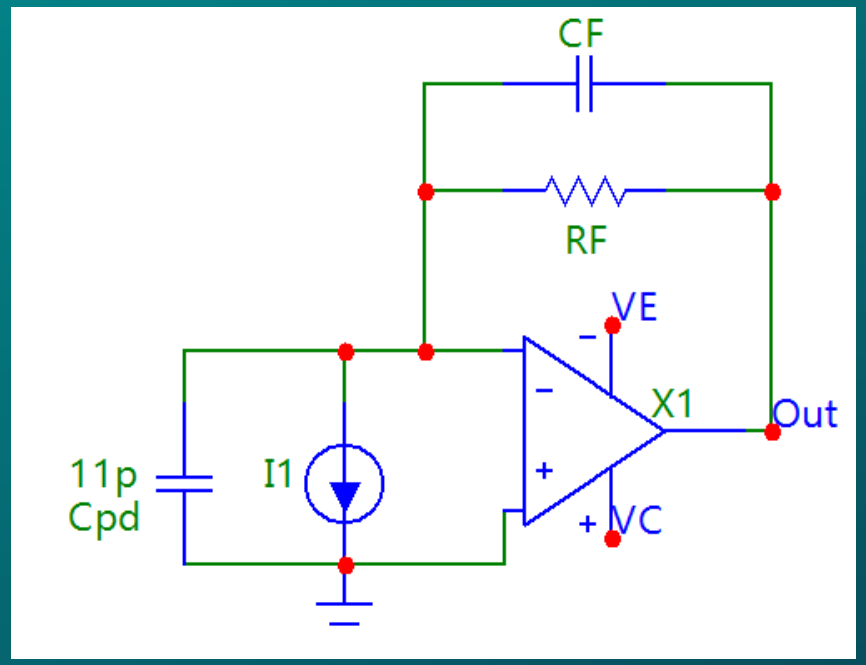
The Photodiode





- A light-dependent current source
- Responsivity, spectral response, dark current and capacitance are most important parameters
- ***Spectral response*** will determine which LED to use
- ***Dark current*** will determine ***noise floor***

Transimpedance Amplifier



- Convert current input to voltage output
- First amplifier in the receiver
  - Will set the noise floor for the receiver
  - Gain should be as large as possible for best noise performance
- RF sets the gain
- CF limits frequency response to $2f_0$, so that the amplifier remains stable
- Smallest capacitor in store: 10 pF
  - Board parasitics 1–10 pF, use 22 pF or larger

Tasks

- Design TZA for f_0 = 20 kHz using LF347
  - Will use the rest of the op-amps in the package in the following tasks
- Simulate TZA in NGSpice
  - Tweak design as necessary
- Determine which LED the PD is most sensitive to
  - Can base your choice on the information contained in the datasheets
- Measure TZA's frequency response from $0.1f_0$ to $10f_0$ at the least
  - The Analog Discovery can easily do the measurement from 100 Hz to 200 kHz in a few seconds

Tips and Tricks

- Carefully inspect the spectral curves for the blue, red and IR LEDs and compare them with that of the OP999 photodetector diode to choose the best LED
- A transimpedance amplifier needs to be driven with a current source but the available signal sources are voltage sources
  - Use a resistor to convert voltage to current
  - The value of this resistor should be larger than that of R_F, or the frequency response will be that of an inverting voltage amplifier

Lab 1 Schedule

- Friday, 1 September - Watch lab briefing before class
- Thursday, 14 September, 4:50 PM: Circuit design & simulation completed, submit notebook for inspection
- Thursday, 21 September, 4:50 PM: Experiments completed, submit notebook for inspection
- Monday, 25 September, 2:00 PM: Submit rough draft of report electronically as a PDF file to your TA
- Monday, 25 September – Thursday, 28 September: Demonstration
- Friday, 29 September, 2:00 PM: Submit final report as a PDF file to your TA