Audio Through Light

By: Stanley Weber

Project Idea

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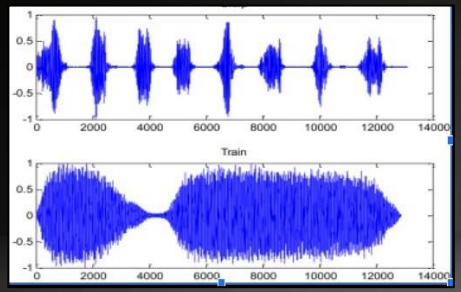
Audio Signal



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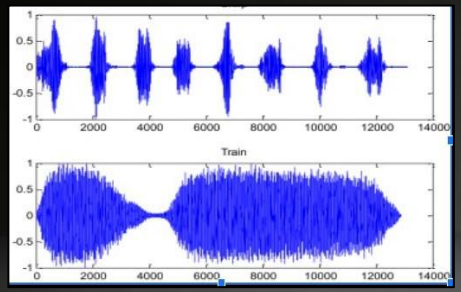

Light Signal

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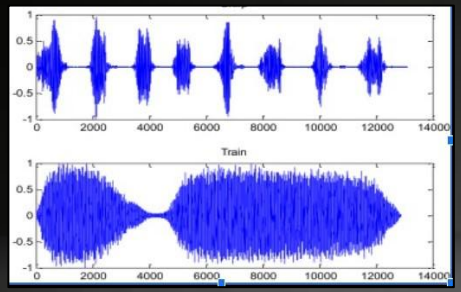
Audio Signal



Light Signal

Audio In/Out Requirements

- Output from audio source (3.5mm Jack):
  - Voltage ~2.5V Peak-To-Peak
  - Power ~ 50mW-1W
  - Frequency full audio range (20Hz - 20kHz)

- Input to speaker (3.5mm Jack):
  - Voltage Limit < 5V Peak
  - Current Limit <5A

Critical Components

- Laser Diode (#VLM-650-28- LPT)
  - Input Voltage = 3V - 5V
  - Input Current <35mA
  - Optical Power Output <1mW
  - Wavelength = 650nm

Critical Components

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- Photoresistor (#NSL-6112)
  - Resistance range = [20,100]kOhms
  - Spectral Peak = 690nm, Max/Min = –

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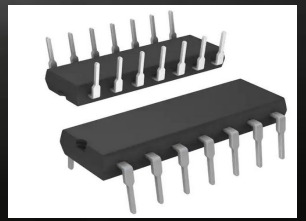
- Laser Diode (#VLM-650-28- LPT)
  - Input Voltage = 3V - 5V
  - Input Current <35mA
  - Power <1mW
  - Wavelength = 650nm
- Photoresistor (#NSL-6112)
  - Resistance range in [20,100]kOhms
  - Spectral Peak = 690nm, Max/Min = –
- Op-Amp (#LF347N)
  - High Frequency (3MHz)
  - Tx/Rx for voltage reference
  - Gain = 100dB (or V_out = 10k*V_in)

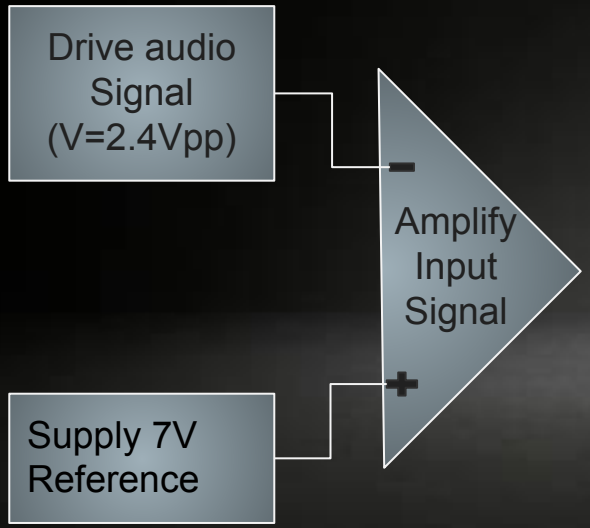


Tx - Flow

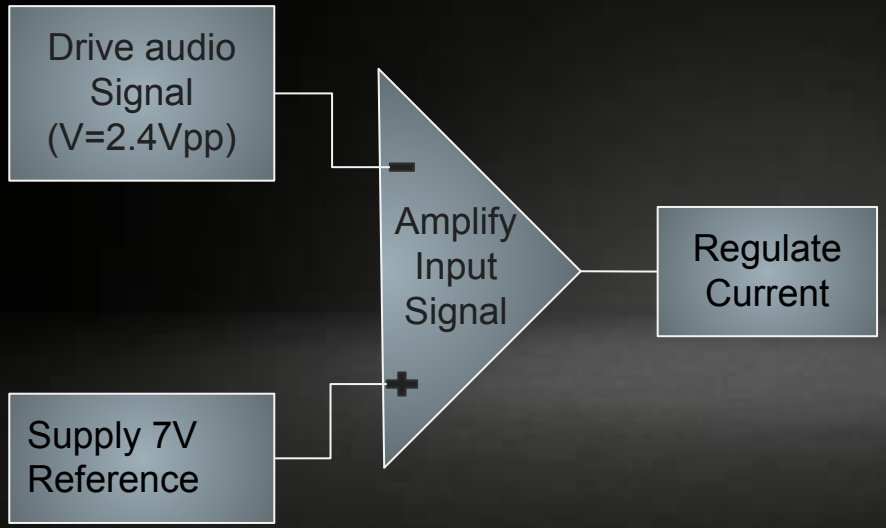
Drive audio Signal (V=2.4Vpp)

Supply 7V Reference

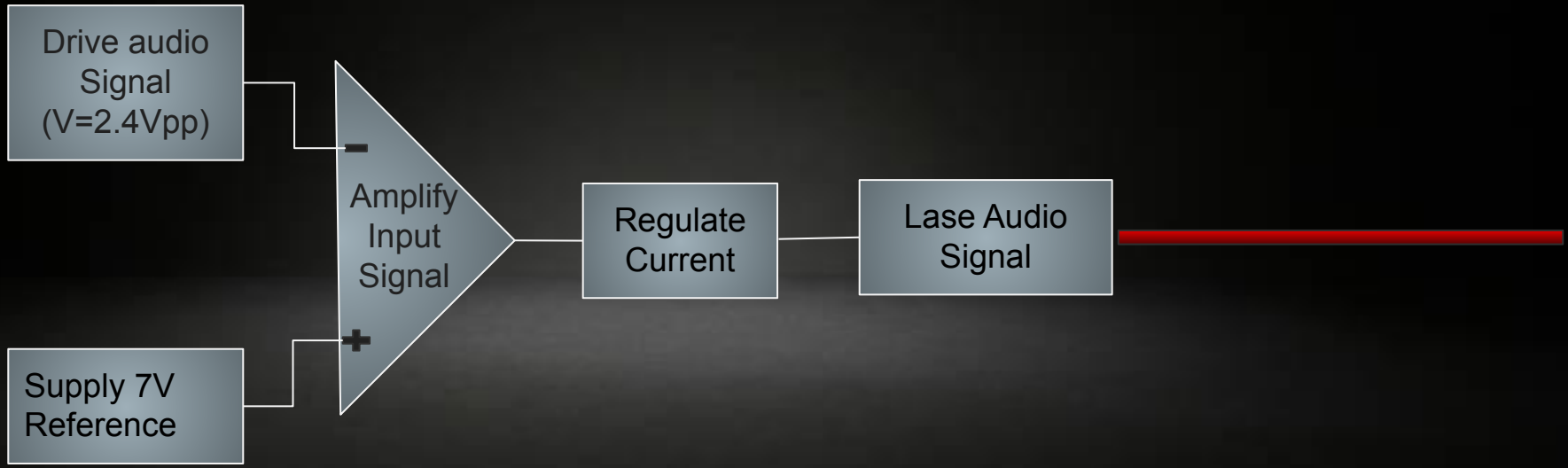
Tx - Flow


Drive audio Signal (V=2.4Vpp)
Supply 7V Reference
Amplify Input Signal
−
+

Tx - Flow


Drive audio Signal (V=2.4Vpp)
Supply 7V Reference
Amplify Input Signal
Regulate Current

Tx - Flow

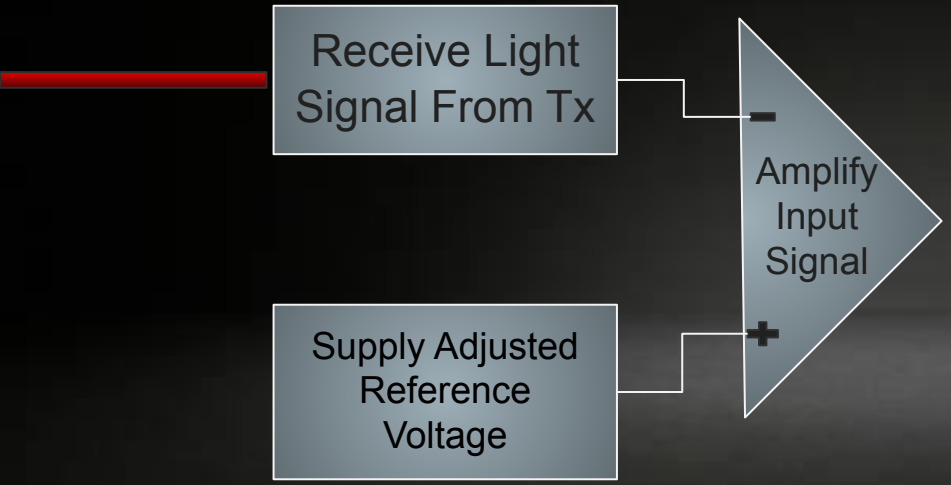

Drive audio Signal (V=2.4Vpp)
Supply 7V Reference
Amplify Input Signal
Regulate Current
Lase Audio Signal

Rx - Flow

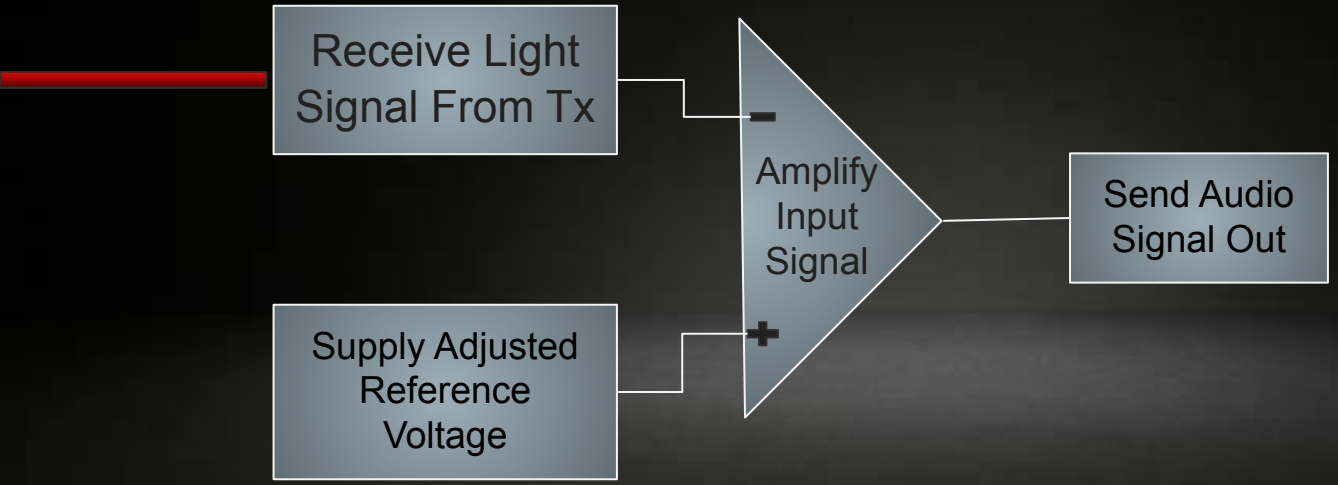
Receive Light Signal From Tx

Supply Adjusted Reference Voltage

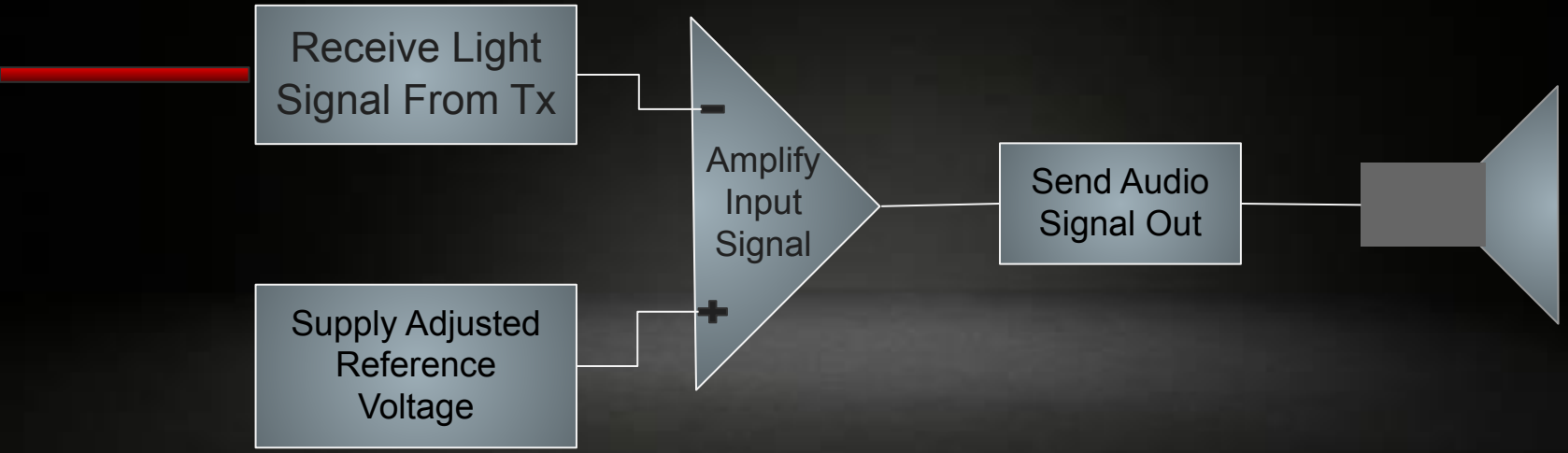
Rx - Flow


Receive Light Signal From Tx
Supply Adjusted Reference Voltage
Amplify Input Signal
-
+

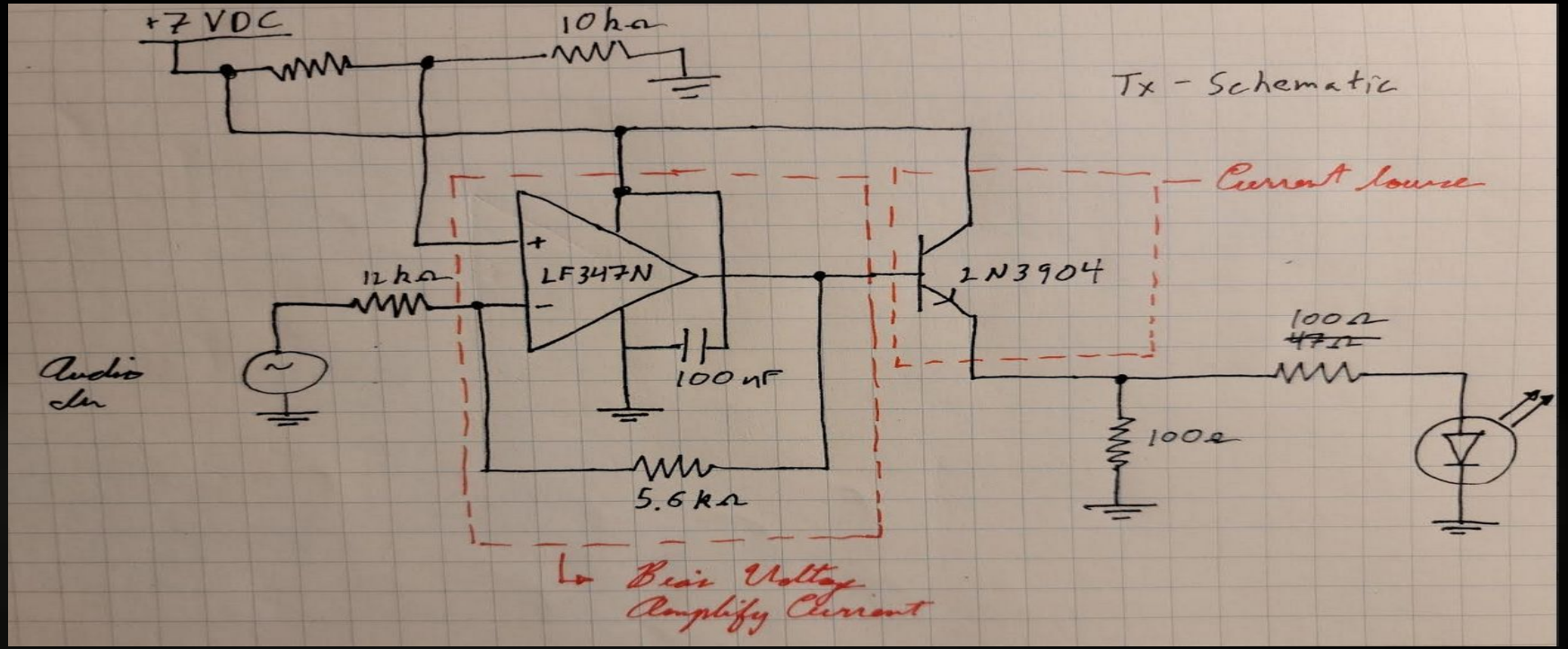
Rx - Flow


Receive Light Signal From Tx
Supply Adjusted Reference Voltage
Amplify Input Signal
Send Audio Signal Out

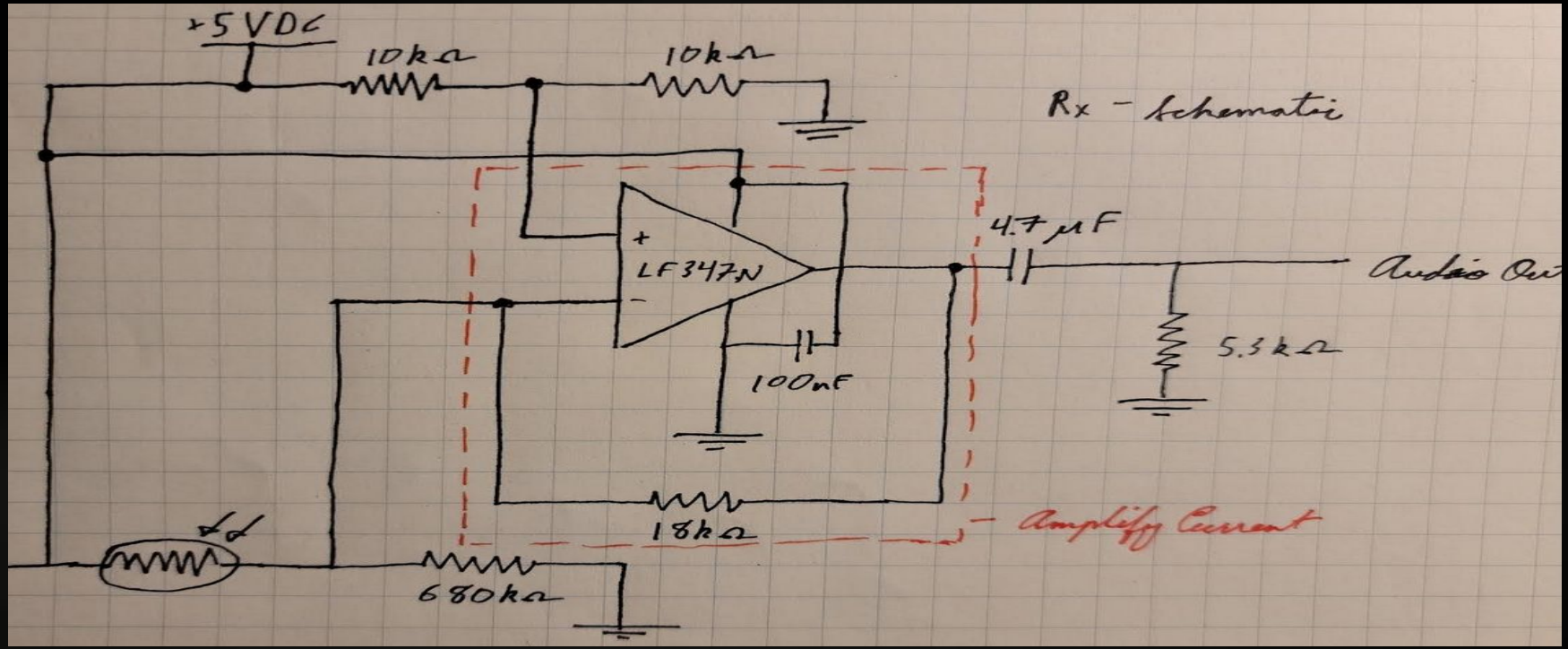
Rx - Flow


Receive Light Signal From Tx
Supply Adjusted Reference Voltage
Amplify Input Signal
Send Audio Signal Out

Tx - Schematic

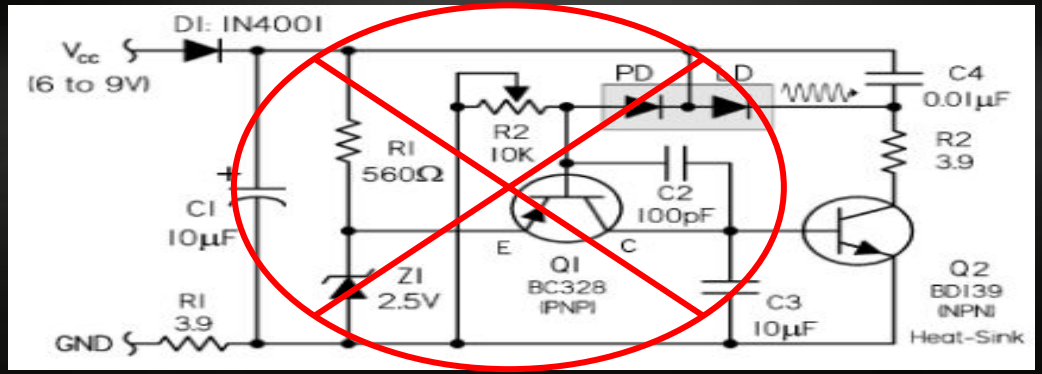


Rx - Schematic



Implementation - Tx

1. Laser Load Test
   a. Remove built-in APC driver from laser
   b. Measure resistance across the diode
   c. Drive Tx circuit with load in place of laser diode
   d. Measure output signal with oscilloscope V>0, Current < 35mA with nice sine formation throughout 20Hz to 20kHz range.

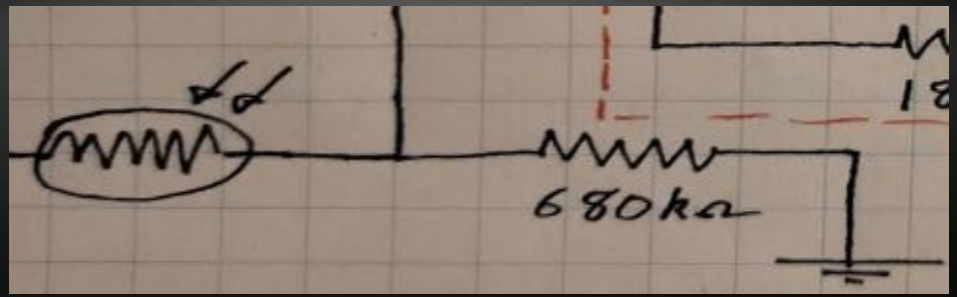


Implementation - Tx

1. Laser Load Test
    a. Remove built-in APC driver from laser
    b. Measure resistance across the diode
    c. Drive Tx circuit with load in place of laser diode
    d. Measure output signal with oscilloscope (V>0 with nice sine formation)
2. Laser Signal Test
    a. Implement laser into Tx circuit
    b. Drive circuit with a 10Hz signal
    c. Check laser for flashing light with papar
    d. Repeat for frequencies 20Hz to 20kHz

Implementation - Rx

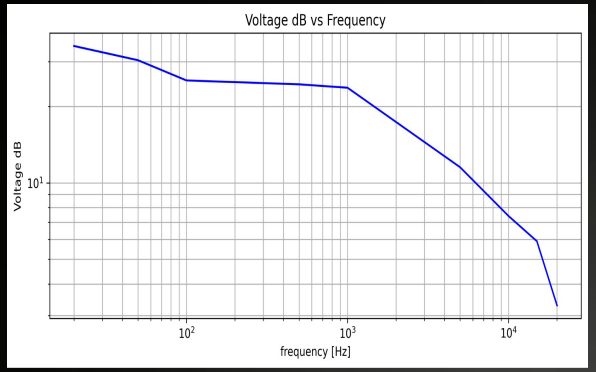
1. Photoresistor Load Test
    a. Implement a 1k POT onto input voltage divider
    b. Drive circuit with a 1kHz frequency
    c. Check that voltage output <3Vpp
    d. Adjust POT if needed
    e. Measure POT resistance and implement equivalent resistor (680kOhm)

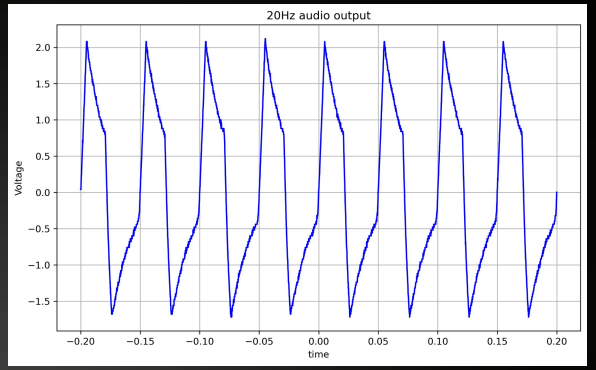


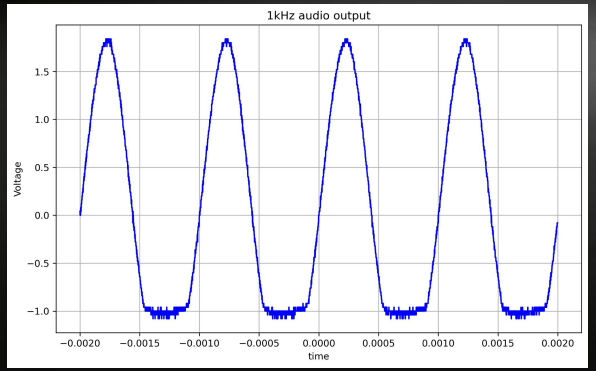
Implementation - Rx

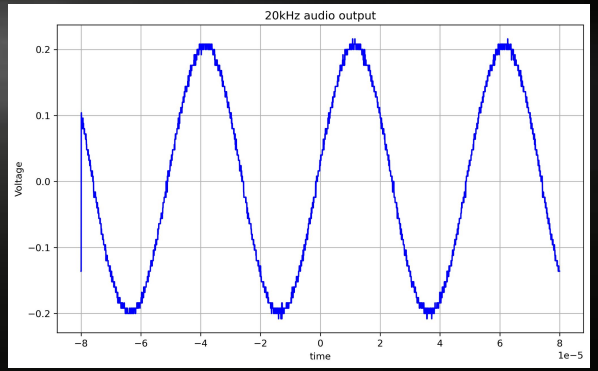
1. Photoresistor Load Test
    a. Implement a 1k POT onto input voltage divider
    b. Drive circuit with a 1kHz frequency in place of photoresistor
    c. Check that voltage output <3Vpp
    d. Adjust POT if needed
    e. Measure POT resistance and implement equivalent resistor
2. Photoresistor Signal Test
    a. Implement the photoresistor into Rx circuit
    b. Drive the circuit with laser from Tx circuit
    c. Measure and compare signal from laser to signal from Rx circuit
    d. Repeat for frequencies between 20Hz to 20kHz

Test Results









Concluding Comments

- Laser very sensitive to current and voltage input
- Photoresistor is picky on where the placement of the laser beam is on its face.
- Rx potentiometer needs to be adjusted to work with Free Space conditions
- Audio Quality is between AM and FM radio