

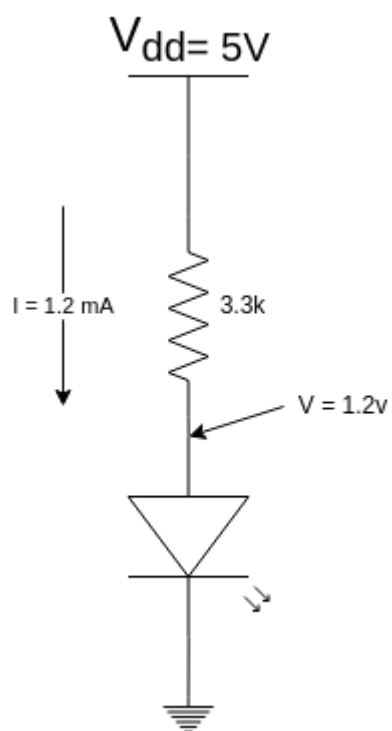
Calvin Passmore

A02107892

ECE 5420

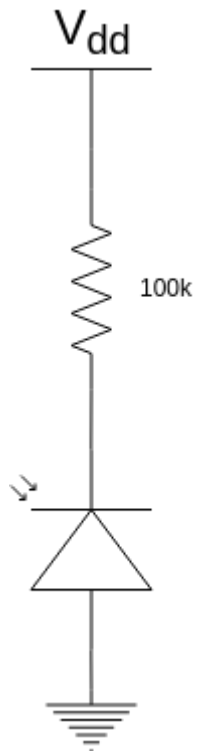
Optoelectronics Pre Lab

DC Operating Point: Transmit Side



$I_{LED} = 1 \text{ mA}$
 $V_F = 1.2 \text{ V}$

DC Operating Point: Receive Side

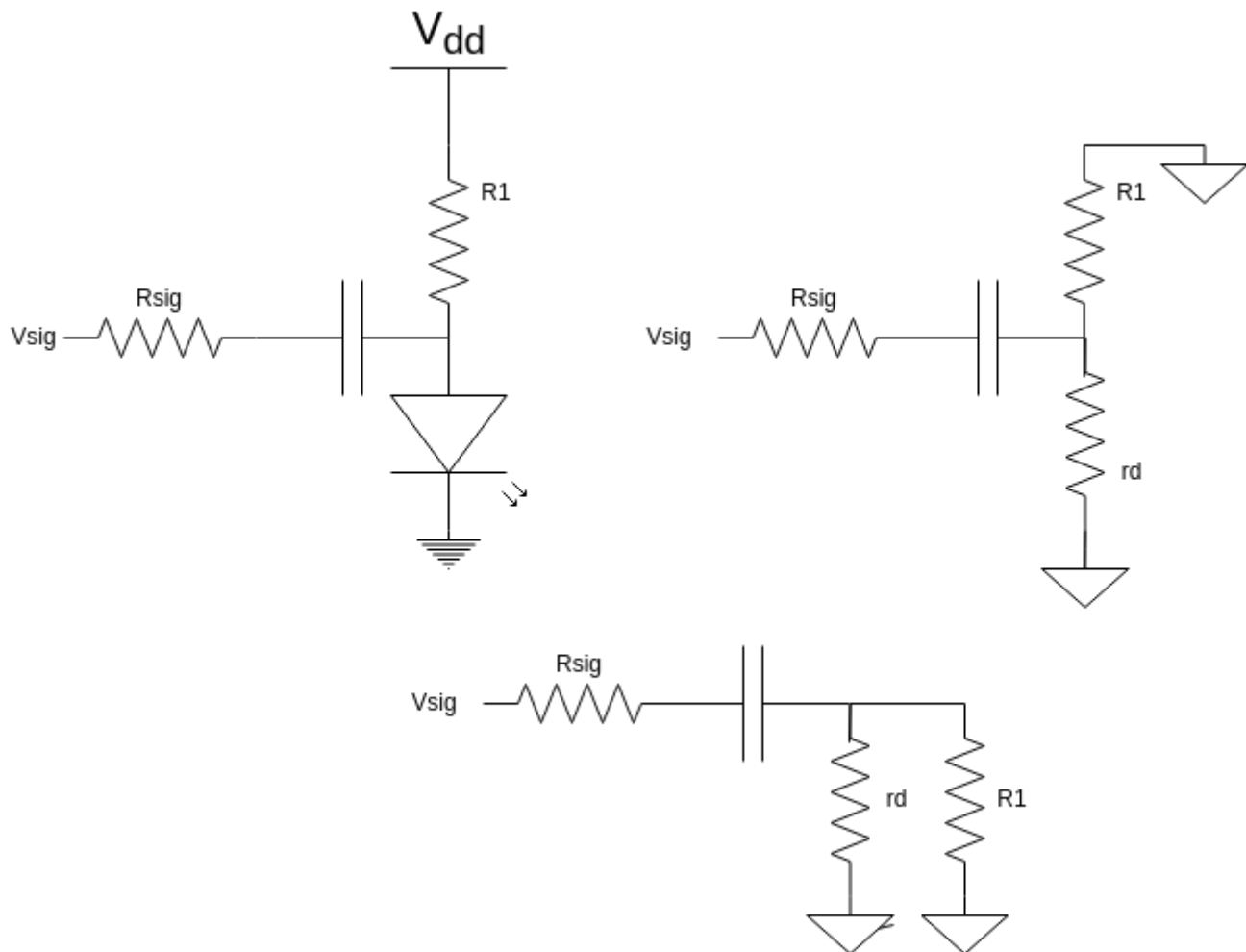


$I_{PH} = 12 \text{ uA}$
 $V_y = 3.7 \text{ v}$

Minimum Signal Frequency

Transformation

Showing the transformation of the circuit to small signal.



High-pass filter

$$H(s) = sRC / (1 + sRC)$$

$$\text{where } R = \frac{R_{\text{sig}}(R_1 + r_d) + R_1 r_d}{R_1 + r_d}$$

$$H(s) = \frac{sC(R_1 \parallel r_d)}{1 + sC \left(\frac{R_{\text{sig}} R_1 + R_{\text{sig}} r_d + R_1 r_d}{R_1 + r_d} \right)}$$

Low-Frequency Cutoff

$$f_L = \frac{1}{2\pi RC}$$

$$\text{where } R = \frac{R_{\text{sig}}(R_1 + r_d) + R_1 r_d}{R_1 + r_d}$$

$$f_L = \frac{1}{2\pi C \left(\frac{R_{\text{sig}}(R_1 + r_d) + R_1 r_d}{R_1 + r_d} \right)}$$

$$f_L = \frac{R_1 + r_d}{2\pi C [R_{\text{sig}}(R_1 + r_d) + R_1 r_d]}$$

$$R_1 \gg r_d, \text{ so } R_1 + r_d \approx R_1$$

$$f_L \approx \frac{1}{2\pi C(R_{\text{sig}} + r_d)}$$

$$C = 1\mu F$$

$$R_{\text{sig}} = 100k\Omega$$

$$r_d = 25 \Omega$$

$$f_L = 1.6 \text{ Hz}$$

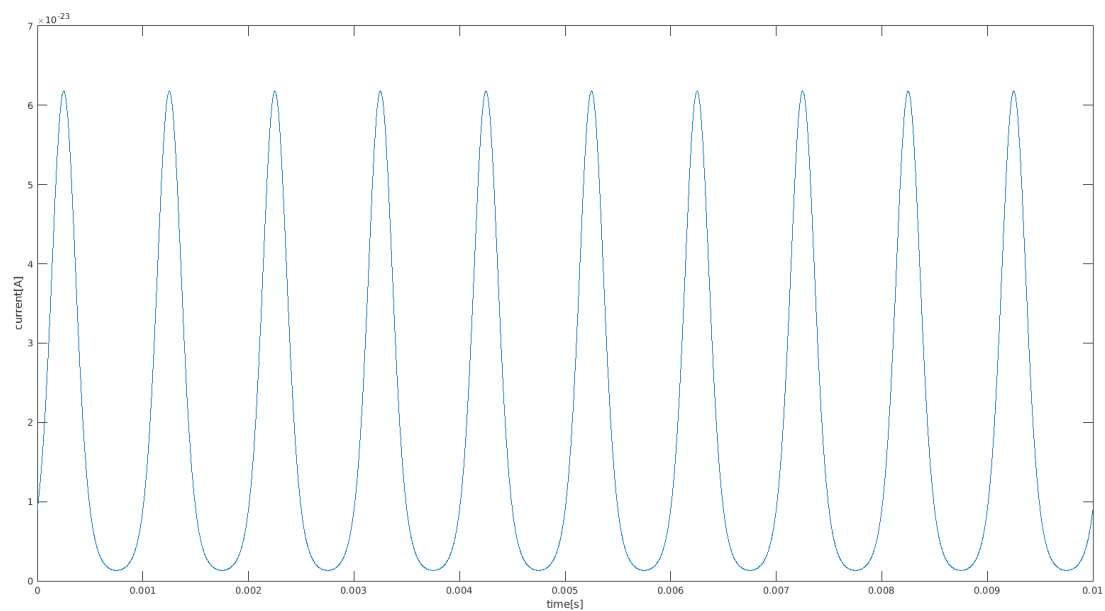
Maximum Signal Frequency

$$V_R = 3.7 \text{ V} \Rightarrow C_j = 26 \text{ pF}$$

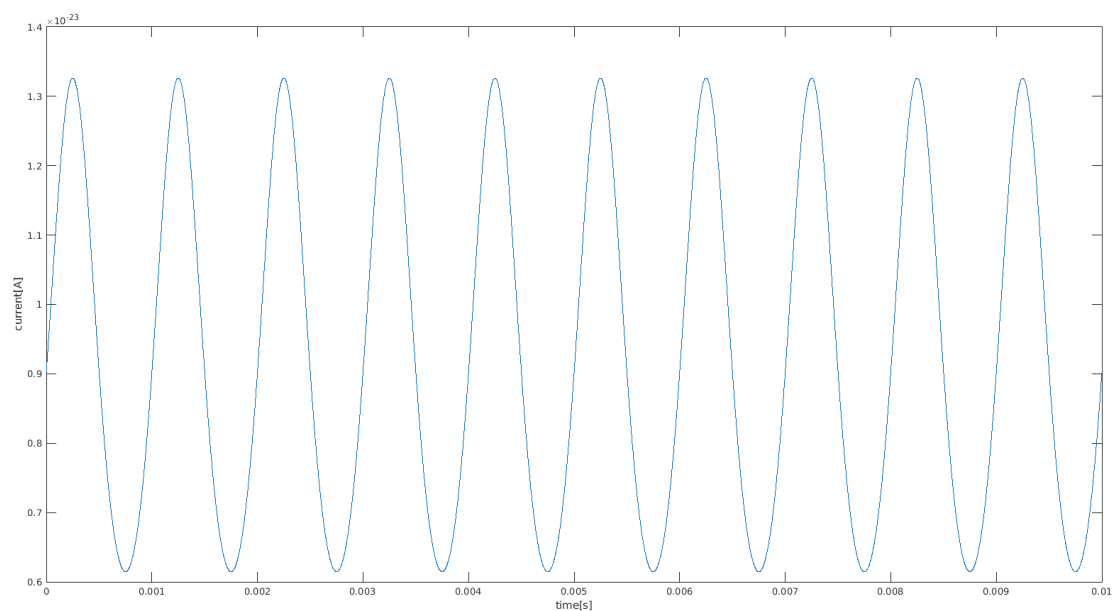
$$f_H = \frac{1}{2\pi RC} \Rightarrow f_H = \frac{1}{2\pi C(R_{sig} + r_d)} = 1.84 \text{ Hz}$$

Signal Distortion: Forward Bias LED

Forward Bias current at 0.05 v

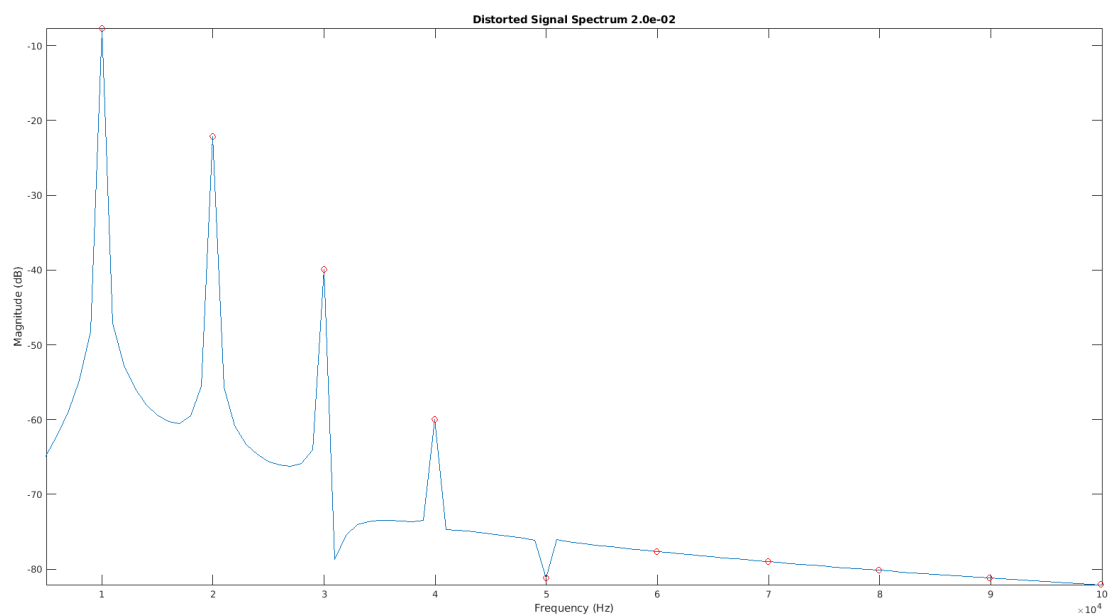


Forward Bias current at 0.05 v

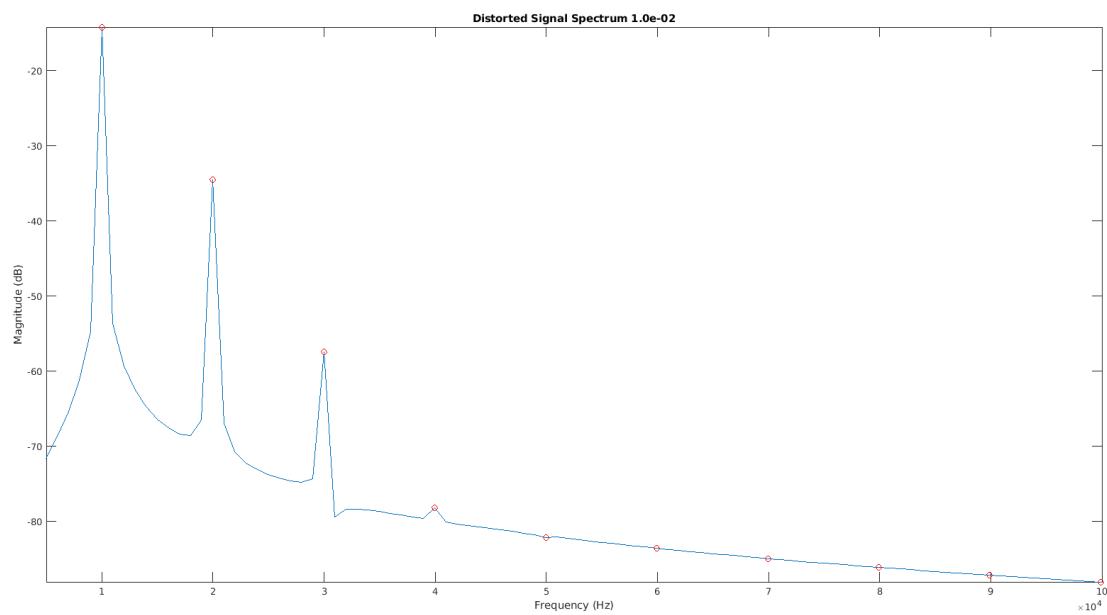


MatLab Data

```
>> plot_signal_spectrum(0.02)
THD: 17.776924%
SNDR: 14.524570 dB
```



```
>> plot_signal_spectrum(0.01)
THD: 9.486085%
SNDR: 20.388633 dB
```



```
>> plot_signal_spectrum(0.005)
```

THD: 4.997734%

SNDR: 26.366854 dB

