BME 386
PreLab4 Solutions

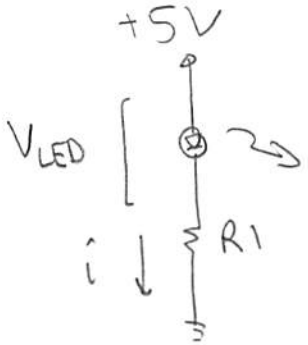
Total = 30 pts

① $5 - V_{LED} - iR_1 = 0$

$$i = \frac{5 - V_{LED}}{R_1} \approx .030A$$

$$R_1 \geq \frac{5 - 2.1}{.030} = 96.7\Omega$$

Choose $R_1 = 100\Omega$



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② Higher absorption → Lower detector current

$V_{pulse} = .002 \times 2.5V = 5\,mV$

60 bpm = 1 $\frac{beat}{sec}$

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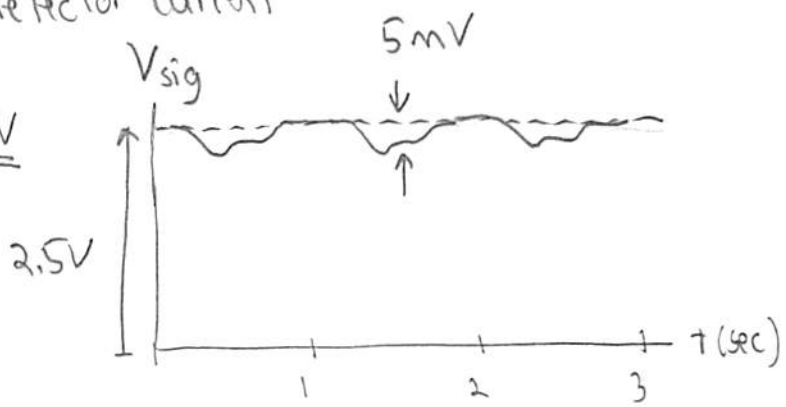

③

- RC circuit blocks the large DC component.
- op Amp circuit does two things:
  1. Amplify the pulses
  2. Suppress noise

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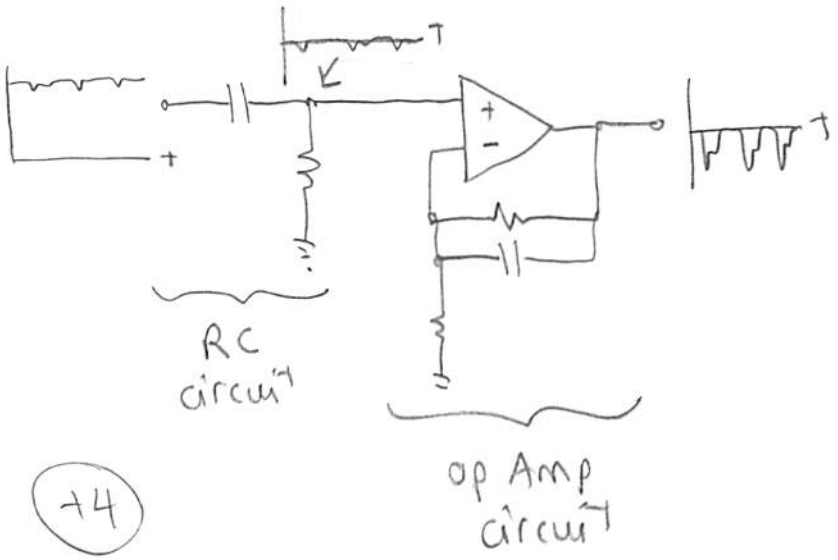
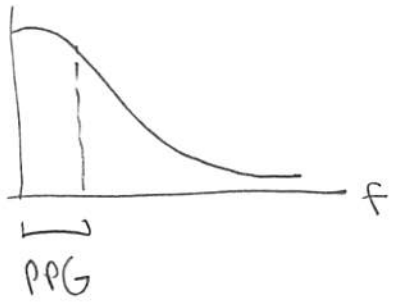


④ $G = 1 + \frac{R_2}{R_1} \frac{1}{1 + j f/f_c}$, $\frac{R_2}{R_1} = \frac{100K}{1K} = 100$

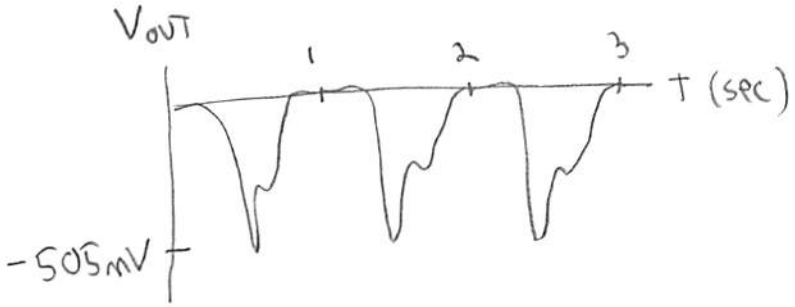
$= 1 + \frac{100}{1 + j f/15.9}$ $f_c = \frac{1}{2\pi(10^5)(.1\times10^{-6})} = 15.9\,Hz$

≈ 101 for PPG signal



$|V_{OUT}| = 101 \times 5mV$

$= 505mV$



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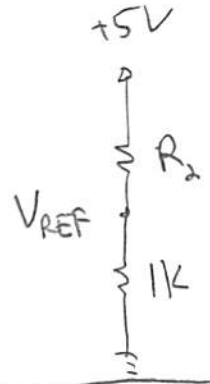
⑤ $V_{REF} = 5 \frac{1K}{1K + R_2} \approx 1V$

$5 = 1 + R_2 \rightarrow R_2 = 4K$ Choose $R_2 = 3.9K$



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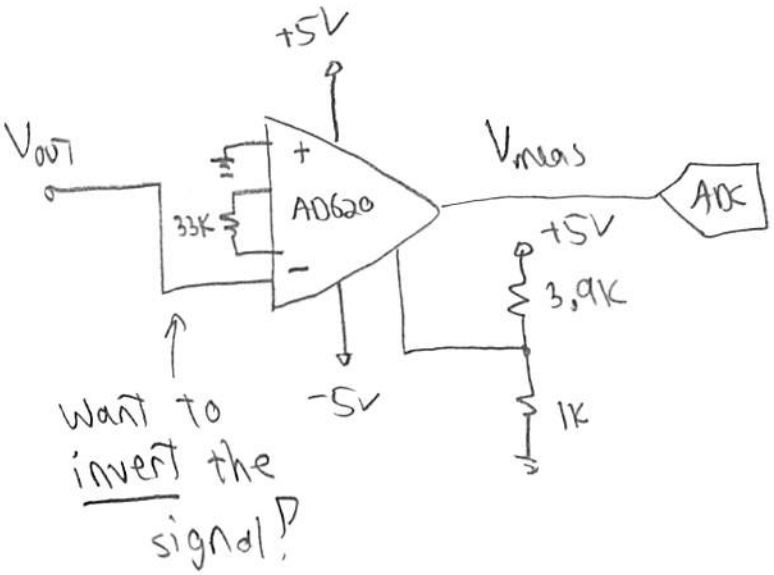
⑥



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⑦ Overall gain: $G_{Total} = G_1 \times G_2 = \boxed{252.5}$

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G_1: 101

G_2: $A_d = 1 + \frac{49400}{33000} = 2.5$

⑧ $V_{meas} = V_{Ref} + A_d \Delta V = 1 + 2.5 \times [0 - V_{out}]$

$= 1 - 2.5 \times [-505\ mV\ pulses]$

$= 1 + [1.263\ V\ pulses]$

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