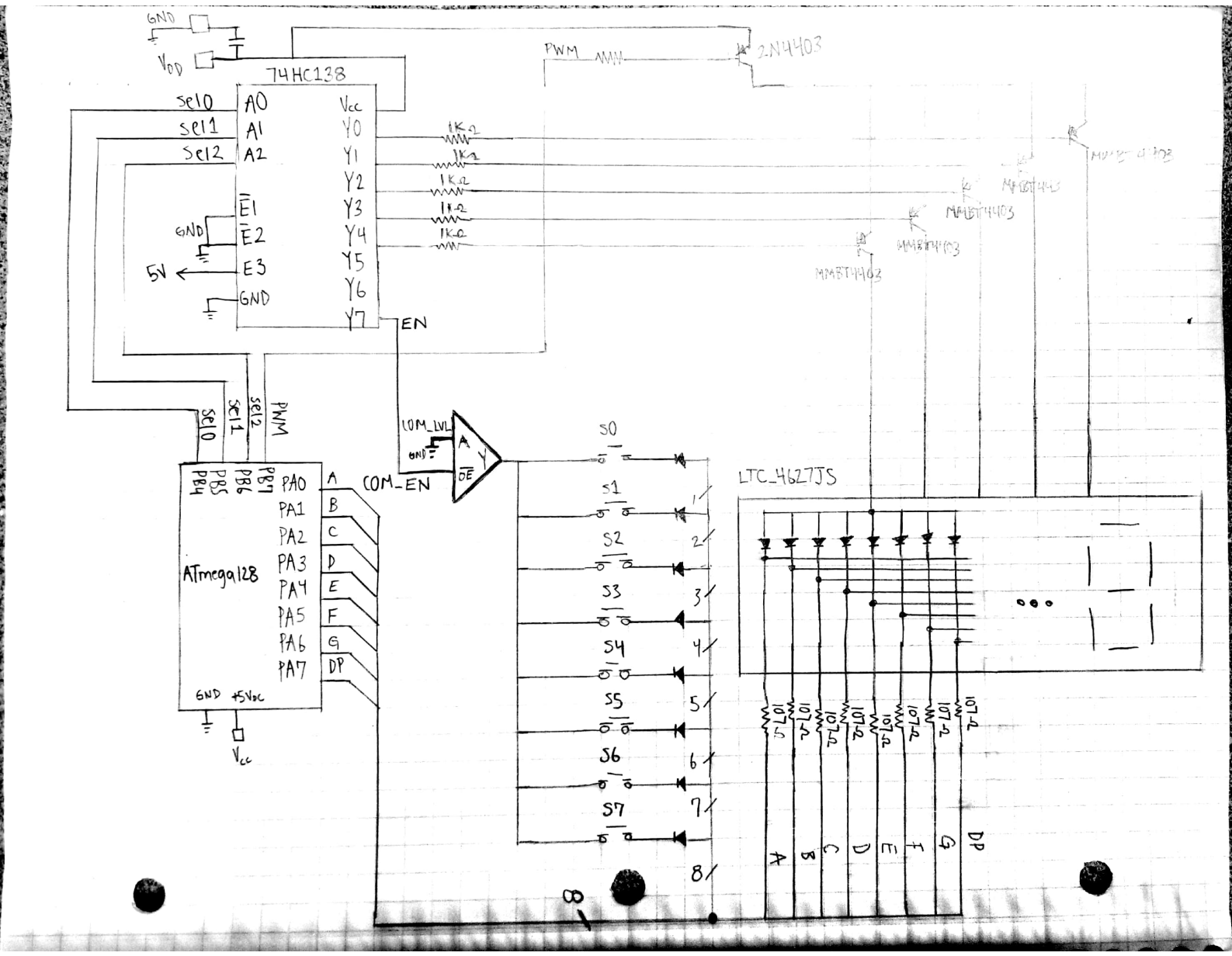
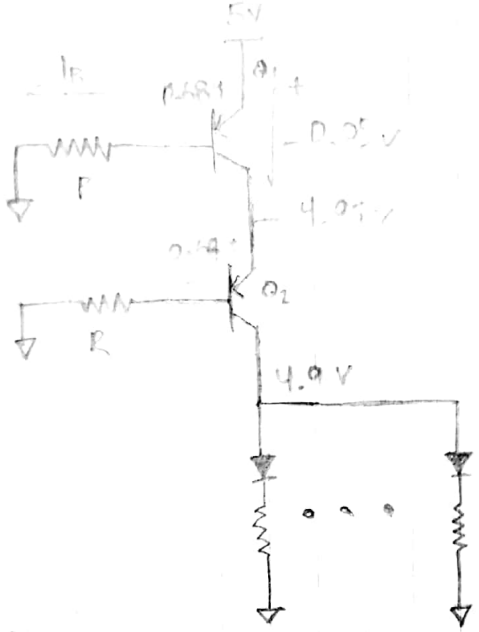


Lab 2 Calculations (Re-done)



Constraints

→ Min # of seg: 2
→ Max # of seg: 8
→ Max current $\sum A0 - A7 = 100$ mA
→ $\frac{I_C}{I_B} = 10$
→ $I_C = 44$ mA
→ $V_{BE(ON)} = 0.68$ V
→ $I_B = \frac{I_C}{10} = \frac{44\text{mA}}{10} = 4.4$ mA
→ $V_{CE(SAT)} = 0.05$ V

Q_1

$V_{B1} = 4.32$

$V = IR$

$R = \frac{V}{I} = \frac{4.32}{44 \cdot 10^{-3}}$

confirm: $-5\text{v} + 0.68 + I_B R = 0$

$I_B R = 4.32$

$R = 981.8\,\Omega \simeq 1\text{k}\Omega$ rounding up

4.32 mA

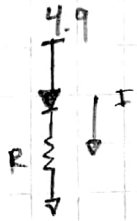
$\frac{I_C}{I_B} = 10$

$I_C = 10 \cdot (4.32 \cdot 10^{-3})$

Q_2

$V_{B2} = 4.95 - 0.68 = 4.27$

$R = V/I = \frac{4.27}{4.4\text{mA}} = 970\,\Omega \simeq 1\text{k}\Omega$



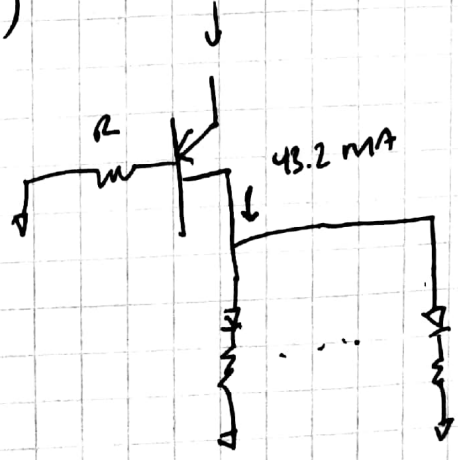
$I = 22$ mA

$V_f = 2.05$ V

$4.9 - 2.05 = 2.85$

$V = IR$

$R = \frac{V}{I} = \frac{2.85\text{ V}}{22\text{ mA}} = 130\,\Omega$



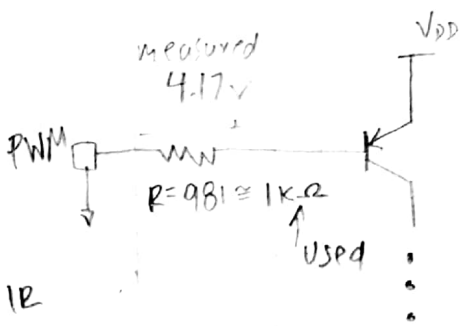
$\frac{I_C}{I_B} = 10$

$I_B = \frac{I_C}{10}$

$4.32 \cdot 10^{-3}$

Voltage Measurements + Current

1st PNP



$V = IR$

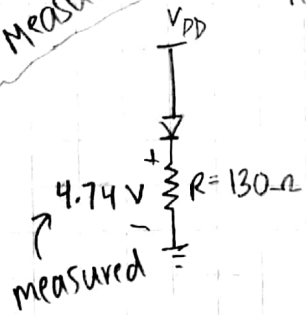
$I = \frac{V}{R} = \frac{4.17\,V}{1000\,\Omega} = 4.17\,mA$ ↑ Actual

vs.

4.47 mA ↑ Estimated } dev. of 0.27 mA

Segment Measurement

*Tested using the #1



$I = \frac{V}{R} = \frac{4.74\,V}{130\,\Omega} = 36.4\,mA$ ↑ Actual V_s Expected ↓ 22 mA } dev of 14.4 mA

Note: This is when current across each segment is highest because we are outputting a minimum of two segments.

Absolute MAX should be 25 mA.

Condition A0-A7 current MUST not exceed 100 mA

since I_C was selected to be 44 mA, then condition is satisfied. 44 mA < 100 mA

Duty Cycle

Duty Cycle:

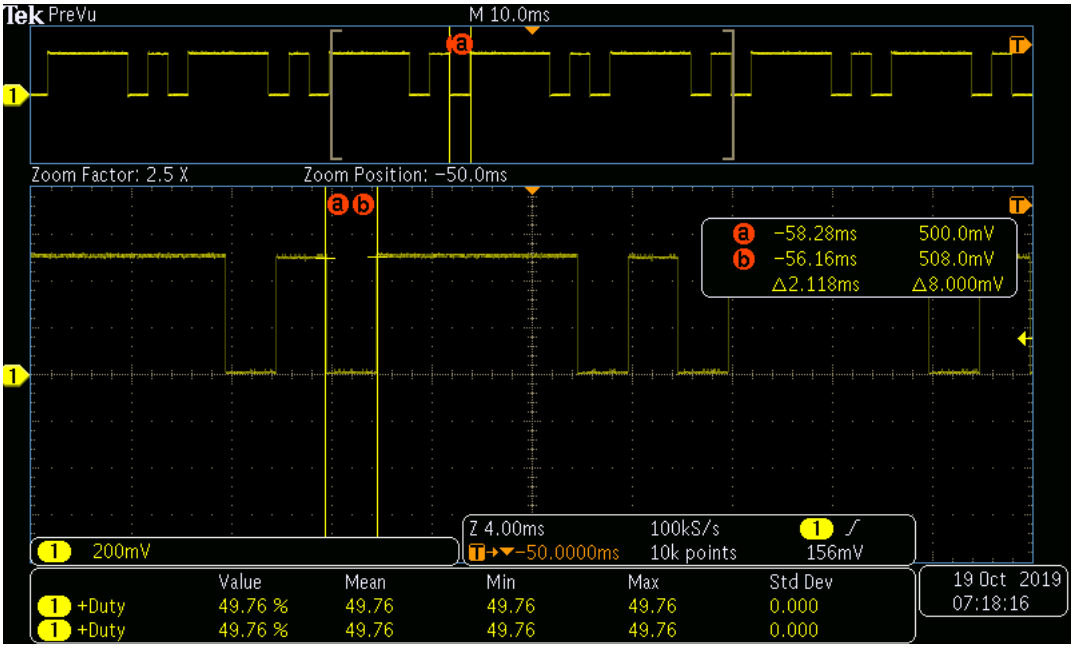


Figure 1: Measuring OO State of the Segment

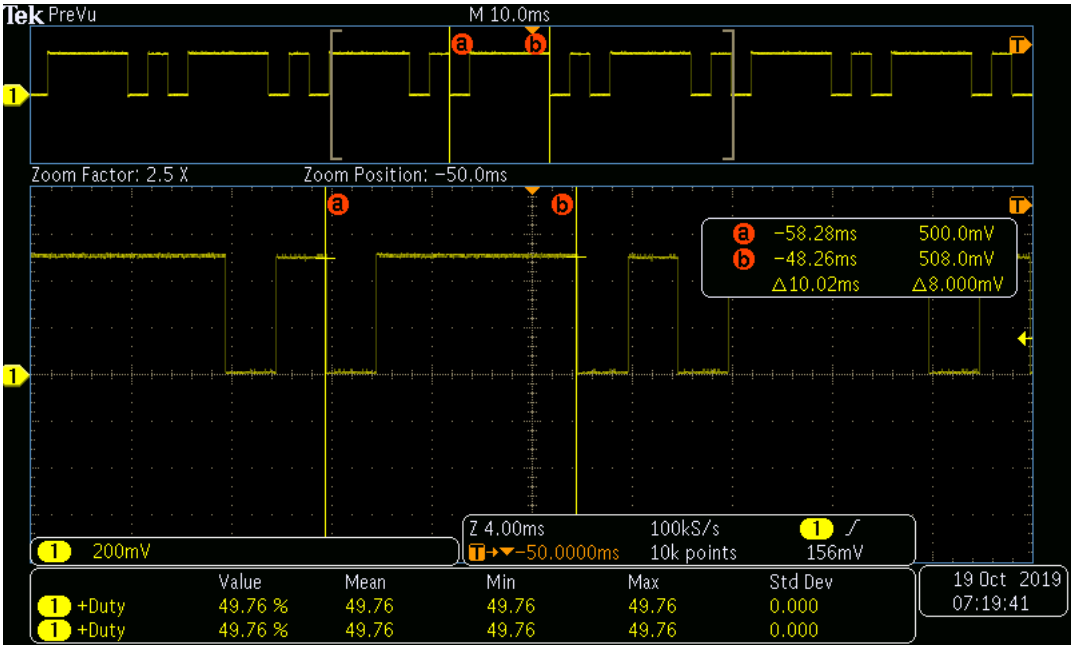


Figure 2: Measuring Full Cycle of Segment

Calculation:

Duty Cycle = ON state/Full Cycle = 2.11/10.02 = 0.21 = 21%
Duty Cycle = 21%