ECE 473 Lab 2 – Calculations, notes, questions

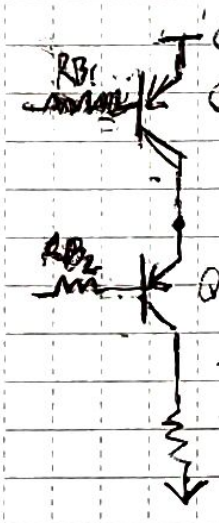
74hC138:
IL max = 6μA
sink/source per pin: 25mA
VCC = 7(max)

→ current of I/O ports → 40mA
- BJTs → use as switches (op as saturation)
- max V_{peak} voltage - 6V
- forward current (from TIEKbots datasheet) → 60mA
- continuous fwd current per seg (from tekbots datasheet) → 25mA
- each I/O port can sink 20mA @ VCC = 5V
  10mA @ VCC = 3V
- Reverse current 100μA

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

$\frac{I_C}{I_B} = 100$

-Each pin can sink 20mA of current
- The peak fwd current of each segment is 60mA
- The continuous fwd current of each segment is 25mA.
  We want to limit current to 20mA max running into Port A



2N4403: β = 100 : I_C min = 10mA
I_C max = 150mA *

MMBT4403: β = 100 I_C min = 10mA *
I_C max = 150mA

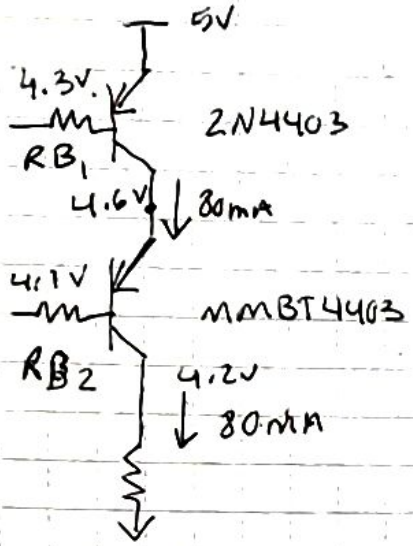
* The min and max vals are from pg datasheet to get a value of β = 100

1 SQUARE = _____

ECE 473 Lab 2 - calcs, notes, q's (contd)

2N4403:	MMBT4403:
$I_B = 2mA$	$I_B = 2mA$
$I_C = 80mA$	$I_C = 80mA$
$\beta = 100$	$\beta = 10'$

$I_C = \beta I_B$ $\quad I_B = \frac{I_C}{\beta}$



The display needs a continuous load current of 25 mA to power on per seg

Max 8 segments on $10mA * 8 = 80mA$

Pwm = 5V

MMBT4403: Given the desired I_C of 80 mA, according to the datasheet the I_B for "turn on" should be around 2mA $V_{be} = \sim 0.6 - 0.7$, $V_{ce} = 0.1V$

2N4403: $V_{ce\ sat} = \sim 0.2mA$ · 100 mA then $I_B = 1.0mA - 2mA$
$V_{be} = \sim 0.75 - 0.9$

R30: $\frac{5V - 0.7}{2mA} \rightarrow \sim 2.2k\Omega$ [2.1k → 2.3kΩ]

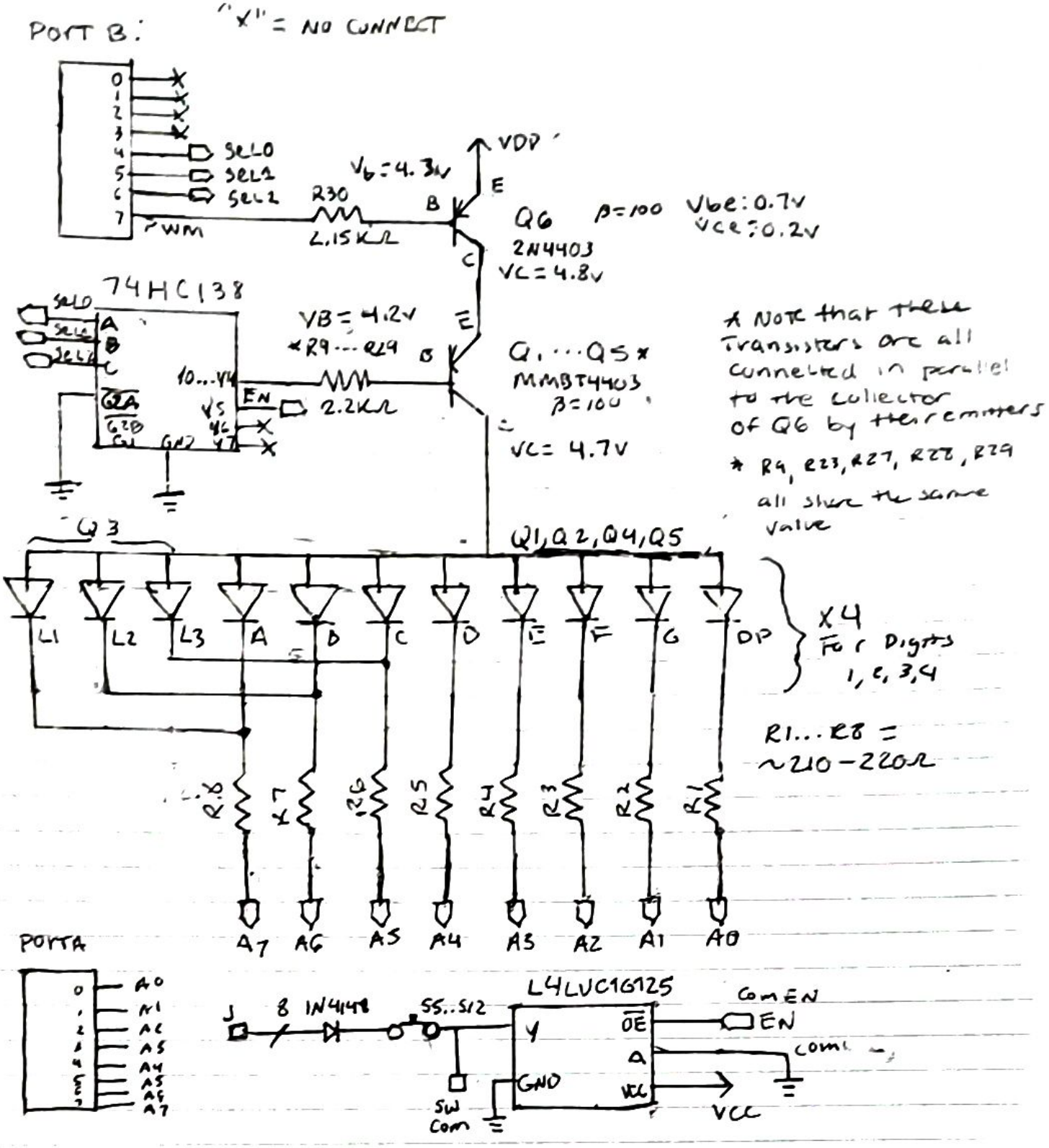
R29 = R9: $\frac{4.8 - 0.5}{2mA} \rightarrow \sim 2.2k\Omega$ [2.1kΩ → 2.3kΩ]

R1–R8:
- output of segments total (worst case) = 80 mA
- The max current the Parts can sink/supply = 20mA
- $V_F = 1.8V$ for 10mA (2.6V max drop per seg)

$\frac{4.8 - 2.06}{10mA} \rightarrow$ R1 ... R8 = ~ 210 - 220Ω

1 SQUARE = _____

ECE 473 Lab 2 schematic



1 SQUARE =

ECE 473 Lab 2

a) PORT A can sink a maximum of .60 mA (20mA per pin). In this case its not overloaded because at maximum the collector current TO each pin should be around 10mA according to my calculations (on the other pages :D).

b) The current from the collector is within the forward current range (10-20mA) needed to drive each segment on the display. Forward current is the necessary current to power on an LED. So since we meet the forward current requirements, the segments will light (assuming the BJT stays in saturation.)

c) In addition the tristate buffer is grounded through pin A. When $\overline{OE}$ is H and A is grounded the output is a high impedance off state. When $\overline{OE}$ is L and A is grounded the output to the switches is low. In order to control the input on the $\overline{OE}$ pin, we can attach it to one of the unused outputs of the CD74HCT138 decoder on the display board. We can toggle these outputs via the seg0, seg1, seg2 address pins.

1 SQUARE = _____