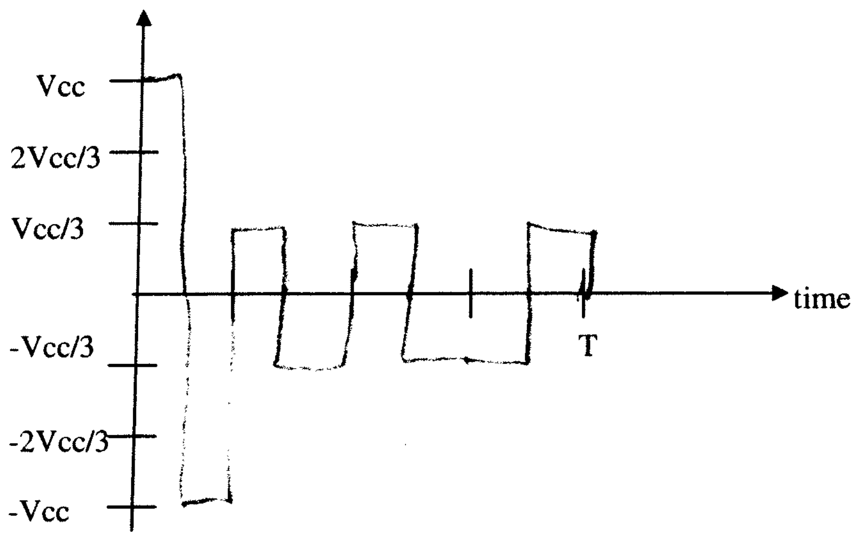
Quiz 11

ECE331 Class Quiz #~~13~~ 11 3 points maximum (Lecture 11 Microcontroller Interfacing)

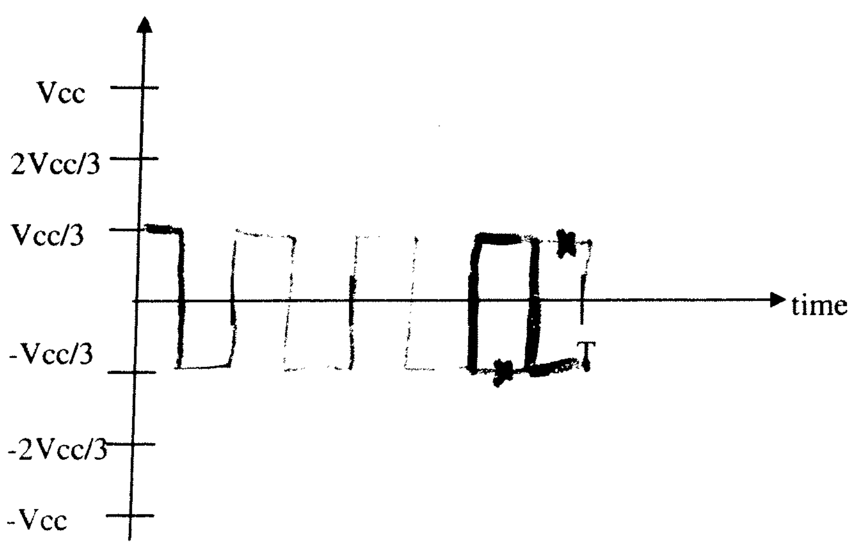
Name: ______________________ ________________ CM Box: __________

1) (1 pt) Recall that in Lecture ' Slide #12, for the case of 1:4 multiplexing discussed in class, the front plane voltage wave m "(f)" corresponds to Segment 1, 2, and 3 ON and Segment 4 off. Let us call this waveform "FPi(f)"
   a) Sketch 1 period (from t = 0..T) of the voltage waveform that exists across Segment 1. This is the segment that is driven by this FPi(f) waveform and the Backplane 1 waveform. Next, sketch 1 period of the voltage waveform that exists across Segment 4.

Vseg1 = (BP1 – FPi(f)), the voltage across Segment 1 of FPi (f)

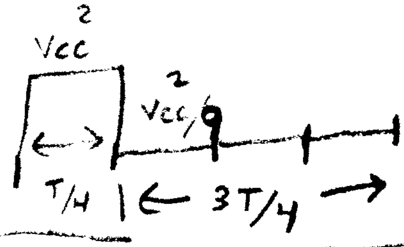


Vseg4 = (BP4 – Fpi(f)), the voltage across Segment 4 of FPi (f)

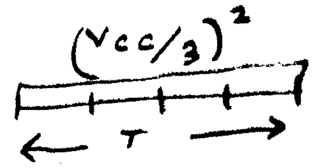


b) Find the RMS voltage of the Segment 1 and Segment 4 waveforms obtained in Part (a), assuming that Vcc = 5.0 Volts. Show your calculations clearly in the space below.

$V_{seg_1}^2$:



$V_{seg_2}^2$:



$$V_{seg_1, RMS} = \sqrt{\frac{1}{T}\int_0^T V_{seg_1}^2 \cdot dt} = \sqrt{\frac{1}{T}\left[V_{cc}^2 \cdot \frac{T}{4} + \frac{V_{cc}^2}{9} \cdot \frac{3T}{4}\right]} = \sqrt{V_{cc}^2\left[\frac{1}{4} + \frac{3}{36}\right]} = \sqrt{\frac{V_{cc}^2}{3}}$$

$$= \sqrt{\frac{(5)^2}{3}} = \sqrt{\frac{25}{3}} = 2.886\,V$$

$$V_{seg_2, RMS} = \sqrt{\frac{1}{T}\left[T \cdot \frac{V_{cc}^2}{9}\right]} = \sqrt{\frac{V_{cc}^2}{3^2}} = \frac{V_{cc}}{3} = \frac{5}{3} = 1.667\,V$$

Vseg1 = 2.886 V,rms

Vseg4 = 1.667 V,rms

c) From the LCD contrast plot presented on an earlier slide, an LCD segment is ON (dark) if its periodic segment voltage is greater than 2.8 V,rms. Likewise a segment is OFF (light) if periodic segment voltage is less than 1.7 V. rms.

d) Indicate the state of Segment 1 and Segment 4 (ON or OFF) based upon your answers to Parts (b) and (c) above.

Segment 1 state ON (dark)
Segment 4 state OFF

e) An LCD display has 416 segments. How many connections need be made to the LCD display if no multiplexing (1:1 multiplexing is used)? 417

$416 + 1 = 417$

How many connections need be made to the LCD display if 1:4 multiplexing is used? 108

$4 + \frac{416}{4} = 104 + 4 = 108$

How many connections need be made to the LCD display if 1:6 multiplexing is used? 76

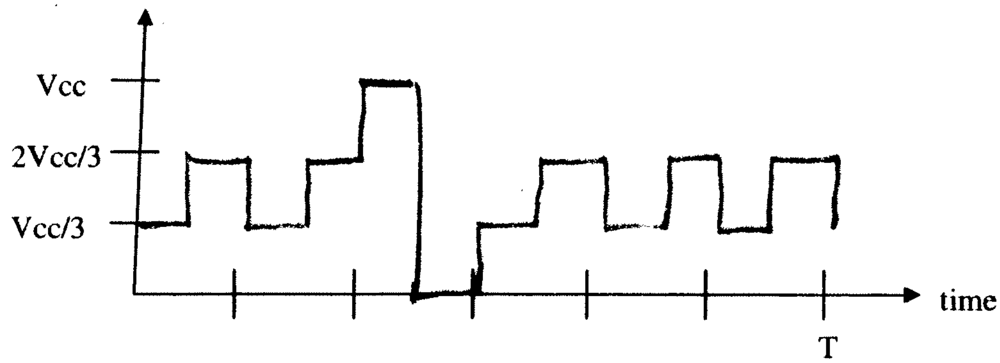
$6 + \frac{416}{6} = 6 + 69.33 = 76$

"rounded" "up" to 70

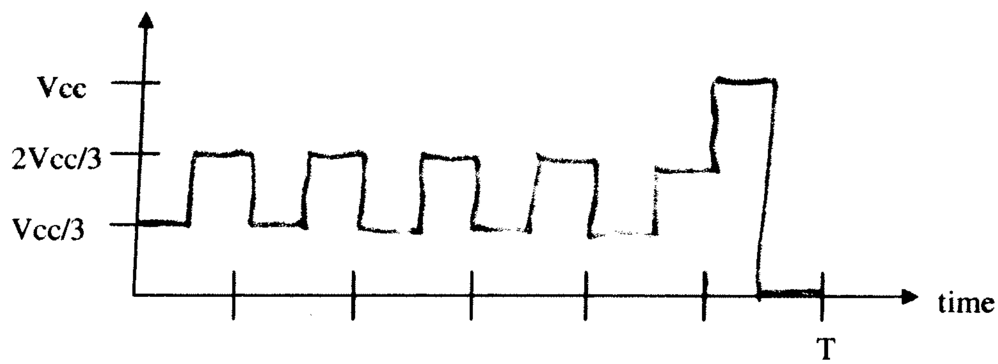
2) (1 pts) Now consider a 1:6 multiplexed display (with 6 backplane signals). The backplane voltage waveforms will still take on the same 4 discrete voltage values as before, and they follow in the same pattern as before.

a) Sketch one period (from t = 0..T) of the BP3 signal and the BP6 backplane voltage waveform below. Also sketch one period of the FPi signal that turns ON the segments over BP1, BP3, and BP5 and turns OFF the segments over BP2, BP4, and BP6.

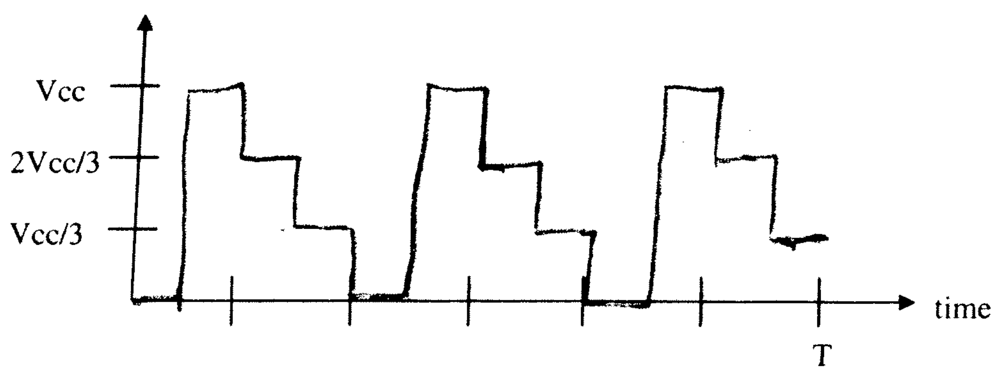
BP3



BP6

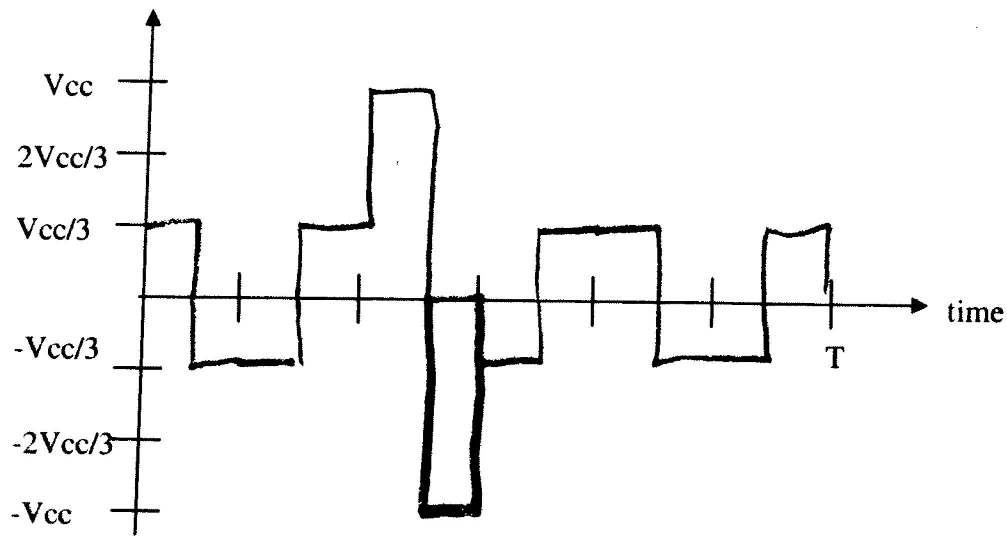


FPi (This waveform should turn ON Segments 1,3,5 and turn OFF Segments 2,4,6)

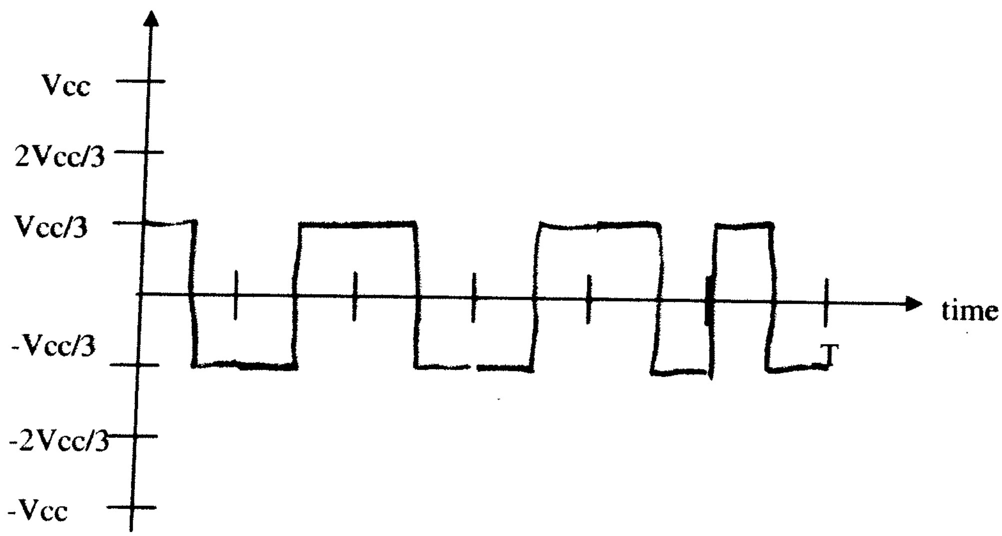


b) Sketch one period of the electrode voltage across segments 3 and 6.

(BP3 – Fpi) Segment 3 periodic voltage waveform



(BP6 – Fpi) Segment 6 periodic voltage waveform



c) Calculate the RMS values of these two segment waveforms in the space below.

$$V_{Seg3,RMS} = \sqrt{\frac{1}{T}\left[\frac{V_{cc}^2}{9}\left(\frac{5T}{6}\right) + V_{cc}^2\left(\frac{T}{6}\right)\right]} = V_{cc}\sqrt{0.2592} = 2.546V$$

$$V_{Seg6,RMS} = \sqrt{\frac{1}{T}\left[\frac{V_{cc}^2}{9}(T)\right]} = 5/3 = 1.667V$$

Vrms_Seg3 = 2.546 V,rms

Vrms_Seg6 = 1.667 V,rms

d) Though the number of wires are fewer for 1:6 multiplexing (as compared to 1:4 multiplexing), explain why the contrast (darkness) of the turned ON segment is lower.

darkness lower since 2.546V < 2.886 /
([illegible] done on "Contrast Curve," [illegible] #2)