

Department of Electrical and Computer Engineering

Computer Engineering

Course ECSE-322B

Problem Set 5

3 February 2008

1. Consider the timings involved in the keyboard circuit discussed in class:
 - a. There is the clock driving the counter.
 - b. There is a clock driving the shift register connected to the serial line.
 - c. There is the user.

We would like to design the clock used for driving the counter such that synchronization problems are avoided. Under the following assumptions:

- The serial line runs at 9600 bits per second (baud).
- The keyboard has 64 keys.
- The user is a good typist and can type 5 characters per second (This translates to about 60 words per minute or about 6 to 7 minutes to type a page).
- When a key is pressed on the keyboard, the switch is closed for half of the time.

Compute a minimum frequency for the counter clock in order to obtain reliable operation of the circuit. Which elements do/don't present synchronization problems for the system?

2. Given the differences in clock speed in the operation of the keyboard, what problems do you foresee if the clock speed on the counter is increased? Describe them in point form. How would you modify the circuit to overcome them?
3. How would you modify the keyboard circuit to allow for two keys to be depressed simultaneously to define a character, e.g. "Ctrl" + "A"?

4. In the keyboard circuit discussed in class, the matrix is scanned by using a clock to drive a counter which, in turn, uses a multiplexer circuit to connect a zero voltage to each of the rows of the matrix sequentially. If the keyboard was designed to handle 144 keys, rather than 64 and the time a user holds a particular key down for is about 50 ms, what would be the maximum frequency that can be used to drive the counter if the key is guaranteed to be recognized only once?

5. In the keyboard described in Question 4, it is desired to eliminate switch bounce, i.e. the possibility that, in closing, a switch makes a circuit, opens and then makes the circuit finally. Describe how you would modify the circuit for the keyboard to avoid recording multiple identical characters for a single keystroke.