

# ECE 204L - FLIP-FLOPS AND LATCHES - LAB 17

## INTRODUCTION TO LATCHES

WINTER 2004

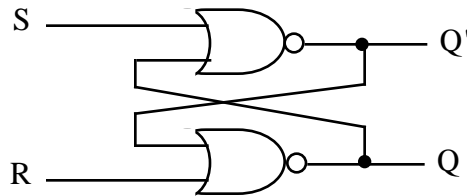
A.P. FELZER

### OBJECTIVE

The objective of this lab is to build and test SR latches.

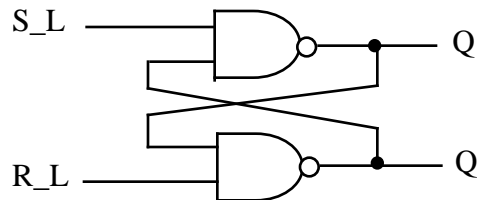
### LAB

1. Given the following active-high SR latch made from NOR gates



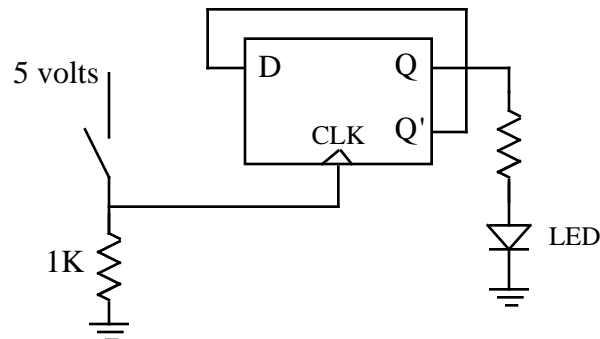
- a. Set the SR latch. Then describe what you did and how you knew the latch was set
- b. Verify that Q is not affected by  $S = 0$
- c. Reset the SR latch. Then describe what you did and how you knew the latch was reset
- d. Verify that Q is not affected by  $R = 0$
- e. Make use of your results in parts (a)-(d) to draw a representative timing diagram of your SR latch

2. Repeat Problem (1) with an active-low SR latch made from NAND gates as follows

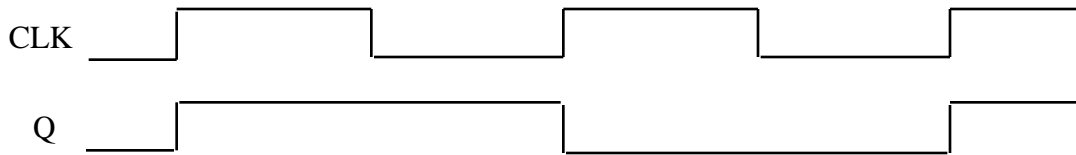


3. Draw the chip diagram of a 7474 D flip-flop

4. The following circuit



has the property that Q and therefore the LED will change their values every time the switch closes as illustrated in the following timing diagram

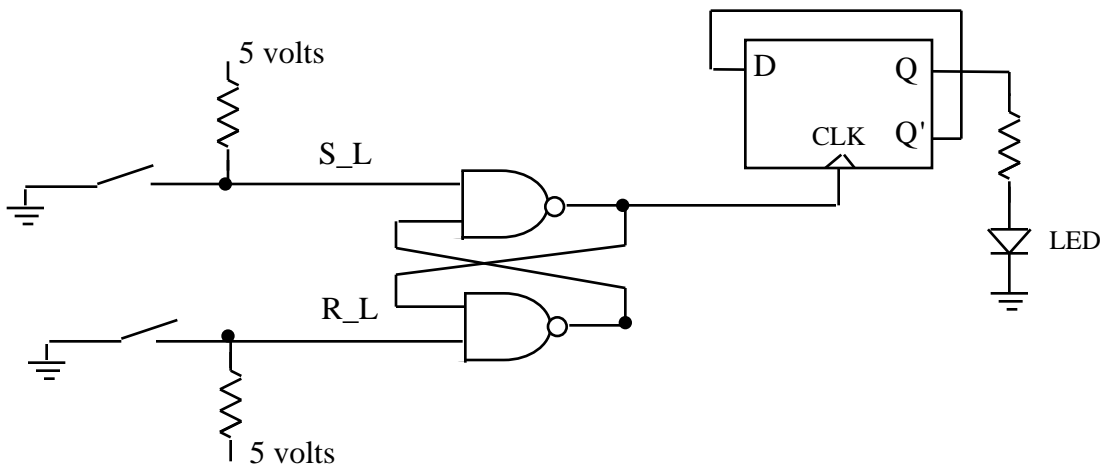


The problem is that real switches like the one in this circuit physically "bounce" as follows



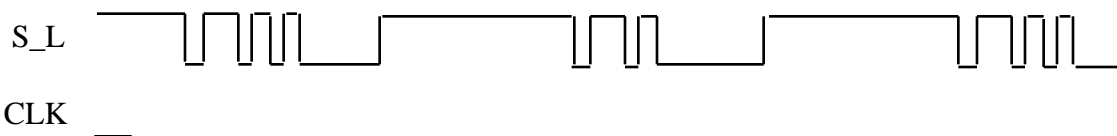
when we try to close them

- Draw the timing diagram for Q when the switch bounces as shown above
  - What will happen to the LED if the switch bounces an odd number of times. Will it keep its original value or will it change
  - What will happen to the LED if the switch bounces an even number of times. Will it keep its original value or will it change
  - Build and then test the circuit. Describe what you observe. Connect 5 volts to the active low CLEAR and PRESET pins. We will discuss these pins in Lab 19
  - Is your switch bouncing. How can you tell
5. The objective of this problem is to show a *switch debouncer* made from an SR latch and two momentary switches as follows



can eliminate the bouncing of CLK

- Complete the following timing diagram for the switch debouncer



- Describe your timing diagram in part (a)
- Explain what's going on in the switch debouncer
- Build and test the circuit with the switch debouncer made from the momentary switches you used in Labs (1) and (2). Did the circuit work. How can you tell