C8

Counter Circuits: 74HC93

CHAPTER ASSIGNMENT

Name _____ Class _____ No. _____ Date _____

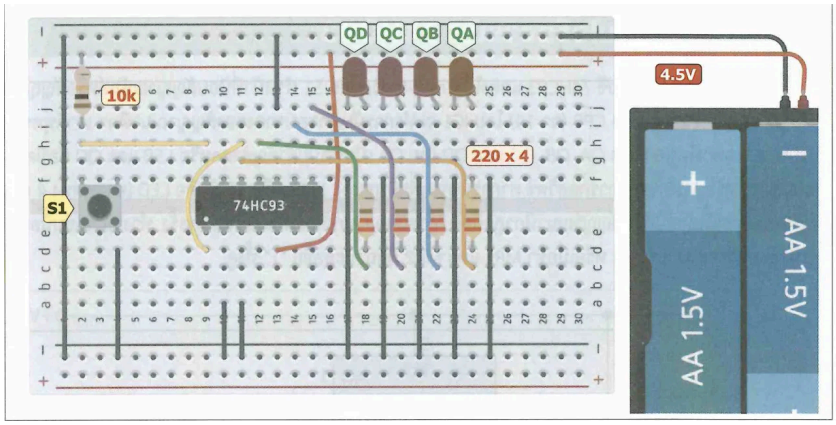
Answer every question in the space given. Show your working. You may use the chapter page to help you.

Questions from the Guru Jazzy chapter page, for classroom use.

Labs

8.1 Count with the 74HC93

1. Build the circuit in Tinkercad (Fig 8-9).
2. Click switch S1 and watch the four LEDs.
3. Build it with real parts (Fig 8-10) and repeat step 2.
4. You may find one press sometimes adds more than one. That is **switch bounce**: the contacts make the clock signal several times — too fast for you to see, but the IC counts them all. The fix is to put a **1–10 µF capacitor across S1** to remove the noise. This is called **debouncing**.

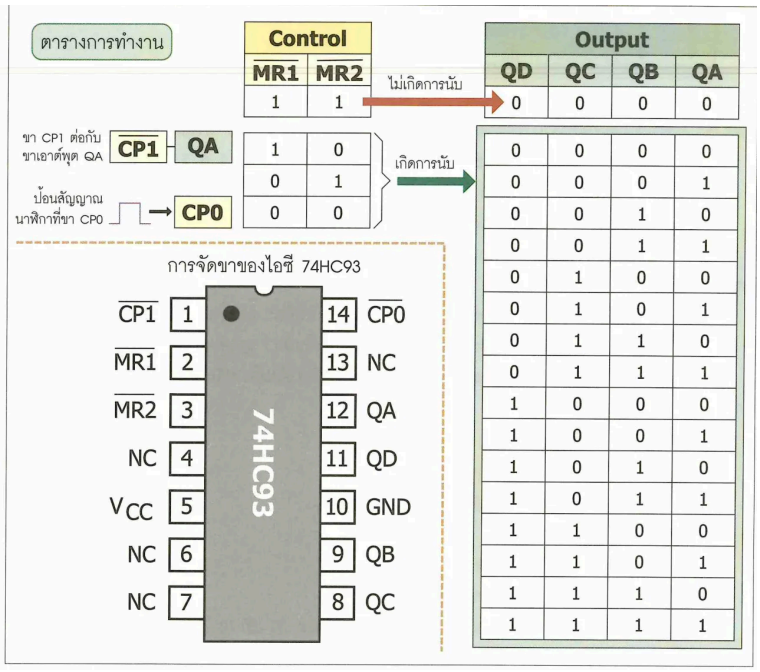


Activity: Extend the counter

1 In Tinkercad, press S1 eight times. Write the LED pattern after each press as binary and decimal.

2. Add a 10 µF capacitor across S1 and check that each press now adds exactly one.

3. Make it a BCD counter: connect QB (pin 9) to MR1 (pin 2) and QD (pin 11) to MR2 (pin 3) instead of grounding them. Does it now count 0–9?



4. Replace S1 with the 555 astable from Chapter 5 (Project 7) as the clock. What happens?

Chapter quiz

1. A modulo-4 up counter counts...

A. 0 → 1 → 2 → 3 → 4 B. 0 → 1 → 2 → 3 → 0 → ... C. 3 → 2 → 1 → 0 D. 0 → 4 → 8

2 In an RS flip-flop built from NOR gates, which input combination is not allowed?

A. R = 0, S = 0 B. R = 0, S = 1 C. R = 1, S = 0 D. R = 1, S = 1

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3 What does a JK flip-flop do when J = 1 and K = 1 and a clock pulse arrives?

A. Holds Q B. Sets Q to 1 C. Resets Q to 0 D. Toggles Q

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4 How far can a 4-flip-flop binary counter count?

A. 0 to 4 B. 0 to 8 C. 0 to 15 D. 0 to 16

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5 Four flip-flops each take 50 ns in an asynchronous counter. What is its highest counting frequency?

A. 50 MHz B. 20 MHz C. 5 MHz D. 200 MHz

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6 What is the advantage of a synchronous counter?

A	B	C	D
It uses fewer parts	All flip-flops get the clock together, so there is no build-up of delay — it works at higher frequencies	It does not need a clock	It can only count down

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7 How is a 4-bit counter turned into a BCD (0–9) counter?

A	B	C	D
Detect 1010 (bits B and D both 1) with an AND gate and use it to reset all flip-flops	Remove one flip-flop	Use a slower clock	Connect QA to ground

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8 On the 74HC93, what makes the outputs all go to 0 and stop counting?

A. MR1 = 0 and MR2 = 0 B. MR1 = 1 and MR2 = 1 C. CP0 = 1 D. Vcc = 2 V

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9 To use the 74HC93 as a 4-bit counter, what must CP1 (pin 1) be connected to?

A. Ground B. Vcc C. QA (pin 12) D. QD (pin 11)

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10 One press of the clock button sometimes adds 2 or 3 to the count. Why, and what is the fix?

A	B	C	D
The IC is faulty; replace it	Switch bounce makes several pulses; add a 1–10 µF capacitor across the switch (debounce)	The battery is flat	The LEDs are the wrong way round

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End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/tinkercad/chapter-8-counter/