

Overview

In this unit your students should:

- learn how to configure a D flip-flop as a one-bit counter
- understand how to connect D flip-flops to make n-bit counters
- know how to use AND gates to reset binary counters after a given number of pulses
- meet a binary to seven-segment decoder

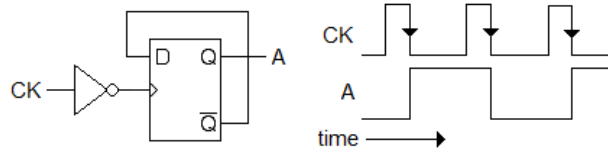
This should not require more than 3 hours of class time.

Hour	Suggested Activity
1	Remind your students of how to convert numbers in binary into decimal. Let students do the Counting in binary practical. Ask them to study 7.1 from the text book before the next session.
2	Get students to work through the Binary Counters exercises. As they finish, let them start the Counting in decimal practical. They will have a chance to continue with it next session. Ask them to answer questions 1, 2 and 3 from page 116 of the text book before the next session.
3	Students who have successfully answered all questions from the text book could continue with the Counting in decimal practical. Although most students should be able to get as far as step 4, only a minority will accomplish step 5 in the time available. Spend time with students who need more time to answer the questions on page 116 of the text book. Then let them continue with the practical. Ask all of them to study 7.2 before the next session.

Model Answers

1

(a)

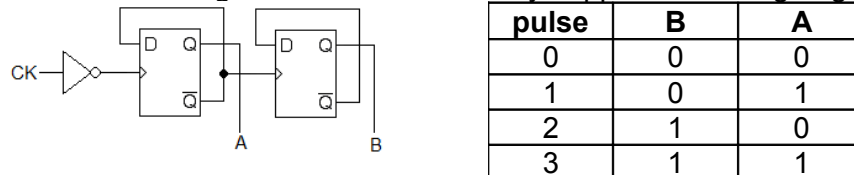


(b)

(c) On each rising edge at its clock terminal, the state of \bar{Q} is copied to A, so changing its state. The NOT gate means that this only happens on falling edges of CK.

(d)

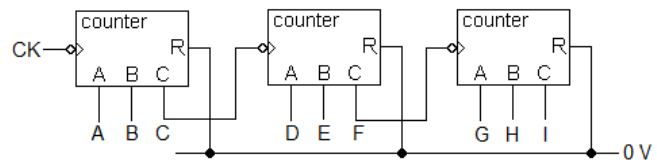
(e)



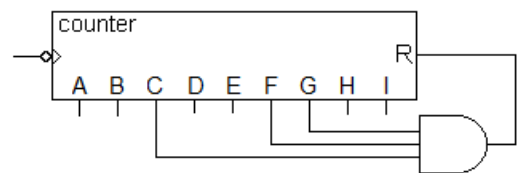
2

(a) Three counters will have nine outputs, so be able to count up to $2^9 = 512$ pulses. Only two counters would be limited to counting $2^6 = 64$ pulses, less than the required 100.

(b)



(c) $100 = 64 + 32 + 4$, so AND gate resets on 1100100.



3

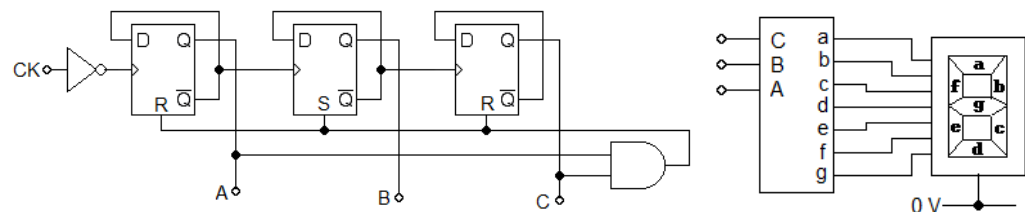
(a) The binary equivalent of four is 100, a three-bit word, so the counter must be able to count as far as four, requiring three D flip-flops.

(b)

pulse	C	B	A
0	0	1	0
1	0	1	1
2	1	0	0
3	0	1	0
4	0	1	1

(c)

(d)



(e) The decoder uses the three-bit word CBA to generate a seven-bit word gfedcba that will cause the LEDs to glow displaying the decimal equivalent of the binary CBA.

show	C	B	A	a	b	c	d	e	f	g
2	0	1	0	1	1	0	1	1	0	1
3	0	1	1	1	1	1	1	0	0	1
4	1	0	0	0	1	1	0	0	1	1