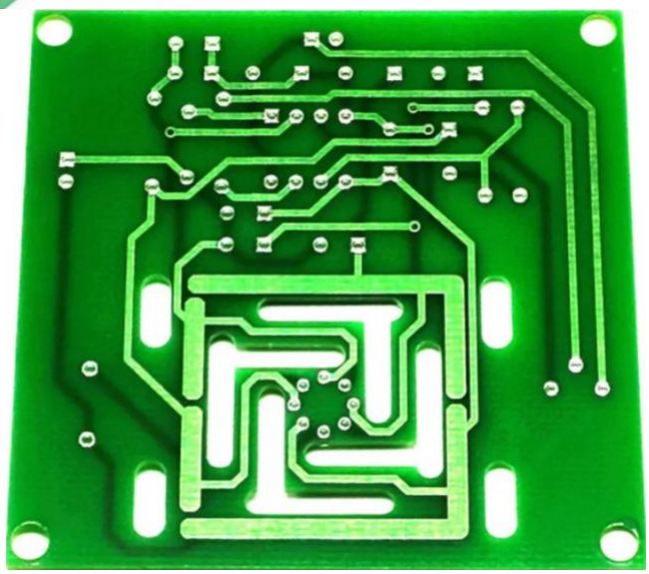
Bahan Ajar

Modul Praktikum

DESAIN DAN SIMULASI RANGKAIAN ELEKTRONIKA

Kode Matakuliah: SKO21425



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2023

Modul 12

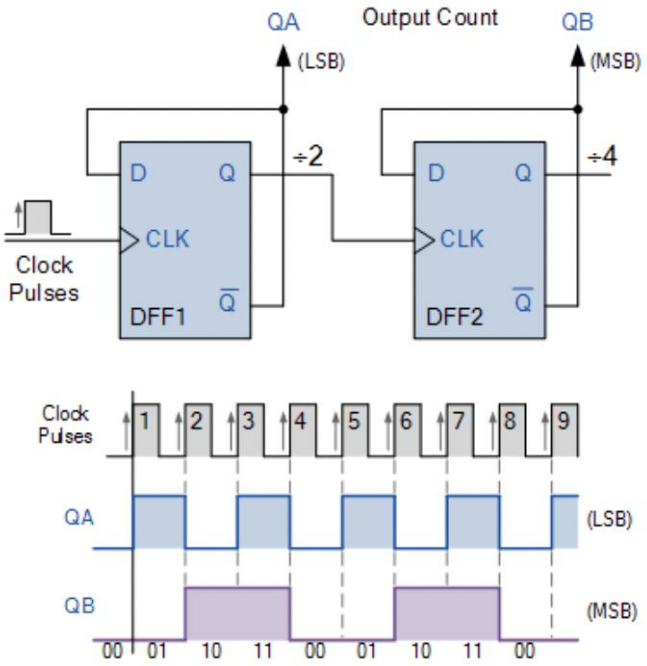
MOD Counters

1. MOD 4 Counters

MOD Counters are cascaded counter circuits which count to a set modulus value before resetting. Technically as well as being a 1-bit storage device, a single flip-flop on its own could be thought of as a MOD-2 counter, as it has a single output resulting in a count of two, either a 0 or 1, on the application of the clock signal. But a single flip-flop on its own produces a limited counting sequence, so by connecting together more flip-flops to form a chain, we can increase the counting capacity and construct a MOD counter of any value.

If a single flip-flop can be considered as a modulo-2 or MOD-2 counter, then adding a second flip-flop would give us a MOD-4 counter allowing it to count in four discrete steps. The overall effect would be to divide the original clock input signal by four. Then the binary sequence for this 2-bit MOD-4 counter would be: 00, 01, 10, and 11 as shown

MOD-4 Counter and Timing Diagram

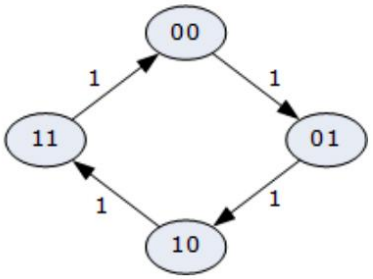


Note that for simplicity, the switching transitions of QA, QB and CLK in the above timing diagram are shown to be simultaneous even though this connection represents an asynchronous counter. In reality there would be a very small switching delay between the application of the positive going clock (CLK) signal, and the outputs at QA and QB.

We can show visually the operation of this 2-bit asynchronous counter using a truth table and state diagram.

MOD-4 Counter State Diagram

Clock Pulse	Present State			Next State		State Diagram
	Q_B	Q_A		Q_B	Q_A	
0 (start)	0	0	⇒	0	1	
1	0	1	⇒	1	0	
2	1	0	⇒	1	1	
3	1	1	⇒	0	0	
4 (repeat)	0	0	⇒	0	1	



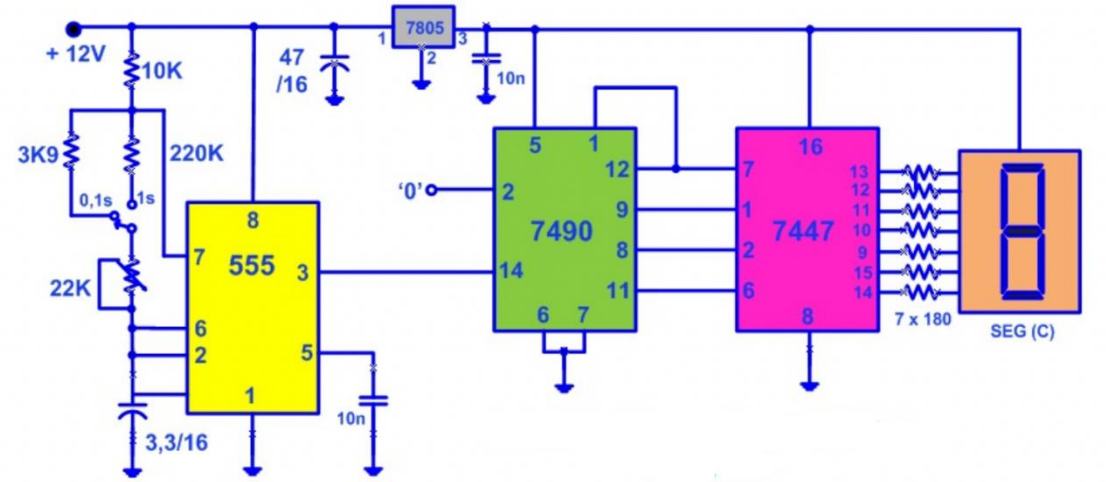
We can see from the truth table of the counter, and by reading the values of QA and QB, when QA = 0 and QB = 0, the count is 00. After the application of the clock pulse, the values become QA = 1, QB = 0, giving a count of 01. After the arrival of the next clock pulse, the values change and become QA = 0, QB = 1, giving a count of 10. Finally the values become QA = 1, QB = 1, giving a count of 11. The application of the next clock pulse causes the count to return back to 00, and thereafter it counts continuously up in a binary sequence of: 00, 01, 10, 11, 00, 01 …etc.

Then we have seen that a MOD-2 counter consists of a single flip-flop and a MOD-4 counter requires two flip-flops,allowing it to count in four discrete steps. We could easily add another flip-flop onto the end of a MOD-4 counter to produce a MOD-8

counter giving us a 23 binary sequence of counting from 000 up to 111, before resetting back to 000. A fourth flip-flop would make a MOD-16 counter and so on, in fact we could go on adding extra flip-flops for as long as we wanted.

JOBSHEET 12

Lakukan Simulasi MOD-4 Counters menggunakan software simulator dengan IC 7490 dan jelaskan tahapan perakitan dan hasil simulasinya.



LAPORAN HASIL PERCOBAAN: