

Astable Multivibrator with Decade Counter

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Abstract

The aim of this project is to design and implementation of astable multivibrator with a Decade counter. A counter is a sequential circuit which is used to count the pulses. The output of the astable multivibrator generates a square wave or clock input for the decade counter. For each negative edge triggering of the clock input, the counter shifts the high state of the output in a sequence from output 0 to output 9 and resets at the 10th clock pulse. This is also known as BCD counter.

Reference Circuit Details

The Astable Multivibrator is cross-coupled transistor switching circuit that has NO stable output states as it changes from one state to the other all the time. The astable circuit consists of two switching transistors, a cross-coupled feedback network, and two time delay capacitors which allows oscillation between the two states with no external triggering to produce the change in state. It produces a square wave output from a pair of grounded emitter cross-coupled transistors. Both transistors in the multivibrator are biased for linear operation and are operated as Common Emitter Amplifiers with 100% positive feedback. This configuration satisfies the condition for oscillation when: ($\beta A = 1 \angle 0^\circ$). This results in one stage conducting “fully-ON” (Saturation) while the other is switched “fully-OFF” (cut-off) giving a very high level of mutual amplification between the two transistors.

Periodic time $t_1 = 0.69C_1R_3$ $t_2 = 0.69C_2R_2$
Frequency of Oscillation $f = 1/1.38RC$

An ordinary four stage counter can be easily modified to a decade counter by adding a NAND gate. As it is a 4 bit binary decade counter, it has 4 output ports QA, QB, QC and QD. When the count reaches 10, the binary output is reset to 0 (0000). FF1 and FF3 are given to NAND gate by a NOT gate, FF2 and FF4 given directly to the NAND gate, the NAND gate output are connected to active low CLR input of each Flipflops. The counter operates as a normal counter until it reaches to decimal value 10(1010). After that the all the inputs of NAND gate become high and the output goes low. This low applied to the CLR input of FFs causes them to reset to 0(0000). Once the FF's reset they start to count again from beginning.

Reference Circuits

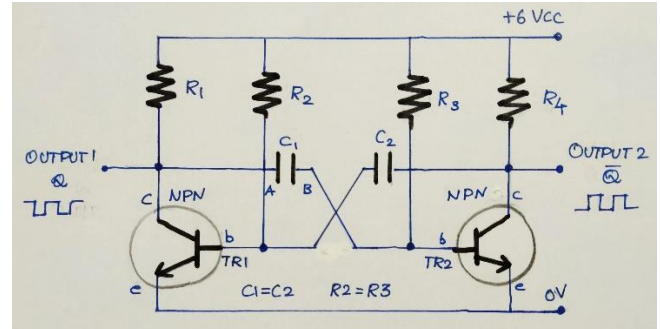


Fig1. Astable Multivibrator

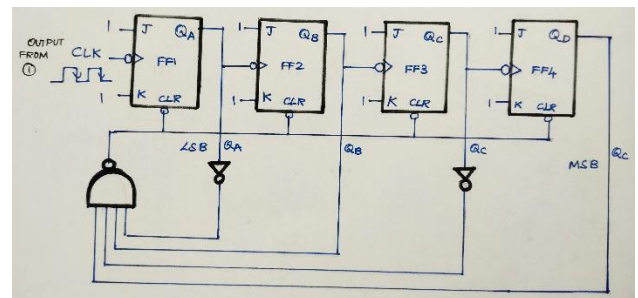


Fig2. Decade Counter

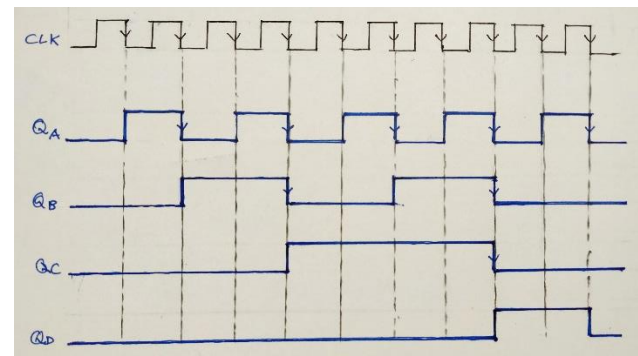


Fig3. Output Waveform

Reference:

- [1] Astable Multivibrator <https://www.electronics-tutorials.ws/waveforms/astable.html>
- [2] Decade Counter <https://www.electronicshub.org/decade-counterbcd-counter/>
- [3] Astable Multivibrator based Decode Counter by N.K.Singh <https://www.scribd.com/doc/99893729/Astable-Multivibrator-Based-Decade-Counter>