Implementation of 2-bit Ripple Up-Counter using T- Flip Flop and 555 Timer Astable Multivibrator Circuit for Clock Generation

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***Abstract*— This paper presents the design of 2-bit ripple up counter using T- flip flops and the clock circuit for this counter is to be designed using 555 timer astable multivibrator. The most widely used application of ripple up counter is to act as an frequency divider circuit so that signal's high frequency can be reduced to usable value for low speed circuits.**

Keywords*— *Astable Multivibrator, 555 Timer, Ripple counter, Asynchronous, Frequency Divider circuit.

I. DESCRIPTION

In this literature survey, the mixed-signal circuit design implementation for the circuit shown in figure1 is explained as below:

1) An **astable multivibrator** is used for clock generation which is given as external clock input to the 2-bit ripple Up-counter(i.e., this input is given to the LSB T-flip flop of the counter). The 555 timer circuitry (shown in figure2) is designed from scratch using analog circuitry block consisting of comparators & transistors and digital circuitry block consisting of SR flip flop & NOT gate. The rectangular waveform generated as an output (resulting in output frequency, Fclk) due to charging and discharging of capacitor (capacitor voltage swinging between 2Vcc/3 and Vcc/3). During charging period, output is HIGH(I.e., logic '1') and during discharging period, output is LOW(I.e., logic '0'). As this 555 timer configuration automatically interchanges its state between logic HIGH and logic LOW, therefore it is also known as free running multivibrator. The various other applications of 555 timer astable multivibrator includes square waveform generator, pulse position modulation and frequency modulation.

2) The **ripple counter** shown in figure 1 is completely implemented as a digital block. In ripple counter, output of one flip flop acts as an clock input to the next serially connected flip flop (hence, clock pulses ripples through the circuit). Here all the flip flops are configured to be operating in toggle mode. When this rectangular waveform (external clock) is given to serially connected T- flip flops then in this ripple counter, the output of 1st T-flip flop(LSB) is given as clock input to 2nd T-flip flop(MSB). Both the T-flip flops are changing their state at falling edge of their corresponding clocks. Then the frequency obtained at the output of 2nd T-flip flop(I.e., at Q1) is Fclk/4. Here Fclk is the frequency of the output from astable multivibrator and '4' indicates the number of unique states obtained using this 2- bit ripple up counter.

II. CIRCUIT DIAGRAMS AND WAVEFORMS

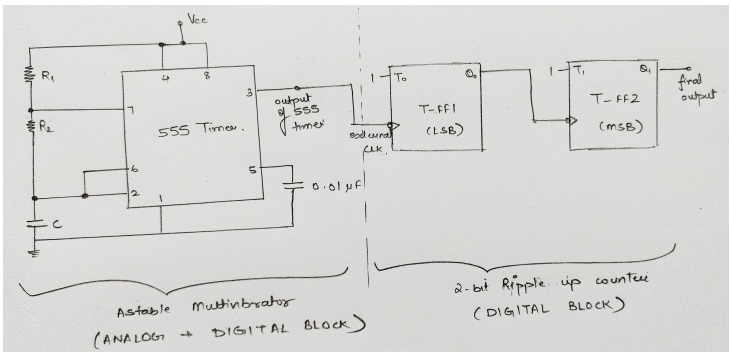

***Figure1**: Circuit diagram of the design to be implemented*

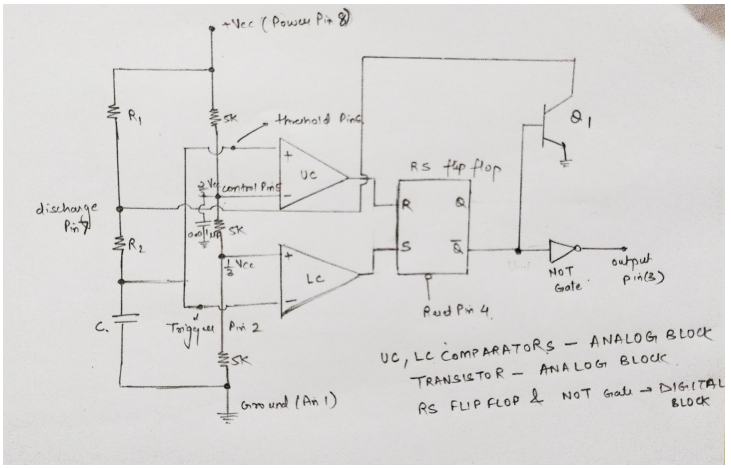

***Figure2**: Circuit diagram of the 555 Timer Astable Multivibrator*

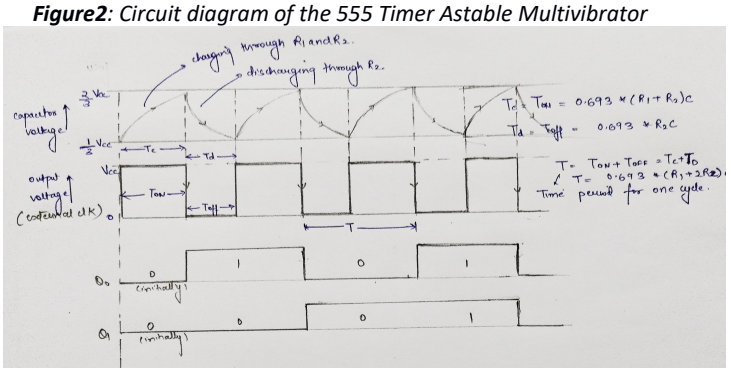

***Figure3**: Waveforms obtained wrt time axis as reference x-axis.*

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