

Design of a Mix-signal Frequency Divider

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27th September 2022

Abstract --- A frequency divider circuit using astable multivibrator and 3-bit asynchronous up counter is proposed in this paper for getting different frequency waveform at different stage of this circuit. The purpose of the circuit is to get divided frequency signal for a given frequency. We can generate desired frequency square wave from astable multivibrator that signal can be fed to counter circuit as a clock input and later at each stage of counter circuit output, we can get desired divided frequency. This way of designing satisfies the criterion of a mix signal design where astable multivibrator act as an analog circuit and counter act as a digital circuit.

Keywords --- Mix signal frequency divider, 3 stage frequency divider.

Reference Circuit Details

Fig 1 shows the proposed design of the circuit. It consists of astable multivibrator made of Op-Amp circuit with a feedback resistor 'R' and source capacitance 'C'. There are two resistors R₁ & R₂. Both C and R₁ terminal are grounded. Op-Amp is having a saturation voltage range (-V_{sat} to +V_{sat}). Let the voltage at non inverting terminal as V₁ then it can be expressed as:

$$|V_1| = \frac{R_1}{R_1 + R_2} |V_{sat}|$$

At the output of the multivibrator the square wave is generated as per fig2. The Time period and frequency of the square wave can be expressed as:

$$T = 2RC \ln \frac{2R_1 + R_2}{R_2}$$
$$f = \frac{1}{2RC \ln \left(\frac{2R_1 + R_2}{R_2} \right)} \text{ Hz}$$

The output wave V₀ in fig2 can be fed into as clock in 3-bit asynchronous counter made of 3 T flip-flop where all T terminal are connected to logic high. Pre-set pins are in logic high and reset pins are in logic low initially. As it is negative edge triggering flip-flop the output will toggle every time the input goes from high to low. The reference waveform of divided frequency has shown in fig3. Here at Q₀ frequency is divided by 2, at Q₁ by 4 and at Q₂ by 8. We can feed any frequency in counter circuit as the input frequency can be varied by R₁ and R₂ resistors connected with multivibrator. This is how it can achieve the purpose and gives a simple frequency dividing solution.

References:

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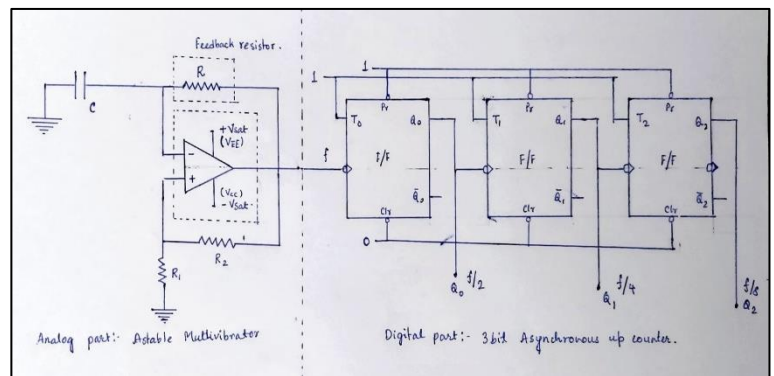


Fig1: Mix-signal Frequency Divider Circuit

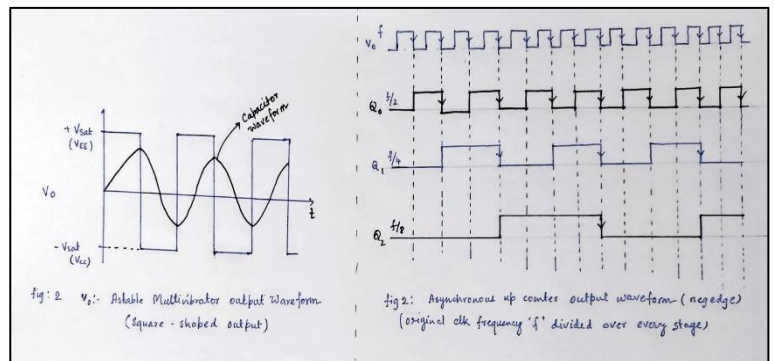


Fig2(Left): Ref. Waveform of astable multivibrator

Fig3(Right): Ref. waveform of asynchronous counter