

Design of a Time-to-Amplitude Converter

Syed Moez Hassan and Saad Pervaiz

LUMS School of Science and Engineering

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1 Time to Amplitude Converter(TAC)

Time to Amplitude converter is an electronic device that detects a pulse and gives output pulse whose amplitude is proportional to the duration of the input pulse. This device is mostly used in Nuclear experiments where it is used to measure the time scales of the nuclear events. Although the commercially available TAC is a very sophisticated circuit, but large scale model (for larger time scales) can be built using simple components and ICs.

KEYWORDS

Monostable-Multivibrator · 555 Timer · Constant Current source

1.1 Circuit Components

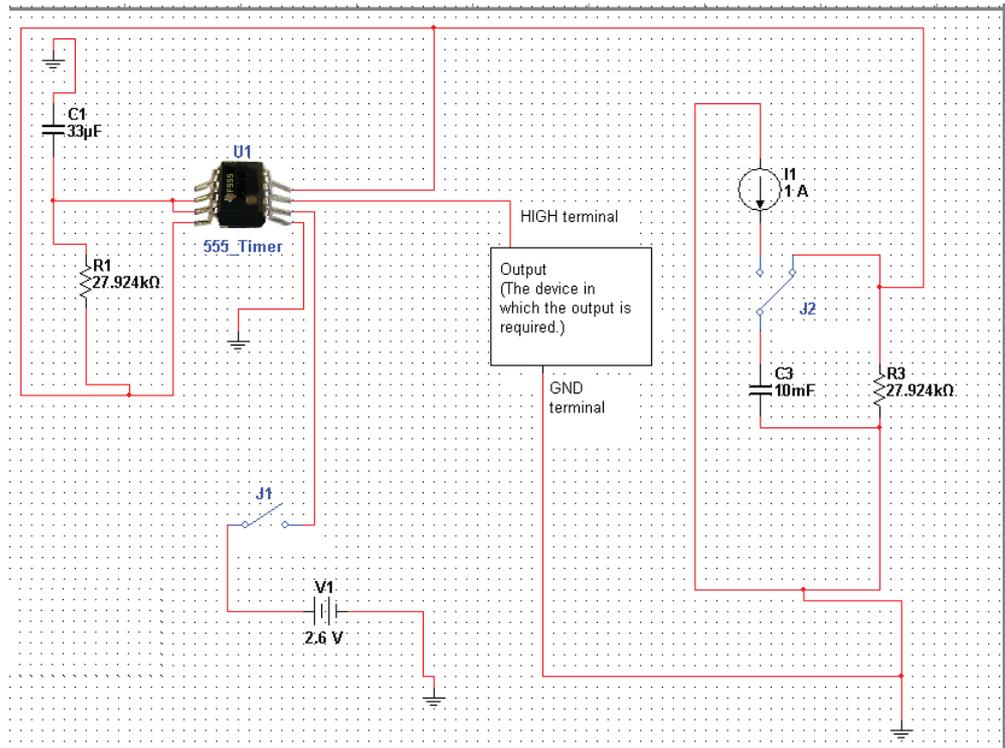
The circuit consists of a constant current source, a 555 timer, some resistors and capacitors, one voltage source and two switches which are to be triggered.

1.2 Operation of the circuit

When the capacitor is connected to the constant current source, it starts charging and the voltage across it is given by:

$$V = \frac{It}{C}. \quad (1)$$

This clearly depends on time, the greater the time, the greater the voltage. Then the capacitor is connected to a resistor through which the output is taken. The 555 is used to generate a square wave instead of an exponential decay (which is a characteristic of discharging capacitors). As soon as the capacitor is connected to resistor, the 555 is triggered. The trigger is normally high. When the capacitor starts discharging, we give it a low and then, instantaneously, give it a high. The output is taken from the 555. (See Figure)



In this circuit, a 555 timer is used as a monostable multivibrator along with a constant current source I_1 . When switch J_2 is connected to I_1 , the capacitor C_3 starts charging. The period of time for which it is charged controls the amplitude of output pulse as is clear from (1). Then, J_2 is disconnected from I_1 and connected to the input of 555 timer. Although a 555 timer normally works with DC voltage, and a capacitor (while discharging) produces an exponential decaying voltage, but here, the duration of pulse is very small, therefore the voltage is almost constant over that time duration. As soon as J_2 is disconnected from I_1 , the 555 timer is simultaneously triggered (Using J_1 , initially it is at high. It is triggered by giving a low and then, instantaneously again high). The output pulse is taken from the 555 timer.

References

- [1] TAC user manual
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- [3] <http://www.canberra.com/>
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