

3-bit resistor string DAC

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Abstract

DACs or digital-analog-converters are used to convert streams of digital data into analog signals. They are crucial components of many devices such as televisions, mobile phones, headphones, etc. They find widespread use in modern audio, video, communication and mechanical systems. Analog signals are what we can experience as humans, while digital data can be compressed and stored quite easily. This converting data from one of digital and analog forms to another is essential. This circuit implements a 3bit digital to analog converter with a resistor string architecture for high frequency, high accuracy, high speed applications with low glitch. It is executed in multiple stages.

1 Circuit Details

The 3 bit Digital to Analog converter was implemented in three blocks: a resistor string network, an 8 to 1 multiplexer and a control signals generator block. The resistor string had 8, which is 2 raised to the power 3, equal resistors between V_{refh} and V_{refl} . The control signals generator block was there to pass the three input bits and their complements to act as select lines for the multiplexer. D Flip Flops which contain CMOS inverters and Transmission gates within them were built for this purpose, and three of them, one for each digital input bit were used. DFFs need both a clock signal and its complement. To obtain the complement, the clock signal was passed through a CMOS inverter. Since this causes an additional delay, the regular clock was sent through a Transmission gate to equalise the delays. Instead of the traditional method of implementing a network of switches in a digital to analog converter, an 8 to 1 multiplexer was used, which was built by using 7 units of 2 to 1 multiplexers. 2 to 1 multiplexers were built using the transmission gates design. The inputs to the 8 to 1 multiplexer were the intermediate voltages from the resistor string and the select lines were the three digital input bits from DFFs in the control signals generator block. The output generated by the 8 to 1 multiplexer is the final analog output.

2 Implemented Circuit

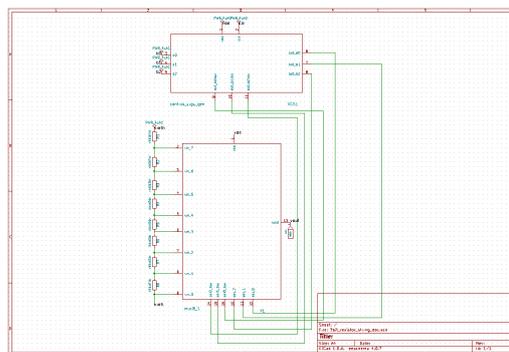


Figure 1: Implemented circuit diagram.

3 Implemented Waveforms

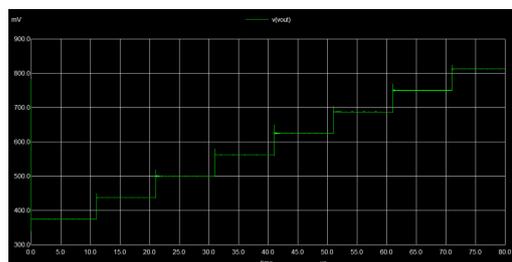


Figure 2: Implemented waveform.

References

- [1] K. E. K. H. Q. A. L. Fouad Farah, Mustapha El Alaoui. A design of a new resistor string dac for phones applications in 130nm technology. <https://ieeexplore.ieee.org/document/8354063>.