Design of a Current Mirror Circuit in 130 nm CMOS Technology

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Abstract

The paper constitutes the design and analysis of a Current Mirror Circuit using CMOS. The current mirror circuits are simple current sources that provide constant current. The current mirror circuit is based on the principle that, if the gate to source voltage of two identical MOSFETs is equal then the drain current flowing through them is equal. A perfect current mirror is just a perfect inverting current amplifier that reverses the current direction and also known as a current-controlled current source. Herewith the help of simulation, we will verify that the magnitude of current through the first PMOS is the same as the second PMOS. The Current Mirror Circuit has been designed using 130nm CMOS Technology.

1 Circuit Details

The Current Mirror Circuit is a popular technique for monolithic IC design. The circuit is designed in a way such that it copies the current through one active device to a different active device with a current control feature. In this, the current flowing through one device is copied into another device but in inverting form. If the current of the primary device is modified, the mirrored current output of the opposite device also will change. So by controlling the current in one device, the current in another device also can be controlled. Thus the current mirror circuit is usually mentioned as a Current Controlled Current Source or CCCS. This current mirror circuit can be implemented with two PMOS transistors. In Figure 1, the two NMOS transistors are considered M1 and M2. An NMOS is always operating in the saturation region when the drain is shorted to its gate, as shown in Figure 1. In this case, Vds is equal to Vgs which is greater than Vth subtracted from Vgs implying saturation always where Vgs is the gate to source voltage, Vth is the threshold voltage, Vds is a drain to source voltage. Thus the first NMOS i.e. M1 is in the saturation region whereas the second NMOS i.e. M2 is in the saturation region if the output voltage is higher than the saturation voltage. Therefore the input current of the first NMOS can control the output current of the second NMOS. Hence the output current can be mirrored like the input current, Iout is equal to Iref.

2 Implemented Circuit

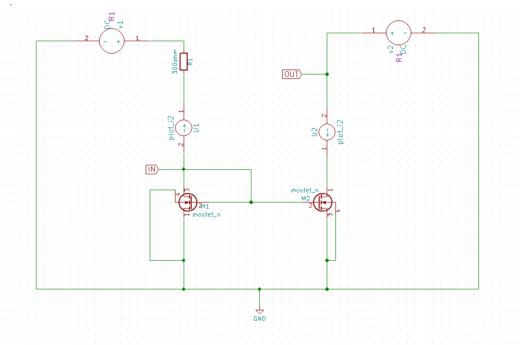

Figure 1: Implemented circuit diagram.

3 Implemented Waveforms

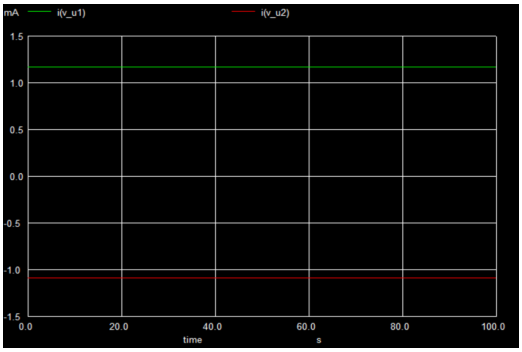

Figure 2: Implemented waveform.

References

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[2] S. Gupta. Current mirror circuit (part 1): Introduction, characteristics and construction. https://cutt.ly/un1JLfH.

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