

# Gilbert Multiplier Cell

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## Abstract

The paper discusses the Gilbert Multiplier Cell, it produces an output proportional to the product of the two given input signals. Gilbert Multiplier Cell is also known as four quadrant multipliers. It is used as amplitude modulators, double sideband modulators, single sideband modulators, AM detectors, SSB and DSB detectors, frequency doublers, squaring circuits, dividers, square root circuits, mixers, AGC amplifiers, and root mean square measuring circuits. The main advantage of the Gilbert Multiplier Cell is that the output of the circuit can be linearly controlled with respect to the input signal.

## 1 Circuit Details

The Gilbert Multiplier Cell is an enhanced version of the source coupled cell and this allows four quadrant multiplication. Two cross coupled source coupled pair forms the structure of the circuit. It produces a particularly useful transfer characteristic. The circuit consists of mainly 4 transistors namely M1, M2, M3, M4. The DC transfer characteristics of the multiplier circuit are the product of the hyperbolic tangent of the two input voltages. The multiplier cell always remains in the saturation region during normal operation. Used in this way the circuit is capable of performing precise multiplication of one continuously varying analog signal by another. the input signal is given at the source terminal junction of the two source coupled cells and the output is taken at the drain terminal of each source coupled cells. Furthermore, the collected output from the drain terminal is passed to a series of three inductor capacitor networks thereby preventing the loading effect at the output terminal of the device. The circuit can operate at lower supply voltages and better noise performance due to the low parasitic ohmic resistance of the inductors. The lower common-source transistors are fed by the differential mm Wave LO signals and the upper quad is composed of thick oxide transistors ensuring reliability against high swings at the drain nodes.

## 2 Implemented Circuit

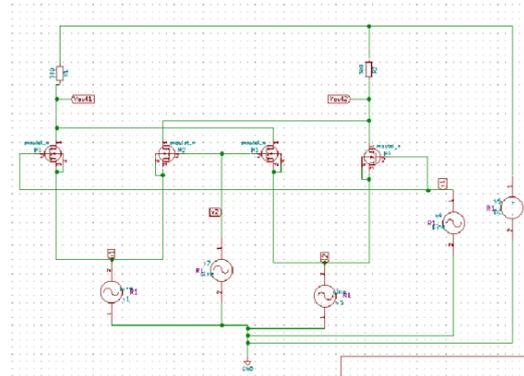


Figure 1: Implemented circuit diagram.

## 3 Implemented Waveforms

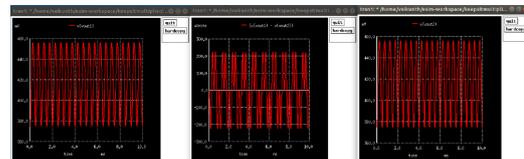


Figure 2: Implemented waveform.

## References

- [1] promach. Gilbert cell mixer implementation. <https://www.edaboard.com/threads/gilbertcell-mixer-implementation.383293/>.