DESIGN OF GILBERT MULTIPLIER USING EMITTER COUPLED CIRCUIT

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The **Gilbert multiplier** is a highly popular circuit topology typically implemented using **bipolar junction transistors (BJTs)** and operating as a four-quadrant multiplier. Its core is an **emitter-coupled pair**, which serves as the fundamental building block.

Key Features-

1. **Four-quadrant operation**: Handles both positive and negative inputs for multiplication.
2. **Differential input-output structure**: Offers improved noise immunity and common-mode rejection.
3. **High linearity**: Ideal for analog signal processing.

In the Gilbert multiplier:

- Input Vx modulates the current in the **lower differential pair** (current steering).
- Input Vy modulates the current in the **upper differential pair**.
- Due to the exponential nature of the BJT current-voltage relationship, the result is a product of Vx and Vy at the output.

Its small signal output current is: $i_c = I_E \tanh\left(\frac{V_{in}}{2V_T}\right)$

Design Considerations-

Linearity: Ensure the input signals Vx and Vy remain in the linear operating range of the BJTs to minimize distortion.

Biasing: Proper bias currents are required in both the upper and lower stages to maintain the desired operating point.

Temperature Stability: Since VT depends on temperature, thermal compensation techniques may be necessary for precise operation.

Supply Voltage: Adequate headroom is required to prevent saturation of the transistors in the stacked configuration.

Reference Paper-

Mayank Kumar,et al Int. Journal of Engineering Research and Applications

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