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Analog multipliers

An analog multiplier is a device that produces an output voltage or current that is proportional to the product of two or more input voltage. Analog multiplication can be accomplished through the Hall Effect.
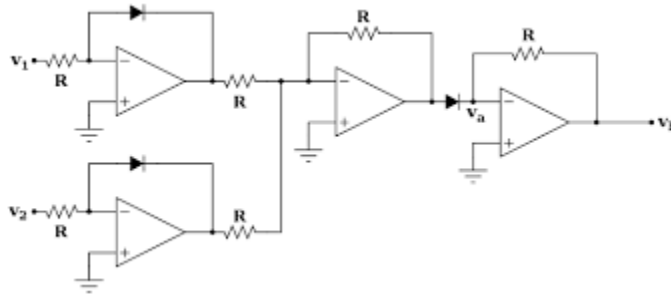

FIG1: Analog multiplier

The Gilbert cell is a great example of an analog multiplier because it serves as a mixer i.e. it produces output signals that are proportional to the product of two input signals. Its output current is a 4 quadrant multiplication of its two differential inputs.
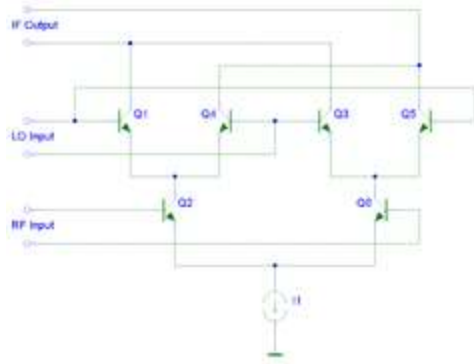

FIG2: Gilbert cell

Application of Gilbert cell

1. If $V_1 < V_T$ and $V_2 < V_T$ then tan $(V_{1.2}/2V_T) = V_{1.2}/2V_T$ then it works as a multiplier.
2. It acts as a modulator if one of the inputs is large compared to V_T, thus multiplies the applied small signal.
3. If both inputs are large compared to V_T it acts as a phase detector.

Phase Locked Loop (PLL)

It is a control system that generates an output Signal whose phase is related to the Phase is related to the Phase of an input signal. It includes a VCO, Phase detector and low pass filter within its loop. Its main purpose is to force the VCO to replicate and track the frequency and Phase at the input when in lock.
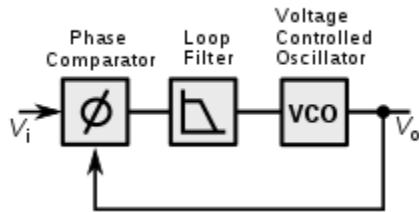
Applications of Phase locked loop
1. Synchronization purposes; in space communications etc.
2. Radio transmitters: It is used to synthesize new frequencies which are a multiple of a reference frequency.
3. Demodulation of Frequency modulation
4. Demodulation of Frequency shift-keying.
5. Recovery of small signals.
6. Demodulation of modems

A Phase locked loop may be implemented as either analog or digital circuits

Analog PLL elements

- Phase detector: It compares the phase at each input and generates an input signal
- Low pass filter
- Voltage controlled oscillator: The VCO acts as a linear, time-invariant system.
- Feed-back path
  As shown in the above diagram.

  Other elements include-
- PLL dynamic response
- Lock range
- Capture range
- Root locus
- Frequency response
- Phase error