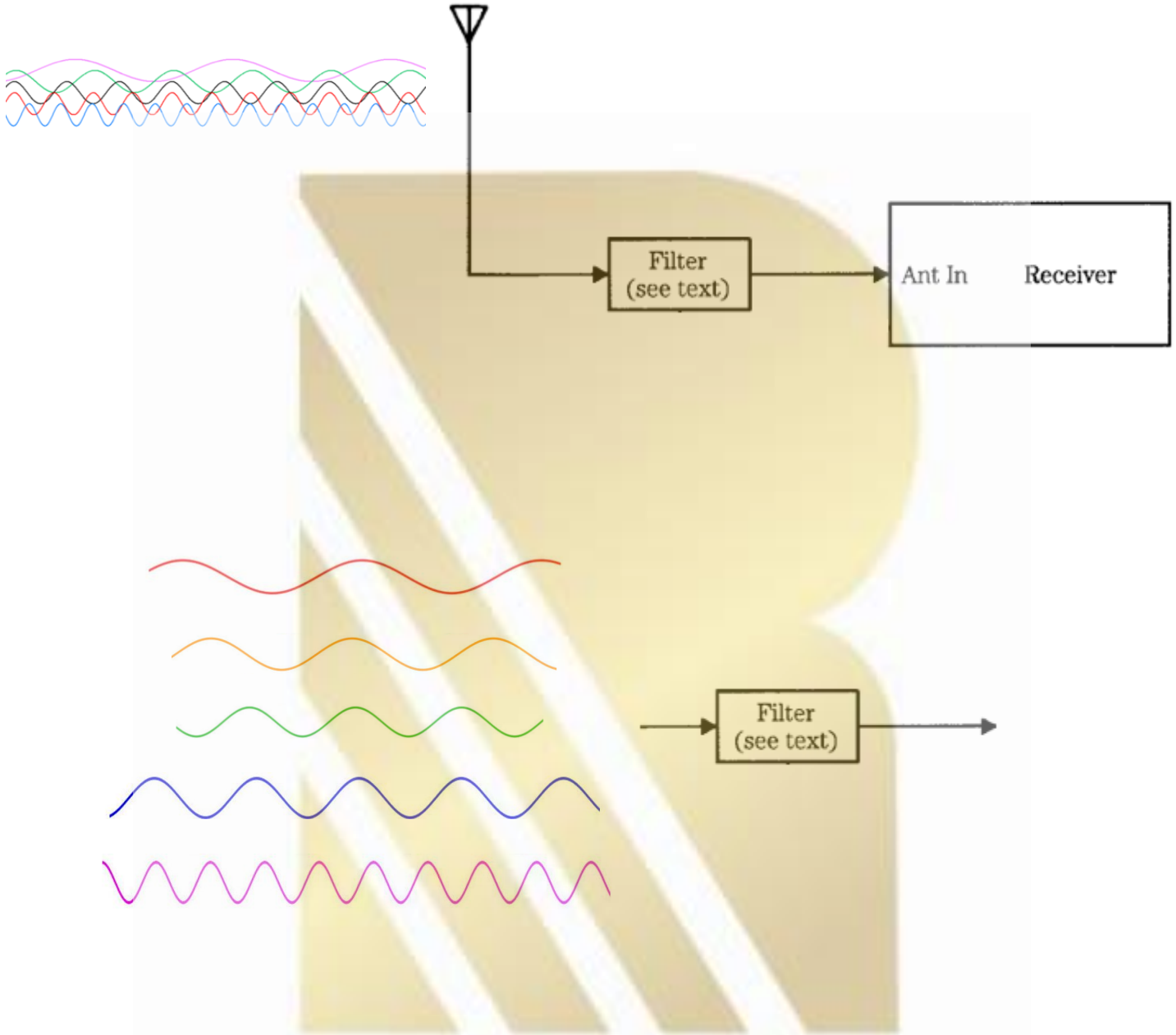
RF Components and Basic Concepts

1.6 - RF Filters

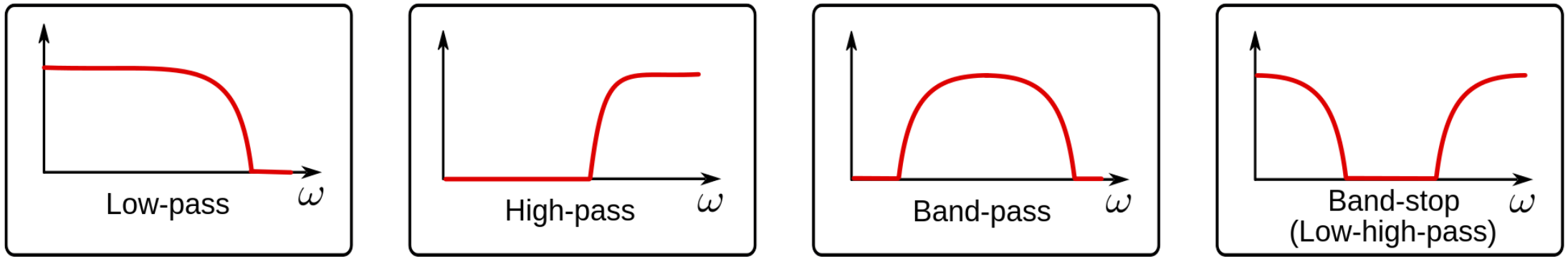
RF Filter

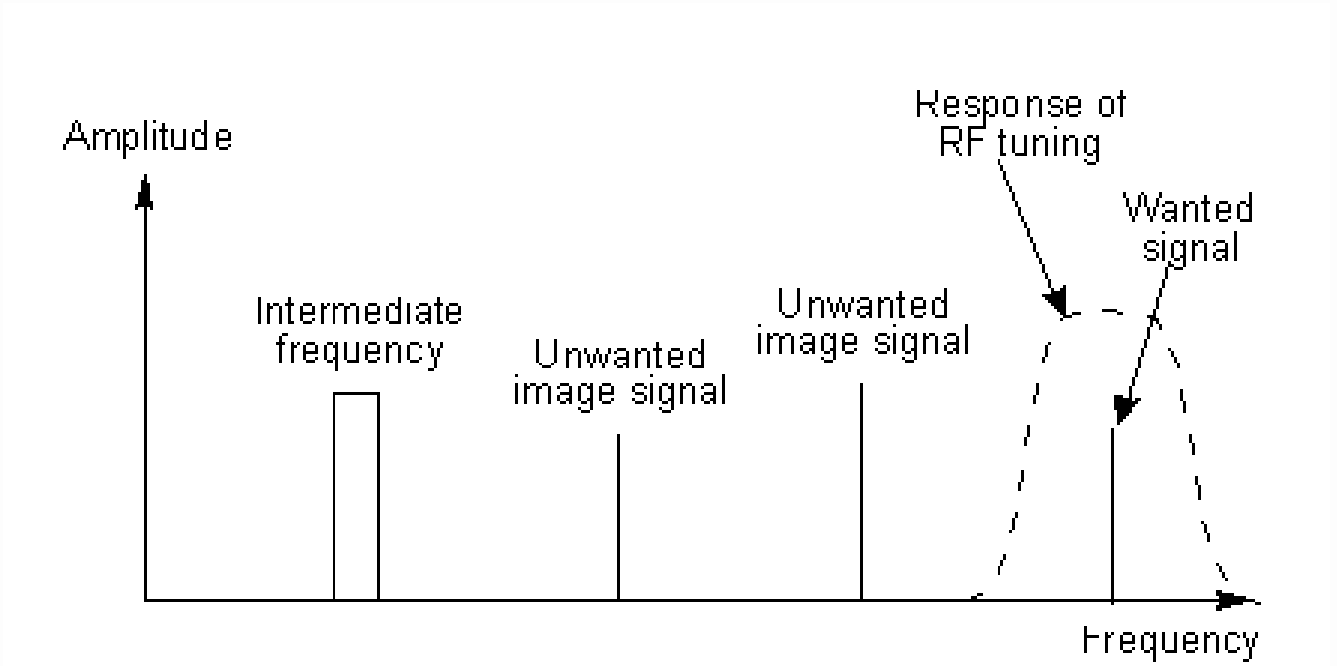
- **Electronic filters** are circuits which perform signal processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones, or both.

- RF devices include some kind of filtering on the signals transmitted or received. RF filters enable the required frequencies to be passed through a circuit, while rejecting the frequencies that are not needed.


Filter
(see text)
Ant In
Receiver
Filter
(see text)

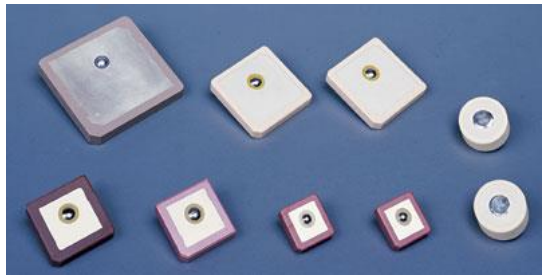
Filter Types




Amplitude
Response of
RF tuning
Wanted
signal
Intermediate
frequency
Unwanted
image signal
Unwanted
image signal
Frequency

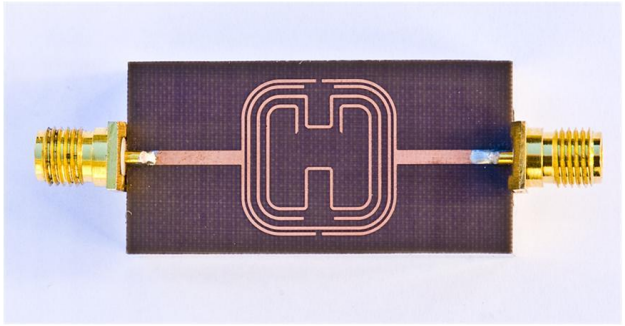
Off-Chip Filter Technologies

LC

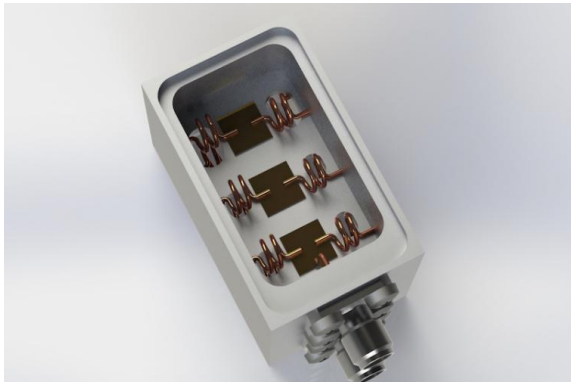


Dielectric Resonator

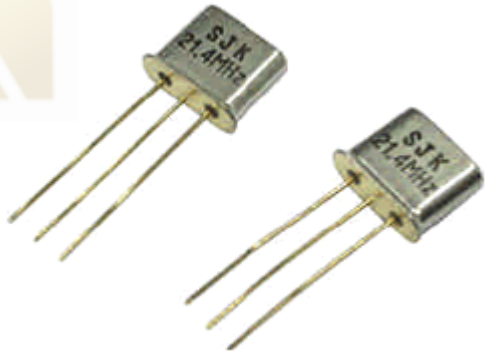
SAW



Microstrip



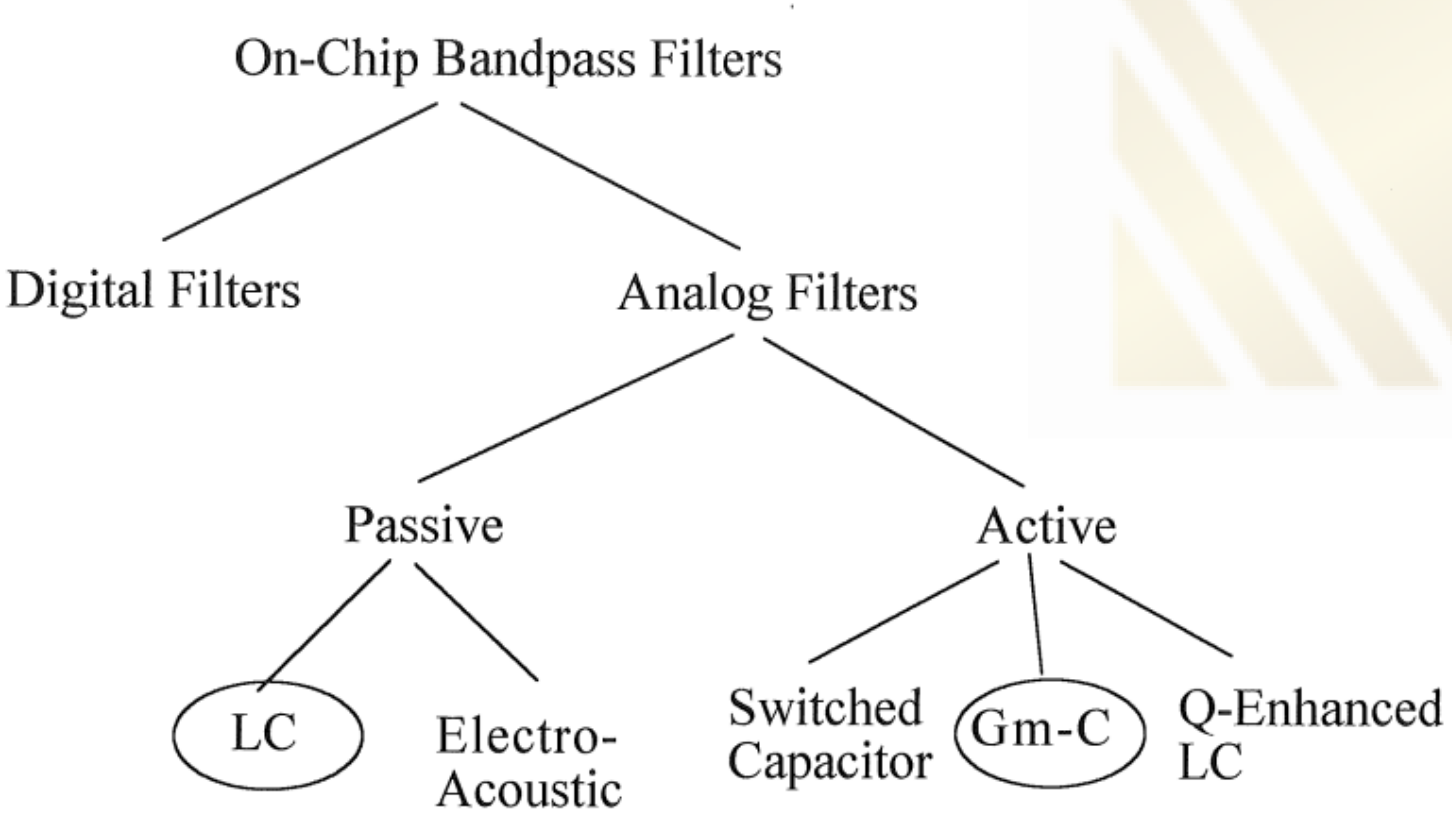
Heilical Resonator



crystal

Technology	*Typical Frequency Range*	*Relative Cost*
LC	10 MHz - 2 GHz	Low
Dielectric Resonator	500 MHz - 2+ GHz	Medium
Surface Acoustic Wave (SAW)	70 MHz - 2 GHz	Med-High
Microstrip	1 GHz - 30 GHz	Low
Heilical Resonators	100 MHz - 1 GHz	Med-High
Crystal	5 MHz - 50 MHz	High
Ceramic (MCF)	250 kHz - 10.7 MHz	Low

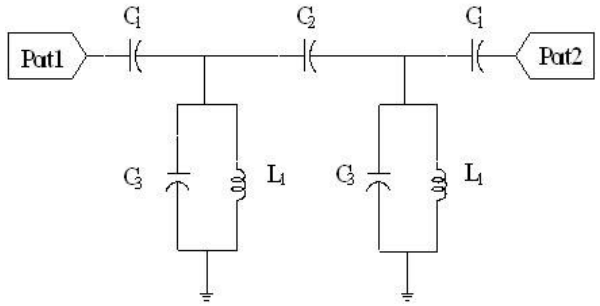
On-Chip Filter

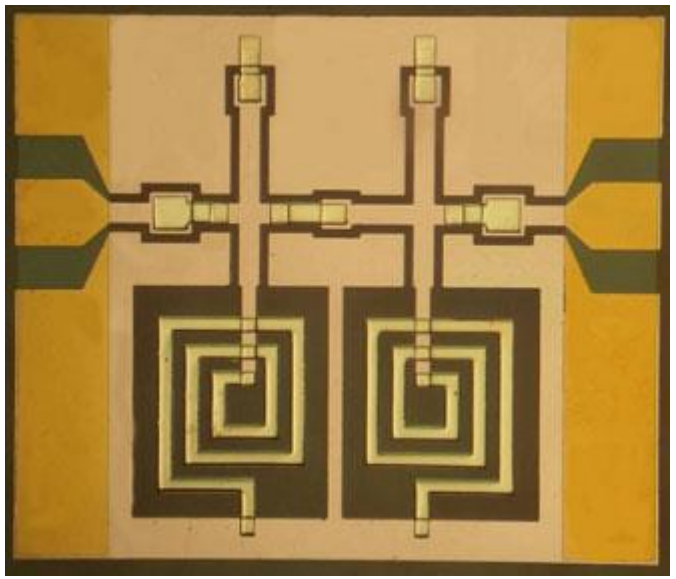


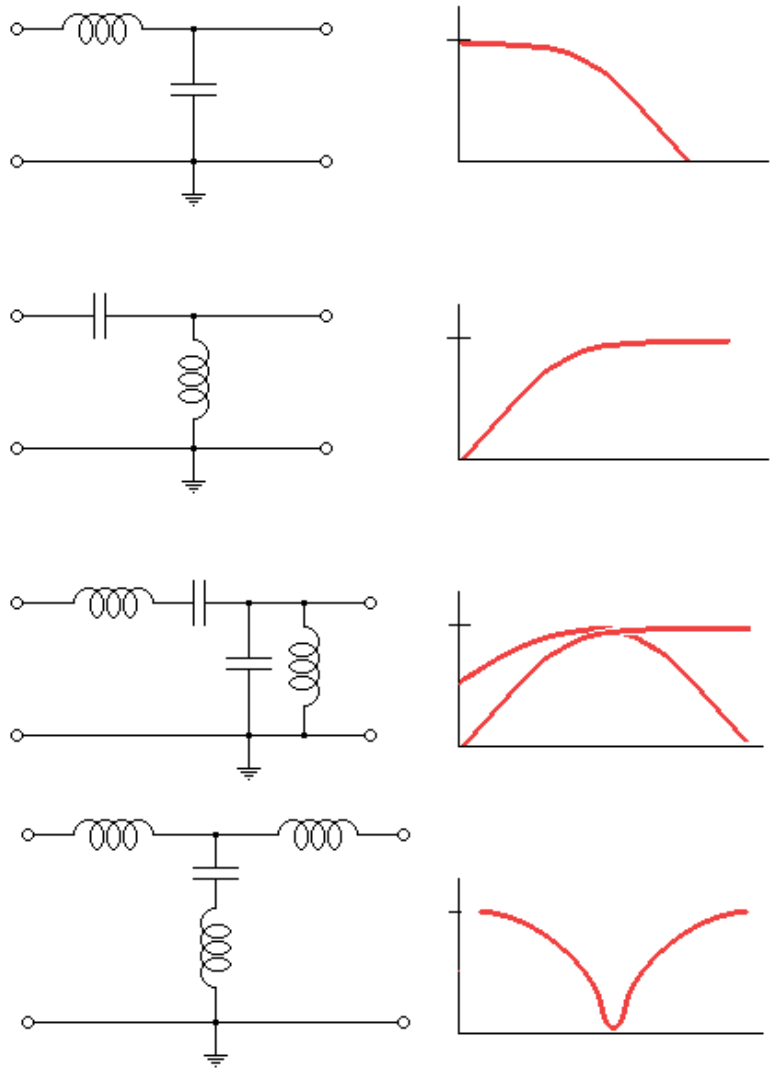
Off chip vs On chip

Off-chip	On-Chip
Higher Q	Lower Q
High precision	lower precision
High Area Consumption	Low Area Consumption
More patristics	Less patristics
Less loss	Higher loss
Less Noise	higher Noise
Separated From IC	Integrated with IC

- LC filter (High Frequency)







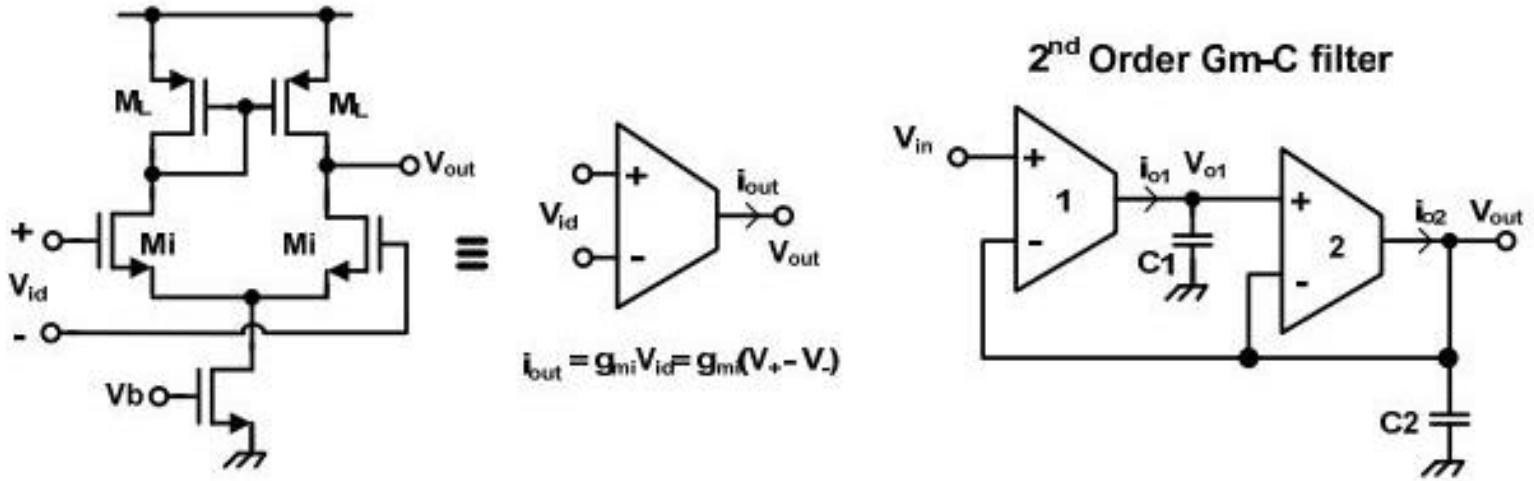
The microphotograph of 5.2 GHz bandpass filters by MIM capacitors (Dimension : 811μm x 678 μm)

Chia Song Wu, Hsien-Chin Chiu, Yi-Feng Lin

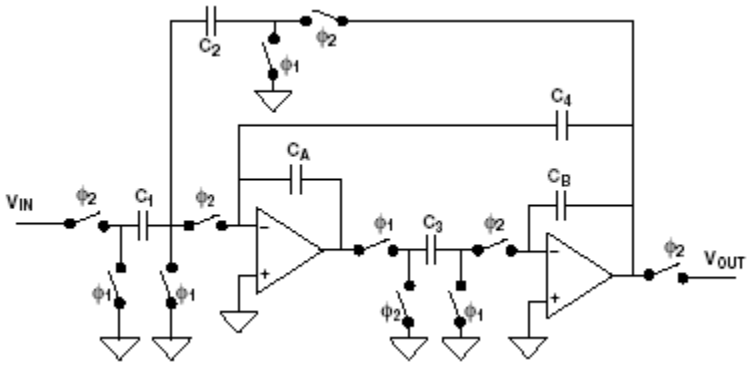
January 25, 2008

On-Chip Filter Examples (Intermediate and Low Frequency)

Gm-C

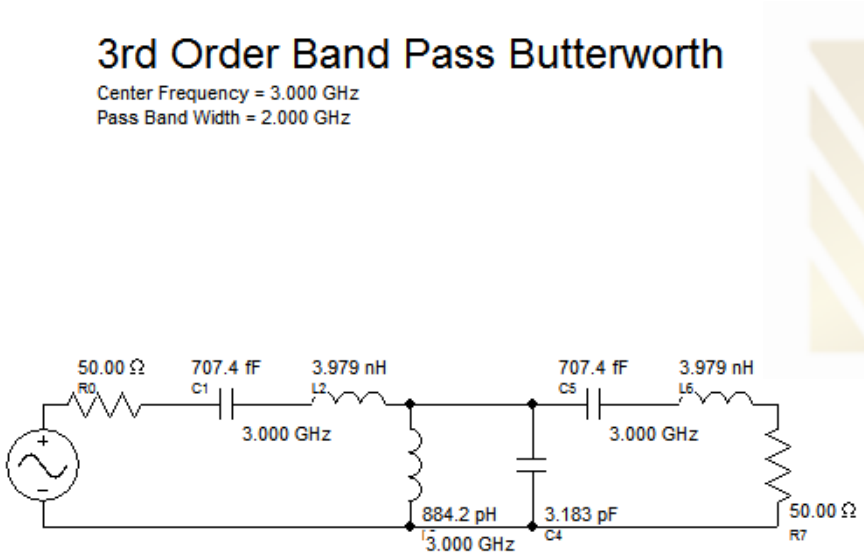


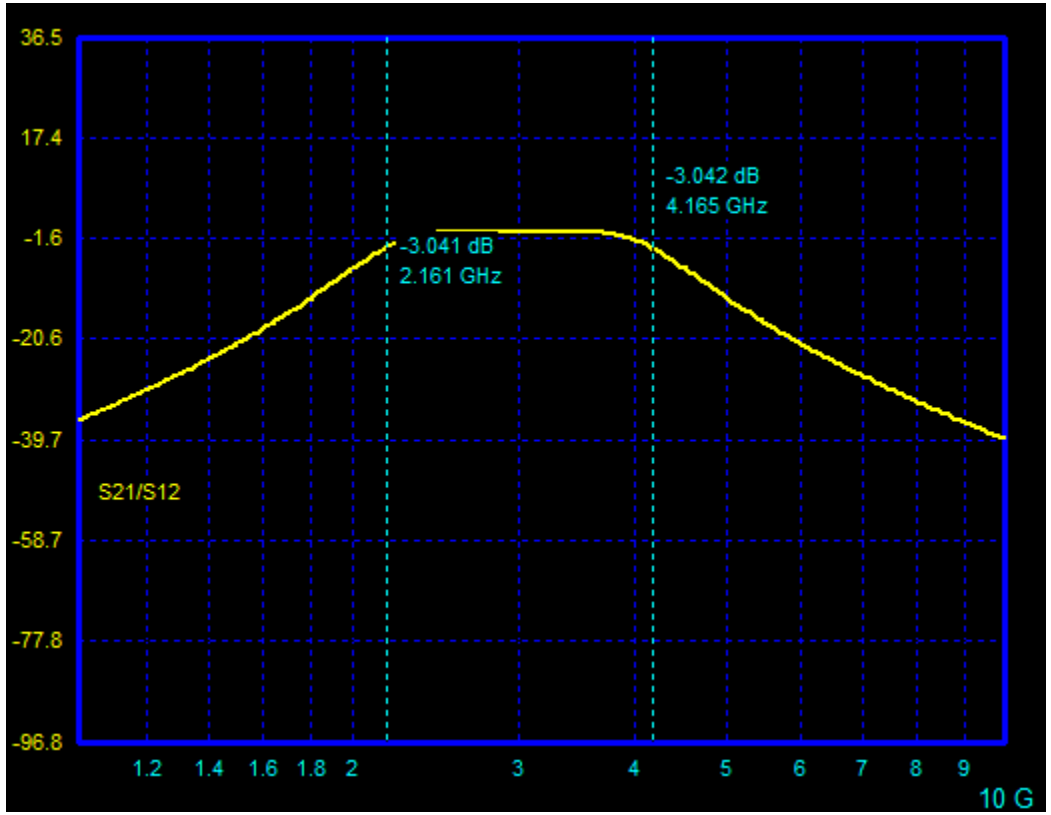
Switched Capacitor



Example

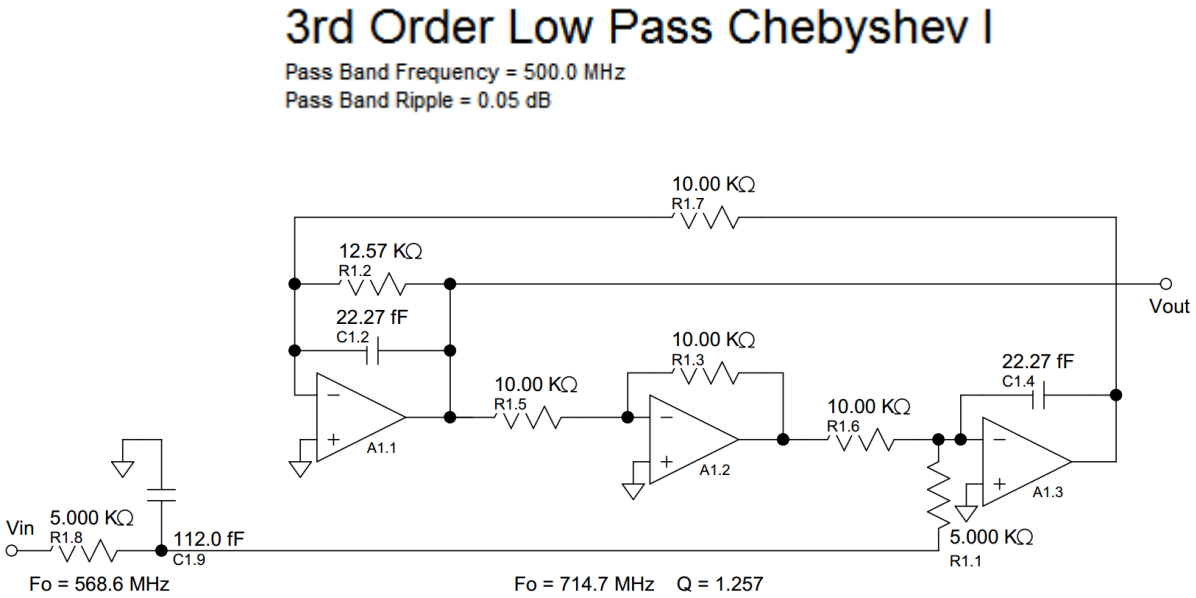
- LC filter

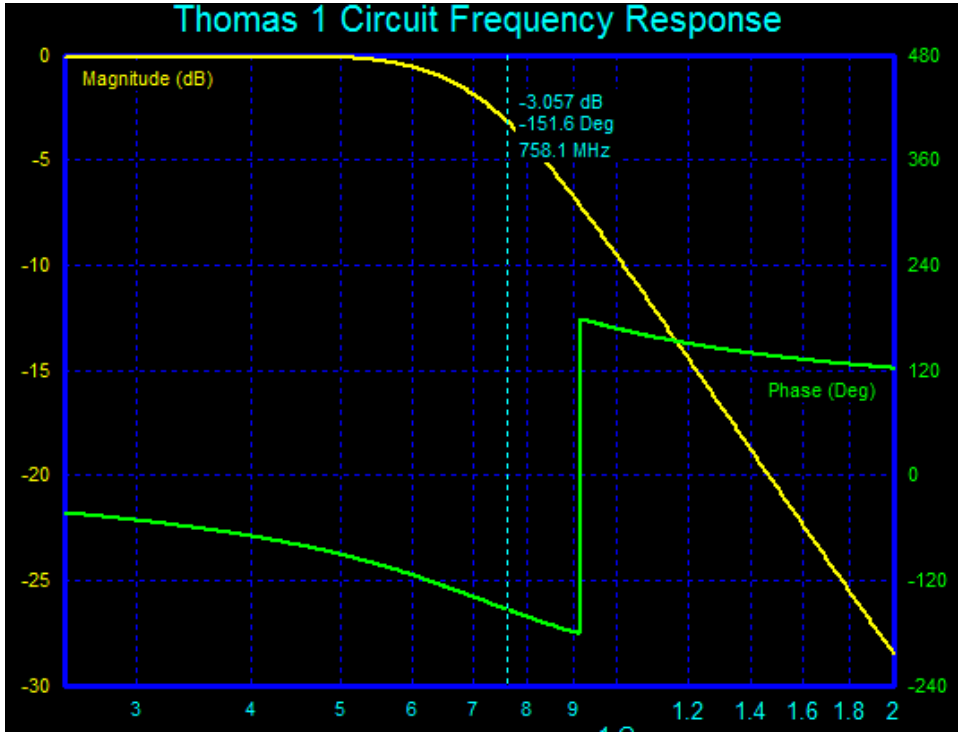




Example

- RC filter (Thomas 1)





Example

- Microstrip Filter