

# Microwave Engineering Notes (EC459)

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## Resonators

- **Cavity Resonators:**
  - - A metallic, enclosed space that stores microwave energy.
  - - Works like an LC circuit at microwave frequencies.
  - - Used in oscillators, filters, frequency meters.
- 
- **Coupling to Cavity:**
  - - Energy fed/extracted using probes, loops, or slots.
  - - Coupling strength controls energy transfer.
- 
- **Q-Factor (Quality Factor):**
  - - Measures energy loss relative to stored energy.
  - - Higher Q = lower loss.
  - -  $Q = 2\pi \times (\text{Energy Stored} / \text{Energy Lost per Cycle})$

## Microwave Components

- - Attenuators: Reduce signal strength.
- - Phase Shifters: Alter signal phase.
- - Directional Couplers: Split signal directionally.
- - Tees: E-plane and H-plane for signal division.
- - Isolators: One-directional signal flow.
- - Circulators: Route signal in loops.
- - Tuning Screws: Fine-tune cavity frequency.
- - Coupling Probes/Loops: Inject/extract signal.
- - Mixers: Convert signal frequency.
- - Detectors: Convert microwave to DC.
- 
- **Scattering Parameters (S-Parameters):**
  - - Describe signal behavior at ports.
  - - S11: Input reflection, S21: Forward transmission.

## Microwave Generators and Amplifiers

- **Velocity Modulation:**
  - - Modulates electron velocity using RF.
- 
- **Klystrons:**
  - - Two-Cavity: Bunching + output cavities.

# Microwave Engineering Notes

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