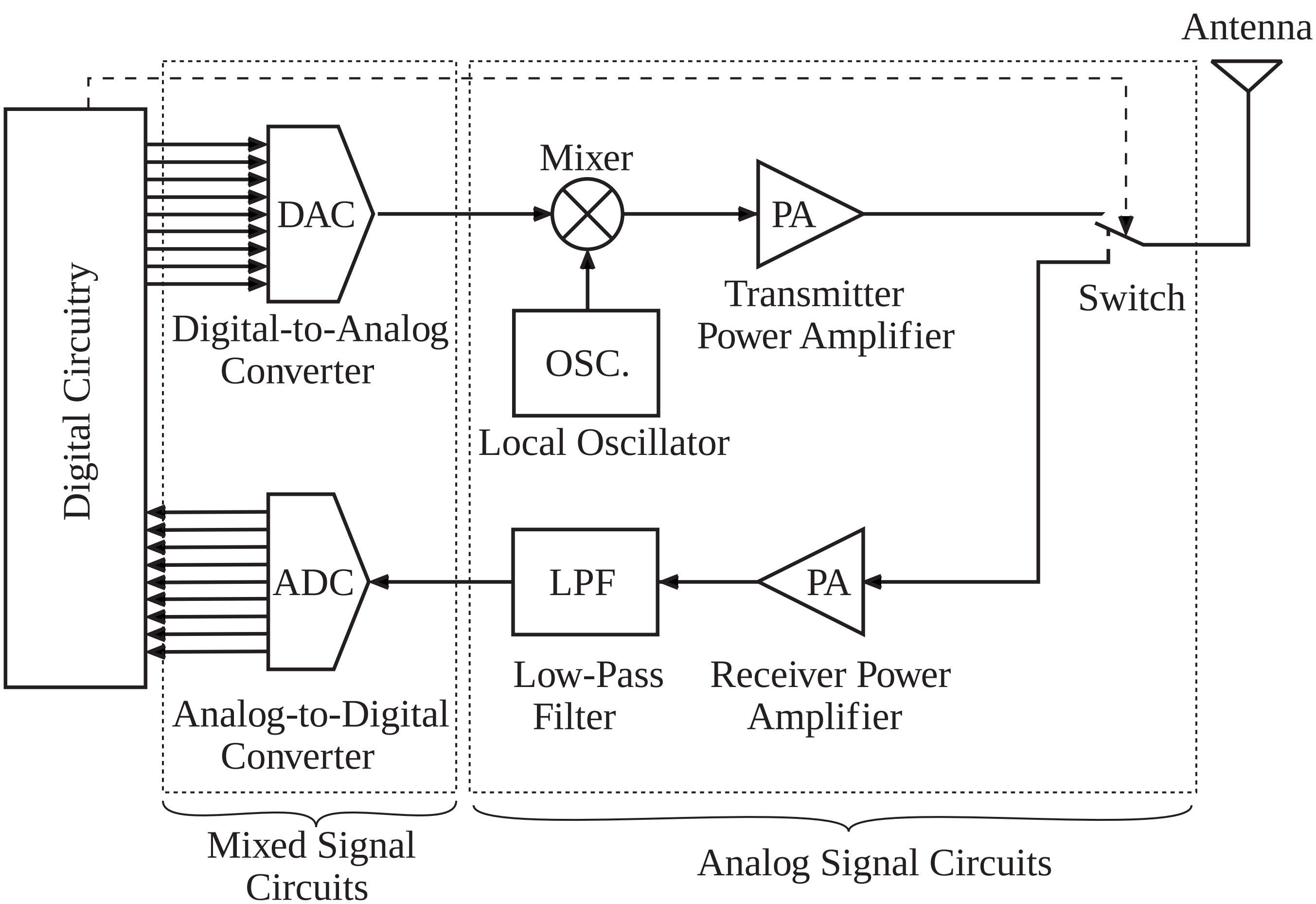


Figure 1-1 Block diagram of a generic RF system.

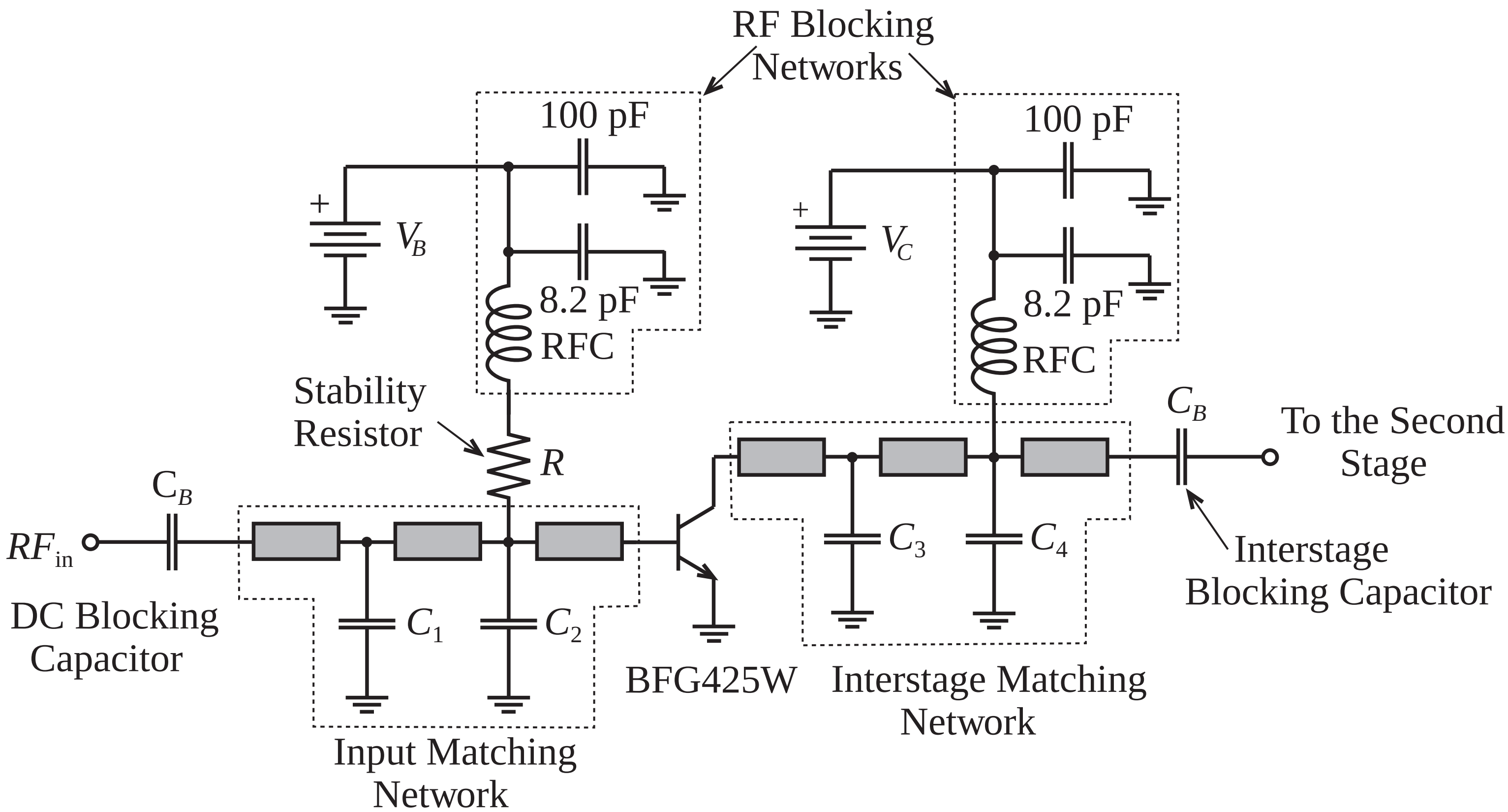


Figure 1-2(a) Simplified circuit diagram of the first stage of a 2-GHz power amplifier for a cellular phone.

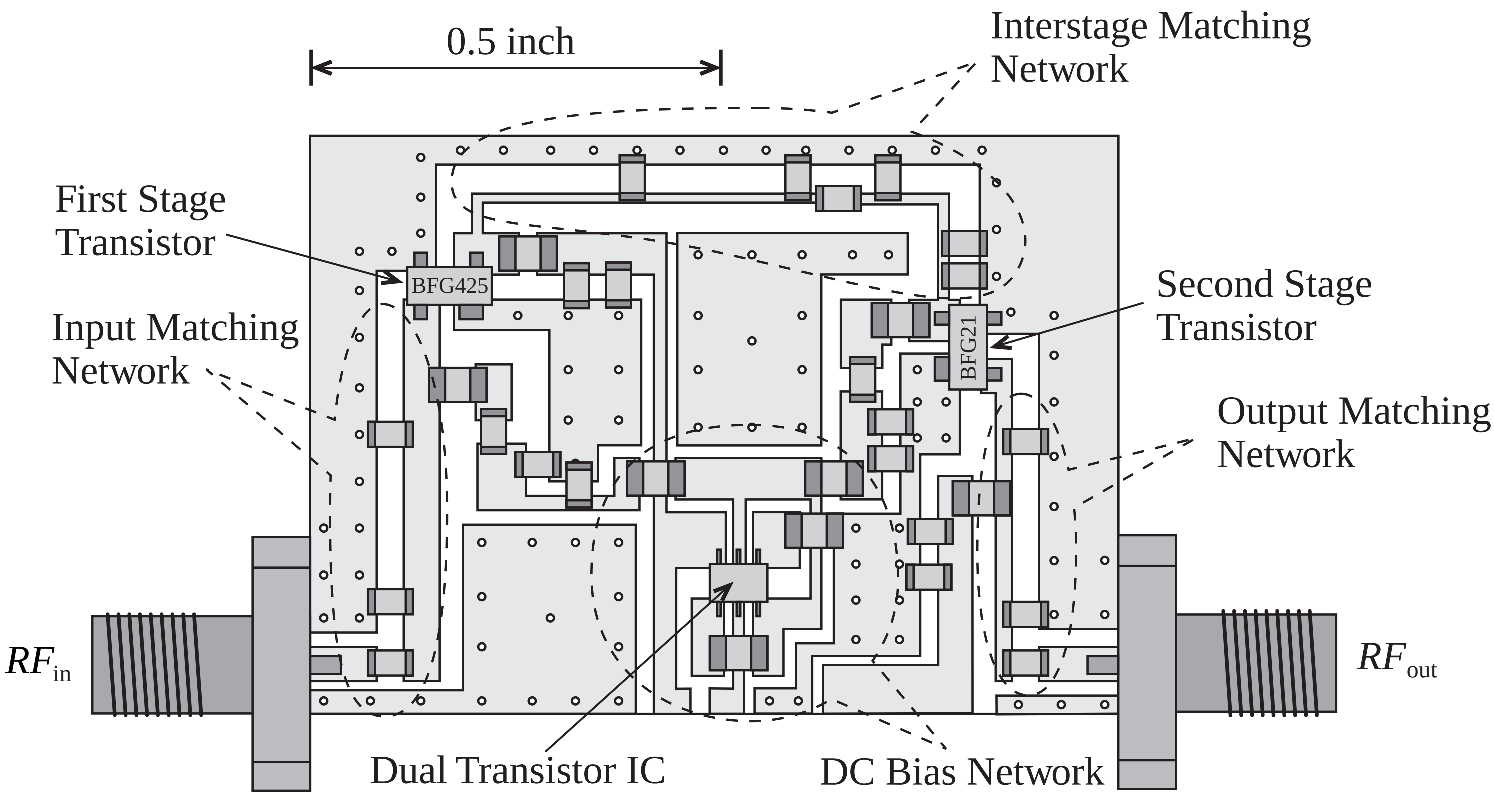


Figure 1-2(b) Printed circuit board layout of the power amplifier.

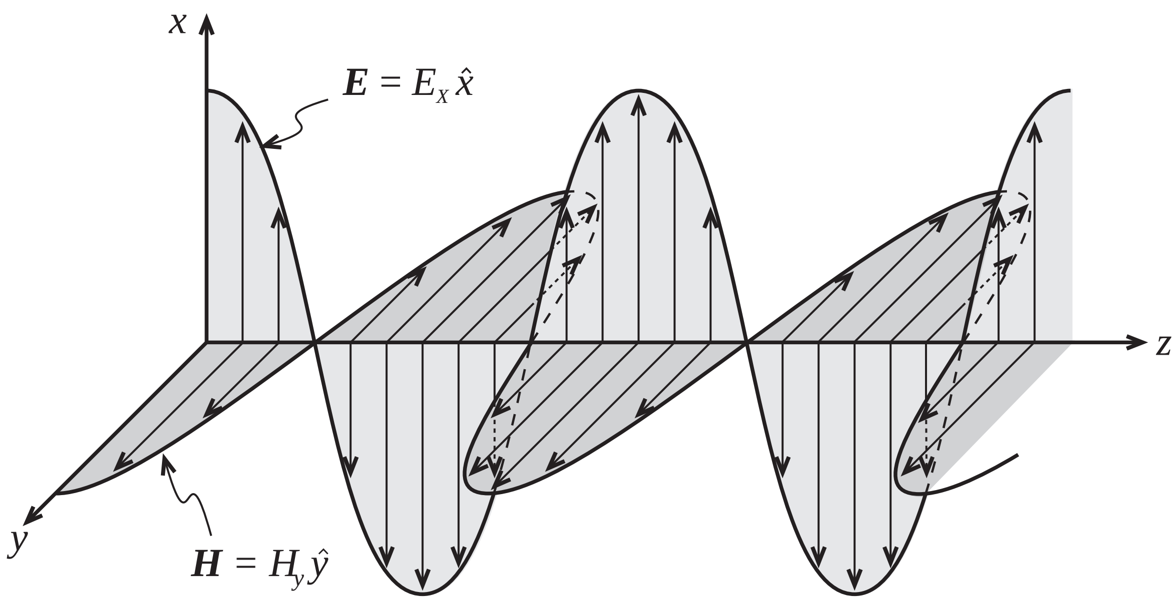


Figure 1-3 Electromagnetic wave propagation in free space. The electric and magnetic field is recorded at a fixed instance in time as a function of space ($\hat{x}$, $\hat{y}$ are unit vectors in x- and y-direction).

Table 1-1 IEEE Frequency Spectrum

Frequency Band	Frequency	Wavelength
ELF (Extreme Low Frequency)	30–300 Hz	10,000–1000 km
VF (Voice Frequency)	300–3000 Hz	1000–100 km
VLF (Very Low Frequency)	3–30 kHz	100–10 km
LF (Low Frequency)	30–300 kHz	10–1 km
MF (Medium Frequency)	300–3000 kHz	1–0.1 km
HF (High Frequency)	3–30 MHz	100–10 m
VHF (Very High Frequency)	30–300 MHz	10–1 m
UHF (Ultrahigh Frequency)	300–3000 MHz	100–10 cm
SHF (Superhigh Frequency)	3–30 GHz	10–1 cm
EHF (Extreme High Frequency)	30–300 GHz	1–0.1 cm
Decimillimeter	300–3000 GHz	1–0.1 mm
P Band	0.23–1 GHz	130–30 cm
L Band	1–2 GHz	30–15 cm
S Band	2–4 GHz	15–7.5 cm
C Band	4–8 GHz	7.5–3.75 cm
X Band	8–12.5 GHz	3.75–2.4 cm
Ku Band	12.5–18 GHz	2.4–1.67 cm
K Band	18–26.5 GHz	1.67–1.13 cm
Ka Band	26.5–40 GHz	1.13–0.75 cm
Millimeter wave	40–300 GHz	7.5–1 mm
Submillimeter wave	300–3000 GHz	1–0.1 mm

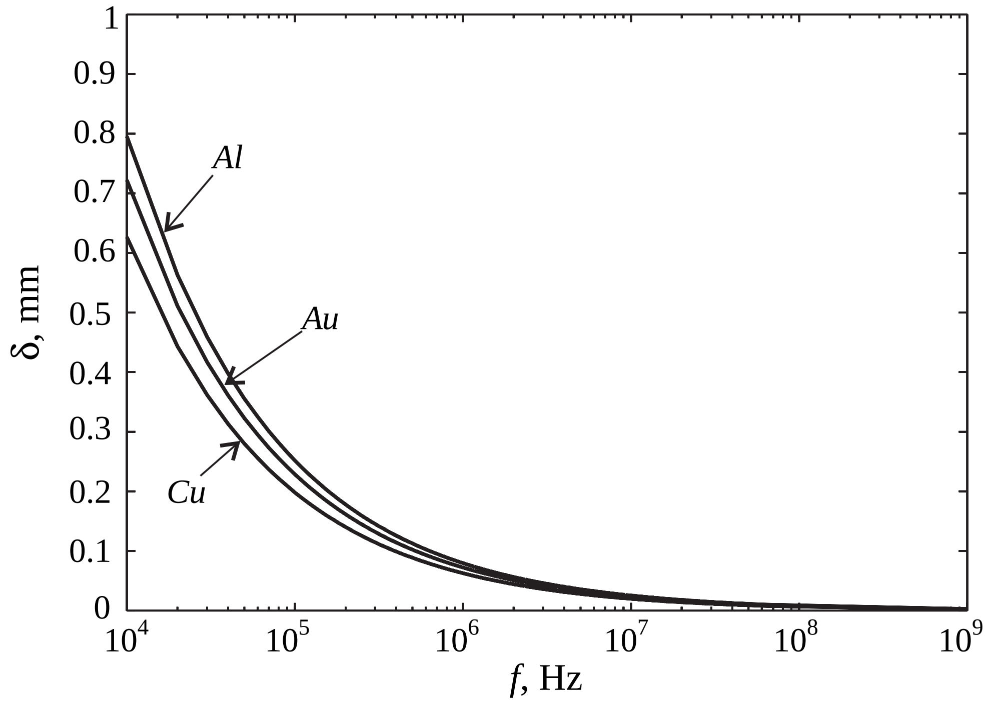


Figure 1-4 Skin depth behavior of copper $\sigma_{Cu} = 64.516\times10^6\ \mathrm{S/m}$, aluminum $\sigma_{Al} = 40.0\times10^6\ \mathrm{S/m}$, and gold $\sigma_{Au} = 48.544\times10^6\ \mathrm{S/m}$.

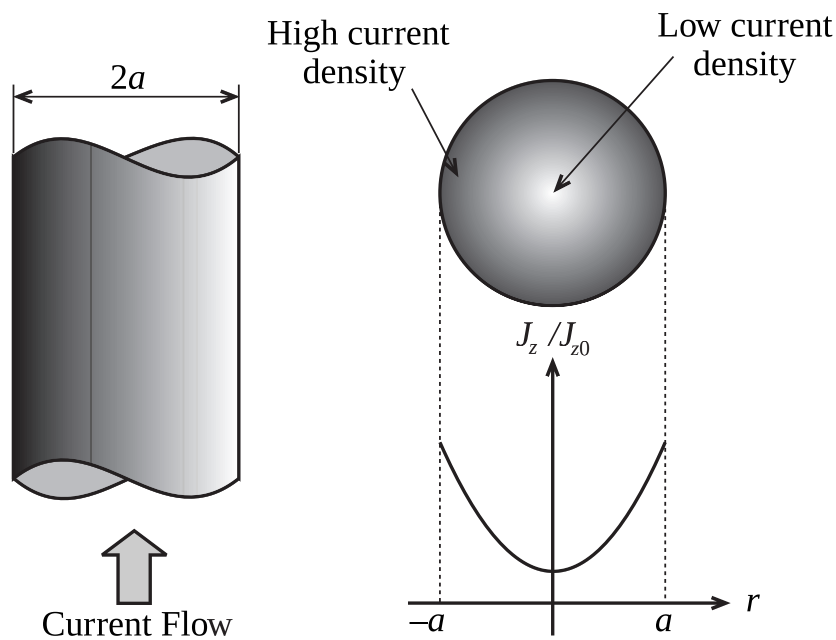


Figure 1-5(a) Schematic cross-sectional AC current density representation normalized to DC current density.

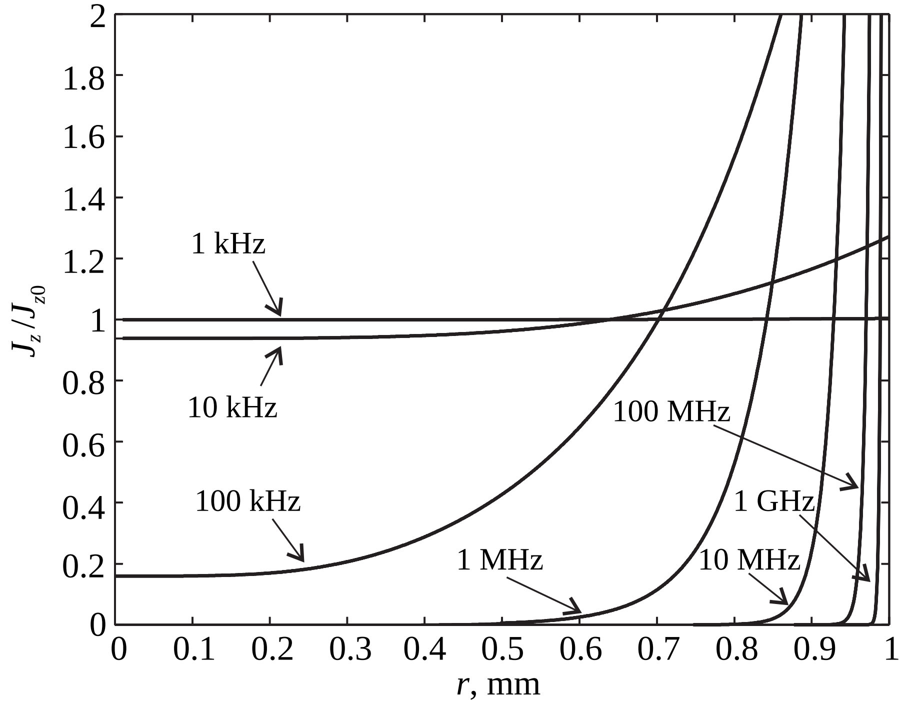


Figure 1-5(b) Frequency behavior of normalized AC current density for a copper wire of radius a = 1 mm.

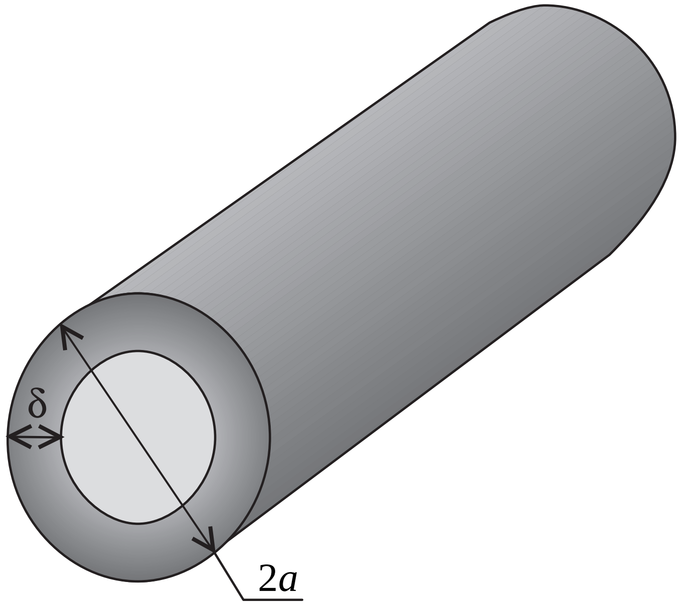


Figure 1-6 Increase in resistance over the cross sectional surface area. The current flow is confined to a small area defined by the skin depth δ.

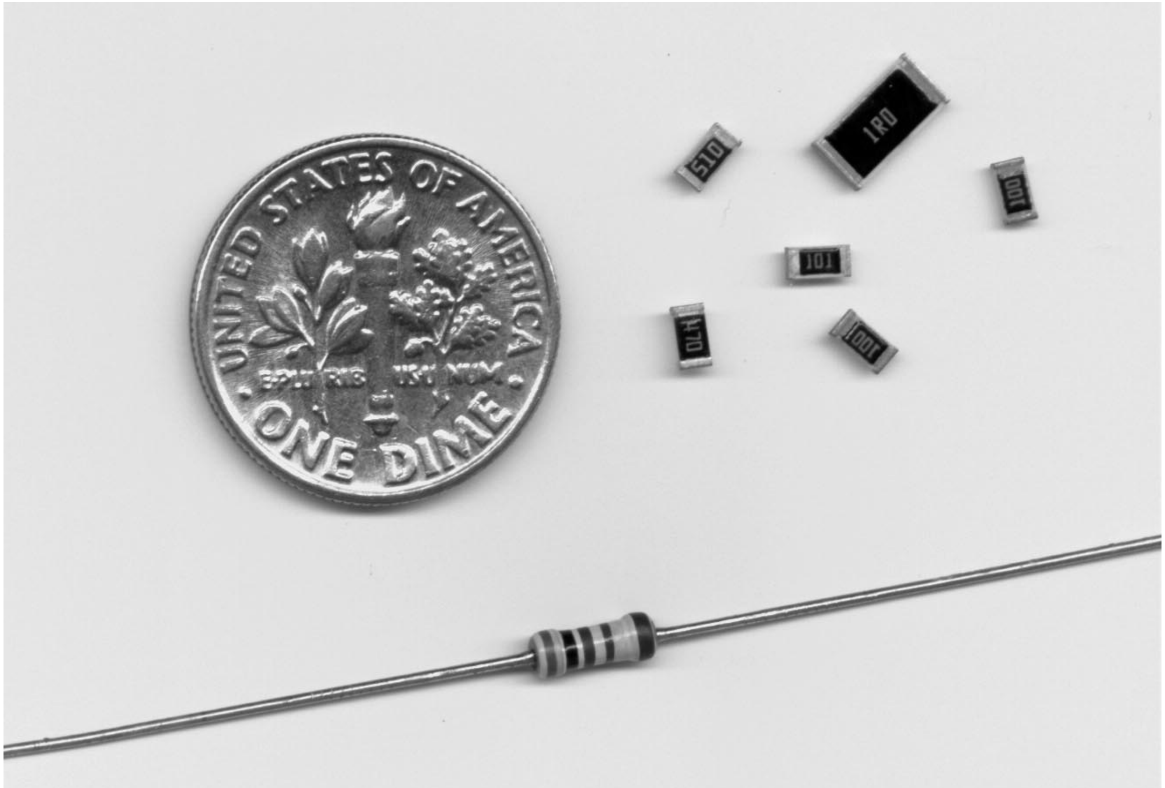


Figure 1-7 One- and quarter-watt thin-film chip resistors in comparison with a conventional quarter-watt resistor.

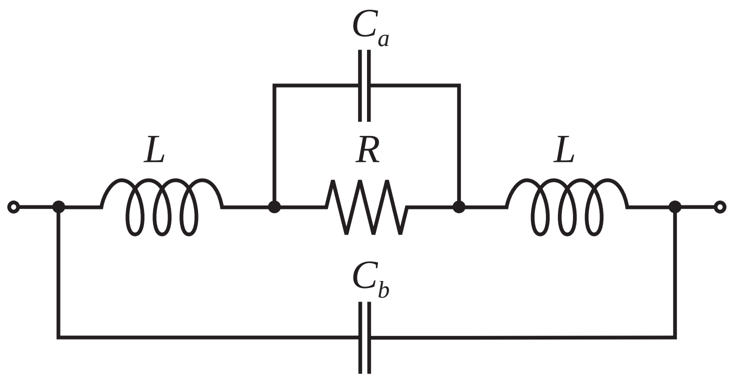


Figure 1-8 Electric equivalent circuit representation of the resistor.

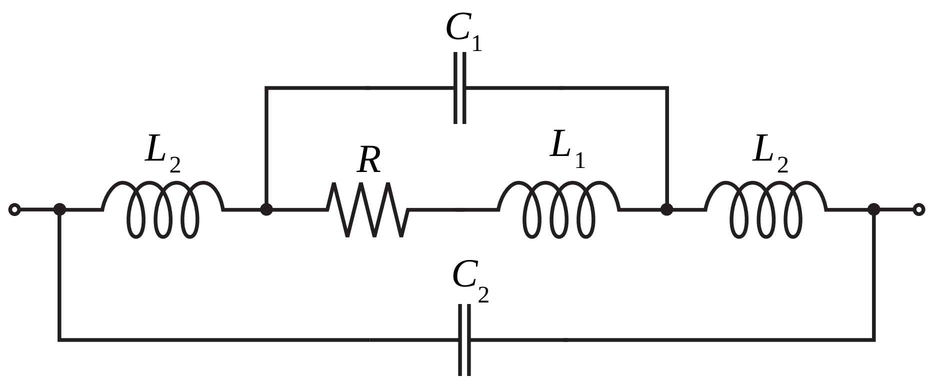


Figure 1-9 Electric equivalent circuit representation for a high-frequency wire-wound resistor.

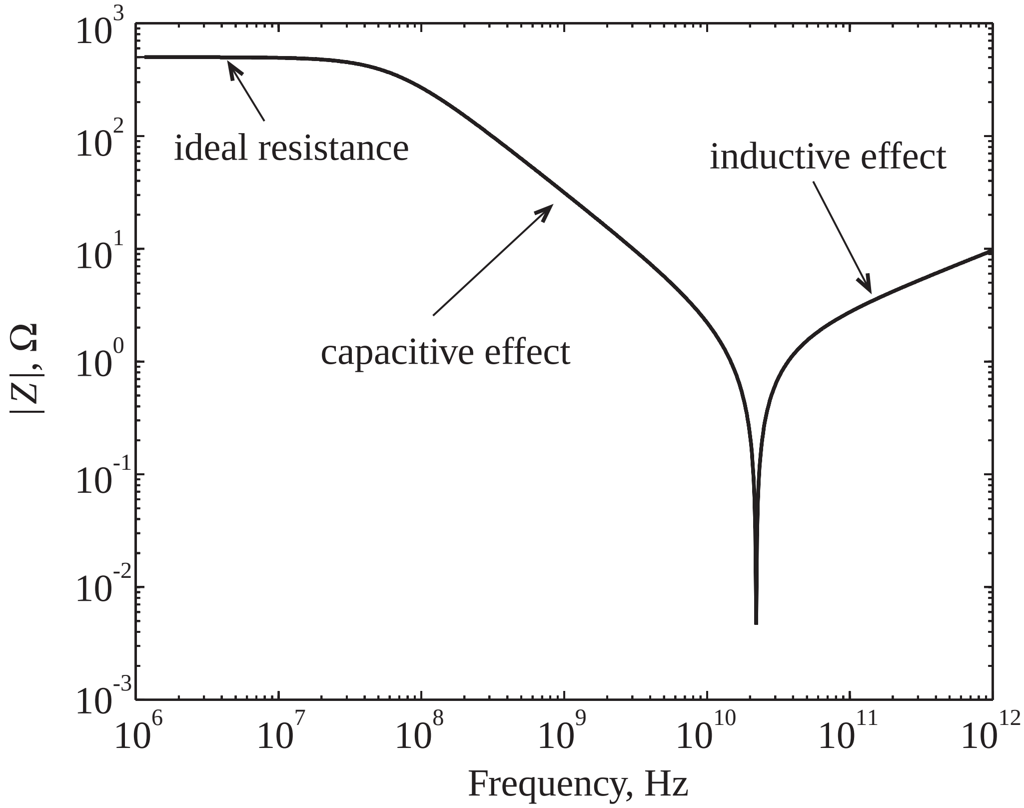


Figure 1-10 Absolute impedance value of a 500-Ω thin-film resistor as a function of frequency.

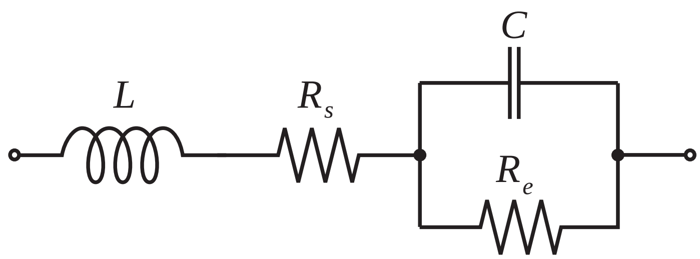


Figure 1-11 Electric equivalent circuit for a high-frequency capacitor.

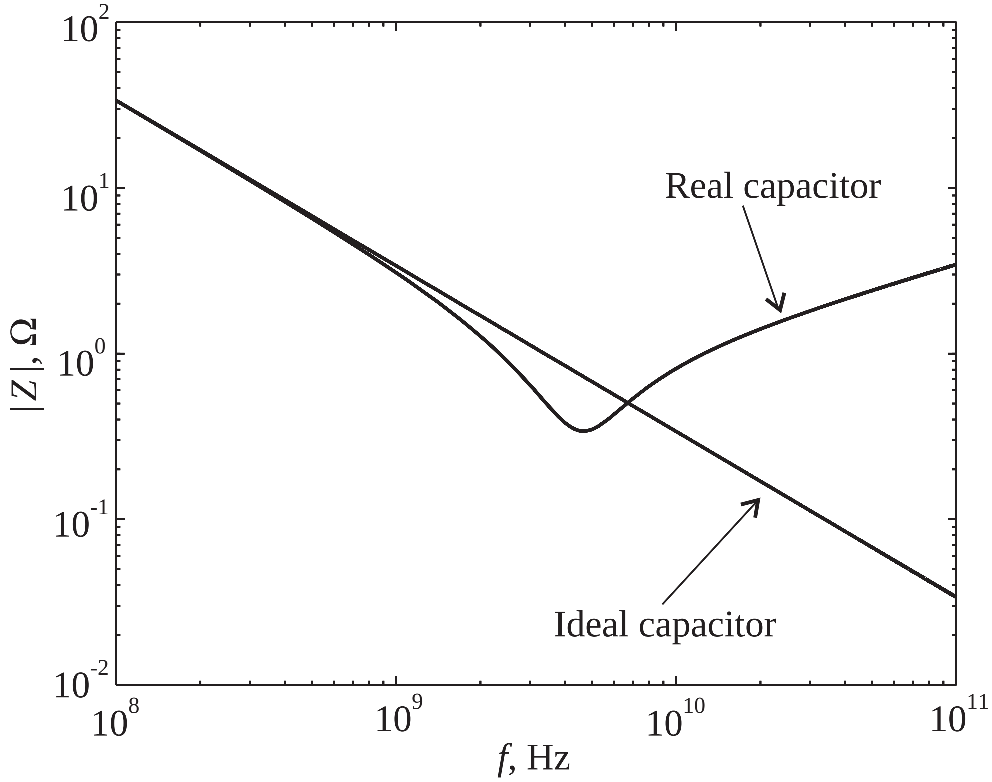


Figure 1-12 Absolute value of the capacitor impedance as a function of frequency.

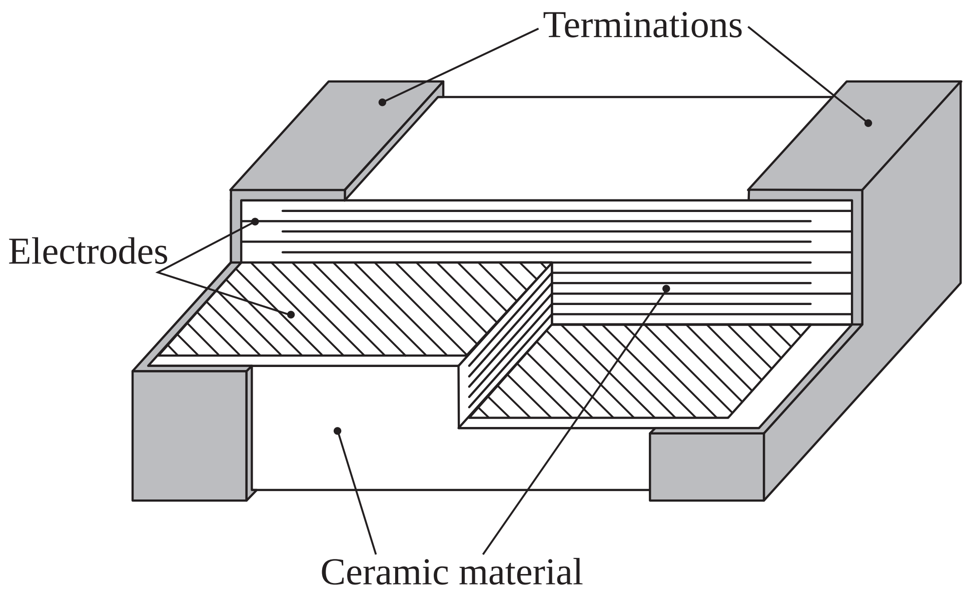


Figure 1-13 Actual construction of a surface-mounted ceramic multilayer capacitor.

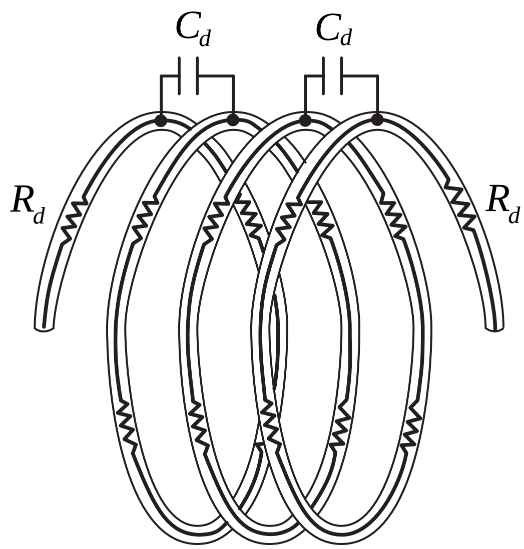


Figure 1-14 Distributed capacitance and series resistance in the inductor coil.

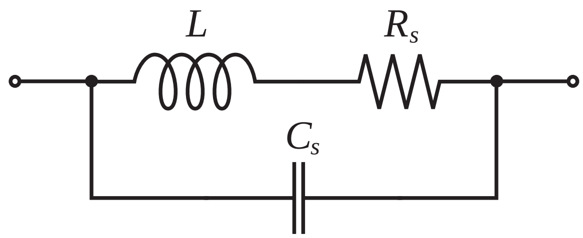


Figure 1-15 Equivalent circuit of the high-frequency inductor.

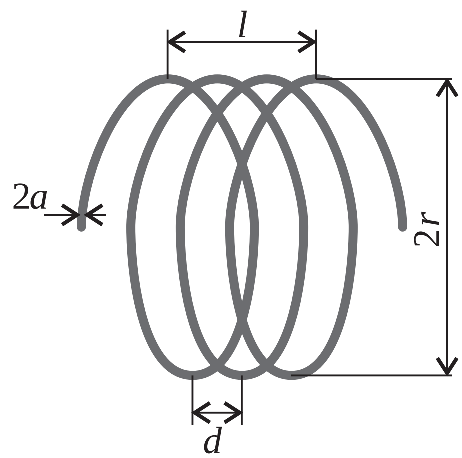


Figure 1-16 Inductor dimensions of an air-core coil.

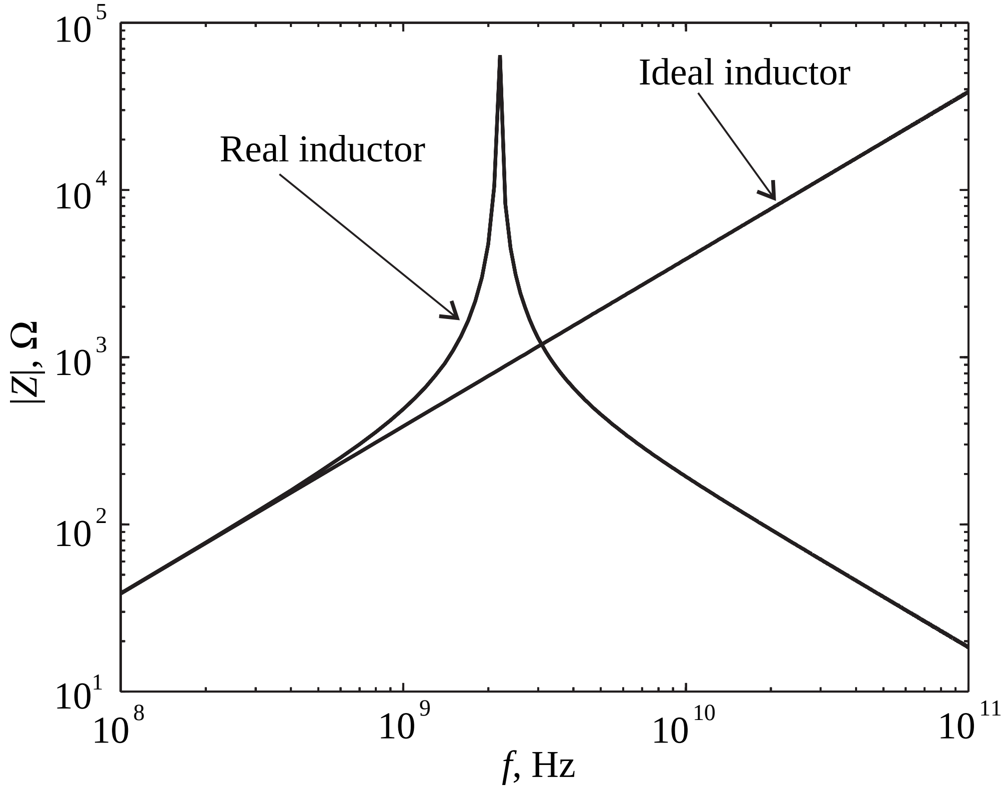
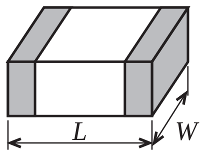


Figure 1-17 Frequency response of the impedance of an RFC.

Table 1-2 Standard sizes of chip resistors

Geometry	Size Code	Length L, mils	Width W, mils
	0402	40	20
	0603	60	30
	0805	80	50
	1206	120	60
	1218	120	180

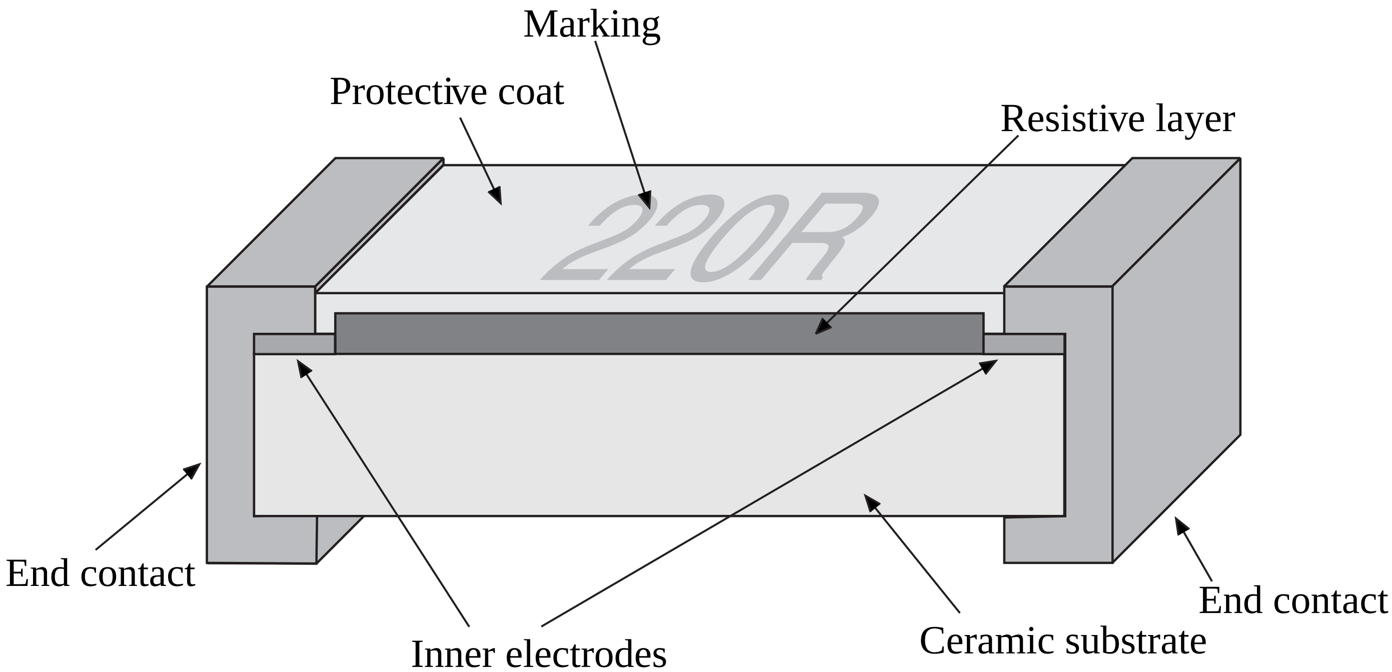


Figure 1-18 Cross-sectional view of a typical chip resistor.

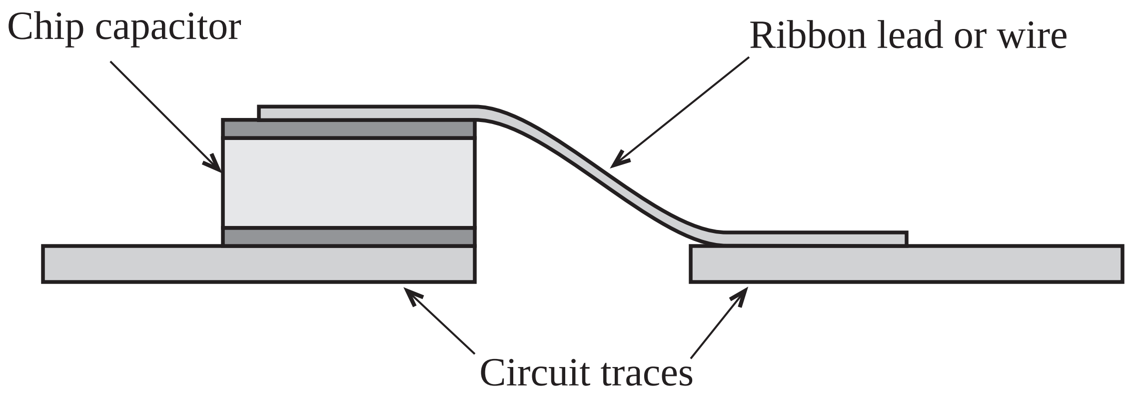


Figure 1-19 Cross section of a typical single-plate capacitor connected to the board.

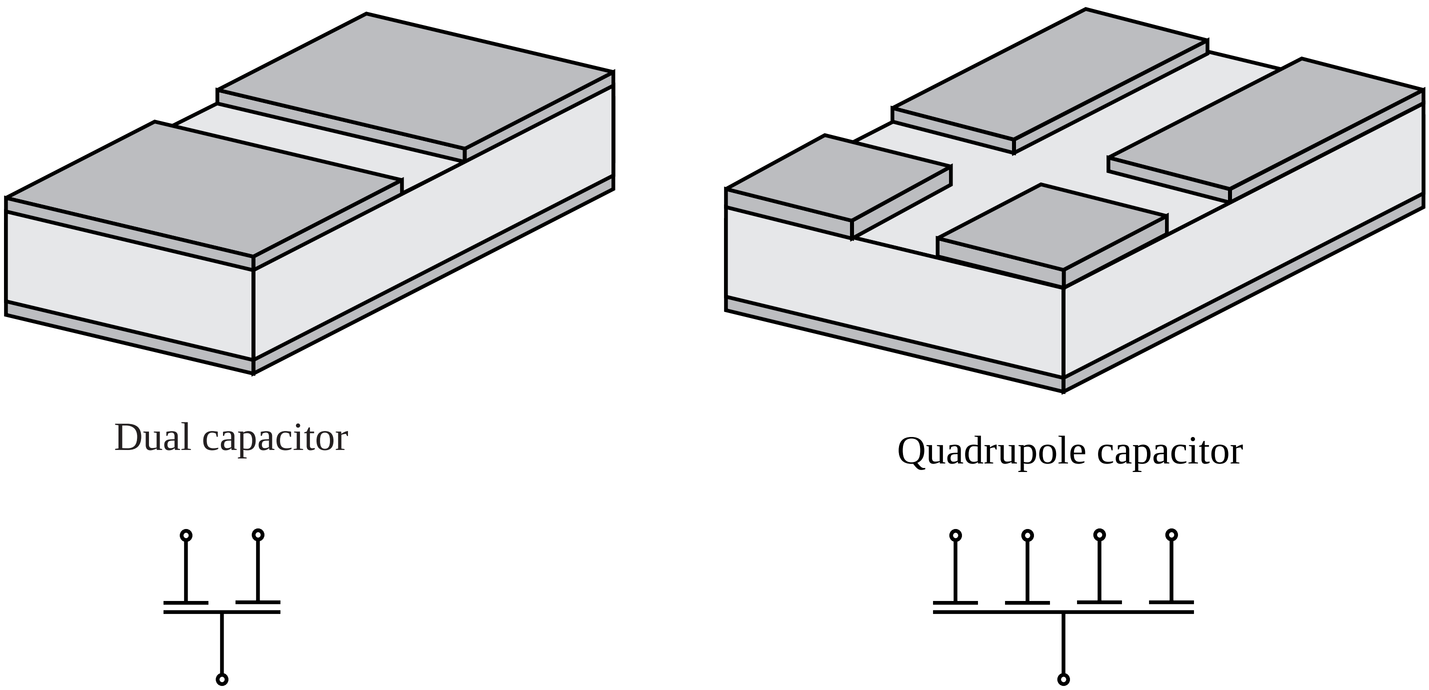


Figure 1-20 Clusters of single-plated capacitors sharing a common dielectric material.

Figure 1-21 Typical size of an RF wire-wound air-core inductor in comparison with a cellular phone antenna (courtesy Coilcraft, Inc.).

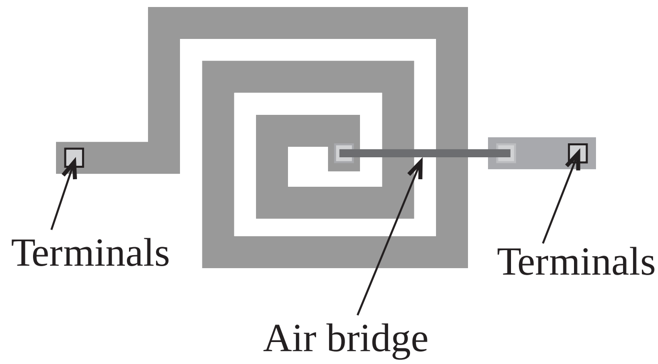


Figure 1-22 Flat coil configuration. An air bridge is made by using either a wire or a conductive ribbon.