

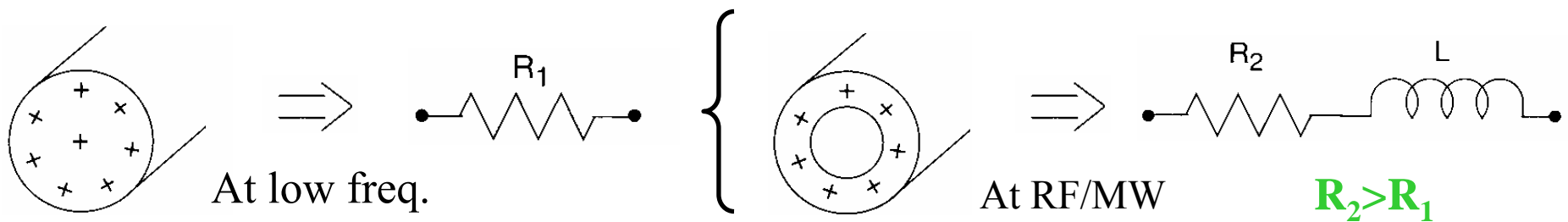
EE 407  
Microwave Engineering

*Lecture 14*

Microstrip Passive components

Dr. Sheikh Sharif Iqbal

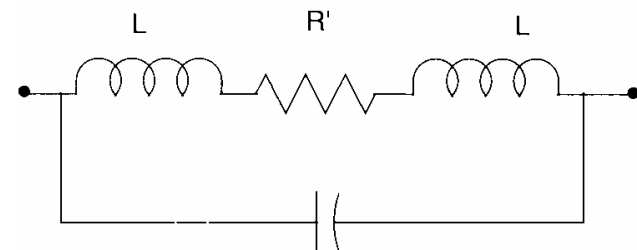
- Lumped element MIC's:** The lumped-element form of MICs consists of capacitors, inductors & resistors, that are a fraction of a wavelength in size.
- Lumped means the values of the components are independent of frequency.
  - In the past, this type of circuit was not feasible at MW frequencies because conventional fabrication techniques could not provide coils and capacitors small enough to behave as true lumped elements.
  - Recently, with the advent of new photolithographic techniques, fabrication of lumped element, that was limited to X-band, can be extended to about 60 GHz
  - **RF/MW Resistors:** At high freq's, due to **skin-effect** & straight-wire-induc



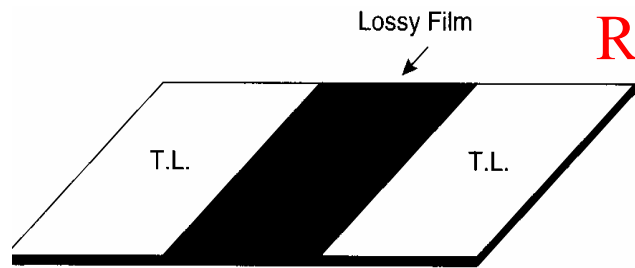
**Thus at RF/MW frequencies:**



Ref. Text book



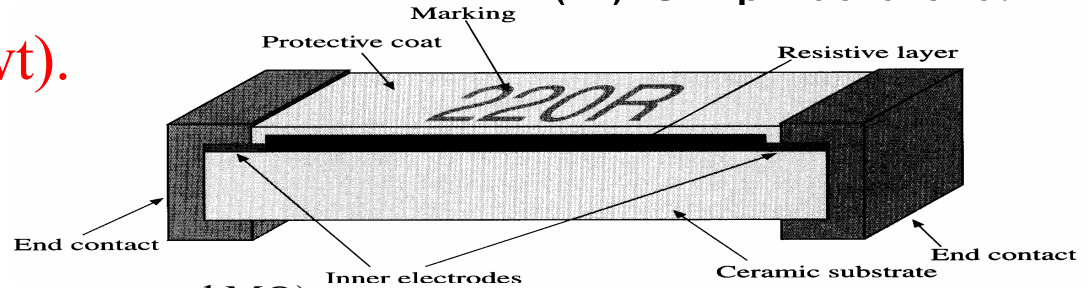
**(1) Thin film resistors:**



$$R = l / (\sigma wt)$$

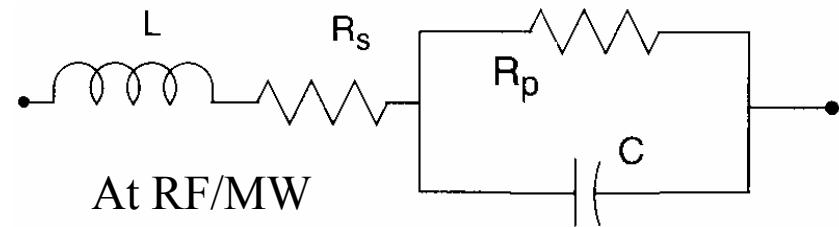
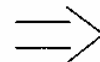
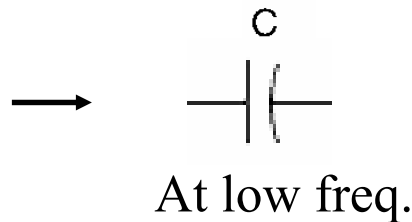
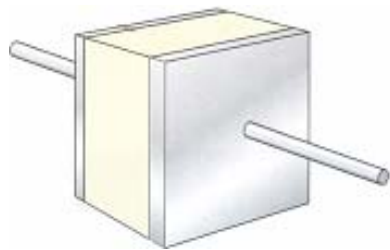
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**(2) Chip resistors:**



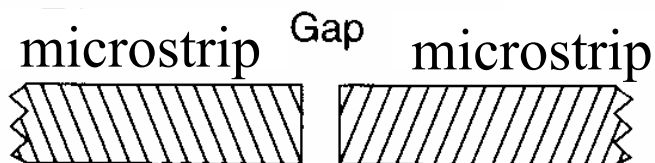
(0.1Ω up to several MΩ)

▪ **RF/MW Capacitors:** At RF/MW frequencies, the parasitic elements of the capacitor become important. In the equivalent circuit, 'C' is actual capacitance,  $R_p$  is insulating resistance,  $R_s$  is series resistance ( $\sim \delta_s$ ) & 'L' is lead inductance.



**(a) GAP capacitor:**

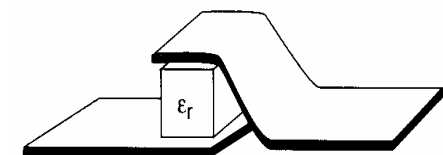
$$C < 1.0 \text{ pF}$$



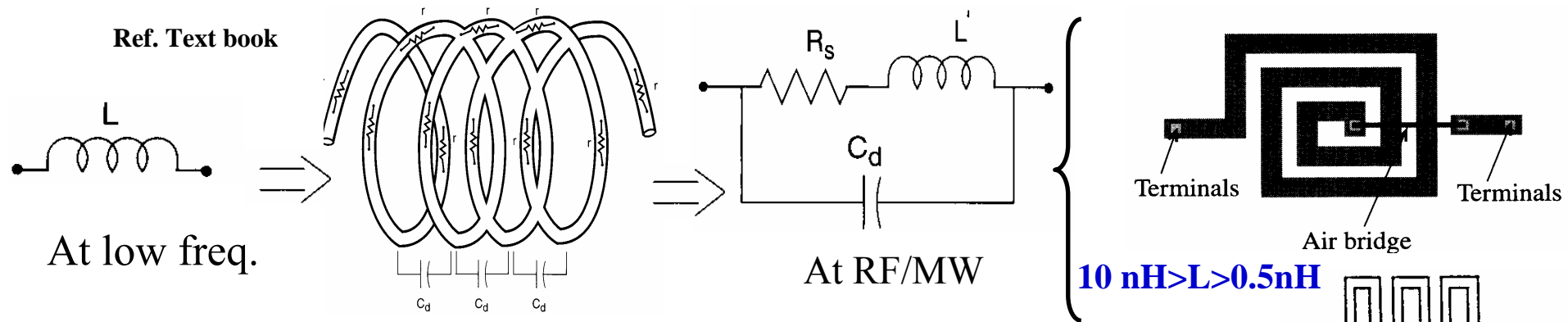
**(b) Interdigitated Capacitors:**



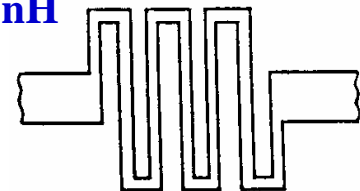
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large capacitance

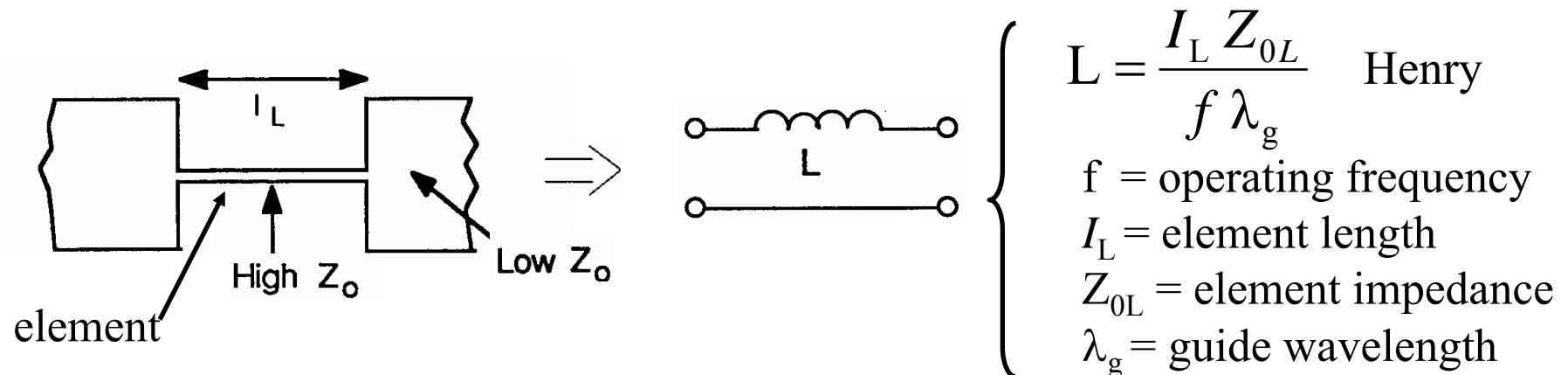


(1) Meander line Inductance, (2) Microstrip Coil inductors:

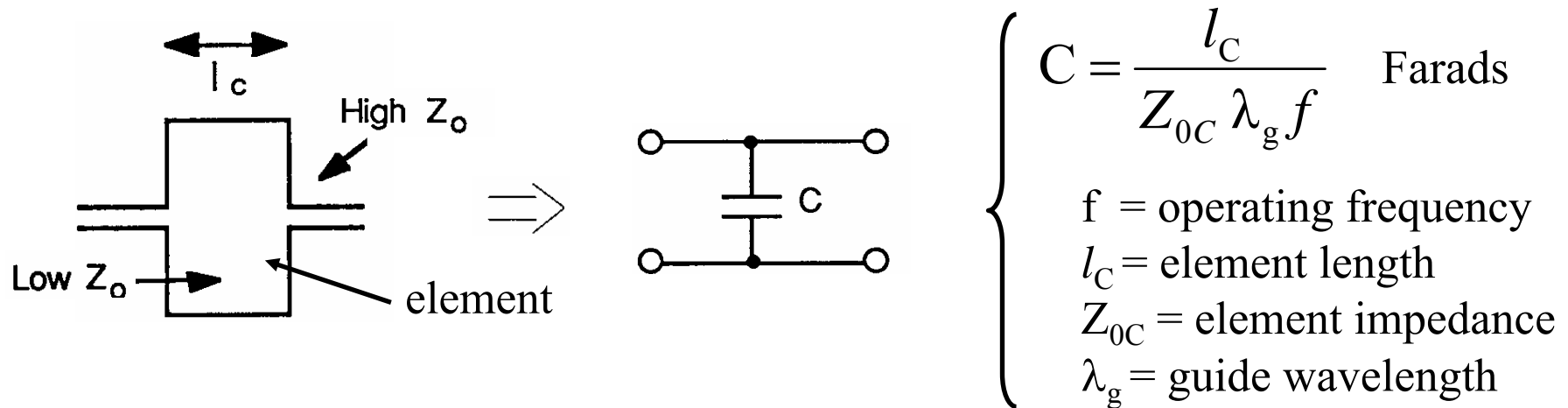


➤ Step in Width Inductors for RF/MW circuits, series inductance are also synthesized using short lengths of high impedance  $\mu$ -strip lines terminated in low impedance  $\mu$ -strip line as shown in figure below.

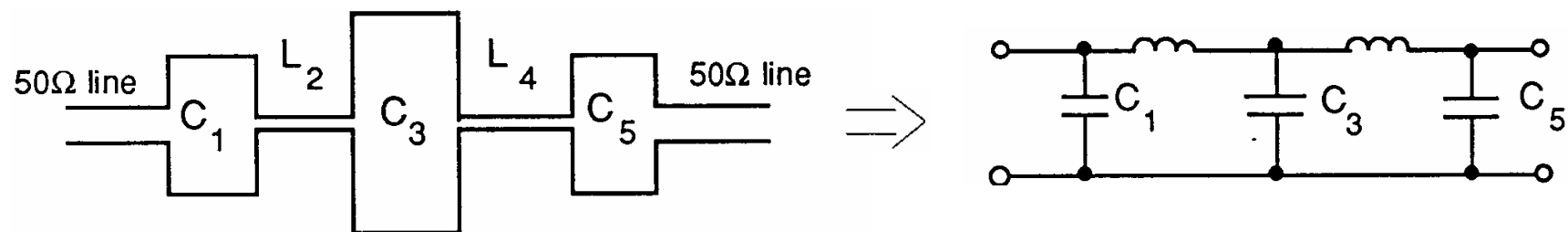
- Characteristic impedance of a microstrip line is a function of its width 'w'. ('w' $\downarrow$ ,  $Z_0 \uparrow$ ). Inductance (L) of the circuit is expressed as;



- **Step in Width Capacitor for RF/MW circuits**, shunt capacitance are also synthesized by terminating short lengths of low impedance  $\mu$ strip lines by a high impedance lines (see fig). Capacitance value are;



- Thus using these inductive and capacitive elements we can construct a **Low Pass Filter** as shown in figure below:



Ref. Text book