Microwave Integrated Circuits

Us electrical engineers are always attempting to make things **smaller**.

Certainly, over the past several decades we have **succeed** marvelously in this quest.

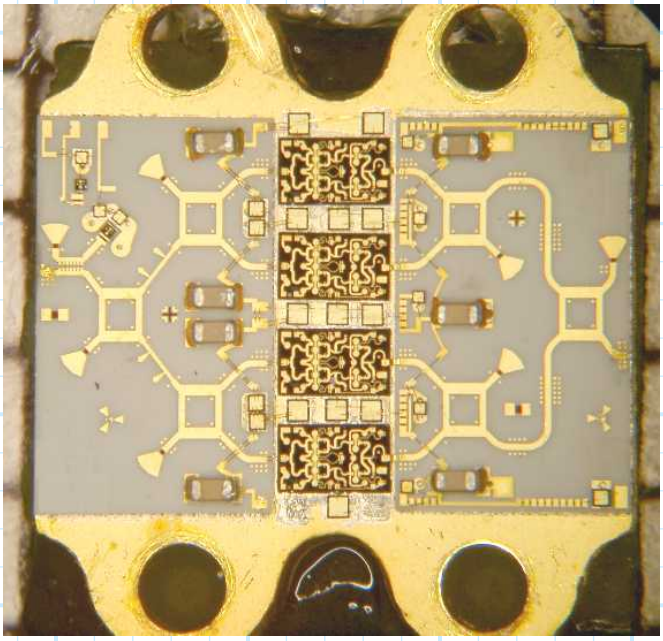
Recall in **microwave engineering** this becomes somewhat easier as we **increase frequency**—things like a $\lambda/4$ length transmission line become physically very small as wavelength diminishes!

But regardless of the frequency, the march toward miniaturization continues. Let's look at current microwave fabrication technology.

1. **Connectorized** – Easy to construct microwave systems, but big and bulky.

2. **Printed Circuit Board (PCB)** – Can implement microstrip or even stripline microwave systems using standard manufacturing techniques.

3. Hybrid Microcircuits - The original microwave miniaturization technology. Microstrip circuits are constructed on ceramic or crystalline substrates, typically with low loss and high dielectric constant. Components such as chip resistors and conductors can be attached, as well as individual integrated circuits.



Interconnections are often made with thin wires (i.e., wire-bonded). The goal is to pack as much "stuff" into as small a space as possible.

4. Monolithic Microwave Integrated Circuit (MMICs) – The same monolithic technology and fabrication techniques applied to integrated circuits can likewise be applied to construct microwave devices and systems.

Inherent in MMICs is a technology known as Micro Electro-Mechanical Systems (MEMS). In MEMS, integrated circuit techniques are used to make what are essentially tiny structures on the integrated circuit. Among these structures are spiral inductors, transmission lines, and switches.

Like all integrated circuit technologies, MMIC technology has high non-recurring costs but minimal recurring (i.e., marginal) costs.