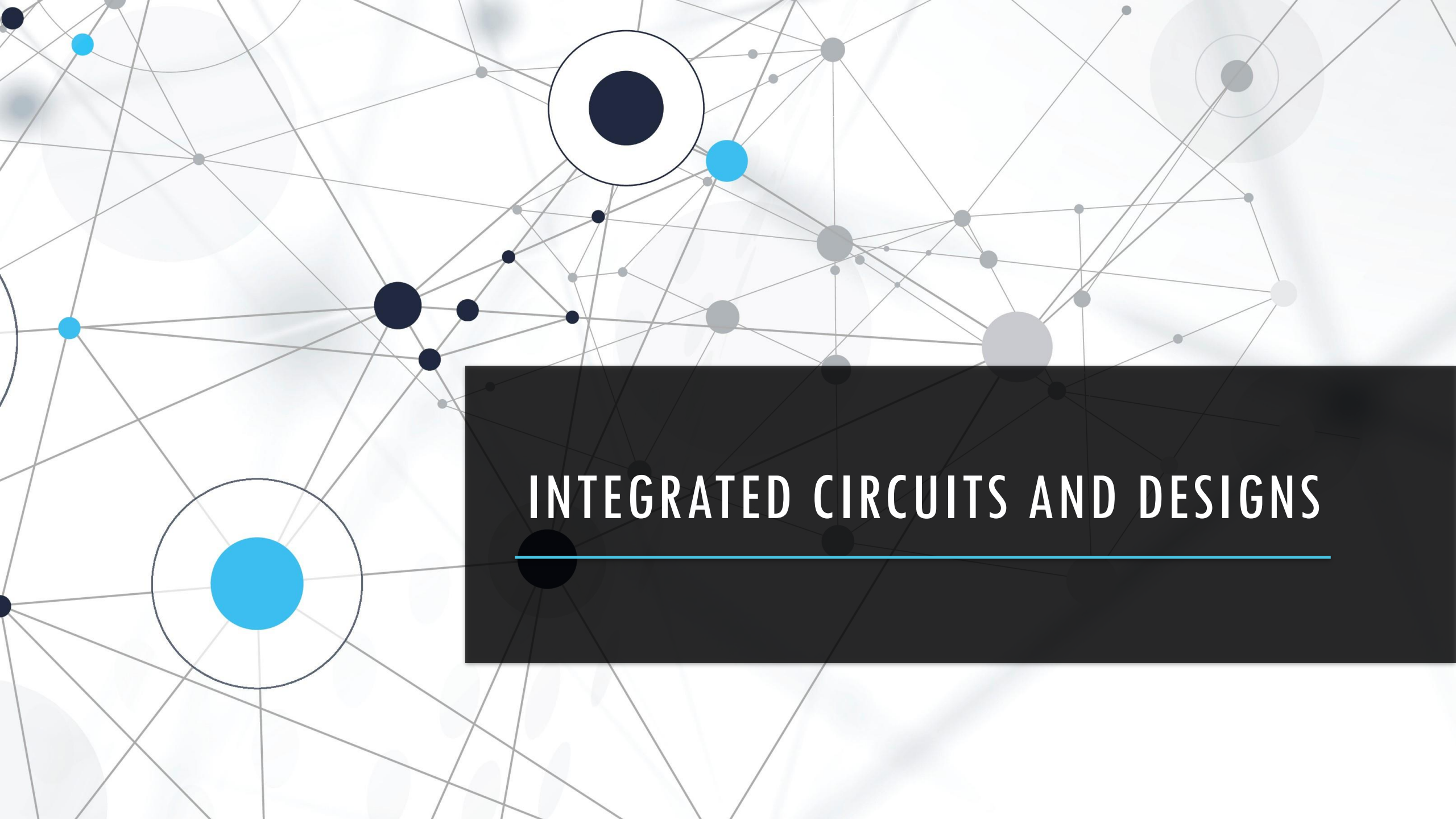


INTEGRATED CIRCUITS AND DESIGNS

INTRODUCTION

Integrated circuits, commonly known as ICs or microchips, are the fundamental building blocks of modern electronics. These miniature marvels pack thousands to billions of electronic components onto a single silicon chip, enabling the functionality of everything from smartphones and computers to automotive systems and appliances. IC design is the intricate process of creating these compact electronic circuits, carefully orchestrating transistors, resistors, and capacitors to perform specific tasks efficiently. It's the heart of technological innovation, shaping the devices and systems that power our connected world.

INTEGRATED CIRCUITS

- An integrated circuit (refered to as an IC, chip or microchip) is an electronic circuit manufactured by the patterned diffusion of trace elements into the surface of a then substrate of a semiconductor . Additional materials are deposited and patterned to form interconnection between semiconductor devices.

- An integrated circuit (IC) is just a packaged electronic circuit. In other words it is a complete electronic circuit in which both the active and passive components are fabricated on a tiny single chip of silicon.
- Active components are those which have the ability to produce gain.
- Examples are : transistors and FETs.
- Passive components or devices are those which do not have this ability.
- Examples are : transistors,capacitors and inductors.

ADVANTAGES OF IC'S

- EXTREMELY SMALL PHYSICAL SIZE
- VERY SMALL WEIGHT
- REDUCED COST
- EXTREMELY HIGH RELIABILITY
- INCREASED RESPONSE TIME AND SPEED
- LOW POWER CONSUPTION
- EASY REPLACEMENT

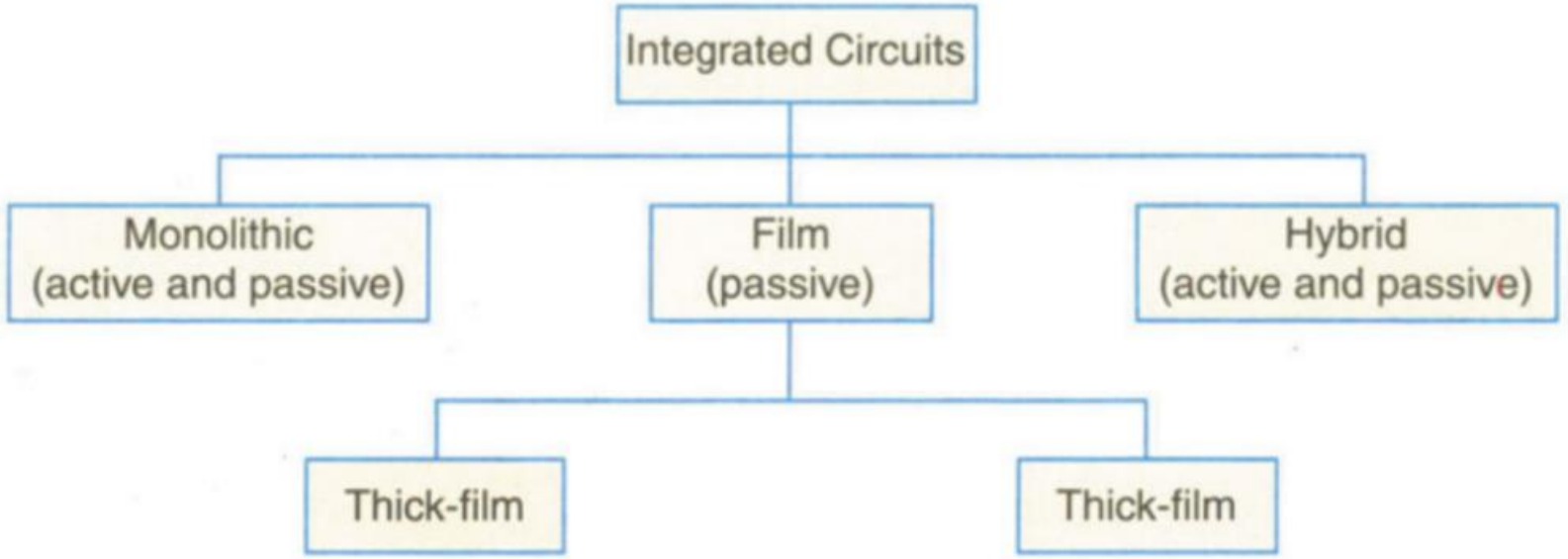
LIMITATIONS OF IC'S

- Coils or inductors cannot be fabricated.
- ICs function at fairly low voltages.
- They handle only limited amount of power.
- They are quite delicate and cannot withstand rough handling or excessive heat.

SCALE OF INTEGRATION

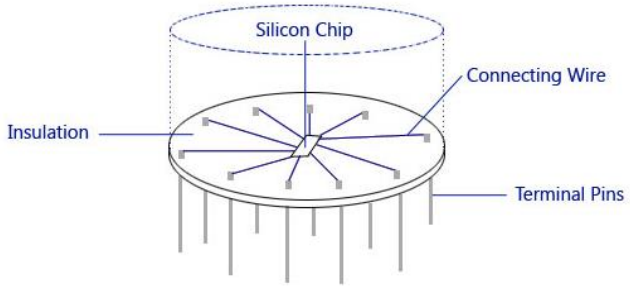
SSI	<	12
MSI		12 – 99
LSI		100 – 9,999
VLSI		10,000 – 99,999
ULSI		100,000 – 999,999
GSI	>	1,000,000

CLASSIFICATION OF IC'S BY STRUCTURE

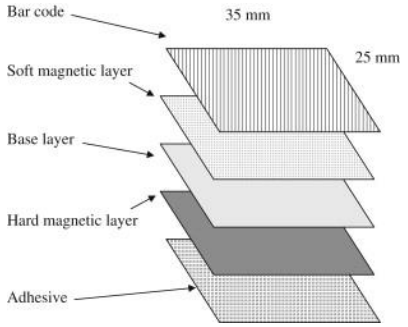


CLASSIFICATION OF IC'S BY STRUCTURE

MONOLITHIC IC:



THICK AND THIN FILMS OF IC'S:



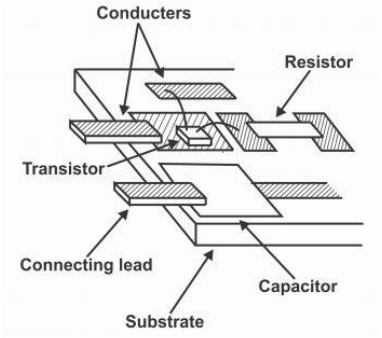


Fig 8.16: Enlarged portion of thick-film IC.

HYBRID OR MULTICHIP IC'S:

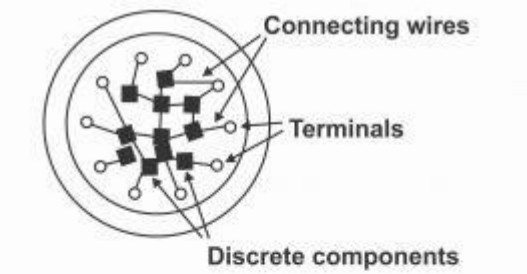


Fig 8.17: Hybrid or multichip IC

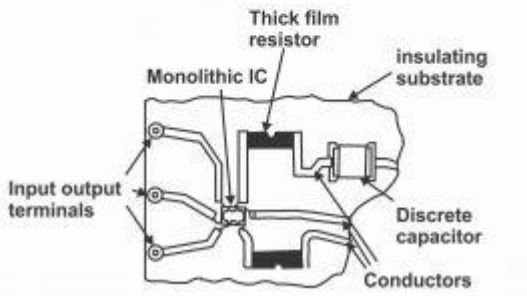


Fig 8.18: A portion of a typical hybrid IC

CAMPARSION BETWEEN DIFFERENT IC'S

Aspect	Monolithic ICs	Film ICs	Hybrid ICs
Fabrication	All components on a single silicon chip	Components on a ceramic substrate	Combines multiple chips or substrates
Integration	High integration (all on one chip)	Low integration (separate components)	Variable integration (mix of chips and components)
Size and Weight	Compact and lightweight	Larger and heavier	Variable size and weight
Reliability	High reliability due to single-chip design	Moderate reliability	May vary depending on connections
Cost	Economical for mass production	Can be costlier due to assembly	Cost varies based on complexity
Applications	Versatile, used in a wide range of devices	Limited applications, e.g., sensors	Specialized applications requiring mixed integration
Notable Examples	Microprocessors, op-amps	Strain gauges, thermistors	Military, aerospace, and certain medical devices

CLASSIFICATION OF IC'S FUNCTION

Aspect	Analog ICs	Digital ICs	Mixed-Signal ICs
Primary Function	Continuous signal processing	Discrete signal processing	Combination of both
Components	Amplifiers, filters, voltage regulators, etc.	Logic gates, flip-flops, counters, etc.	Combines analog and digital components
Signal Type	Continuous (analog)	Discrete (digital)	Both continuous and discrete
Applications	Audio, sensors, power management	Computers, memory, microcontrollers	Data converters, communication systems
Examples	Op-amps, voltage regulators	Microprocessors, memory chips	Analog-to-digital converters (ADCs), digital-to-analog converters (DACs)
Use Cases	Signal conditioning, amplification	Data processing, binary operations	Bridging between analog and digital domains
Complexity	Moderate to high complexity	High complexity	Moderate to high complexity
Power Consumption	Low to moderate	Low to moderate	Varies depending on the application
Market Segment	Specific analog applications	General-purpose digital applications	Applications requiring mixed analog and digital functionality
Notable Characteristics	High precision, sensitivity	High-speed data processing	Versatility in handling diverse signal types

LINEAR INTEGRATED CIRCUITS :

A linear IC (Integrated Circuit) is an electronic device that processes analog signals with linear relationships between input and output, making it ideal for tasks like amplification, filtering, and regulation. It maintains signal integrity and does not switch between discrete states, in contrast to digital ICs. Linear ICs find use in audio amplifiers, voltage regulators, and other applications where signal continuity and precision are crucial.

1. Operational amplifiers,
2. Small-signal amplifiers,
3. Power amplifiers,
4. *RF* and *IF* amplifiers,
5. Microwave amplifiers,
6. Multipliers
7. Voltage comparators,
8. Voltage regulators *etc.*

DIGITAL INTEGRATED CIRCUITS:

1. logic gates
2. flip-flops
3. counters
4. clock-chips
5. calculator chips
6. memory chips
7. microprocessors (mP) etc.