ADITYA ENGINEERING COLLEGE (A)

INTEGRATED CIRCUITS AND APPLICATIONS

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Unit - I

Introduction to Integrated Circuits

Integrated Circuit or IC

The Integrated Circuit or IC is a miniature, low cost electronic circuit consisting of active and passive components that are irreparably joined together on a single crystal chip of silicon.

Integrated Circuits

Advantages of IC over interconnection of discrete components:

1. Miniaturization and hence increased equipment density
2. Cost reduction due to batch processing
3. Increased system reliability due to elimination of soldered joints
4. Improved functional performance (as it is possible to fabricate even complex circuits for better characteristics)
5. Matched devices
6. Increased operating speeds (due to the absence of parasitic capacitance effect)
7. Reduction in power consumption.

Integrated Circuits Classification

- Digital ICs
- Analog ICs

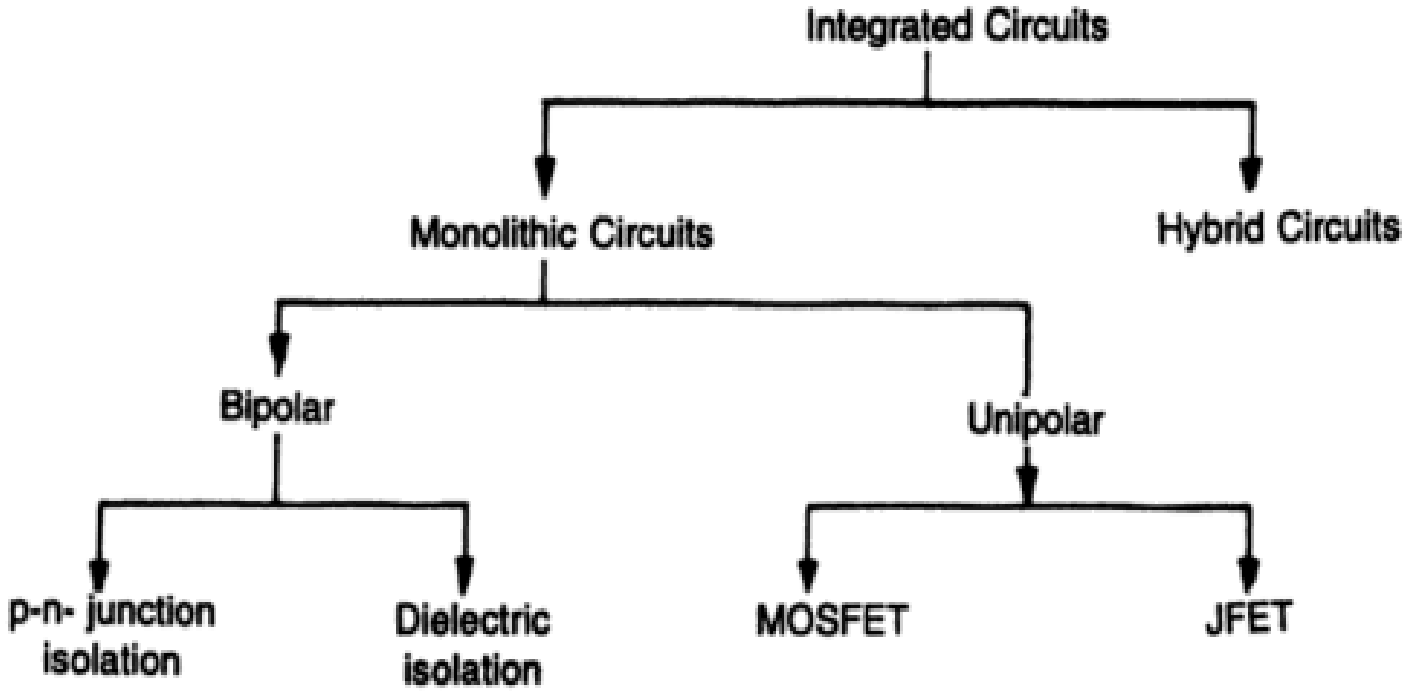


Fig. 1.1 Classification of ICs

IC chip size and circuit complexity

Invention of transistor (Ge)		1947
Development of Silicon transistor		1955–1959
Silicon Planar Technology	Junction transistor diode	1959
First ICs, Small Scale Integration (SSI)	3 to 30 gates/chip approx. or 100 transistors/chip (Logic gates, Flip-flops)	1960–65
Medium Scale Integration (MSI)	30 to 300 gates/chip or 100 to 1000 transistors/chip (Counters, Multiplexers, Adders)	1965–1970
Large Scale Integration (LSI)	300 to 3000 gates/chip or 1000–20,000 transistors/chip (8 bit microprocessors, ROM, RAM)	1970–1980
Very Large Scale Integration (VLSI)	More than 3000 gates/chip or 20,000–1,00,00,00 transistors/chip (16 and 32 bit microprocessors)	1980–1990
Ultra Large Scale Integration (ULSI)	$10^6 - 10^7$ transistors/chip (Special processors, Virtual reality) machines, Smart sensors	1990–2000
Giant-Scale Integration (GSI)	> 10^7 transistors/chip	

Integrated Circuit chips

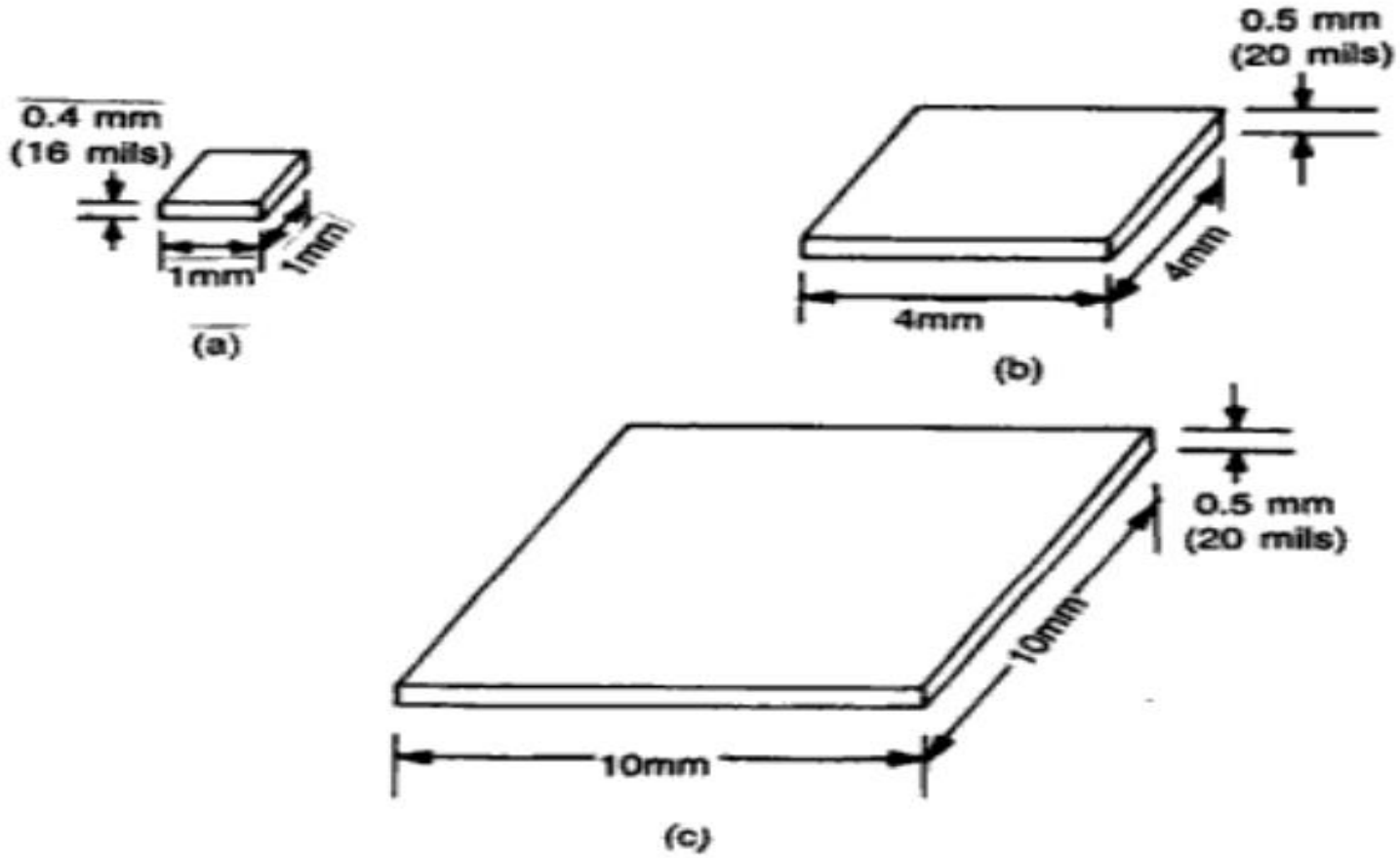
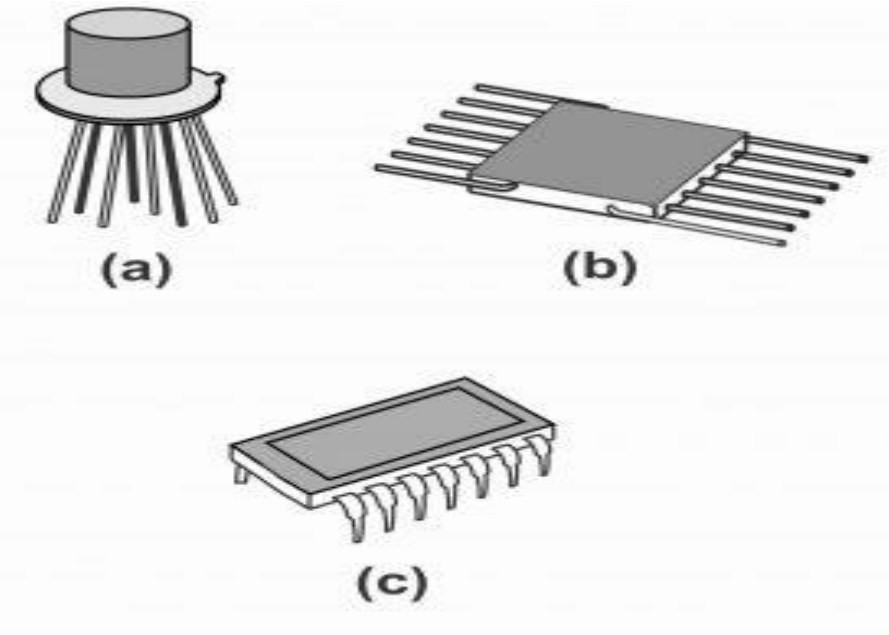


Fig. 1.2 Integrated circuit chips (a) SSI chip (b) MSI chip (c) LSI or VLSI chip

IC packages

1. Metal can package
2. Ceramic flat package
3. Dual-in-line (Ceramic or plastic type) package



Operational Amplifier (OP-AMP)

Linear IC is an Operational Amplifier

Operational Amplifier is a multi-terminal device

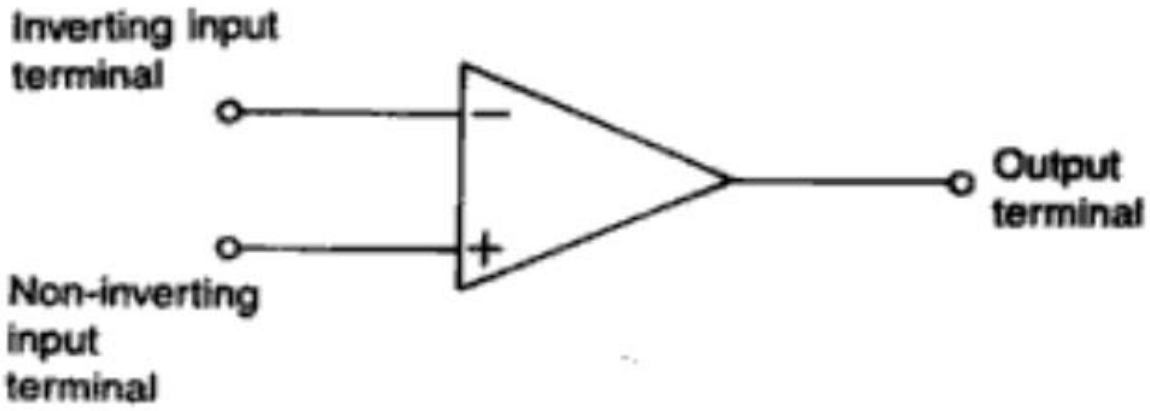
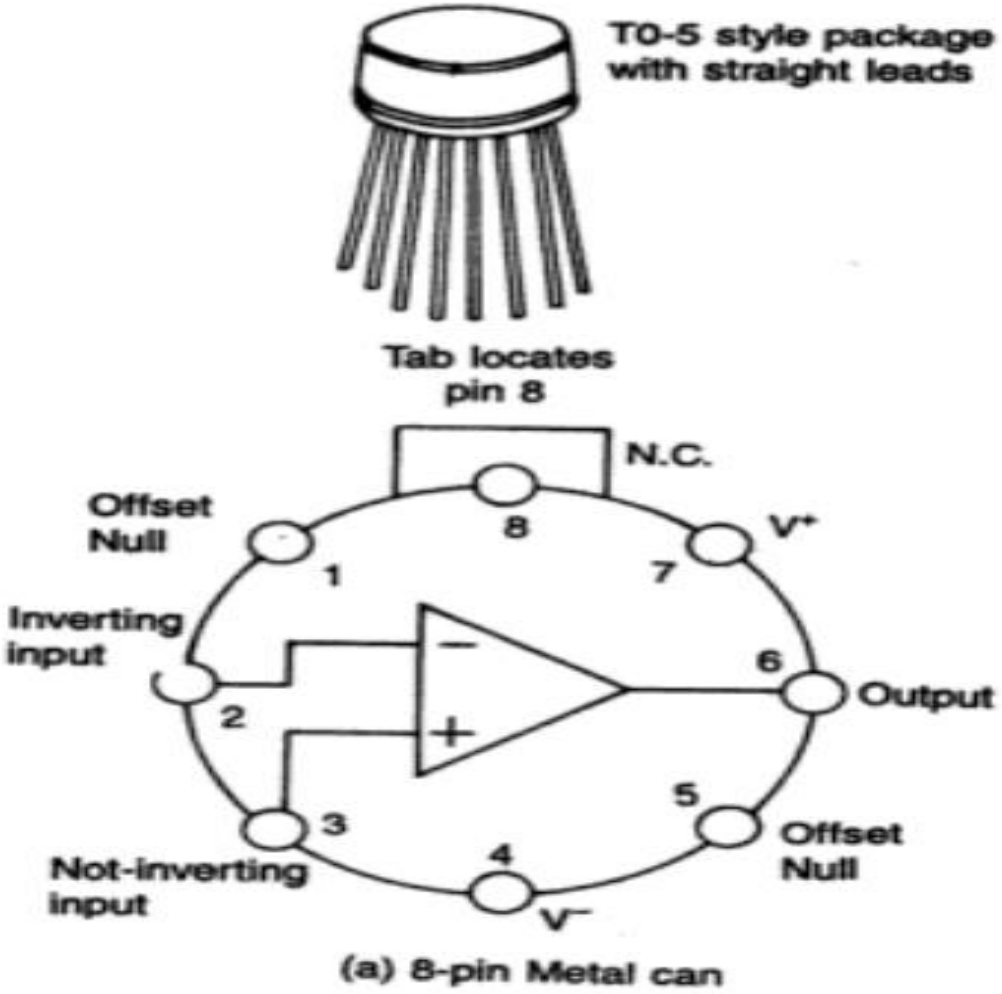
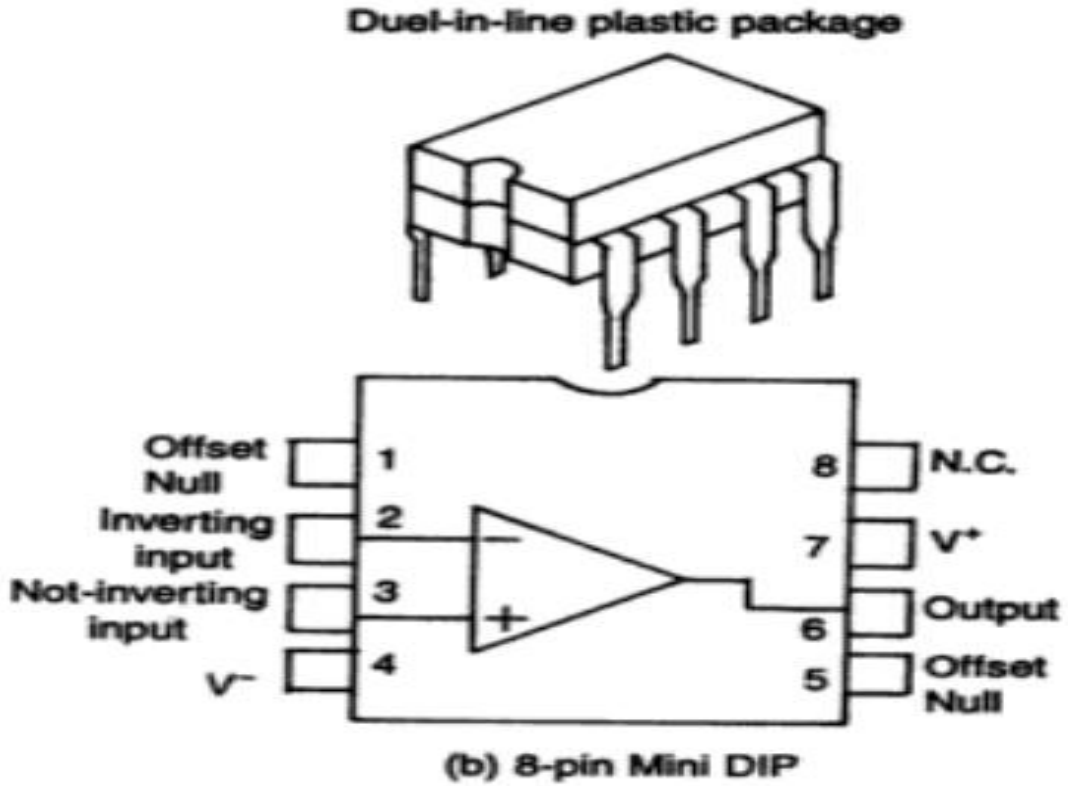


Fig. 2.1 Op-amp circuit symbol

Operational Amplifier (OP-AMP)



(a) 8-pin Metal can



(b) 8-pin Mini DIP

Operational Amplifier (OP-AMP)

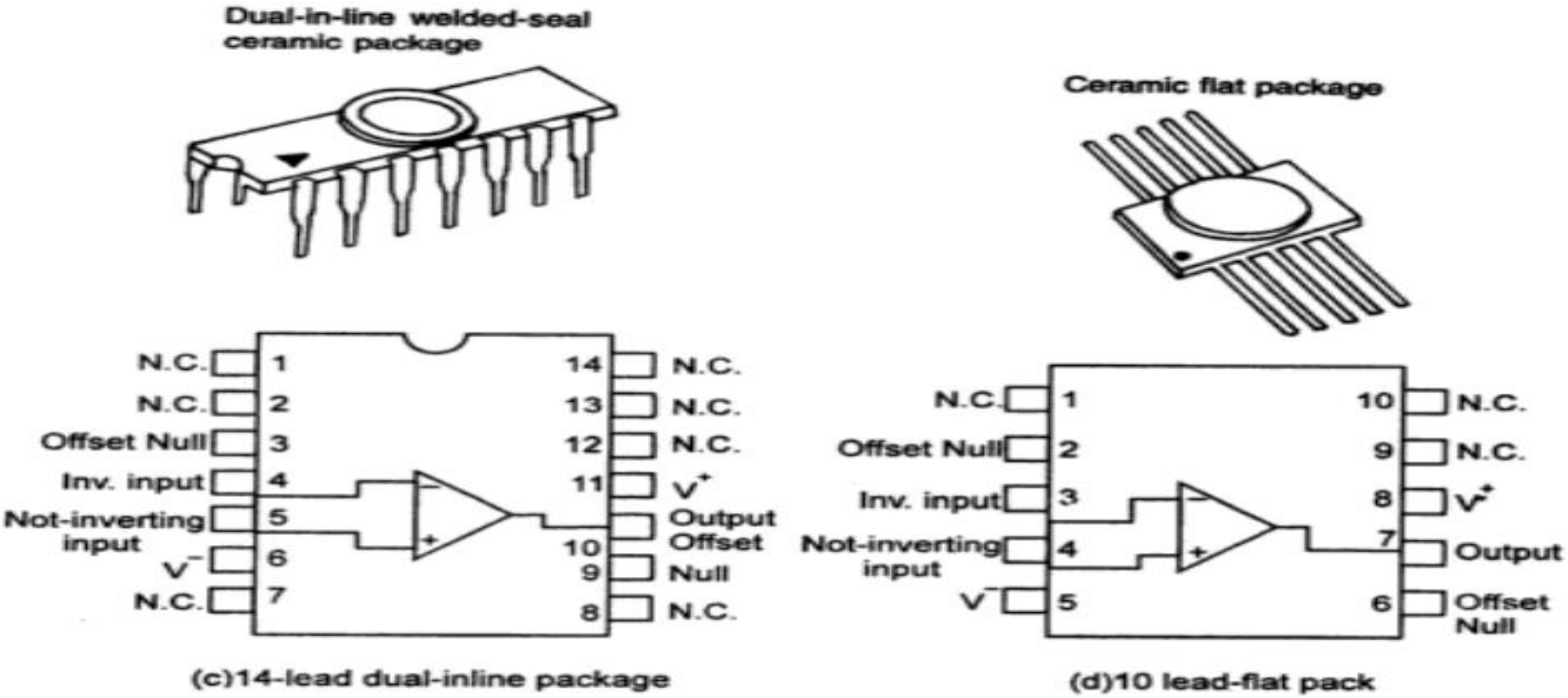
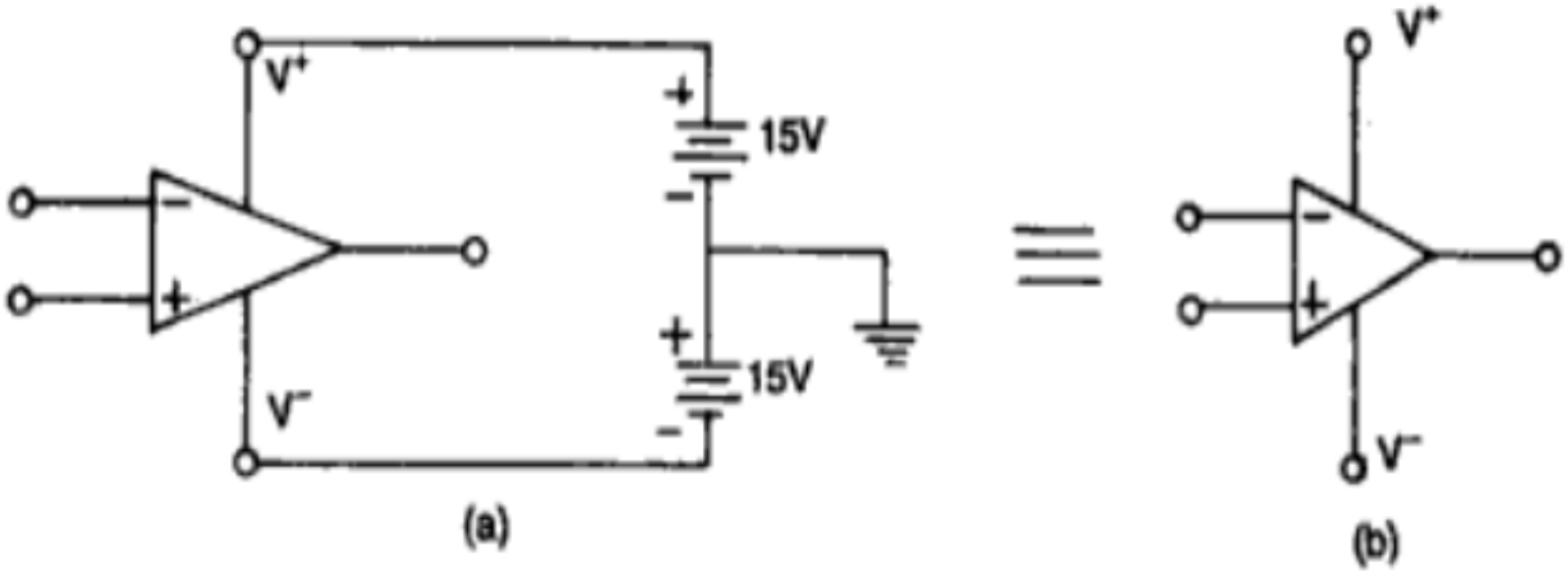


Fig. 2.2 (a, b, c, d) Various IC packages of μA741 op-amp along with connection diagrams (top view)

Operational Amplifier (OP-AMP)

Powe Supplies:



Operational Amplifier (OP-AMP)

Powe Supplies:

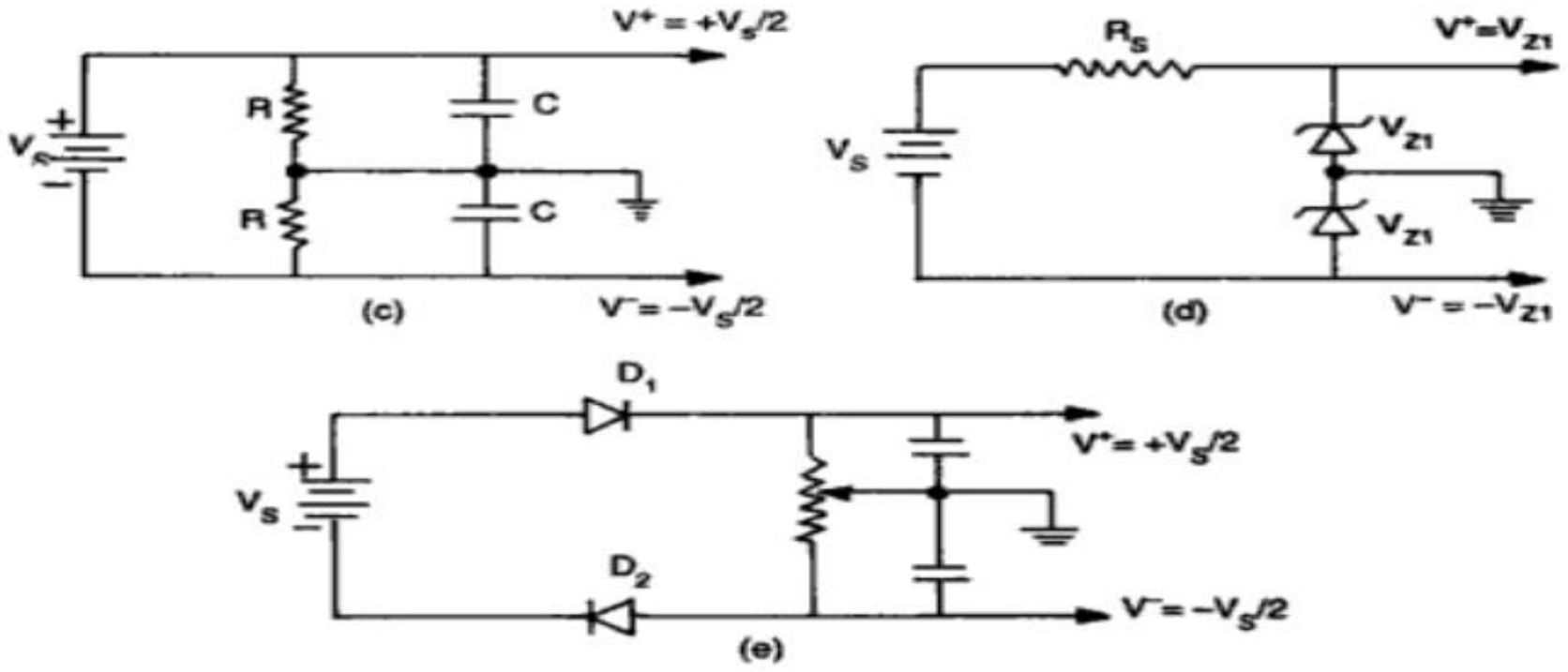


Fig. 2.3 (a) Power supply connections (b) Circuit symbol showing power supply terminals (c, d, e) Different circuits for obtaining positive and negative supply voltages for op-amp

Operational Amplifier (OP-AMP)

Ideal OP-AMP characteristics:

Open loop voltage gain,	A_{OL}	=	∞
Input impedance,	R_i	=	∞
Output impedance	R_o	=	0
Bandwidth	BW	=	∞

Zero offset, i.e. $v_o = 0$ when $v_1 = v_2 = 0$.

Operational Amplifier (OP-AMP)

The equation shows that the op-amp amplifies the difference between the two input voltages.

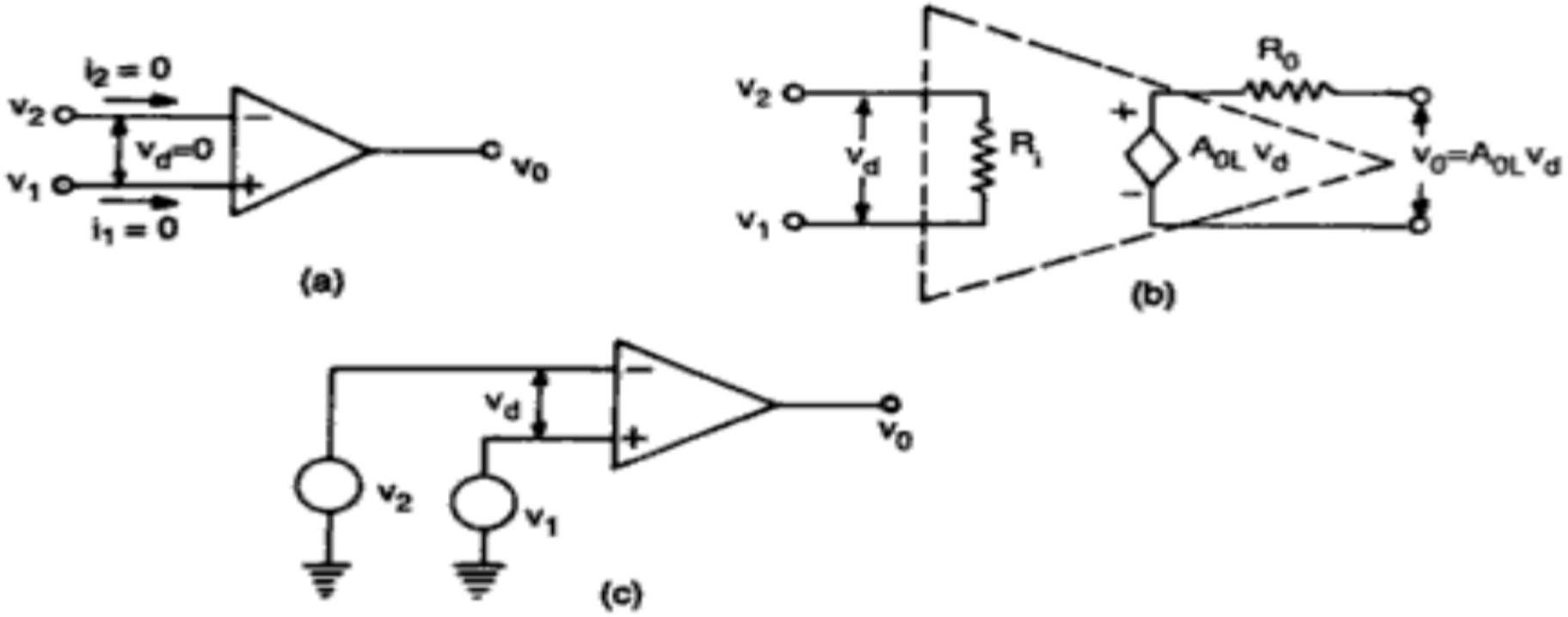


Fig. 2.4 (a) Ideal op-amp (b) Equivalent circuit of an op-amp (c) Open loop circuit

Operational Amplifier (OP-AMP)

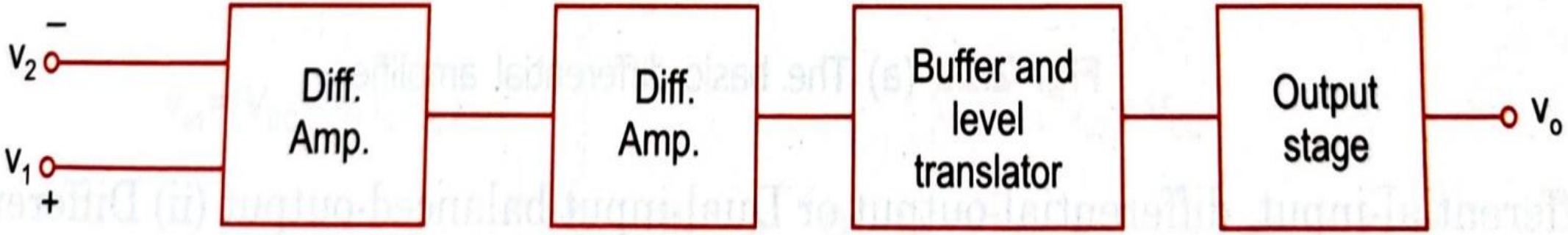


Fig. 2.10 Block schematic of an op-amp