ECE F341/ EEE F341 /INSTR F341

Analog Electronics

Lecture -1 and 2

Dr. Tushar Sakorikar

Course Introduction

- **NAME OF SUBJECT : ANALOG ELECTRONICS**
- **SUBJECT CODE : ECE/EEE /INSTR F341**
- **LECTURE HOURS : 3**
- **TUTORIAL HOURS : 1**
- **LAB HOURS : 2**

Scope and Objective of the Course

- The aim of the course is to deal with various electronic techniques and building blocks used in Analog signal processing.
- Discrete and Integrated electronic circuits will be studied.
- Experiments using discrete IC modules will be carried out using PSPICE (Simulation Program with Integrated Circuit Emphasis) is used as a simulation tool for circuit analysis.

Objectives

At the end of this course, the students should be able to:

- Discuss about the functions of the op-amp
- Demonstrate the op-amp application in amplifiers
- Adders, subtractors, instrumentation amplifiers
- Non-linear op-amp applications
- Signal sources, and Phase Locked Loops
- Voltage regulators
- Tuned amplifiers
- D/A and A/D converters and troubleshooting.

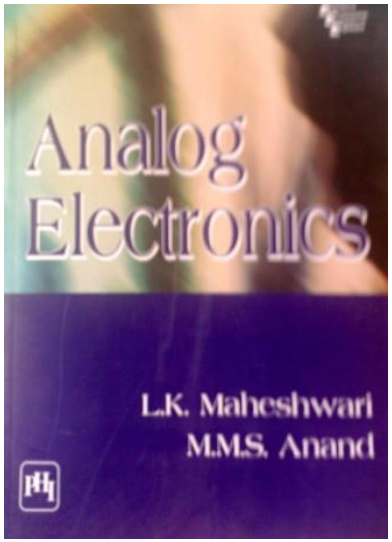
S.No	Topic	No. of Lectures	Reference to Text
1	Introduction & Review of Concepts	1	TB1 Ch 1
2	Op-amp basics	3	TB1 Ch 2
3	Special purpose opamp circuits	3	TB1 Ch 3
4	Filters	6	TB1 Ch 4
5	Non-linear Op-amp circuits	5	TB1 Ch 5
6	Signal Sources & Phase lock loop	6	TB1 Ch 6
7	Voltage Regulators	5	TB1 Ch 7
8	IC Power Amplifiers	3	TB1 Ch 8
9	Tuned Amplifiers	2	TB1Ch 9
10	Data Converters-D/A, A/D Converters	4	TB1Ch10
11	IC sensors and Analog Systems	2	TB1Ch 11
	Total lectures	40	

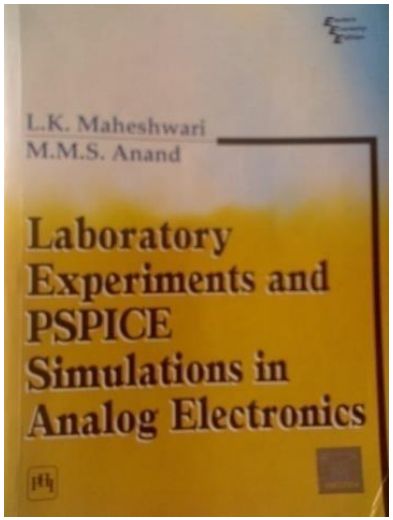
Text Books

L.K. Maheshwari, Analog Electronics, PHI, 2008

L.K. Maheshwari and M.M.S. Anand, Laboratory Experiments &

PSPICE Simulation in Analog Electronics Experiments, PHI, 2008.





Reference Books

1. Sergio Franco

   Design with Operational Amplifiers and Analog Integrated Circuits

   Third Edition

2. Ramakant A. Gayakwad

   Op-Amps and Linear Integrated Circuits, PHI 2009

3. Sedra Smith

   Microelectronic Circuits Fifth Edition, OXFORD

Evaluation Scheme

Component	Duration	Marks	Date and Time	Remarks
Mid Sem Exam	90 min	80	3/3/2025 (2 – 3:30 pm)	Closed Book
Online Quiz (Two)		15+15	TBA	Open Book
Online Test (PSPICE Computer Simulation)		20	TBA	Open Book
Laboratory Experiments/Viva	2 hours	30	Regularly	Open Book
Laboratory Compre Examination		30	TBA	Closed Book
Comprehensive	3 hours	110	2/5/2025 (FN)	Closed Book
TOTAL		300		

Makeup Policies and Notices

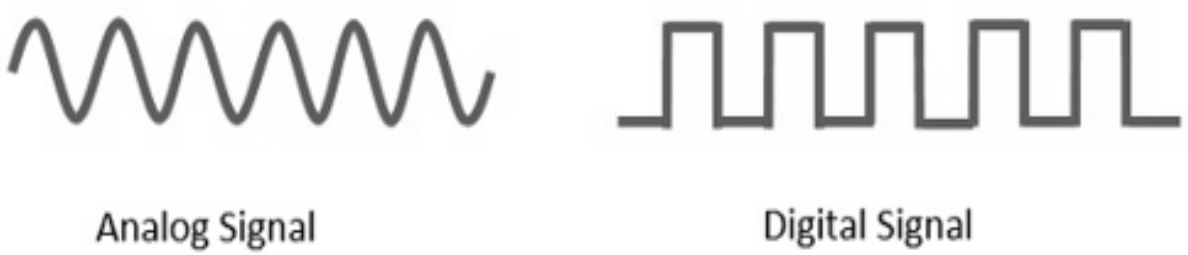
Make-up Policy : Make-up shall be granted only on extremely genuine grounds only. Application for Make-up will be considered only for mid-sem and Comprehensive Examination. An application in writing with relevant certificates attached needs to be submitted to the IC of the course at least a day before the scheduled exam. No make-up will be given for labs, lab evaluations, tests, tutorials and quizzes..

What is analog?

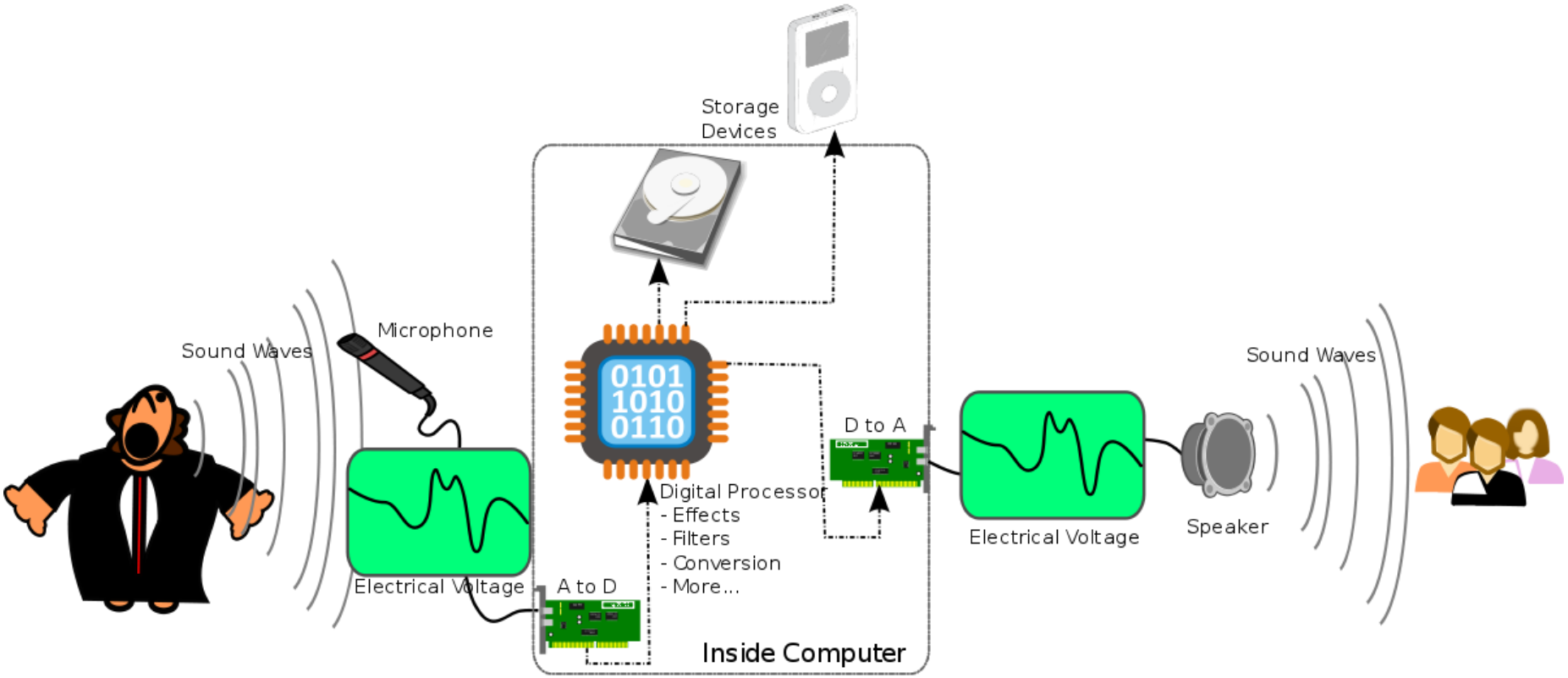
analog 1 of 2 **adjective**

an·a·log ˈa-nə-ˌlȯg -ˌläg

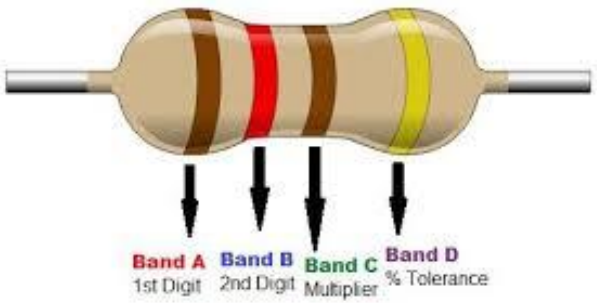
1 a : of, relating to, or being a mechanism or device in which information is represented by continuously variable physical quantities


Analog Signal
Digital Signal

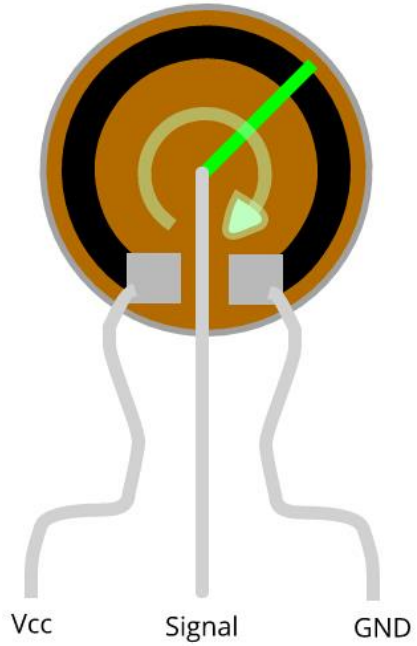
010101010


Storage
Devices
Sound Waves
Microphone
0101
1010
0110
D to A
Sound Waves
Digital Processor
- Effects
- Filters
- Conversion
- More...
Electrical Voltage
Speaker
Electrical Voltage
A to D
Inside Computer

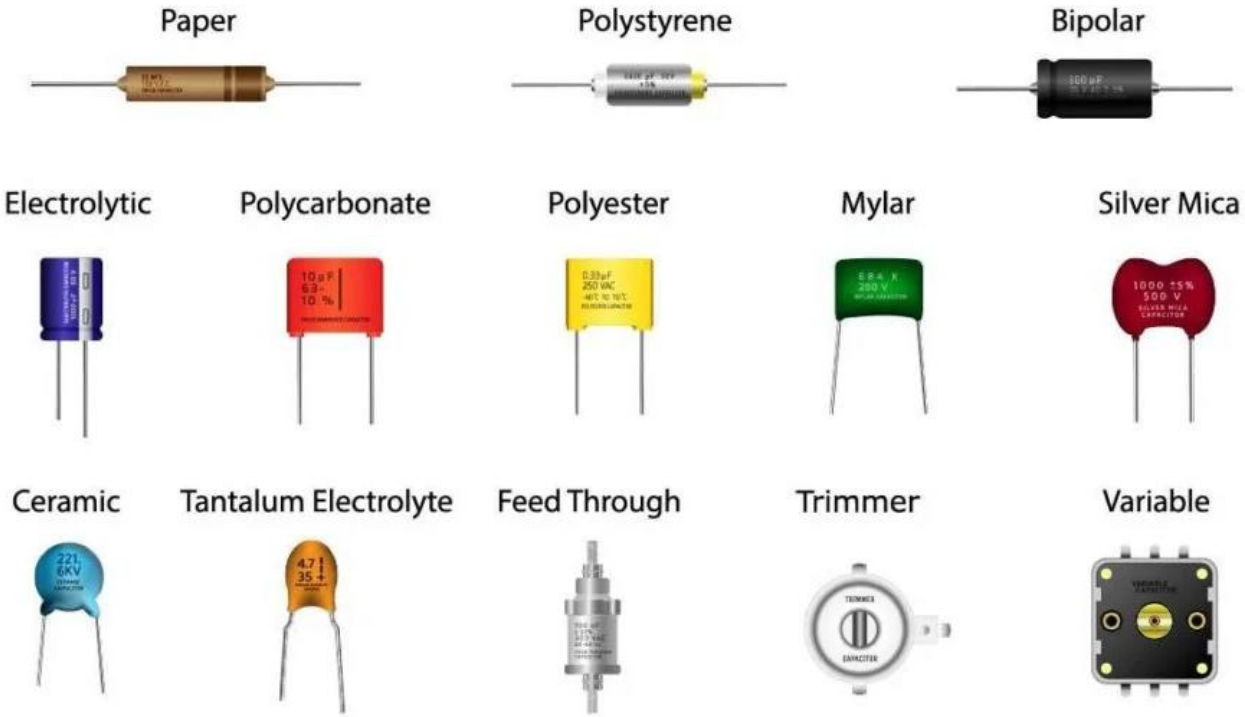
Passive Components



Black	0	0	x 1	
Brown	1	1	x10	±1%
Red	2	2	$x10^2$	±2%
Orange	3	3	$x10^3$	±3%
Yellow	4	4	$x10^4$	±4%
Green	5	5	$x10^5$	±0.5%
Blue	6	6	$x10^6$	±0.25%
Violet	7	7	$x10^7$	±0.1%
Grey	8	8	$x10^8$	±0.05%
White	9	9	$x10^9$	
Gold			$x10^{-1}$	±5%
Silver			$x10^{-2}$	±10%



Passive Components



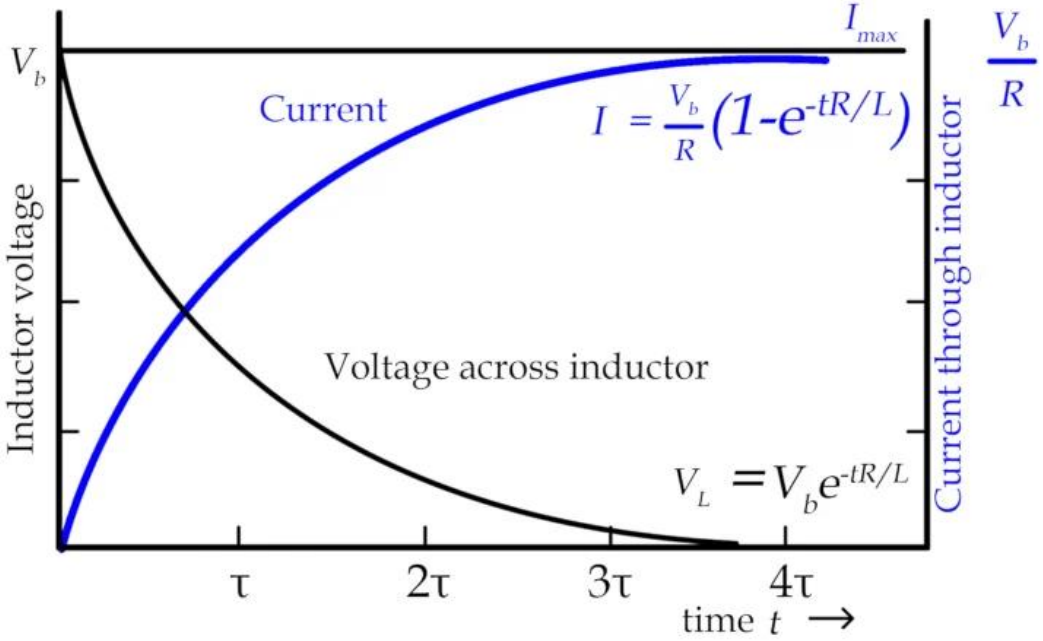
Common ones in your lab experiments:

Ceramic

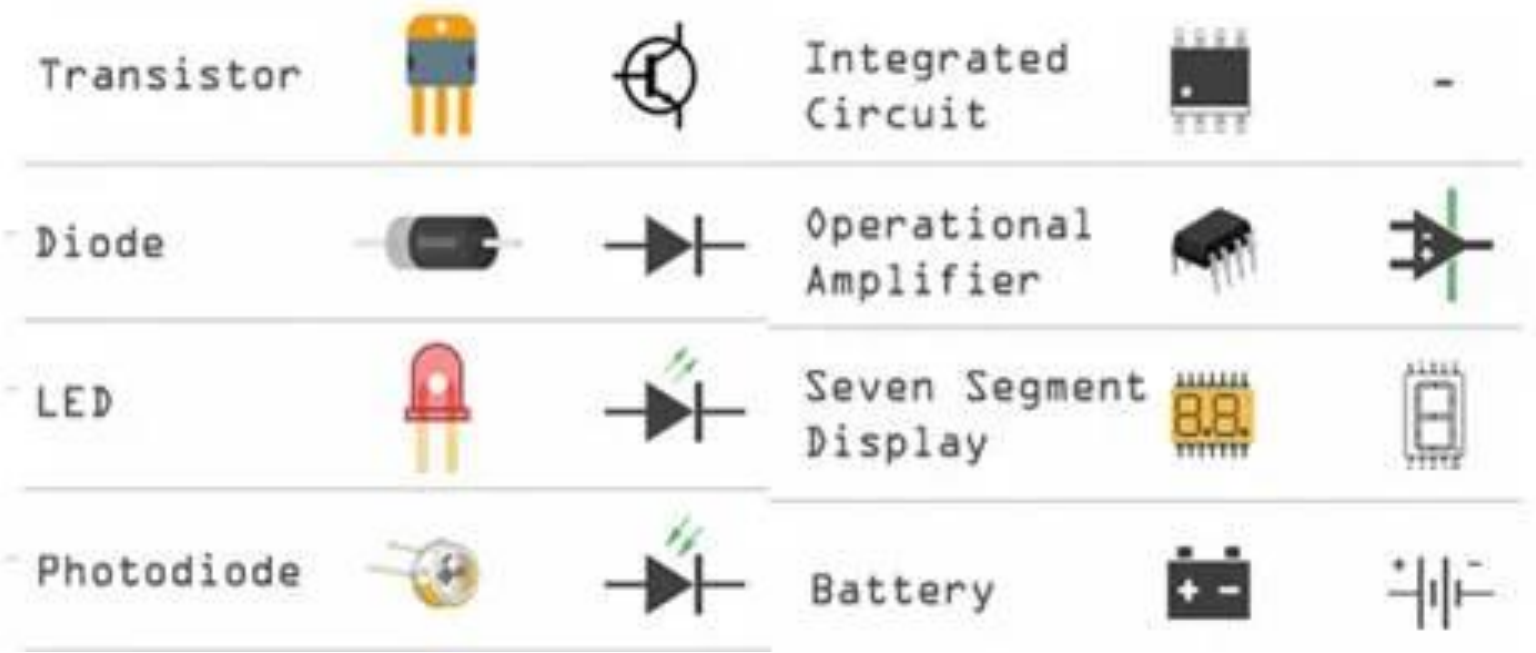
Electrolytic

Passive Components

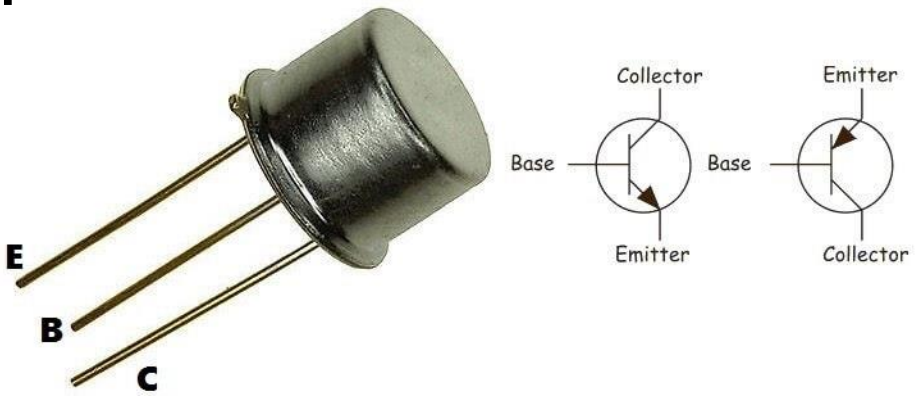
Air core inductor

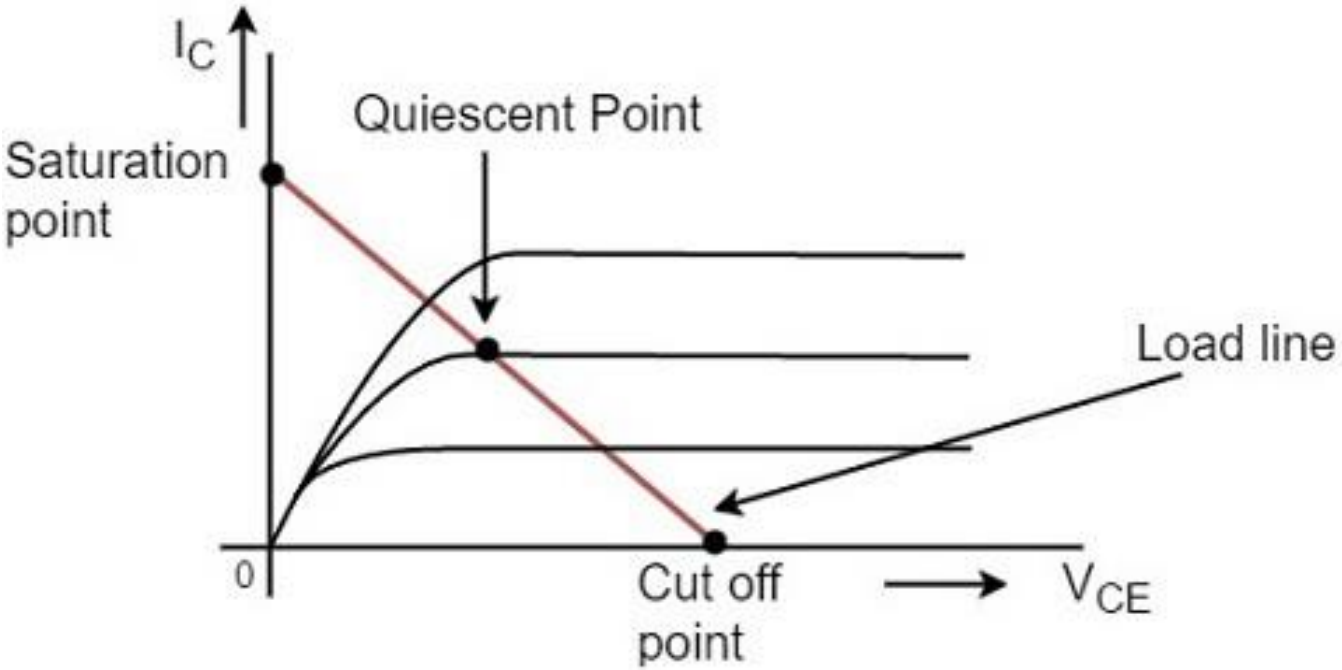


Active Components



Active Components





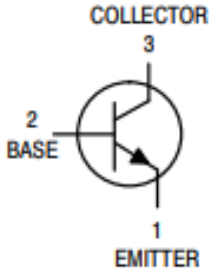
onsemi

DATA SHEET
www.onsemi.com

General Purpose Transistors

NPN Silicon

2N3903, 2N3904



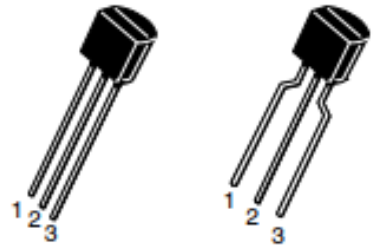
Features

- Pb–Free Packages are Available*

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector – Emitter Voltage	V_{CEO}	40	Vdc
Collector – Base Voltage	V_{CBO}	60	Vdc
Emitter – Base Voltage	V_{EBO}	6.0	Vdc
Collector Current – Continuous	I_C	200	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	 625 5.0	 mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	 1.5 12	 W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

TO–92
CASE 29
STYLE 1



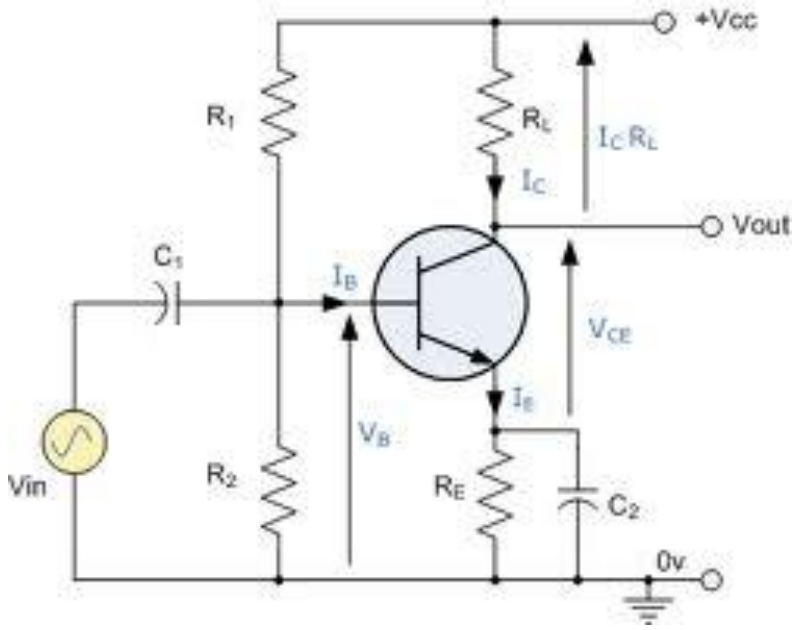
STRAIGHT LEAD
BULK PACK

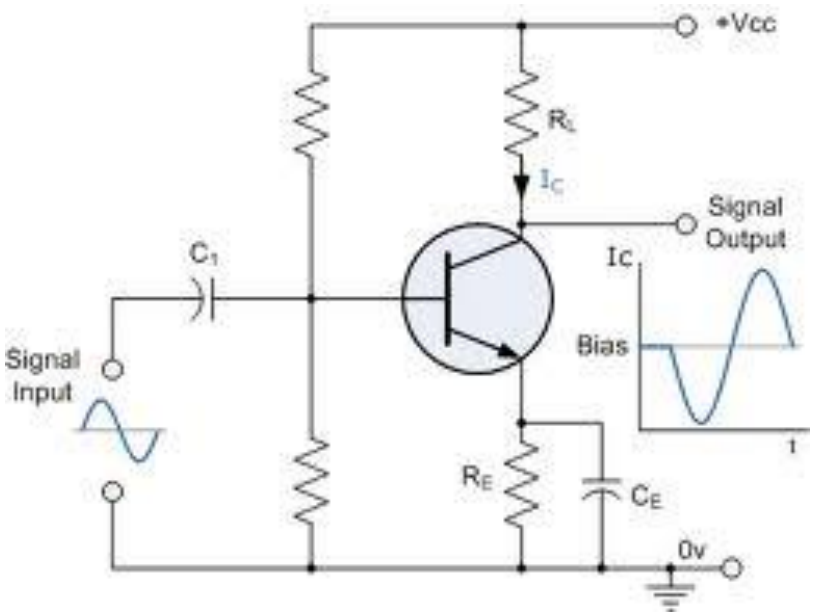
BENT LEAD
TAPE & REEL
AMMO PACK

MARKING DIAGRAMS

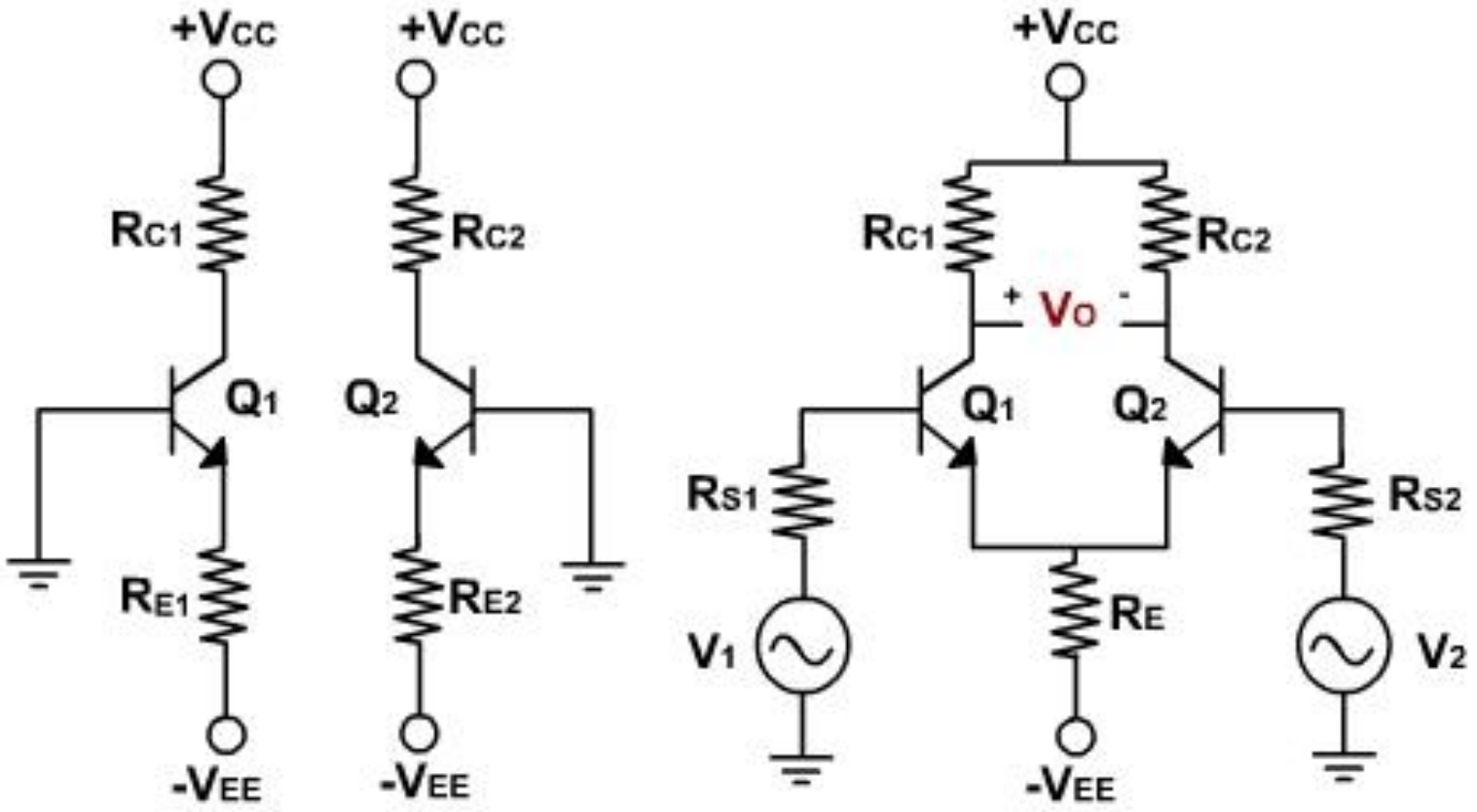
T_A : Ambient temp
T_C : Case temp

Transistor as an Amplifier





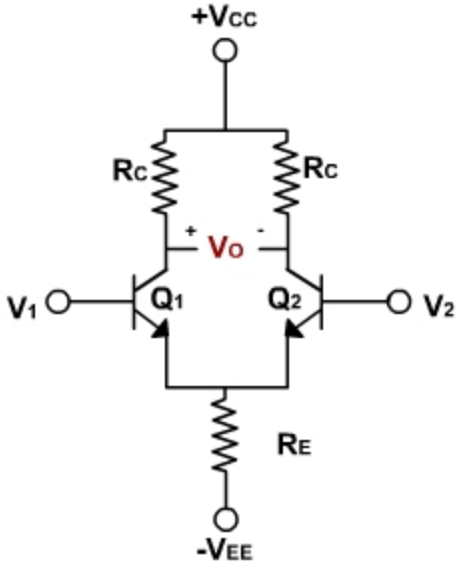
Differential Amplifier

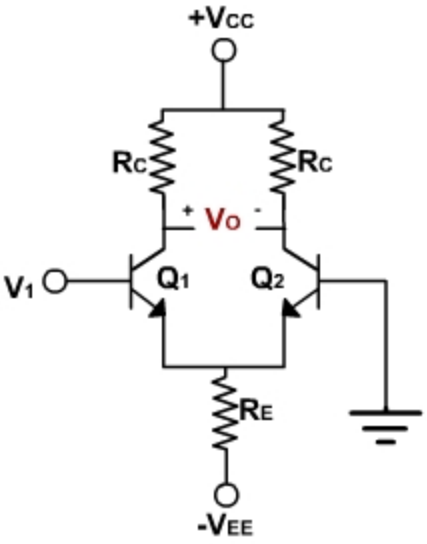


Differential amplifier configurations

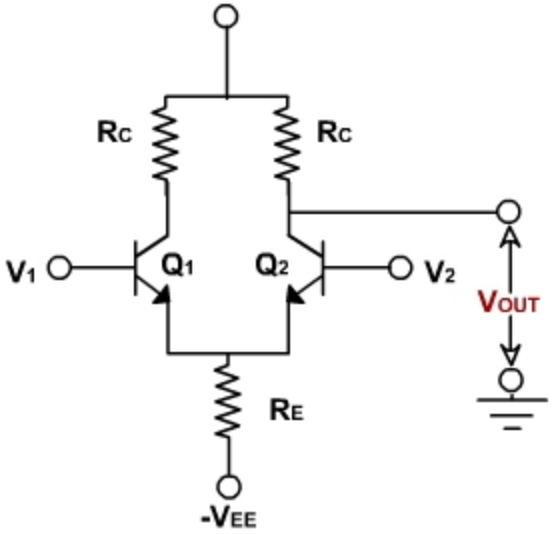
- **Dual input, balanced output differential amplifier.**
- **Dual input, unbalanced output differential amplifier.**
- **Single input balanced output differential amplifier.**
- **Single input unbalanced output differential amplifier.**

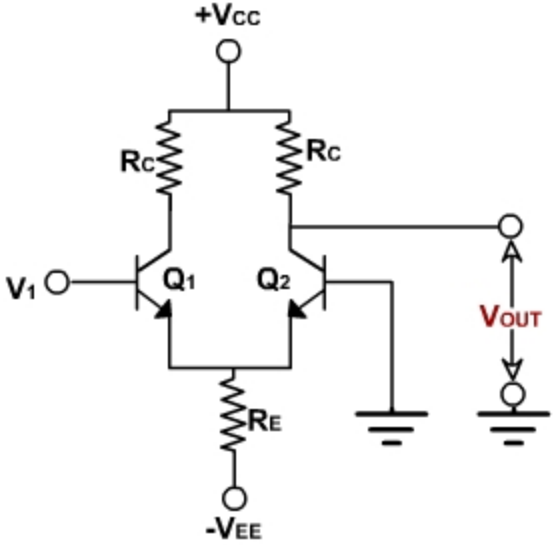
Balanced output



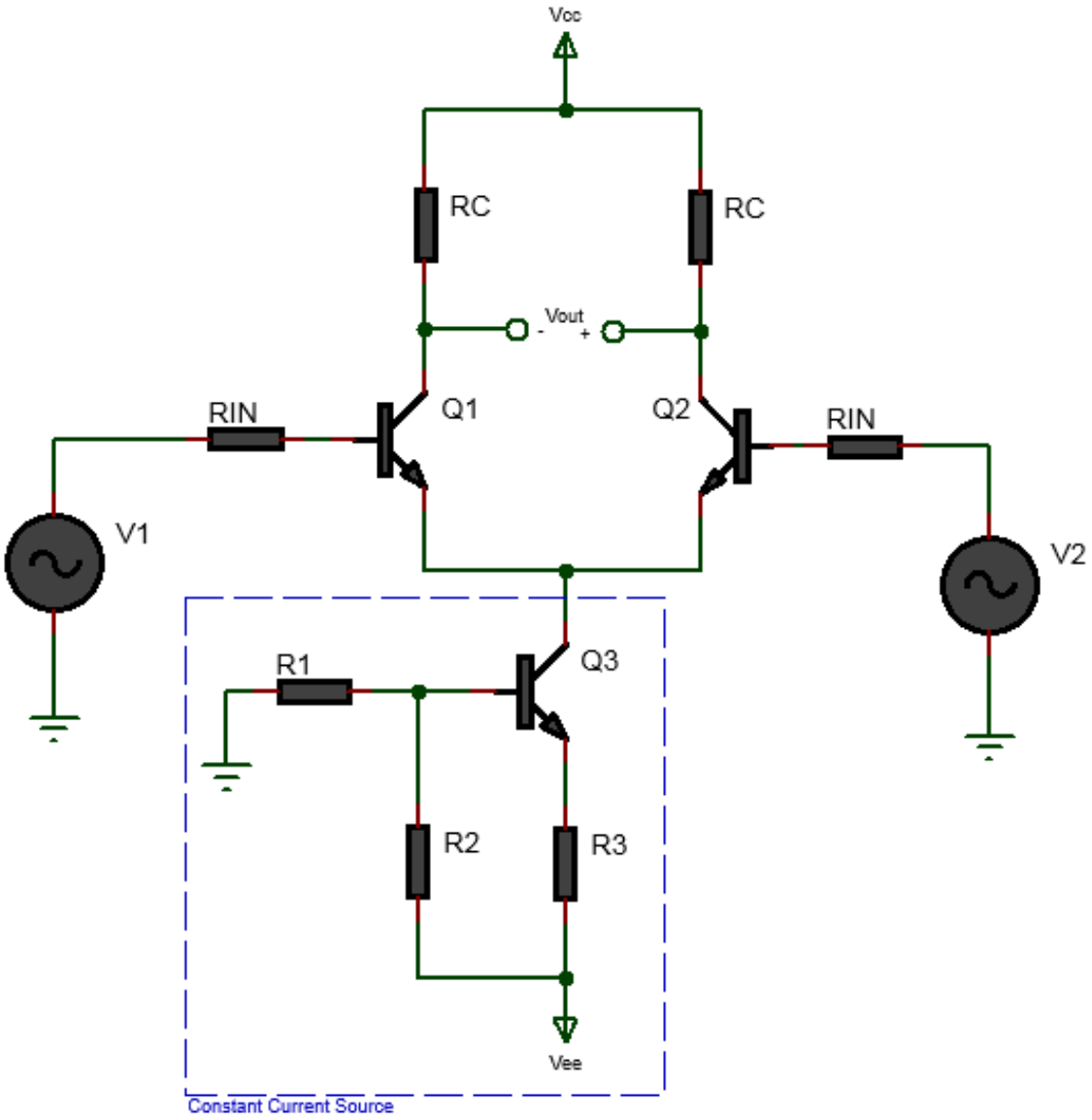


UnBalanced output

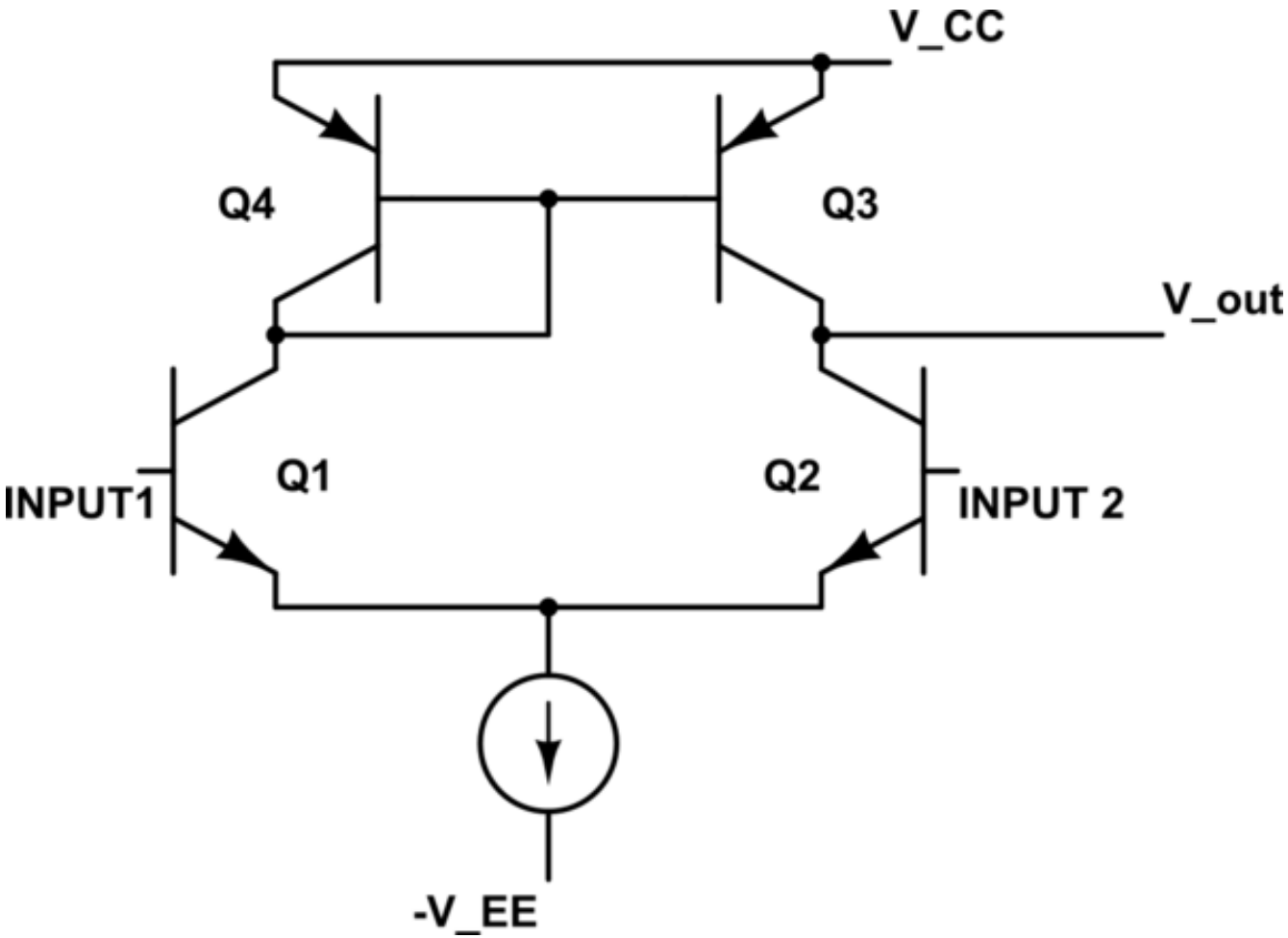




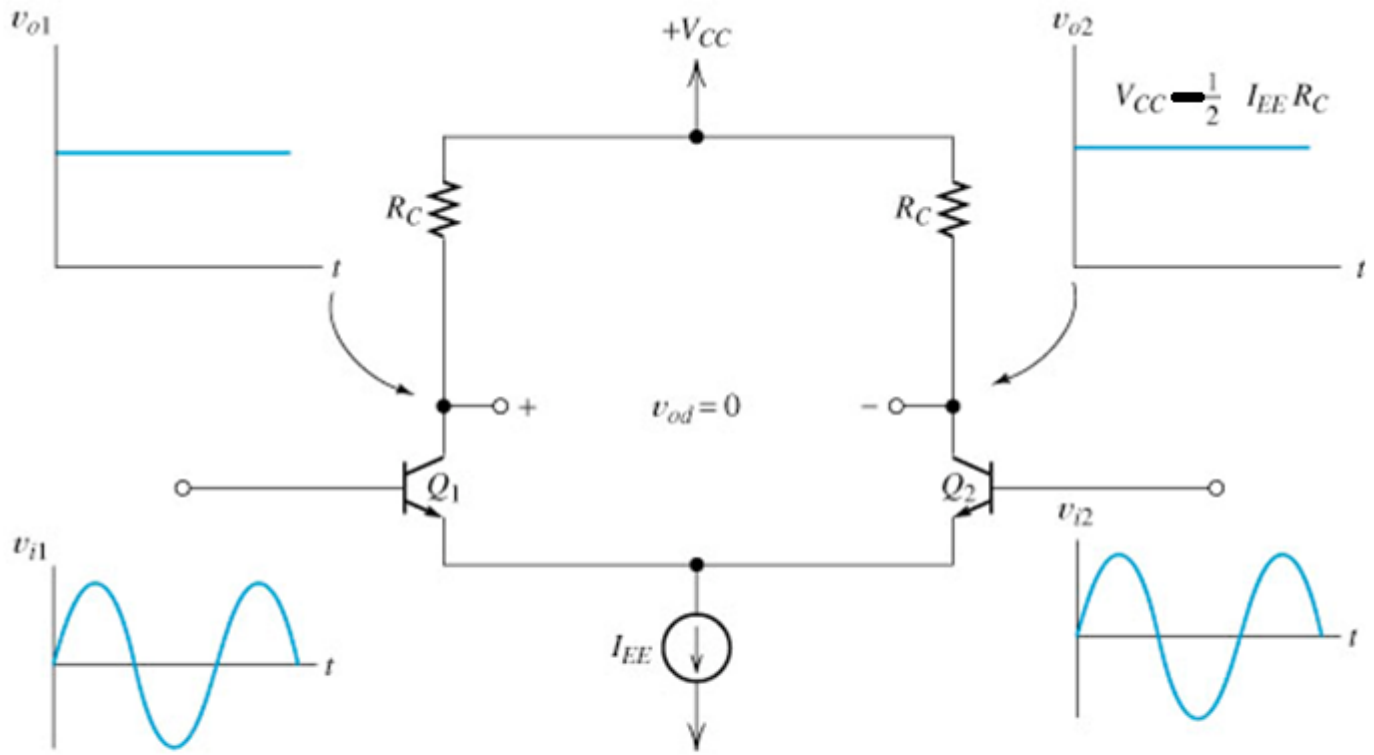
Differential Amplifier with current source



Differential Amplifier with active current mirror load

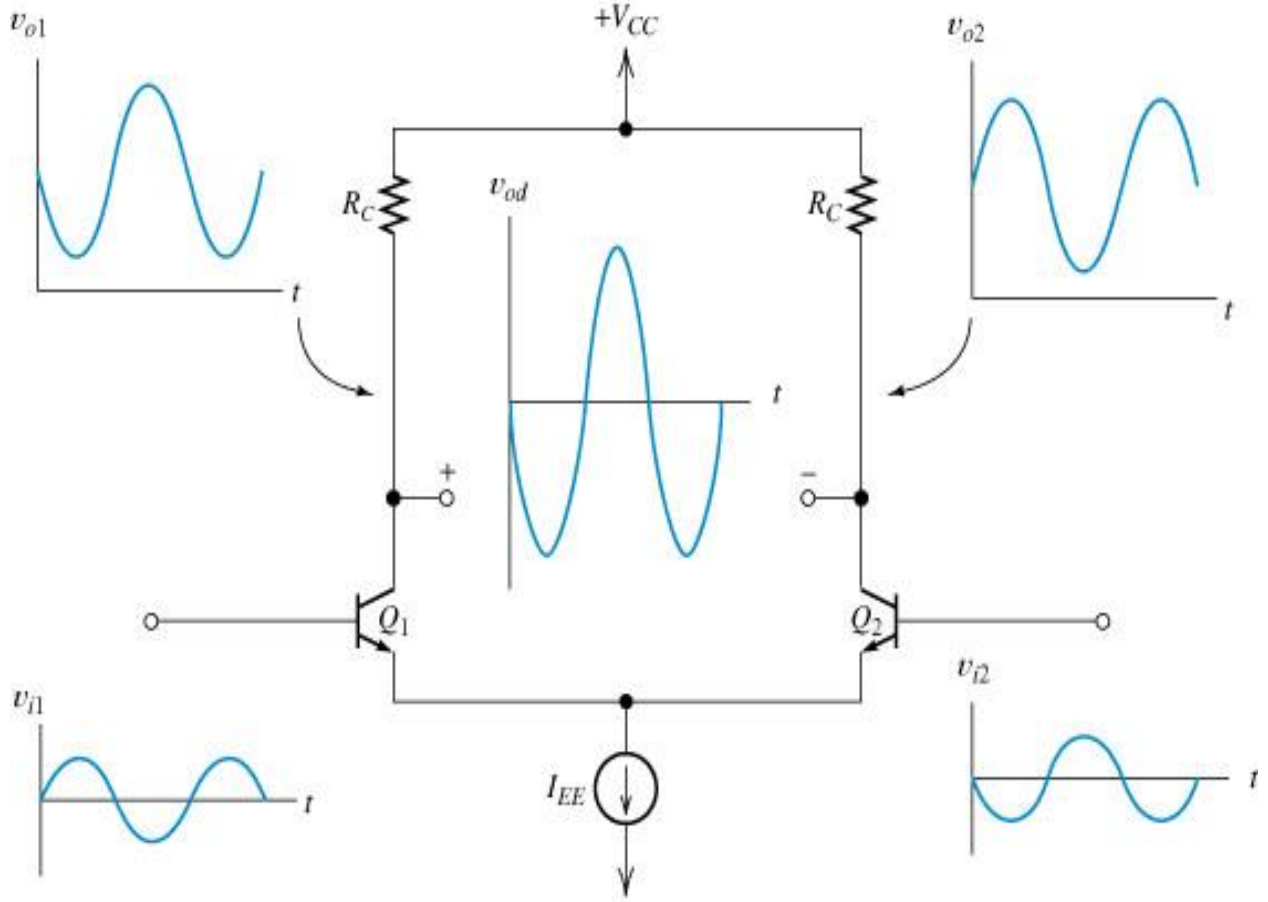


Differential Amplifier with common mode signal



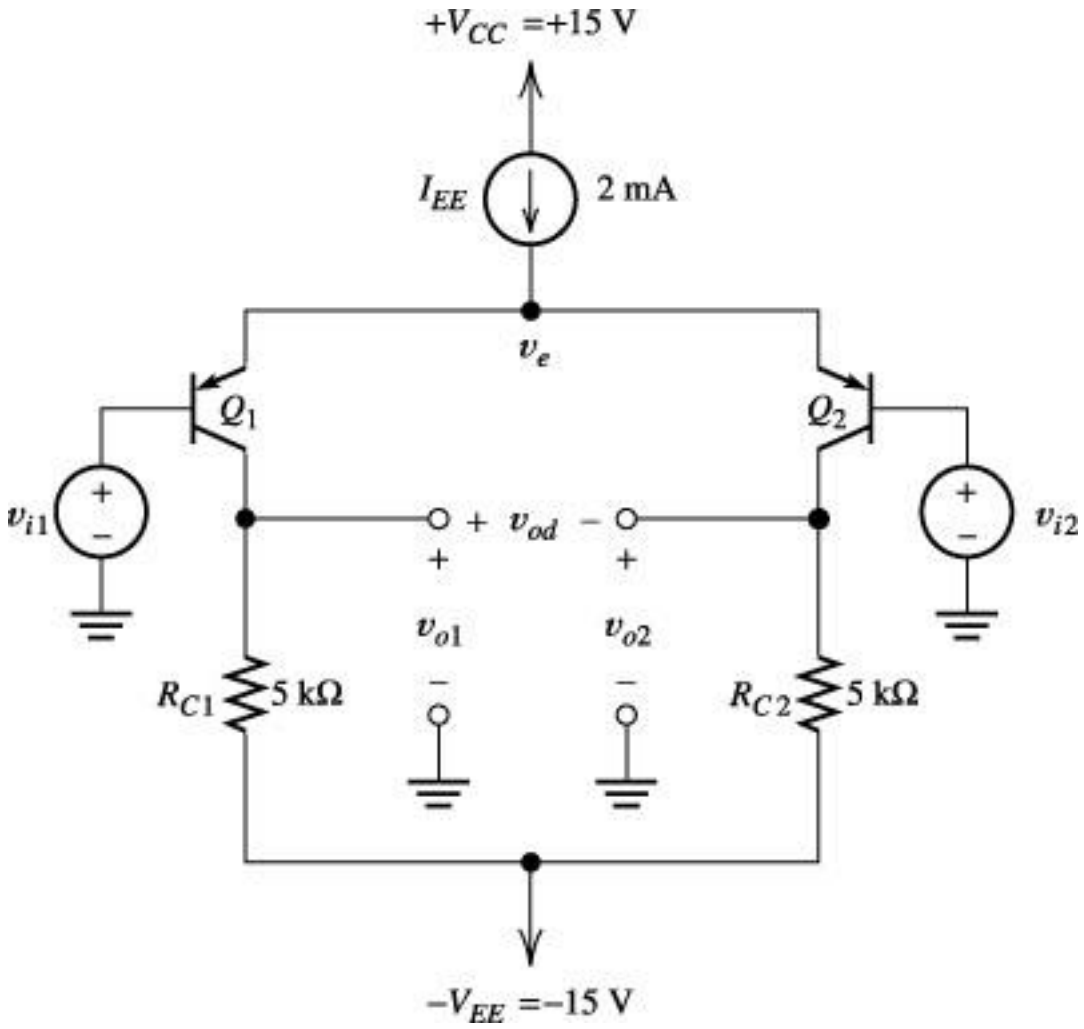
(a) Common-mode input signal ($v_{i1} = v_{i2}$)

Differential Amplifier with differential input

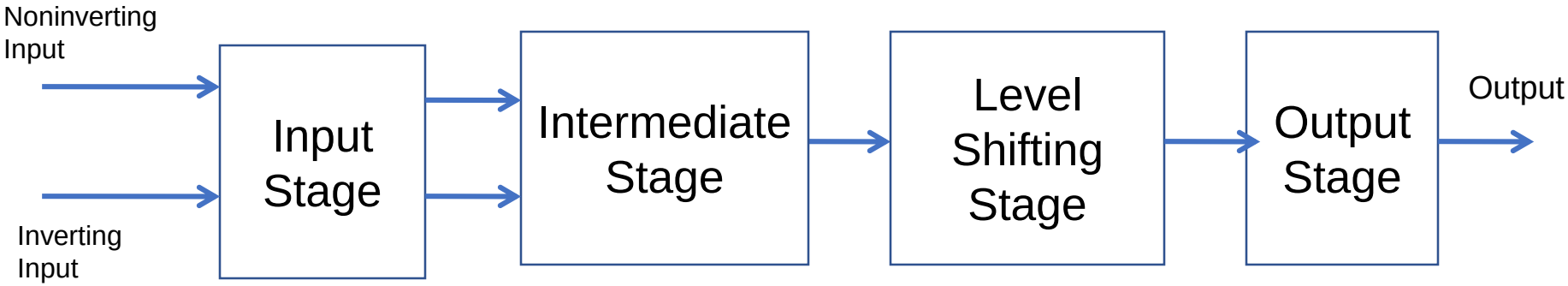


(b) Differential input signal ($v_{i2} = -v_{i1}$)

Differential Amplifier with pnp transistors



Block diagram of a typical opamp



Dual-Input balanced-output differential Amplifier

Dual-Input unbalanced-output differential Amplifier

Such as emitter follower using constant current source

Complimentary symmetry push-pull Amplifier