SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

19EET202 / ANALOG ELECTRONICS

II YEAR / III SEMESTER

UNIT-4: AMPLIFIERS AND SWITCHING CIRCUITS

DIFFERENTIAL AMPLIFIERS

What We'll Discuss

TOPIC OUTLINE

Introduction

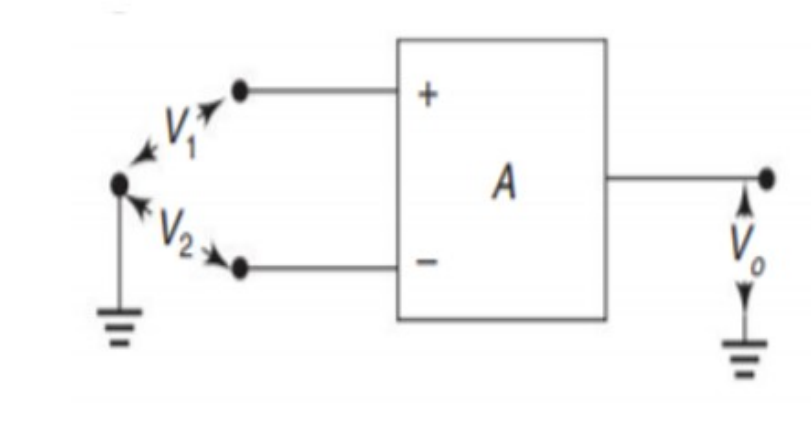
Classification

Working

Applications

Introduction

- The function of a differential amplifier is to amplify the difference between two signals.
- The basic block diagram of a differential amplifier consists of two input terminals and one output terminal.



Differential Amplifiers

- The output signal in a differential amplifier is proportional to the difference between the two input signals.

$$V_o \alpha V_1 - V_2$$

- If V1 = V2, the output voltage is zero.
- A non-zero output voltage is obtained if V1 and V2 are not equal

Differential Amplifiers

•The difference-mode input voltage is defined as

$$V_d = (V_1 - V_2)$$

•• The common-mode input voltage is defined as

$$V_{cm} = \frac{(V_1 + V_2)}{2}$$

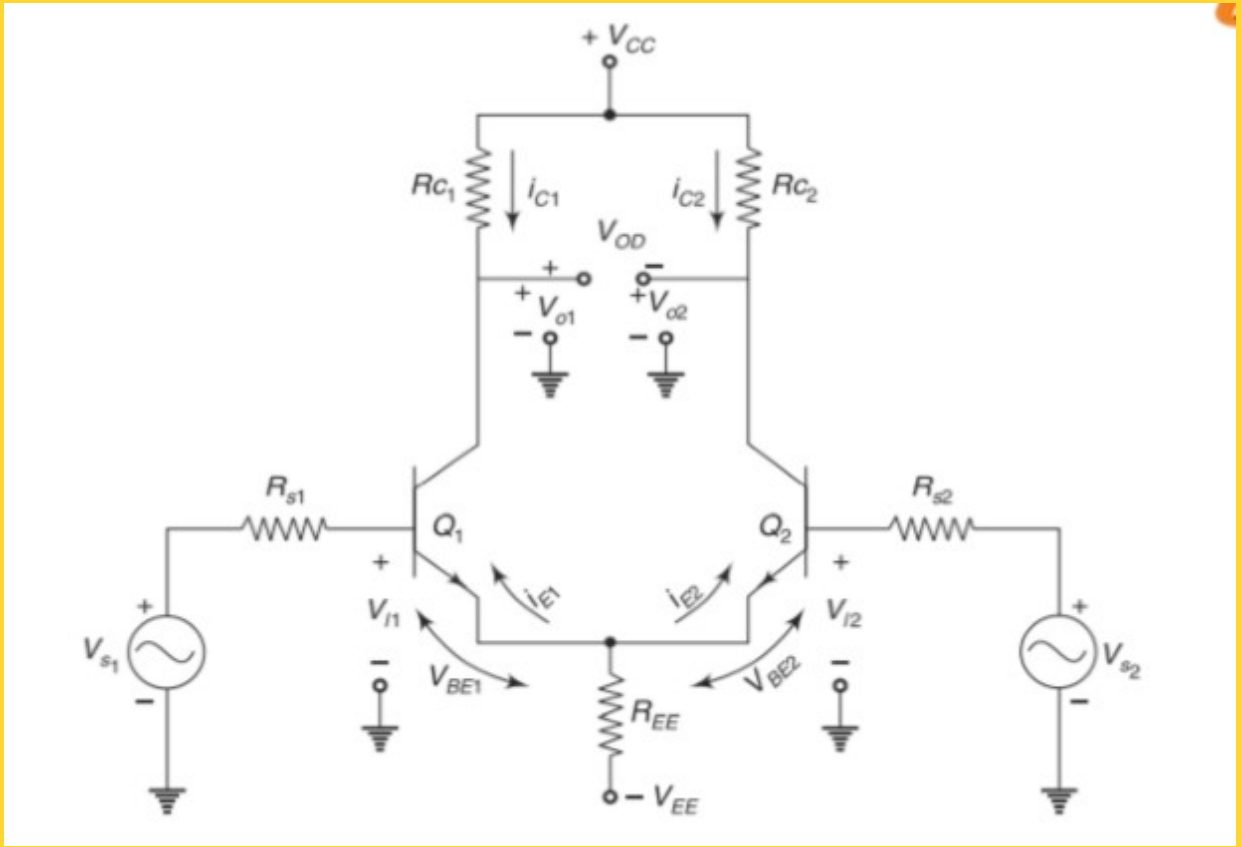
Working

- A differential mode amplifier has two modes of operations

They are

- • Differential mode operation
- • Common mode operation

Differential Mode Operation



Output Equations

Output $V_o \alpha V_1 - V_2$

$$V_o = A_d (V_1 - V_2)$$

$$V_o = A_d V_d$$

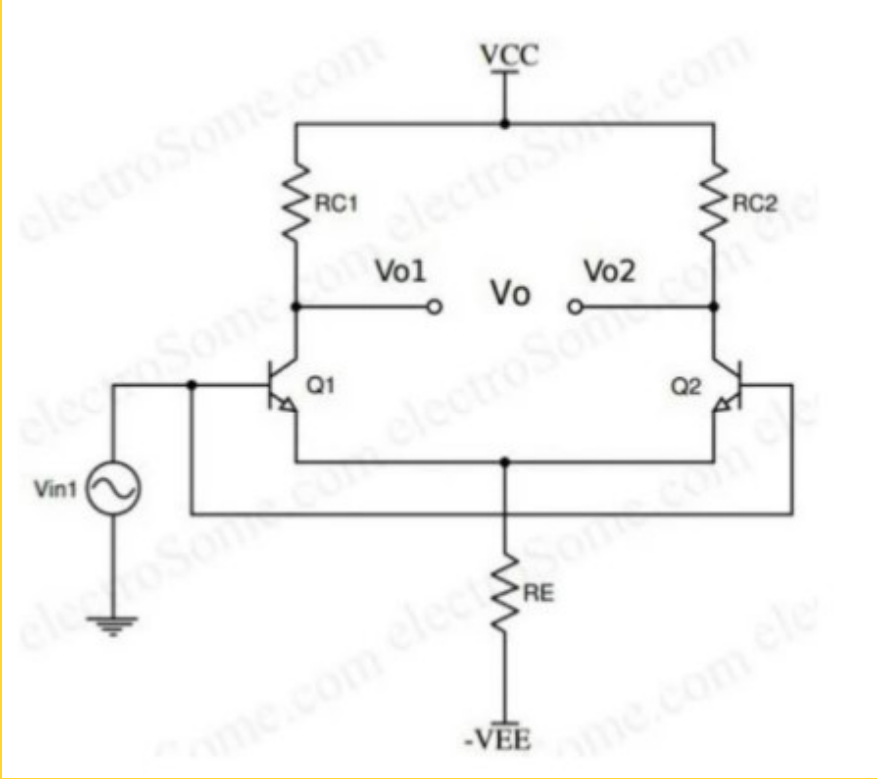
Differential gain $A_d = V_o / V_d$

Common Mode Operation

- A differential amplifier is said to be in common mode when same signal is applied to both inputs and the expected output will be zero,ie ideally common mode gain is zero.

$$V_c = \frac{V_1 + V_2}{2}.$$

$$V_o = A_c V_c.$$



Common Mode Rejection Ratio (CMRR)

- CMRR is introduced to define the ability of a differential amplifier to reject common mode signal.
- CMRR is defined as the ratio of the differential voltage gain Ad to common mode gain Ac and is generally expressed in dB.

$$\text{CMRR} = 20 \log_{10} \left| \frac{A_d}{A_c} \right|$$

Features of Differential Amplifier

- • High differential voltage gain
- • Low common mode gain
- • High CMRR
- • High Input impedance
- • Large bandwidth
- • Low output impedance

Applications

- Differential amplifiers are vital in numerous electronic systems and devices, including but not limited to:
- **Operational Amplifiers (Op-Amps):** Most operational amplifiers employ a differential input stage, enhancing their performance by offering high input impedance and common-mode noise rejection.
- **Analog-to-Digital Converters (ADCs):** Differential amplifiers are crucial in the design of ADCs. They help in eliminating noise and other common-mode signals before the analog signal is converted into a digital one.
- **Audio Systems:** These systems often utilize differential amplifiers to minimize noise interference and maintain high-quality sound reproduction.

THANK YOU