[C] Topic: Double-Ended Input operation of Dn

two (PG: III sem.)

The inputs of the differential amplifier can receive two signals simultaneously in the following two ways

(i) Differential-mode Signal in which both signals are equal in amplitude but 180° out of phase.

(ii) Common-mode Signals: in which both signals are equal in amplitude having the same phase

The differential mode input is shown in fig (1)

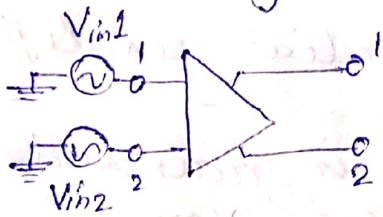


Fig (1)

The output voltage due to input at different terminals are shown in fig (2) & (3) as below.

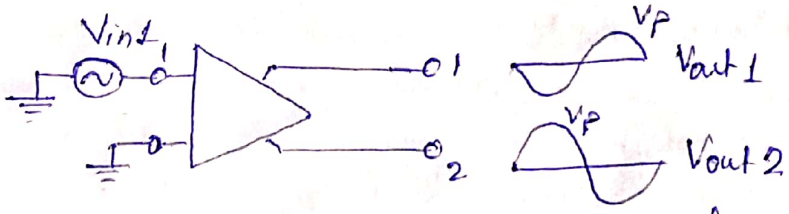


Fig (2) → output due to Vin1

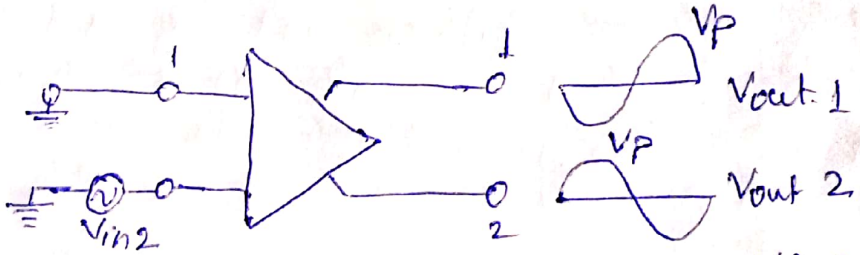
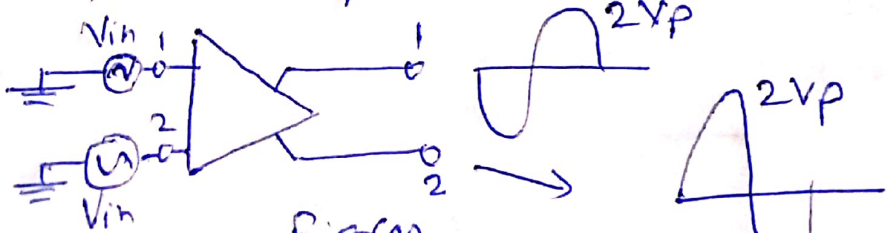
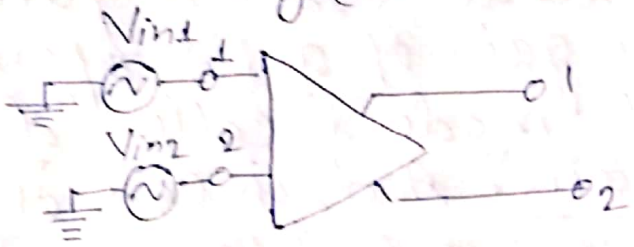


Fig (3) → output due to Vin2

When these two inputs ~~sing~~ signals are simultaneously applied, the amplified output is shown in fig (4)



On common-mode input, two signals equal in amplitude and having the same phase are applied to the inputs of DA as shown in fig(5).



Fig(5)

The output voltage in this mode for input at different terminals are shown in fig ⑥ & ⑦ as below

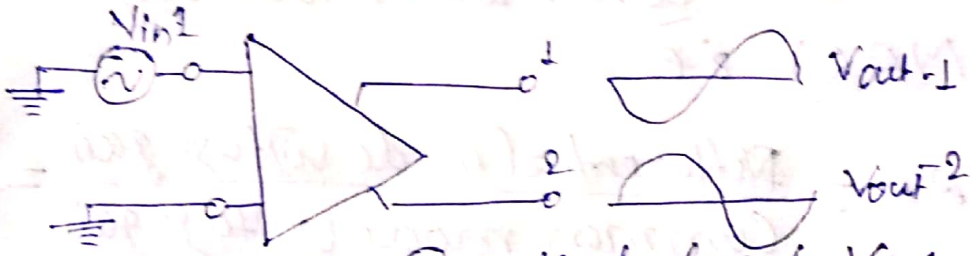


Fig ⑥ output due to Vin1

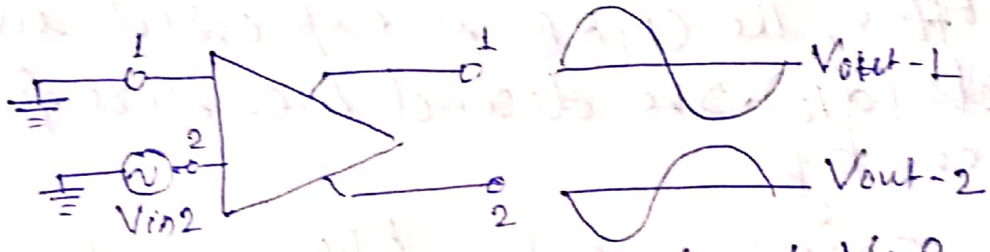
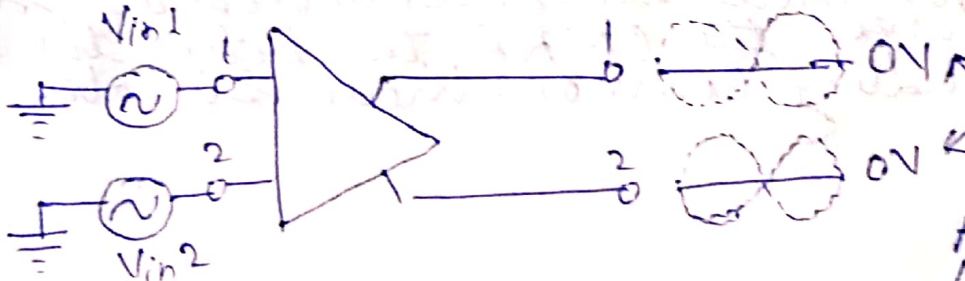


Fig ⑦ → output due to Vin2

The output voltage due to the signals applied at both inputs is shown in fig(8).



Thus we see that superimposition of two signals in common mode input cancels each other & produces zero output voltage. Therefore common-mode signals are rejected by DA. This action is called

"Common-mode rejection". However, practically, differential amplifiers do exhibit a very small common-mode gain while providing a high differential voltage gain.

The voltage gain of a DA operating in differential mode is called "differential mode voltage gain". And, in case of common-mode operation it is called "common mode voltage gain."

The ratio of these two voltage gain is known as "Common-mode Rejection Ratio (CMRR) i.e

$$CMRR = \frac{\text{Differential mode voltage gain}}{\text{Common mode voltage gain}} = \frac{A_{DM}}{A_{CM}}.$$

Very often, the CMRR is expressed in decibels (dB). The decibel measure for CMRR is given by

$$CMRR_{dB} = 20\log_{10}\frac{A_{DM}}{A_{CM}} = 20\log_{10} CRMM$$

The CMRR is the ability of DA to reject the common-mode signals (undesired signal). The larger the CMRR, the better the DA is at eliminating common-mode signals.