2. Input offset current

The algebraic difference between the currents flowing into the two input terminals of the op-amp

It is denoted as $I_{ios} = | I_{b1} – I_{b2}|$

For op-amp 741C the input offset current is 200nA

4. Differential Input Resistance

It is the equivalent resistance measured at either the inverting or non-inverting input terminal with the other input terminal grounded

It is denoted as R_i

For 741C it is of the order of 2MΩ

5. Input capacitance

It is the equivalent capacitance measured at either the inverting or non-inverting input terminal with the other input terminal grounded.

It is denoted as C_i

For 741C it is of the 1-4 pF

10. Offset voltage adjustment range

The range for which input offset voltage can be adjusted using the potentiometer so as to reduce output to zero

For op-amp 741C it is ± 15mV

13. Power Consumption

It is the amount of quiescent power to be consumed by op-amp with zero input voltage, for its proper functioning

It is denoted as P_c

For 741C it is 85mW

Slew rate equation

$V_s = V_m \sin\omega t$

$V_o = V_m \sin\omega t$

$$\frac{dVo}{dt} = V_m\, \omega \cos\omega t$$

$$S = \text{slew rate} = \left.\frac{dVo}{dt}\right|_{max}$$

$S = V_m \omega = 2\pi f V_m$

$$\boxed{S = 2\pi f V_m \text{ V / sec}}$$

This is also called **full power bandwidth** of the op-amp

For distortion free output, the maximum allowable input frequency f_m can be obtained as

$$\boxed{f_m = \frac{S}{2\Pi V_m}}$$

15. Gain – Bandwidth product

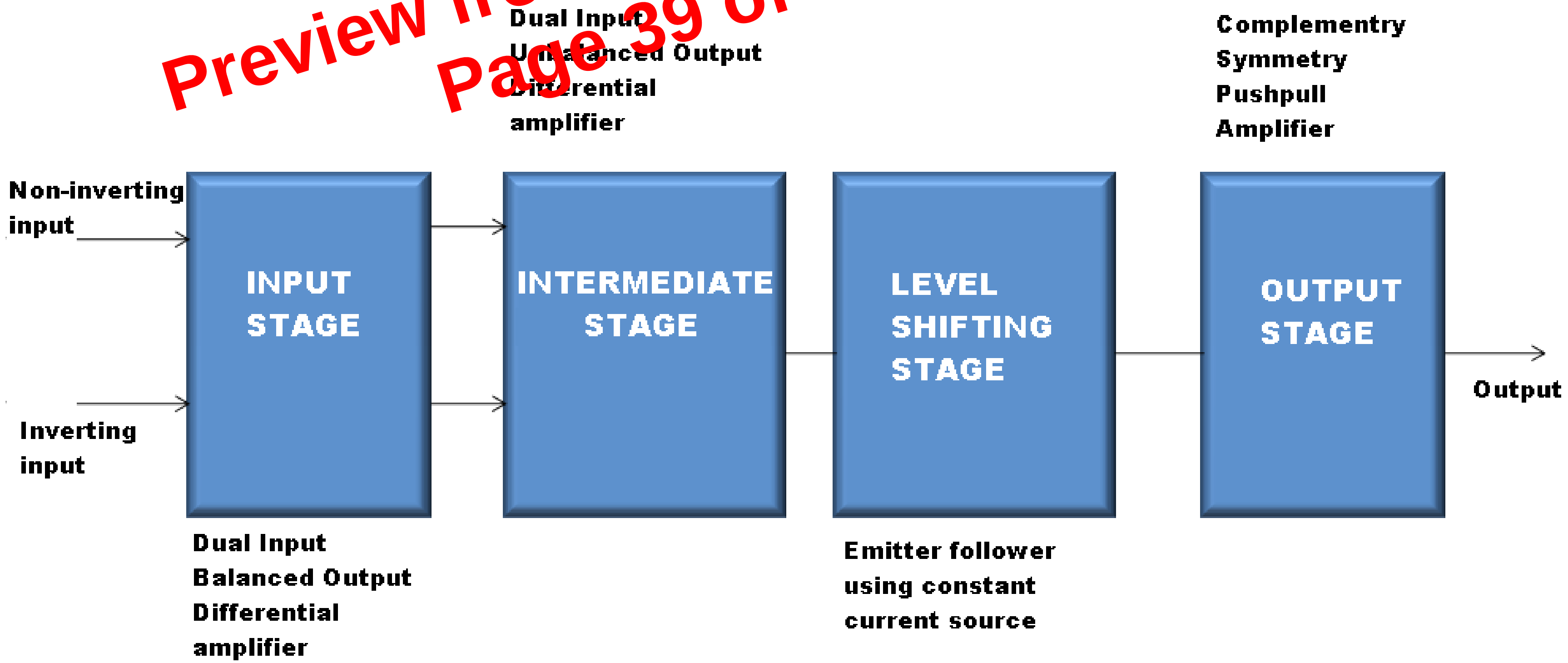
It is the bandwidth of op-amp when voltage gain is unity (1).

It is denoted as GB.

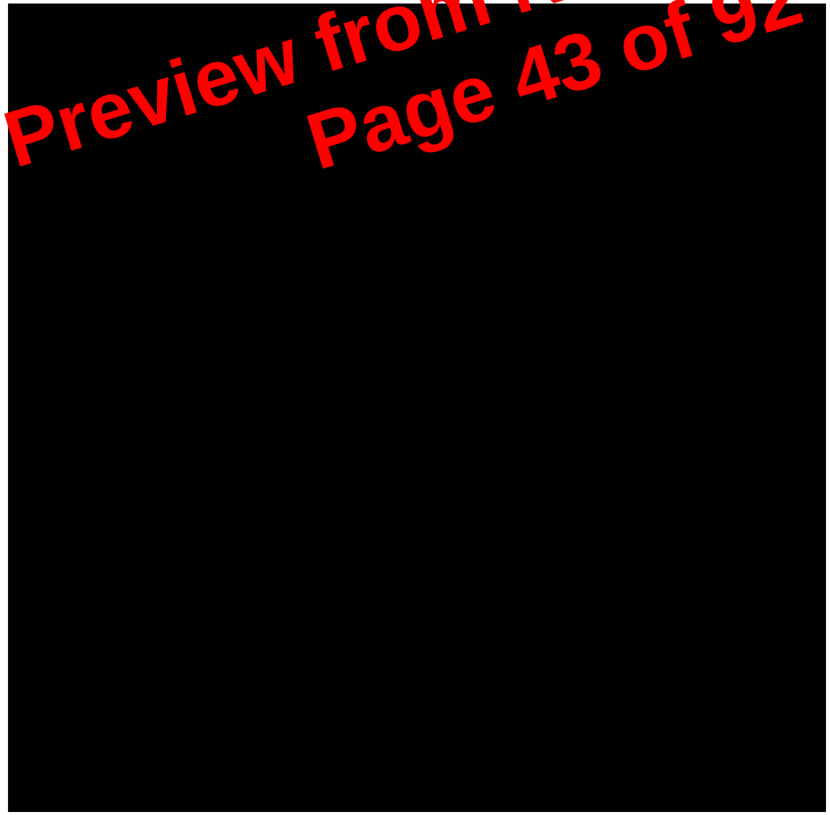
The GB is also called unity gain bandwidth (UGB) or closed loop bandwidth

It is about 1MHz for op-amp 741C

Block diagram of op amp



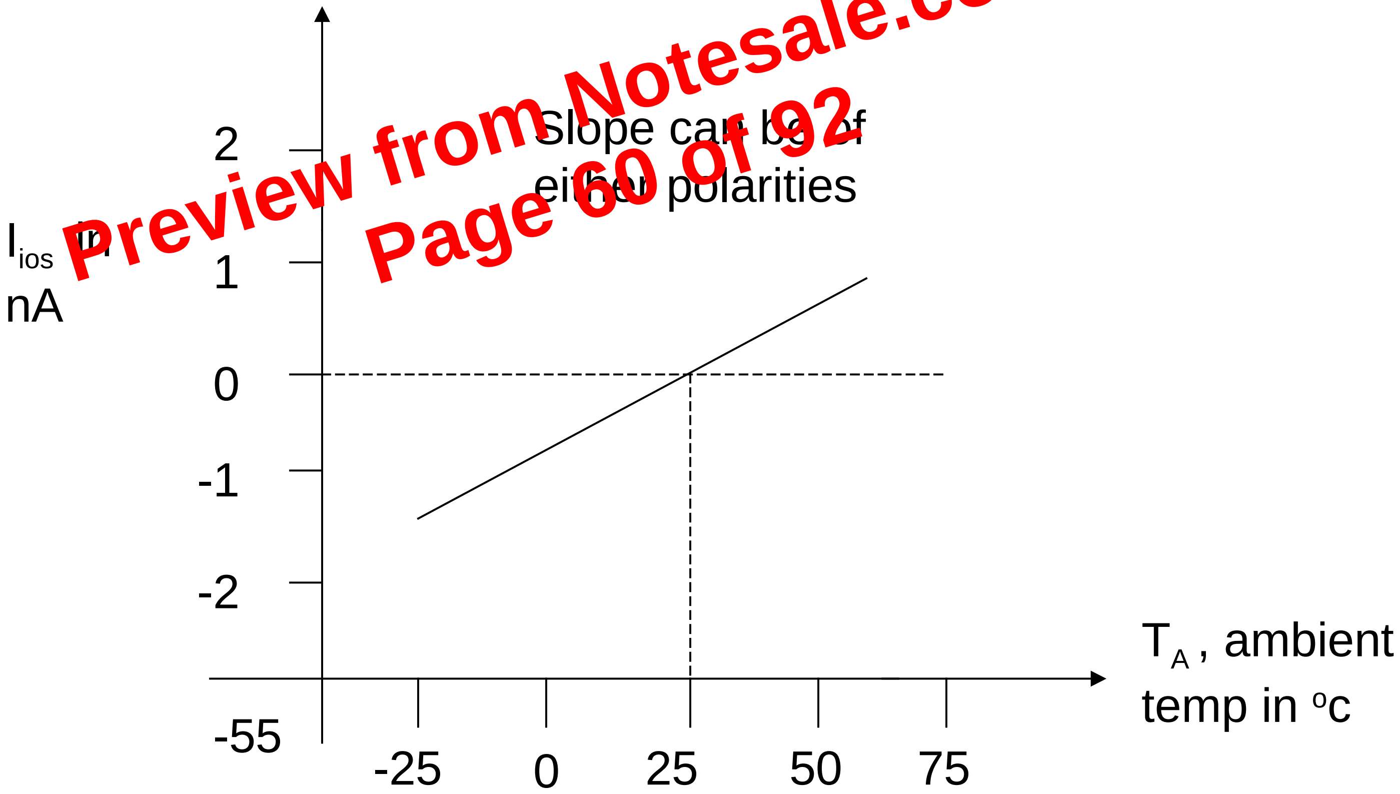
The Non-Inverting Amplifier



$$V_{out} = \left(1 + \frac{R_f}{R_g}\right) V_{in}$$

$$A = 1 + \frac{R_f}{R_g}$$

Input Offset current Drift



When the gain in decibels, phase angle in degrees are plotted against logarithmic scale of frequency, the plot is called ***Bode Plot***

The manner in which the gain of the op-amp changes with variation in frequency is known as the *magnitude plot*.

The manner in which the phase shift changes with variation in frequency is known as the *phase-angle plot*.

For an op-amp with single break frequency f_o , after f_o the gain bandwidth product is constant equal to UGB

$$UGB = A_{OL} \; f_o$$

UGB is also called gain bandwidth product and denoted as f_t

Thus f_t is the product of gain of op-amp and bandwidth.

The break frequency is nothing but a corner frequency f_o . At this frequency, slope of the magnitude plot changes. The op-amp for which there is only once change in the slope of the magnitude plot, is called single break frequency op-amp.

Open loop op-amp configurations

- The configuration in which output depends on input, but output has no effect on the input is called open loop configuration.
- No feed back from output to input is used in such configuration.
- The opamp works as high gain amplifier
- The op-amp can be used in three modes in open loop configuration they are

1. Differential amplifier
2. Inverting amplifier
3. Non inverting amplifier

Inverting Amplifier

The amplifier in which the output is inverted i.e. having 180^o phase shift with respect to the input is called an inverting amplifier

$$V_o = -A_{OL} V_{in2}$$

Keypoint: The negative sign indicates that there is phase shift of 180^o between input and output i.e. output is inverted with respect to input.

Practical Non-Inverting Amplifier

Closed Loop Voltage gain =

$$A_{CL} = \frac{A_{OL}(R_1 + R_f)}{R_1 + R_f + R_1 A_{OL}}$$