Advantages of negative feedback

$A_f = A/(1+A\beta)$ for –ve feedback

$A_f = A/(1-A\beta)$ for +ve feedback

- Gain Stability
- Improvement of frequency response
- Reduction of non-linear distortions
- Reduction of output noise
- Increase in band width
- Modification of input and output impedance

Gain Stability

$A_f = A/(1 + A\beta)$

If we make $A\beta >> 1$ then

$A_f = A/A\beta$

or $A_f = 1/\beta$ (feedback taken through resistive network)

Thus the gain Af of feedback amplifier is made independent of internal gain A. So if β is independent of frequency then A_f will also be independent of frequency. This reduces frequency and phase distortions.

Reduction of non-linear distortions

Non linear distortions in large amplitude signals where the operation of device extends beyond range of linear operation.

In open loop config. $V_o=AV_i+V_d$ --------------------1.

where V_d is harmonic distortion output.

In Feedback config. $V_i=V_s- \beta V_o$

Eq. 1 becomes $V_o=A(V_s- \beta V_o)+V_d$ --------------------2

Now $A_f=A/(1+A\beta)$ where $A_f= V_o/V_s$ and $A=Vo/V_i$

=> $V_o/V_s=Vo/V_i (1+A\beta)$

=> $V_s= V_i (1+A\beta)$ --------------------3

Putting 3 in 2 we get

$V_o=A[V_i (1+A\beta) - \beta V_o]+V_d$

or$V_o (1+A\beta) = A (1+A\beta) V_i +V_d$

or $V_o=AV_i +V_d/ (1+A\beta)$

Reduction in output noise

- In V_n is the noise voltage in the input of amplifier, it gets amplified by A at the output.

  $$V_{noise}=AV_n$$

- We know in negative feedback $A_f=A/(1+A\beta)$

  $\Rightarrow (V_{noise})_f = A/(1+A\beta)\ V_n$

  $\Rightarrow (V_{noise})_f = V_{noise}/(1+A\beta)$

Hence, the noise voltage is reduced in negative feedback.

Increase of Bandwidth

The range b/w lower cutoff frequency f_1 and upper cutoff frequency f_2 in frequency response curve is called bandwidth.

$$A_l = \frac{A_m}{1 - \frac{jf_1}{f}}$$

$$A_{lf} = \frac{A_l}{1 + \beta A_l}$$

$$(A_{lf}) = \frac{\frac{A_m}{1 - \frac{jf_1}{f}}}{1 + \frac{\beta A_m}{1 - j\frac{f_1}{f}}} = \frac{A_m}{1 + \beta A_m - j\frac{f_1}{f}}$$

$$(A_{lf}) = \frac{\frac{A_m}{1+\beta A_m}}{1 - j\frac{f_1}{(1+\beta A_m)f}} = \frac{\frac{A_m}{1+\beta A_m}}{1 - j\frac{f_{1new}}{f}}$$

$$f_{1new} = \frac{f_1}{(1 + \beta A_m)}$$

$$f_{2new} = (1 + \beta A_m) f_2$$