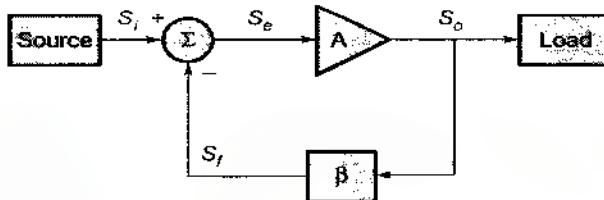


9

Feedback Amplifiers

Basic Feedback Concept



where,

A = Open loop gain

β = Feedback factor

S_i = Input signal

S_e = Error signal

S_f = Feedback signal

Gain with feedback

$$A_f = \frac{A}{1 + AB} \text{ for } -\text{ve feedback} ; \quad A_f = \frac{A}{1 - AB} \text{ for } +\text{ve feedback}$$

Remember:

The amount of feedback introduced into amplifier is often expressed in dB and is given by

$$N(\text{Feedback in dB}) = 20 \log \left| \frac{1}{1 + AB} \right|$$

Here, $N \rightarrow -\text{ve}$ for $-\text{ve}$ feedback and $N \rightarrow +\text{ve}$ for $+\text{ve}$ feedback.

Loop gain or return ratio

$$\text{Loop gain} = -AB$$

Return difference

- Difference between unity and loop gain is called *return difference (D)*.

$$D = (1 + AB)$$

- D is also called *desensitivity*.

Sensitivity

In case of negative feedback if,

$$\frac{dA}{A} \rightarrow \% \text{ change without feedback.}$$

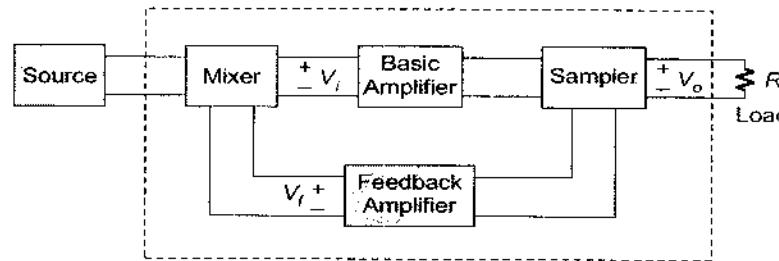
$$\frac{dA_f}{A_f} \rightarrow \% \text{ change with feedback.}$$

$$\frac{dA_f}{A_f} = \frac{dA/A}{1+A\beta}$$

i.e. reduction in sensitivity of amplifier.

General Block Diagram of Feedback Network.

Feedback Amplifier



Sample Circuit		Mixer (Comparator)	
1. Voltage/Shunt Sampler	2. Current/Series Sampler	1. Series/Voltage Mixer (Comparator)	2. Shunt/Current Mixer (Comparator)
<p>A basic amplifier with its output connected to a load resistor R_L. The output voltage is V_o. A feedback factor β is shown between the output and the input.</p>	<p>A basic amplifier with its output current I_o passing through a load resistor R_L. The output current is I_o. A feedback factor β is shown between the output and the input.</p>	<p>A voltage source V_s is connected to the input of an amplifier. The output of the amplifier is connected to a load resistor R_L. A feedback signal V_f is taken from the output and fed back through a feedback factor β.</p>	<p>A current source I_s is connected to the input of an amplifier. The output of the amplifier is connected to a load resistor R_L. The output current is I_o. A feedback signal I_f is taken from the output and fed back through a feedback factor β.</p>

Effect of Feedback

- Reduction in noise

$$N_{of} = \frac{N_o}{1 + A\beta}$$

N_o = Noise without feedback

N_{of} = Noise with feedback

- Lower cutoff frequency

$$f_{lf} = \left(\frac{f_l}{1 + A\beta} \right)$$

f_{lf} = Lower 3-dB frequency with feedback

f_l = Lower 3-dB frequency without feedback

- Upper cutoff frequency $f_{hf} = f_h(1 + A\beta)$

where, f_{hf} = Upper 3-dB frequency with feedback.

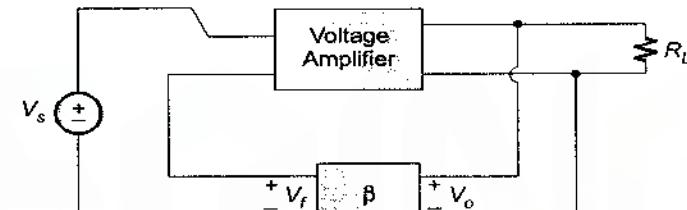
f_h = Upper 3-dB frequency without feedback.

Note:

Bandwidth increases with -ve feedback.

Feedback Topology

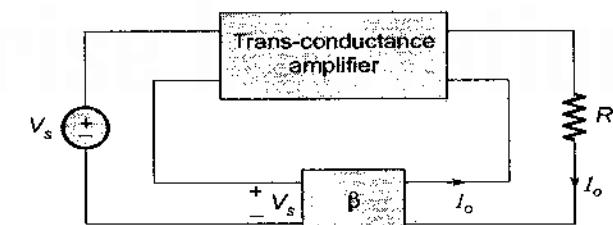
1. Voltage series topology



(i) β is dimensionless.

(ii) Voltage series feedback stabilizes the voltage gain.

2. Current series topology



(i) Unit of β is Ohm.

(ii) It stabilizes trans-conductance gain of the amplifier.