Feedback Amplifiers

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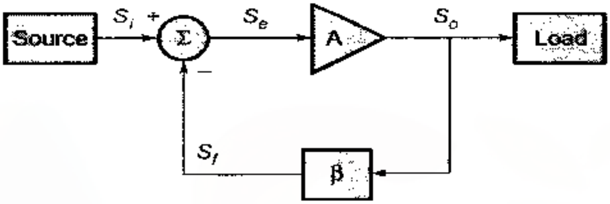
Basic Feedback Concept



where, A = Open loop gain

β = Feedback factor

S_i = Input signal

S_e = Error signal

S_f = Feedback signal

Gain with feedback

$$A_f = \frac{A}{1+A\beta}$$ for −ve feedback ; $$A_f = \frac{A}{1-A\beta}$$ for +ve feedback

Remember:

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

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

Here, $N \rightarrow$ −ve for −ve feedback and $N \rightarrow$ +ve for +ve feedback.

Loop gain or return ratio

$$\text{Loop gain} = -A\beta$$

Return difference

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

$$D = (1 + A\beta)$$

- D is also called ***desensitivity***.

Sensitivity

In case of negative feedback if,

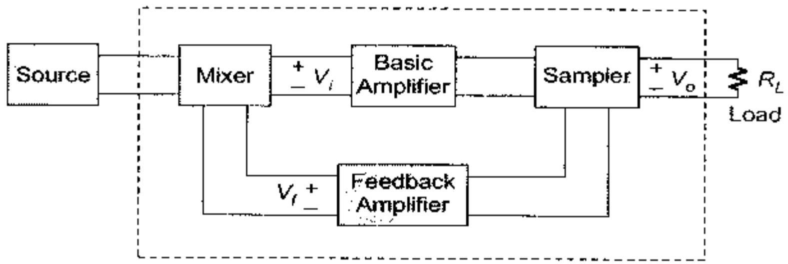
$\frac{dA}{A} \rightarrow$ % change without feedback.

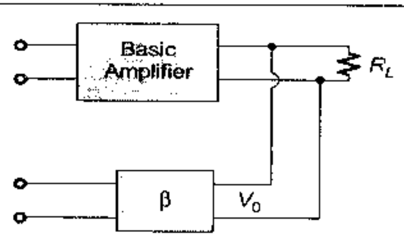
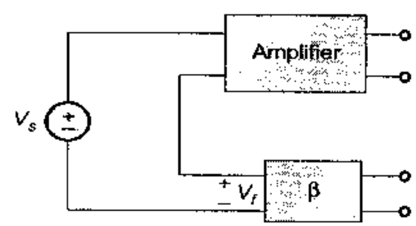
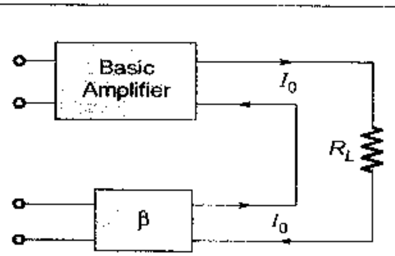
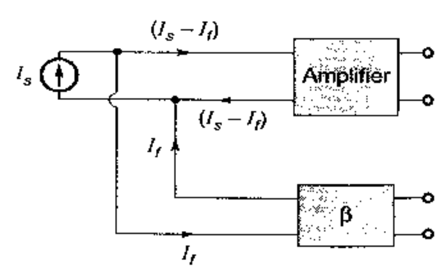
$\frac{dA_f}{A_f} \rightarrow$ % change with feedback.

$$\boxed{\frac{dA_f}{A_f} = \frac{dA/A}{1+A\beta}}$$ i.e. reduction in sensitivity of amplifier.

General Block Diagram of Feedback Network.

Feedback Amplifier



Sample Circuit	Mixer (Comparator)
1. Voltage/Shunt Sampler	**1. Series/Voltage Mixer (Comparator)**
	
2. Current/Series Sampler	**2. Shunt/Current Mixer (Comparator)**
	

Effect of Feedback

- Reduction in noise

  $$\boxed{N_{of} = \frac{N_o}{1+A\beta}}$$ N_o = Noise without feedback, N_{of} = Noise with feedback

- Lower cutoff frequency

  $$\boxed{f_{lf} = \left(\frac{f_l}{1+A\beta}\right)}$$ f_{lf} = Lower 3-dB frequency with feedback, f_l = Lower 3-dB frequency without feedback

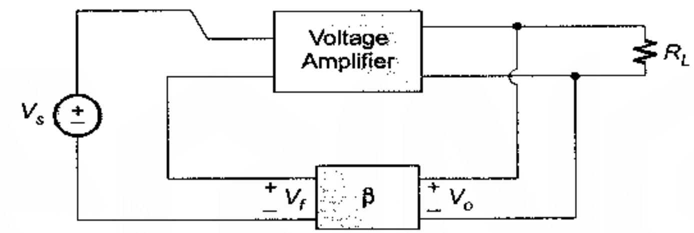
- Upper cutoff frequency $\boxed{f_{Hf} = f_H(1+A\beta)}$

  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

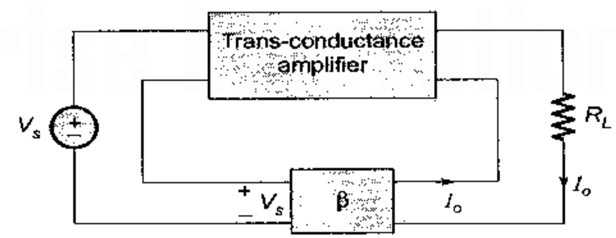
1. Voltage series topology



(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.