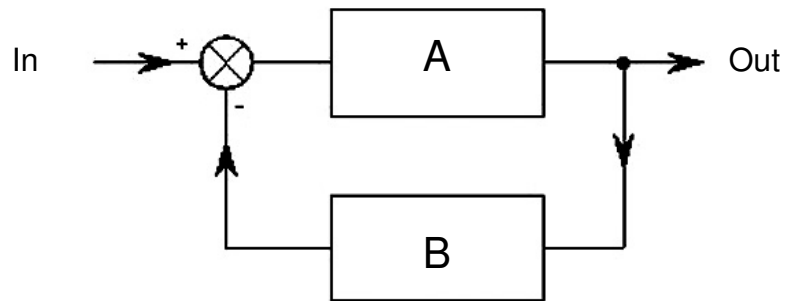


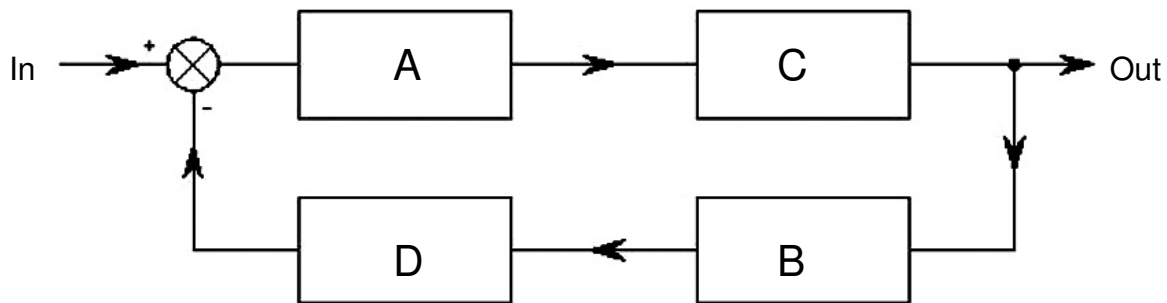
The Analysis of Noise Sources in Feedback Systems



Normal Feedback Loop

$$\text{Out} = \text{In} \frac{A}{1+AB}$$

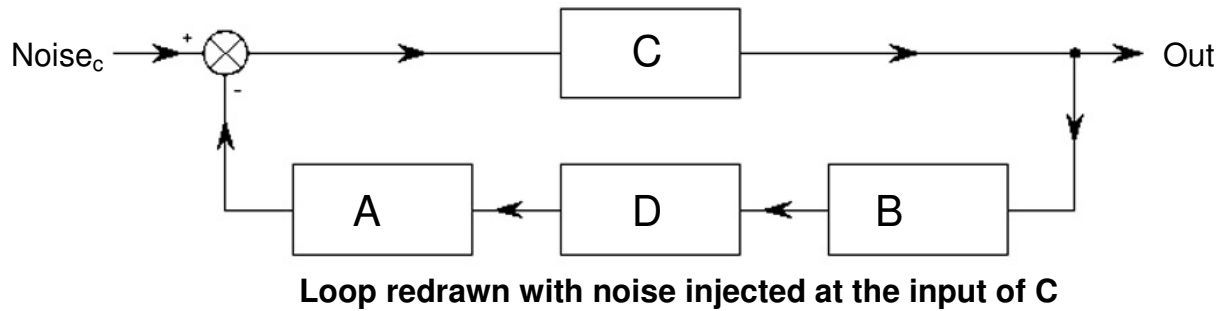
$$\text{Out} \approx \text{In} \frac{1}{B} \text{ for } AB \gg 1$$



**Feedback Loop having two blocks
in forward and feedback paths.**

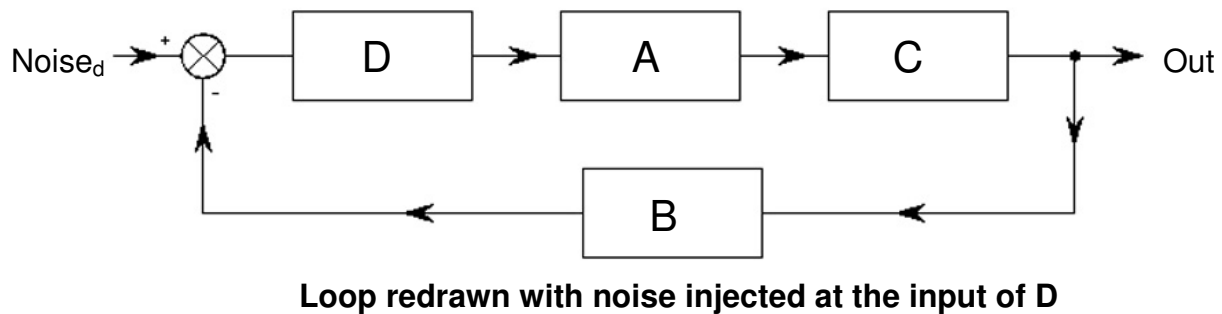
$$\text{Out} = \text{In} \frac{AC}{1+ACBD}$$

or
$$\text{Out} \approx \text{In} \frac{1}{BD} \text{ for } ACBD \gg 1$$



$$\text{Out} = \text{Noise}_c \frac{C}{1+ABCD}$$

or $\text{Out} \approx \text{Noise}_c \frac{1}{ABD}$ for $ABCD \gg 1$



$$\text{Out} = \text{Noise}_d \frac{DAC}{1+ABCD}$$

or $\text{Out} \approx \text{Noise}_d \frac{1}{B}$ for $ABCD \gg 1$

These represent the two general cases of a noise source in either of the forward or feedback paths.

For a noise source, Noise_c , in the forward path at the input of C, and using the high loop-gain approximations the equivalent input noise In_{eq} can be found.

$$\text{In}_{eq} \frac{1}{BD} = \text{Out} = \text{Noise}_c \frac{1}{ABD}$$

So the equivalent input signal is given by:

$$\text{In}_{eq} = BD \text{Noise}_c \frac{1}{ABD}$$

or $\text{In}_{eq} = \text{Noise}_c / A$

For a noise source, Noise_d , in the feedback path at the input of D, again, assuming high loop-gain, we have:

$$\text{In}_{eq} \frac{1}{BD} = \text{Out} = \text{Noise}_d \frac{1}{B}$$

So $\text{In}_{eq} = BD \text{Noise}_d \frac{1}{B}$

or $\text{In}_{eq} = \text{Noise}_d D$

However, for the purposes of testing we may also be interested in the absolute value of the output noise signal, not its value as referred to the input. In that case the first equations are appropriate, that is:

$$\begin{aligned} & \text{Noise}_{\text{out}} = \text{Noise}_c C / (1 + ABCD) \\ \text{or} \quad & \text{Noise}_{\text{out}} \approx \text{Noise}_c 1 / ABD \quad \text{for } ABCD \gg 1 \end{aligned}$$

and

$$\begin{aligned} & \text{Noise}_{\text{out}} = \text{Noise}_d DAC / (1 + ABCD) \\ \text{or} \quad & \text{Noise}_{\text{out}} \approx \text{Noise}_d 1 / B \quad \text{for } ABCD \gg 1 \end{aligned}$$