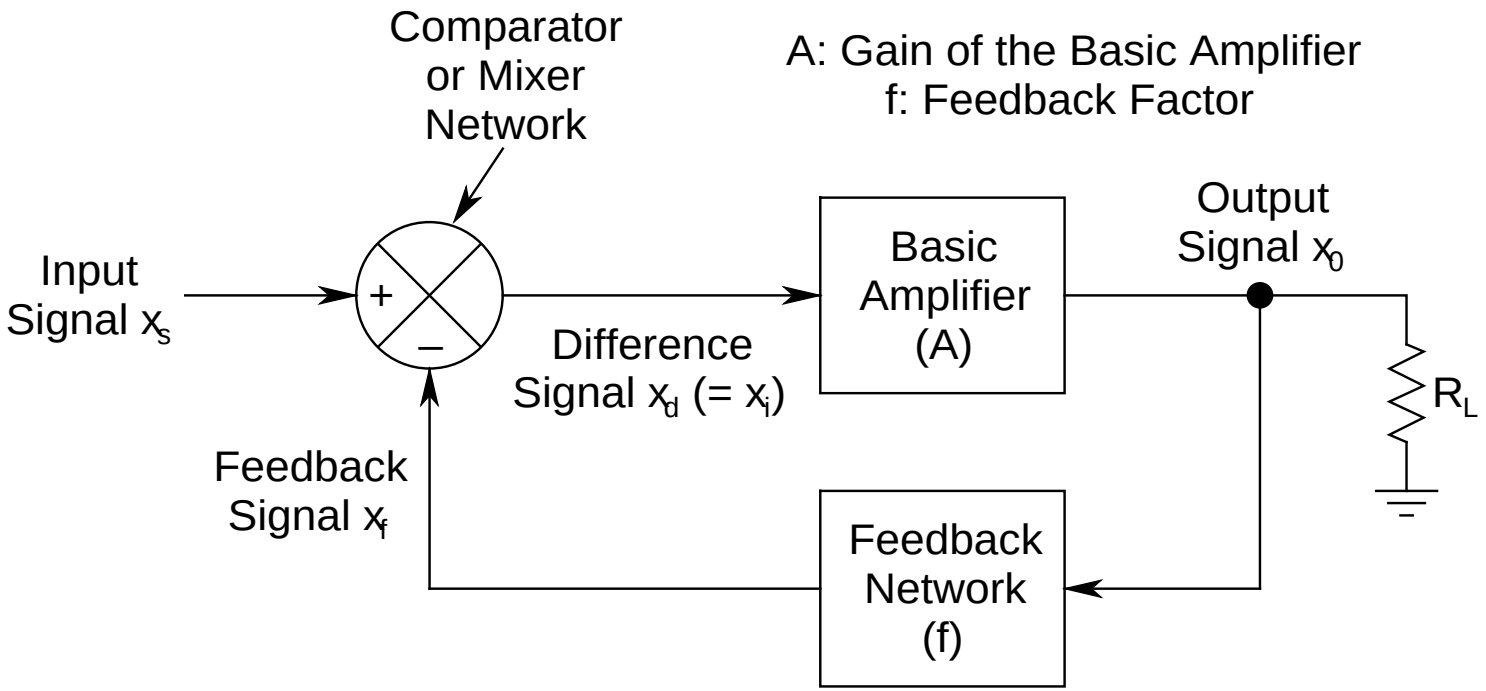
- ***Mathematical Foundation of Negative Feedback*:**



Block Schematic of a Negative Feedback System

- ***3 Main Blocks***:
  - ***The Basic Amplifier*** (***Gain A***)
  - ***The Feedback Network*** (***Feedback Factor f***)
  - ***The Mixer*** (***note the negative sign***)
- ***Defining Relations***:
  - ***Input Signal*** x_s
  - ***Output Signal*** $x_0 = Ax_i$
  - ***Feedback Signal*** $x_f = fx_0$
  - ***Difference Signal*** $x_d = x_i = x_s - x_f$
- ***Gain with feedback***: $A_f = x_0/x_s$

- Thus:

$$A_f = \frac{x_0}{x_s} = \frac{x_0}{x_i}\frac{x_i}{x_s} = A\frac{x_s - x_f}{x_s} = A\left(1 - \frac{x_f}{x_s}\right)$$

$$= A\left(1 - \frac{x_f}{x_0}\frac{x_0}{x_s}\right) = A\left(1 - fA_f\right)$$

- Gives the ***fundamental expression*** for ***negative feedback***:

$$A_f = \frac{A}{1 + fA}$$

- ***Some Definitions***:
  - ***Loop Gain*** (L) = fA
  - ***Return Difference*** (D) = 1 + L
  - ***Amount of Feedback*** (N) = 20 $\log_{10}$D (dB)
- ***Positive Feedback***:
  - ***Output fed back to the input through the mixer, but now with a positive sign***

    $\Rightarrow$ ***Feedback signal gets added to the input signal***