Feedback Amplifiers

$A(\omega)$ = **Amplifier Gain (No Feedback)**
$f(\omega)$ = **Feedback Coefficient**

$$A'(\omega) = \frac{A(\omega)}{1 + f(\omega)A(\omega)}$$

Instability in Feedback Amplifiers

$$\frac{A(\omega)}{1 + f(\omega)A(\omega)} \rightarrow \infty$$

$$1 + f(\omega)A(\omega) \rightarrow 0$$

Nyquist Criterion for Stability

$$\theta \equiv \arctan \frac{Im(A(\omega)f(\omega))}{Re(A(\omega)f(\omega))}$$

Instability if

$$|A(\omega)f(\omega)| > 1$$

where $\theta = 180°$

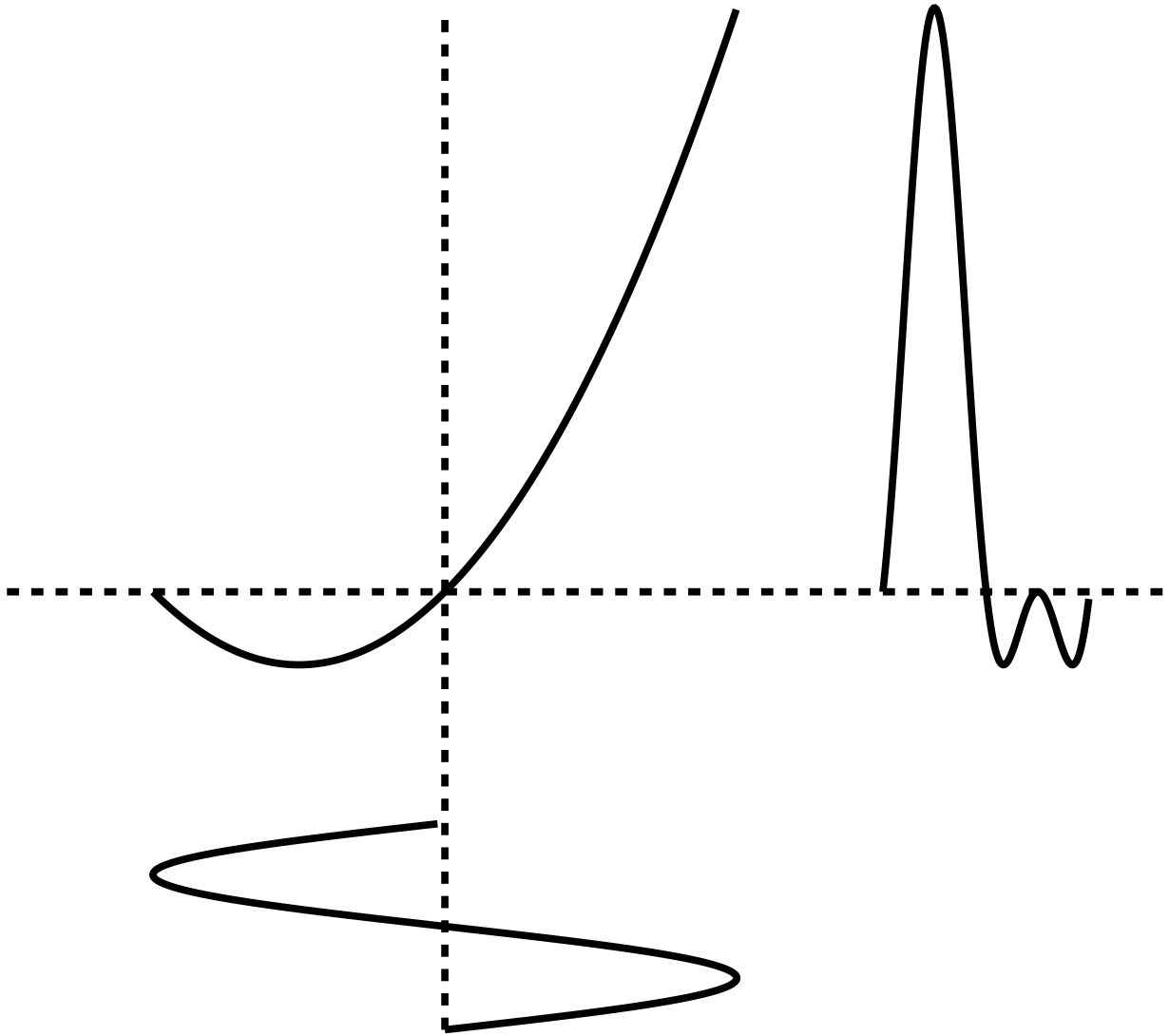
Noise and Bandwidth

$$P_{noise} = 4kTB$$

B=Bandwidth

$$V_{noise} = \sqrt{4kTBR}$$

Nonlinearity



Distortion and Nonlinearity

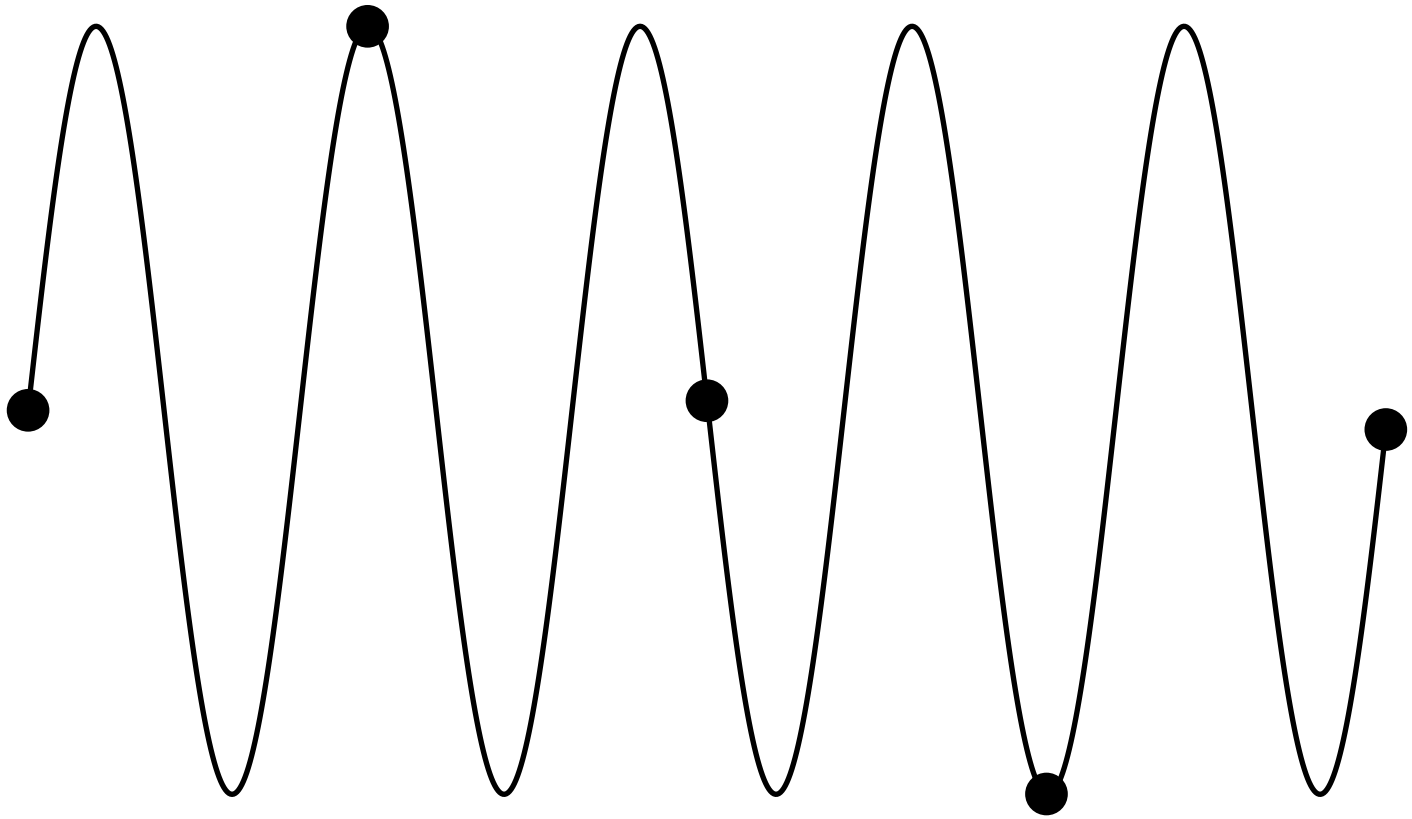
$$V_{in} = A_{in}\cos(\omega t)$$

$$V_{out} = A_1\cos(\omega t) + A_2\cos(2\omega t) + ...$$

Total Harmonic Distortion (THD)

$$THD = \frac{\sqrt{A_2^2 + A_3^2 + ...}}{A_1}$$

Aliasing Example



Nyquist Sampling Theorem

$$f_{sample} \geq 2 f_{signal}(MAX)$$