Maximum input voltage in open loop configuration. $A_0=10^5, \mathrm{VDD}=-\mathrm{VSS}=10 \mathrm{~V}, V_{\text{out , range }}=18 \mathrm{~V} \Rightarrow V_{\text{in, } \max }=V_{\text{out,range }} / A_0=90 \mu \mathrm{V} \square V_{\text{offset }}$ Opamps should be used in closed loop configuration max input Tradeoff between open loop gain and accuracy

When using the opamp in feedback, stability becomes a concern! Stability criterion: Simplified Nyquist criterion (negative feedback) loop gain: $T(\omega)=\beta \cdot A_o(\omega) \Leftrightarrow$ linear phase margin: $\left|T\left(\omega_1\right)\right|=1 \Rightarrow \mathrm{PM}=180^{\circ}+\angle\left(T\left(\omega_1\right)\right)$ gain margin: $\angle\left(T\left(\omega_2\right)\right)=-180^{\circ} \Rightarrow \mathrm{GM}=20 \cdot \log 10\left(\frac{1}{T\left(\omega_2\right)}\right)<1 \Leftrightarrow_{\text{stable}}$

" Assuming $Z_i \mapsto \infty$

$$V_{\mathrm{x}}=\beta \cdot V_{\text{out }}=\beta \cdot A(\omega) \cdot\left(V_{\text{in }}-V_{\mathrm{x}}\right)=\beta \cdot A(\omega) \cdot\left(V_{\text{in }}-\beta \cdot V_{\text{out }}\right)$$

$\frac{V_{\text{out }}}{V_{\text{in }}}=\frac{A(\omega)}{1+\beta \cdot A(\omega)} \approx \frac{A(\omega)] 1}{\beta}$ the faiv is independent

Very basic feedback theory $-A_0(\omega)$ is the forward gain (open loop gain) $-\beta$ is the feedback gain $-\beta \cdot A_0(\omega)$ is the loop gain $-1+\beta \cdot A_o$: feedback factor - Closed-loop TF:

$A_c=\frac{V_{\text{out }}}{V_{\text{in }}}=\frac{A_0(\omega)}{1+\beta \cdot A_o(\omega)}$

- There is a tradeoff between open loop gain and DC accuracy. Tradeoff of gain vs. bandwidth. Tradeoff of input and output resistance. (depending on the type of feedback)