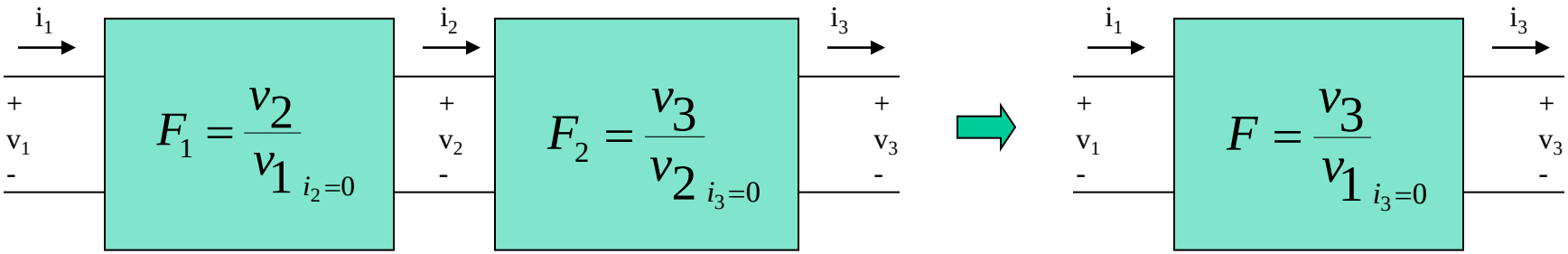
Stability of blocks in cascade 1/5



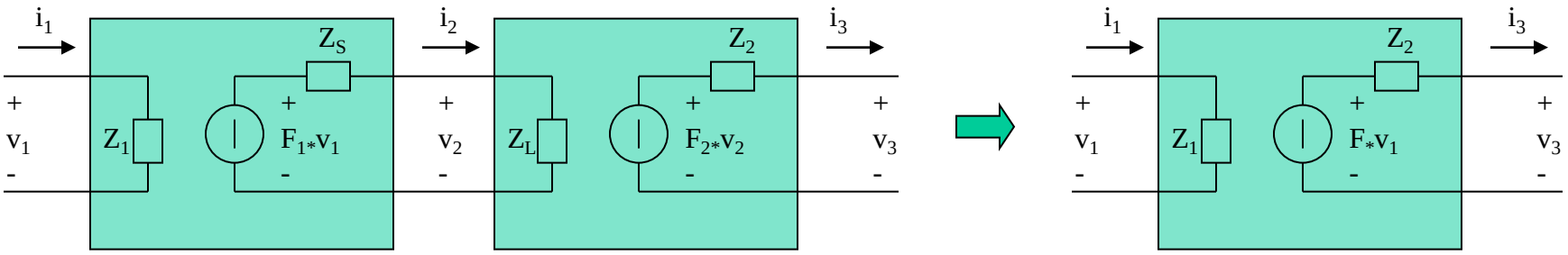
Statement of the problem

If F1 and F2 are stable, which are the

- Sufficient
- Necessary

conditions for the stability of the cascade F of the two blocks F1 and F2 ?

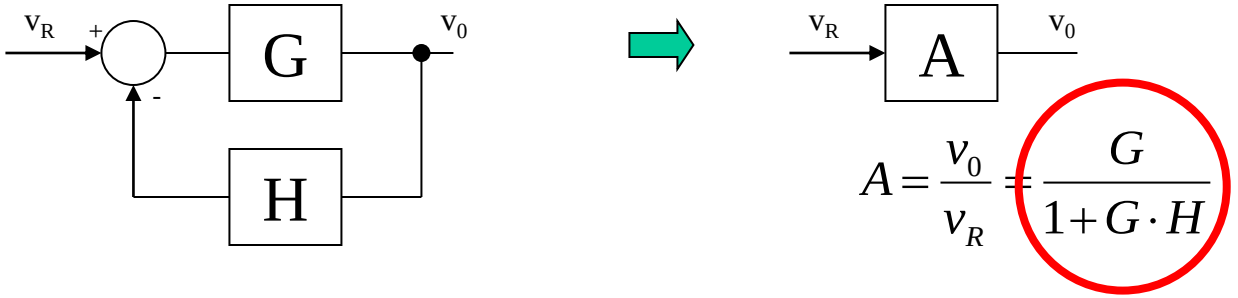
Stability of blocks in cascade 2/5



$$F_1 = \frac{v_2}{v_1}_{i_2=0} \qquad F_2 = \frac{v_3}{v_2}_{i_3=0} \qquad F = \frac{v_3}{v_1}_{i_3=0}$$

$$F = \frac{F_1 \cdot F_2}{1 + \frac{Z_S}{Z_L}}$$

Note the analogy with stability of closed loops:



$$A = \frac{v_0}{v_R} = \frac{G}{1 + G \cdot H}$$

Stability of blocks in cascade 3/5

$$F = \frac{F_1 \cdot F_2}{1 + \frac{Z_S}{Z_L}}$$

$$A = \frac{G}{1 + G \cdot H}$$

$$G = \frac{P}{1 + Q}$$

Conditions for Stability

Necessary & Sufficient

The criterion of Nyquist, of course!

Sufficient

For example, the following "revised" Bode Stability Criterion:

a closed-loop system is stable if the **open-loop system Q is stable** and the frequency response of the open-loop transfer function has an amplitude ratio of less than unity at all frequencies corresponding to f =-180 -n*360 deg, where n=0,1,2,....

Stability of blocks in cascade 4/5

Example 1,
"Just" stable

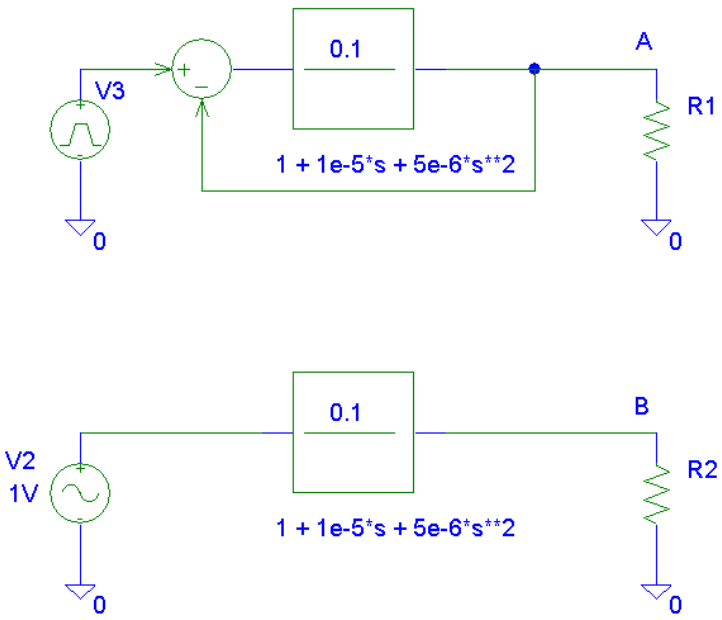
Bode plot

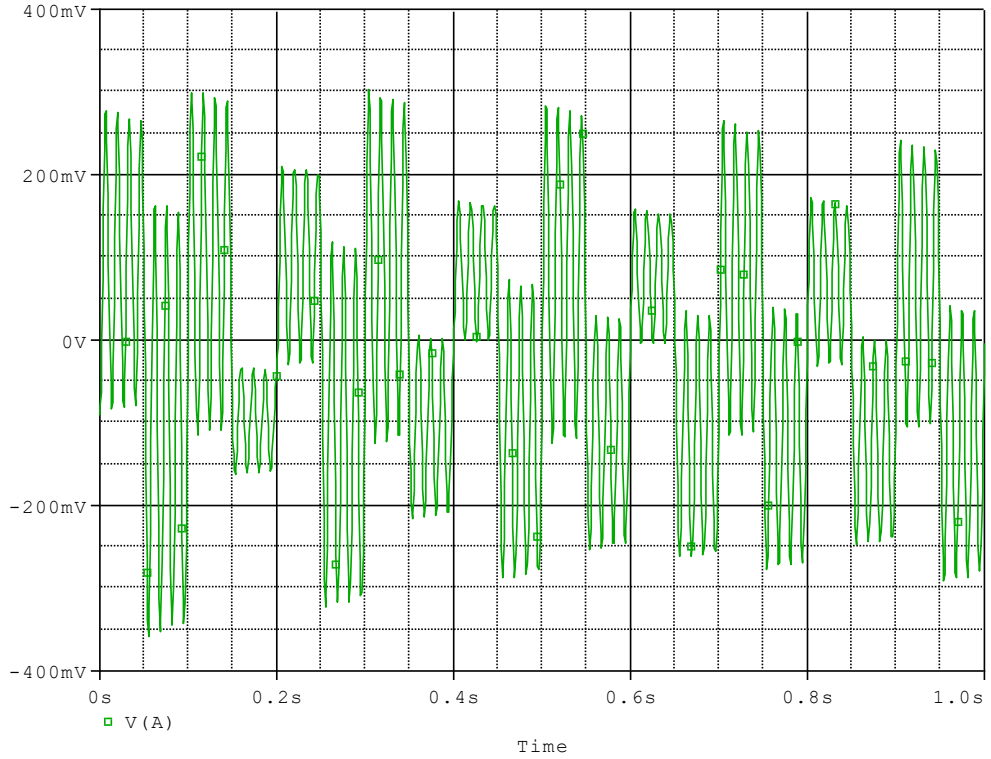
Adobe Acrobat Document

Nyquist plots

Adobe Acrobat Document

Adobe Acrobat Document





Stability of blocks in cascade 5/5

Example 1,
“Just” unstable

Bode plot

Adobe Acrobat Document

Nyquist plot

Adobe Acrobat Document