Structured Electronic Design

Example:
Bandwidth of a
Negative Feedback Integrator

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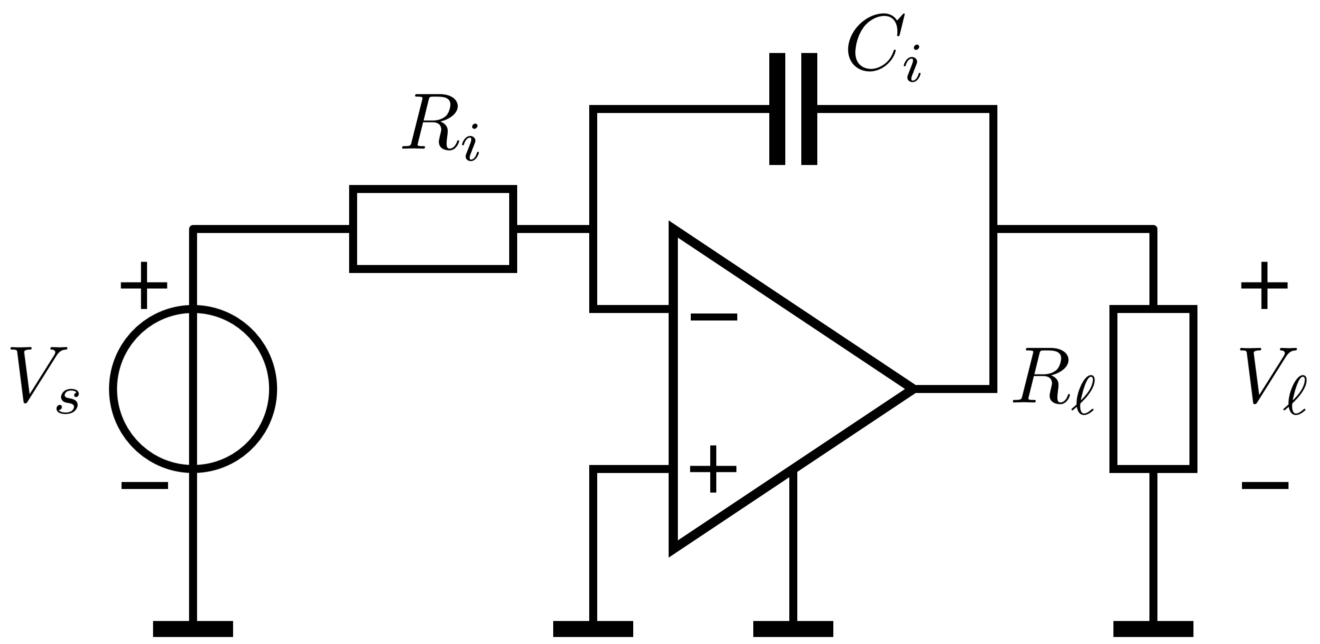
Example integrator bandwidth

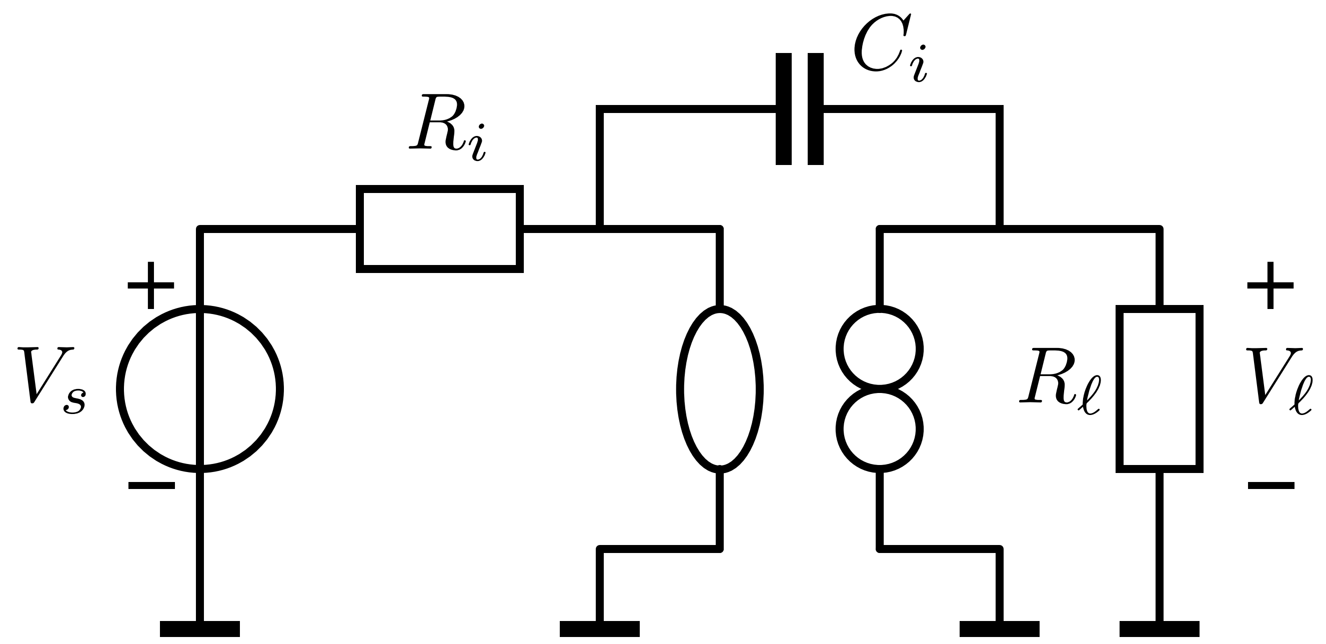


OpAmp modeled as VCVS:

$$A_v = \frac{A_0}{1+s\frac{A_0}{2\pi \mathrm{GB}}}$$

Example integrator bandwidth

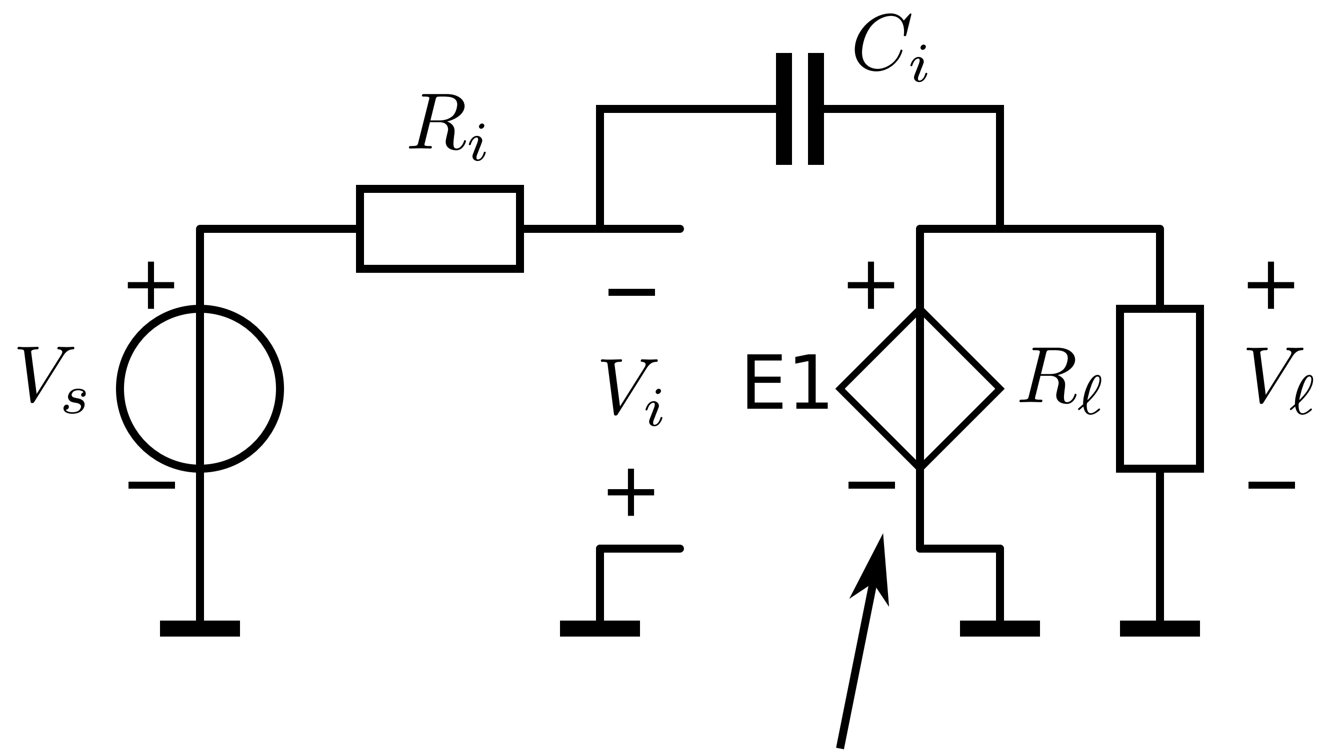
Ideal gain: replace controller with a nullor:



$$\frac{V_\ell}{V_s} = -\frac{1}{sR_iC_i}$$

Example integrator bandwidth

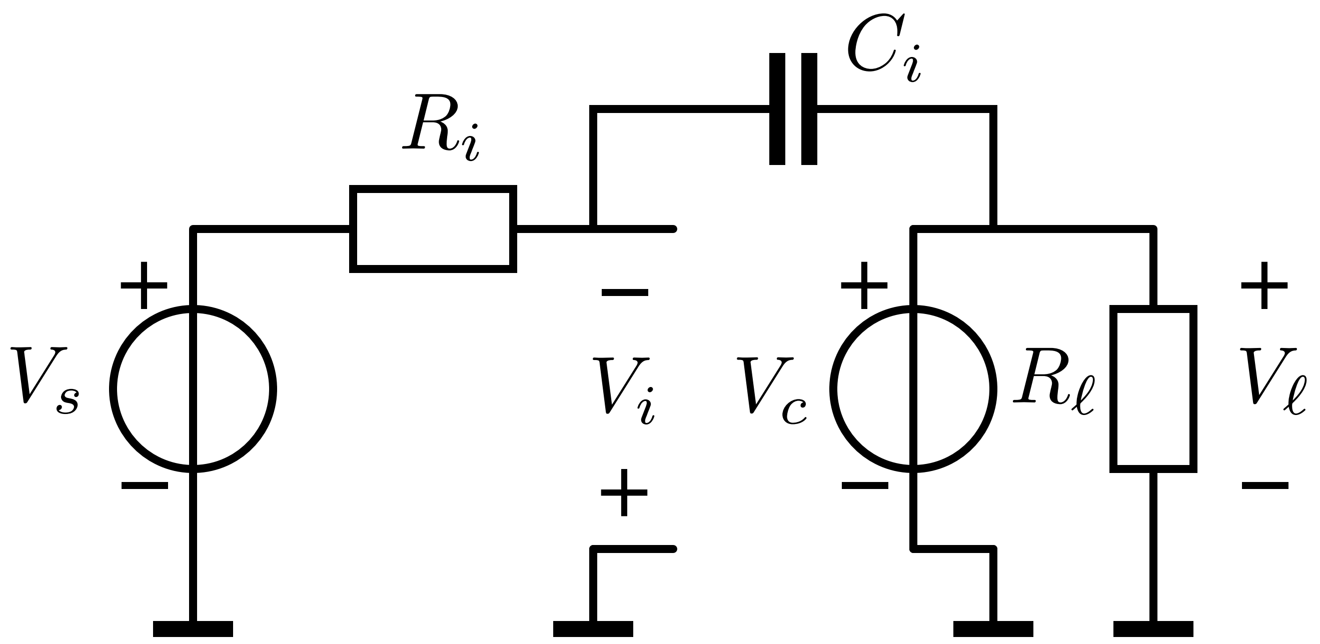
Select loop gain reference such that the asymptotic gain equals the ideal gain



$$V_i \frac{A_0}{1+s\frac{A_0}{2\pi \mathrm{GB}}}$$

Example integrator bandwidth

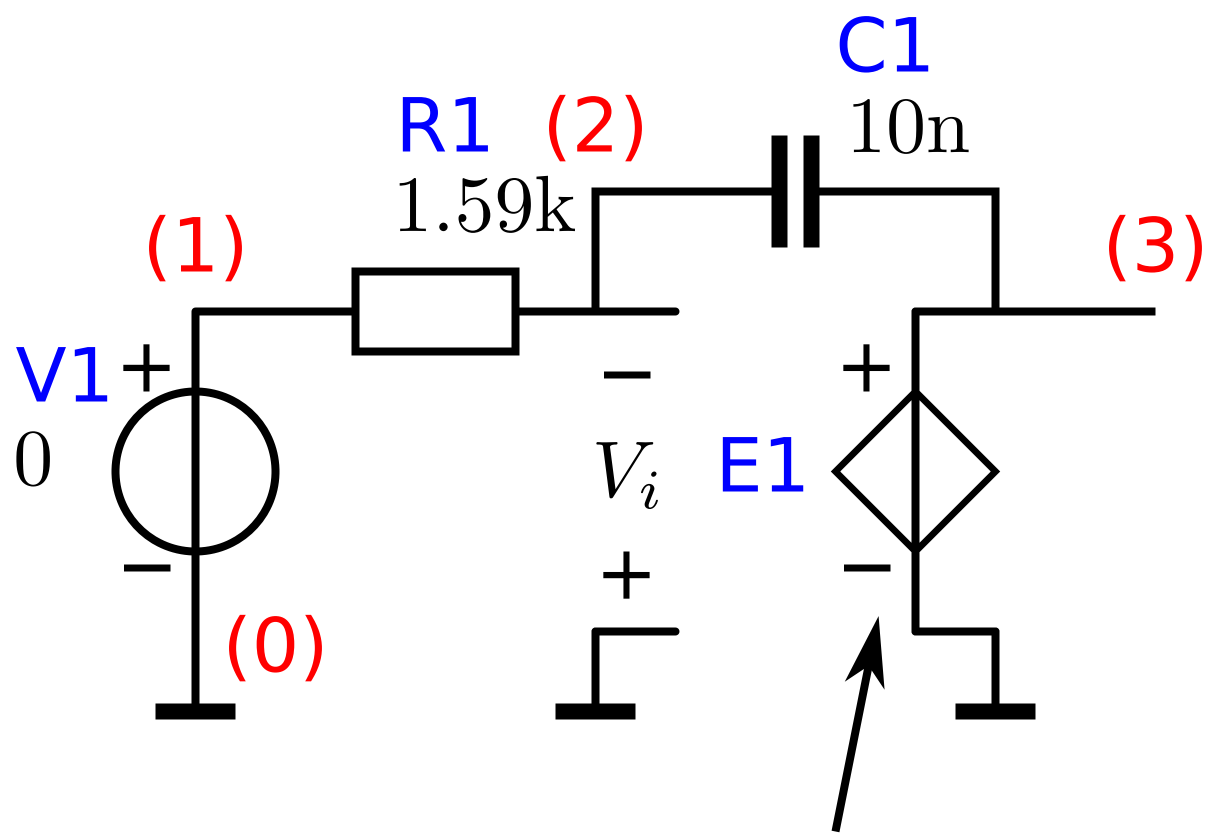
Evaluate the loop gain:



$$A_{\text{ref}} = \frac{A_0}{1+s\frac{A_0}{2\pi \text{GB}}}$$

$$\lambda\beta\kappa = \left.\frac{V_i}{V_c}\right|_{V_s=0} = -\frac{sR_iC_i}{1+sR_iC_i} \qquad L = -\frac{sR_iC_i}{1+sR_iC_i}\frac{A_0}{1+s\frac{A_0}{2\pi \text{GB}}}$$

Example integrator bandwidth



$$V_i \frac{1000}{1+628.3s}$$

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Integrator
V1 1 0 0
R1 1 2 1.59k
C1 2 3 10n
E1 3 0 0 2 {1k/(1+s/2/pi/100)}
.end
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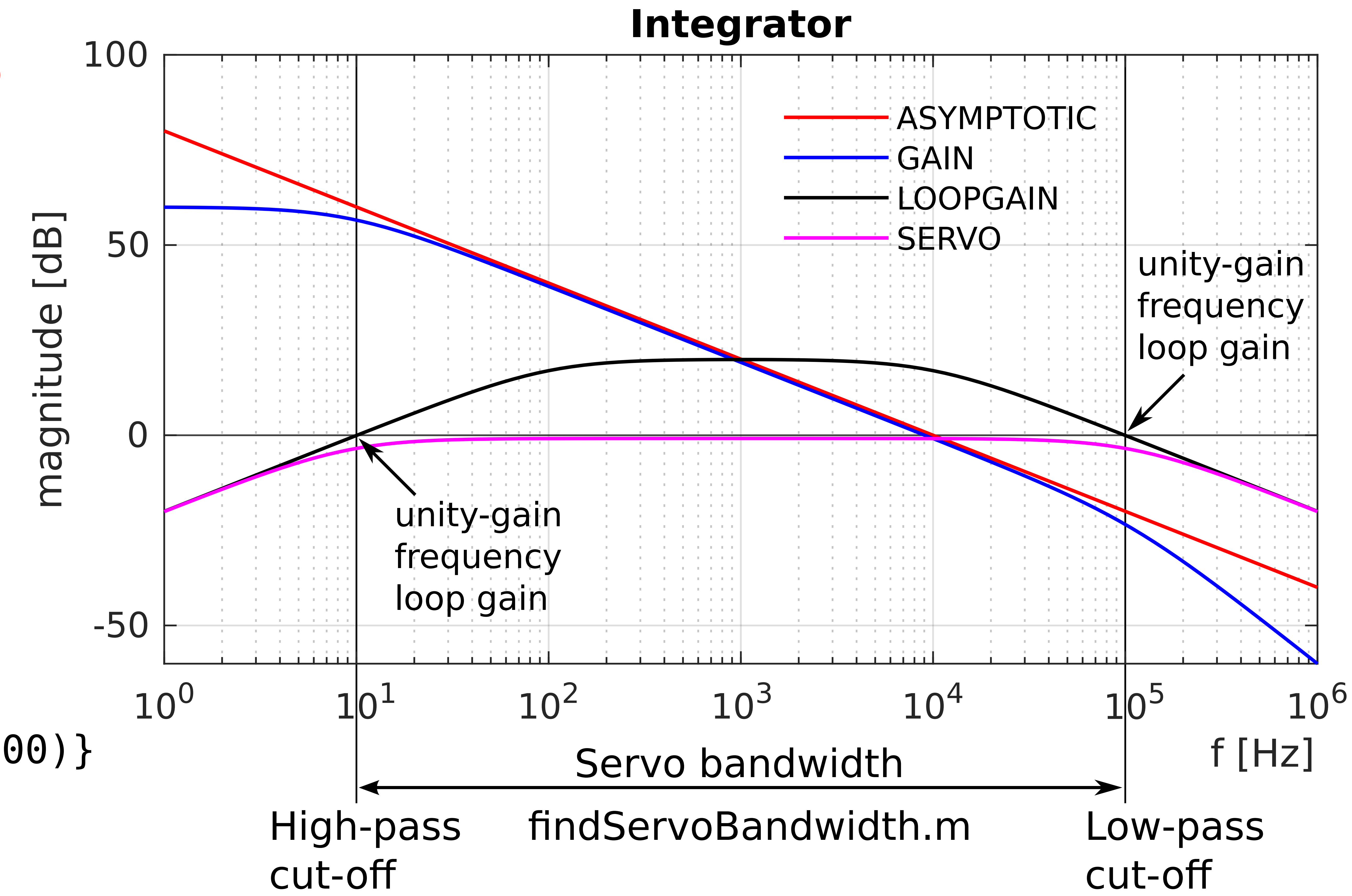

Design questions

- In which way, and to what extend does the controller contribute to the bandwidth of the servo function?

- The product of the DC loop gain and the dominant poles of the loop gain, determines the bandwidth of the servo function

- The contribution of the controller to this product should be large enough

