Structured Electronic Design

All-pole loop gain and servo bandwidth

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All-pole loop gain

$$A_f(s) = A_{f\infty}(s)\frac{-L(s)}{1-L(s)} \qquad L(s) = \frac{L_{DC}}{\prod_{i=1}^{n}\left(1-\frac{s}{p_i}\right)}$$

$$S(s) = \frac{-L(s)}{1-L(s)} = \frac{-L_{DC}}{\prod_{i=1}^{n}\left(1-\frac{s}{p_i}\right)-L_{DC}} = \frac{-L_{DC}}{1-L_{DC}}\frac{1}{1+\ldots+\frac{(-s)^n}{(1-L_{DC})\prod_{i=1}^{n} p_i}}$$

loop gain-poles (LP) product

Denominator coefficient of highest order of s determined by loop gain-poles (LP) product

If all poles are dominant:

$$\omega_n = \sqrt[n]{\left|(1-L_{DC})\prod_{i=1}^{n} p_i\right|}$$

$$\omega_n = \sqrt[n]{\left|\mathrm{LP}_n\right|} \longleftarrow \text{n-th order LP product}$$

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