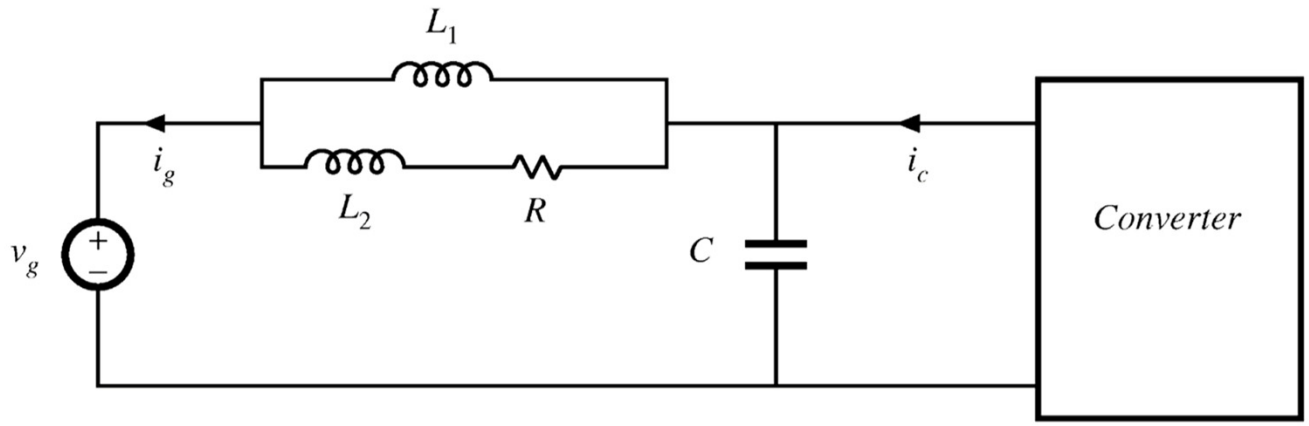
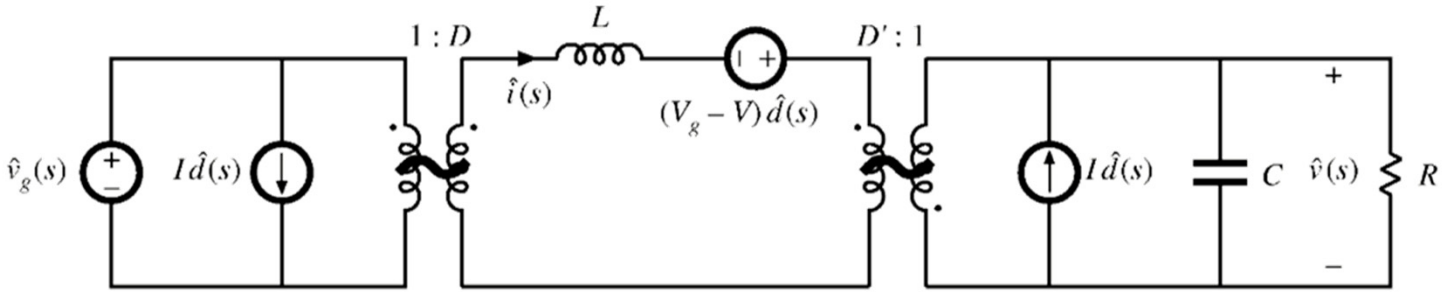
Example: Damped Input EMI Filter



$$G(s) = \frac{i_g(s)}{i_c(s)} = \frac{1 + s\,\dfrac{L_1 + L_2}{R}}{1 + s\,\dfrac{L_1 + L_2}{R} + s^2 L_1 C + s^3\,\dfrac{L_1 L_2 C}{R}}$$

Approximate Roots of High-Order Polynomial

Graphical Construction: Output Impedance



$$G_{va}(s) = \left(-\frac{V_g - V}{D'}\right) \frac{1 - sL\frac{I}{D'(V_g - V)}}{1 + \frac{sL}{D'^2R} + s^2\frac{LC}{D'^2}}$$

Numerical Example

$L = 160\ \mu\text{H}$

$D = 0.6$

$R = 10\ \Omega$

$C = 160\ \mu\text{F}$

$V_g = 30\ \text{V}$

$V = -45\ \text{V}$

$$\frac{L}{D'^2} = 1\text{mH}$$

$$\omega_0 = \sqrt{\frac{D'^2}{LC}} = 2.5\ \text{krad/s} \quad \rightarrow \quad f_0 = 400\ \text{Hz}$$

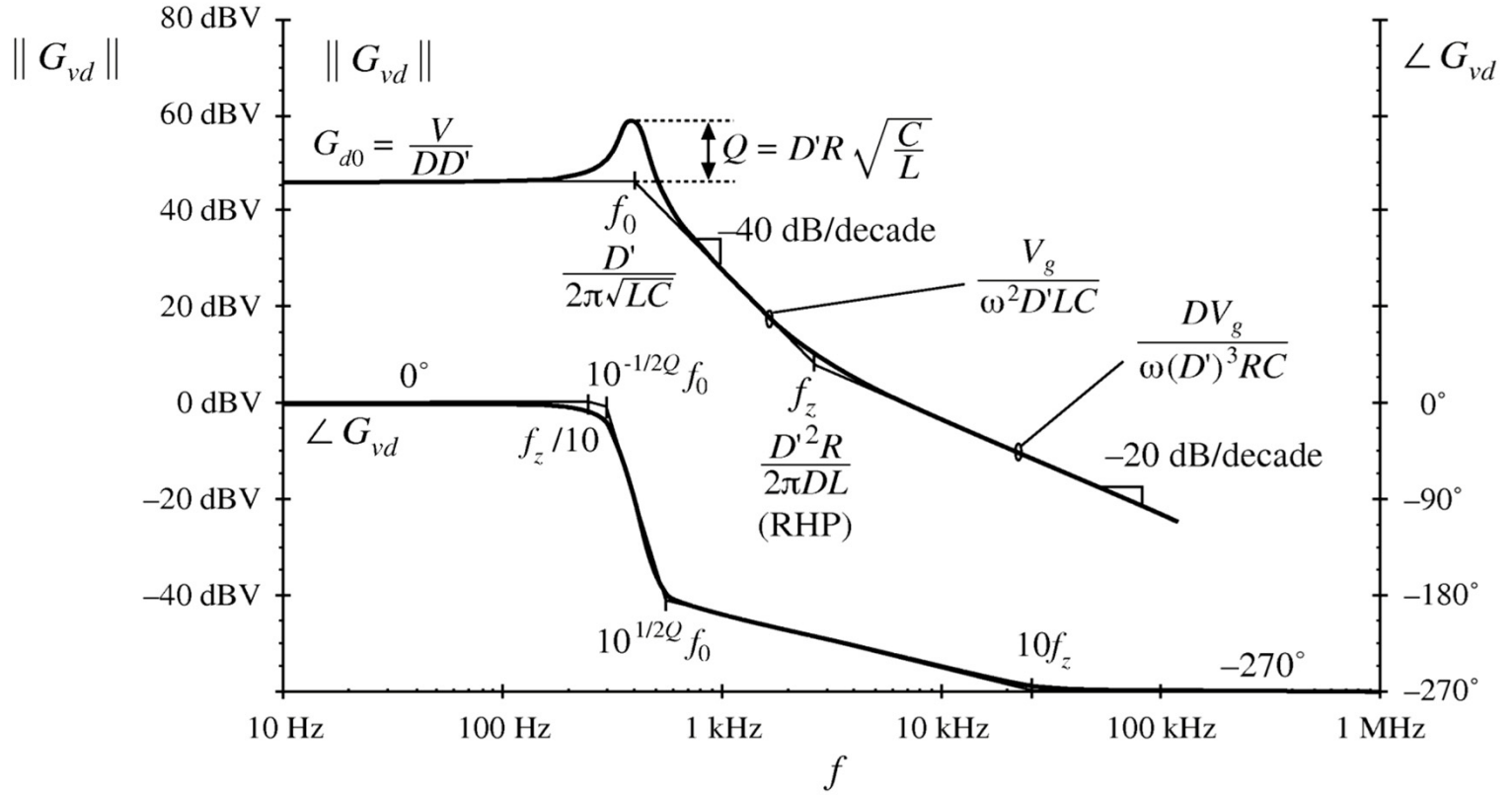
$$Q = \frac{D'R}{\sqrt{L/C}} = 4 \quad \rightarrow \quad \|Q\|_{\text{dB}} = 12\ \text{dB}$$

$$\omega_z = \frac{LI}{(Vg - V)} = 16.7\ \text{krad/s} \quad \rightarrow \quad f_z = 2.7\ \text{kHz}$$

$$G_{d0} = \frac{V_g - V}{D'} = 187.5\ \text{V} \quad \rightarrow \quad \| G_{d0} \|_{\text{dB}} = 45.5\ \text{dBV}$$

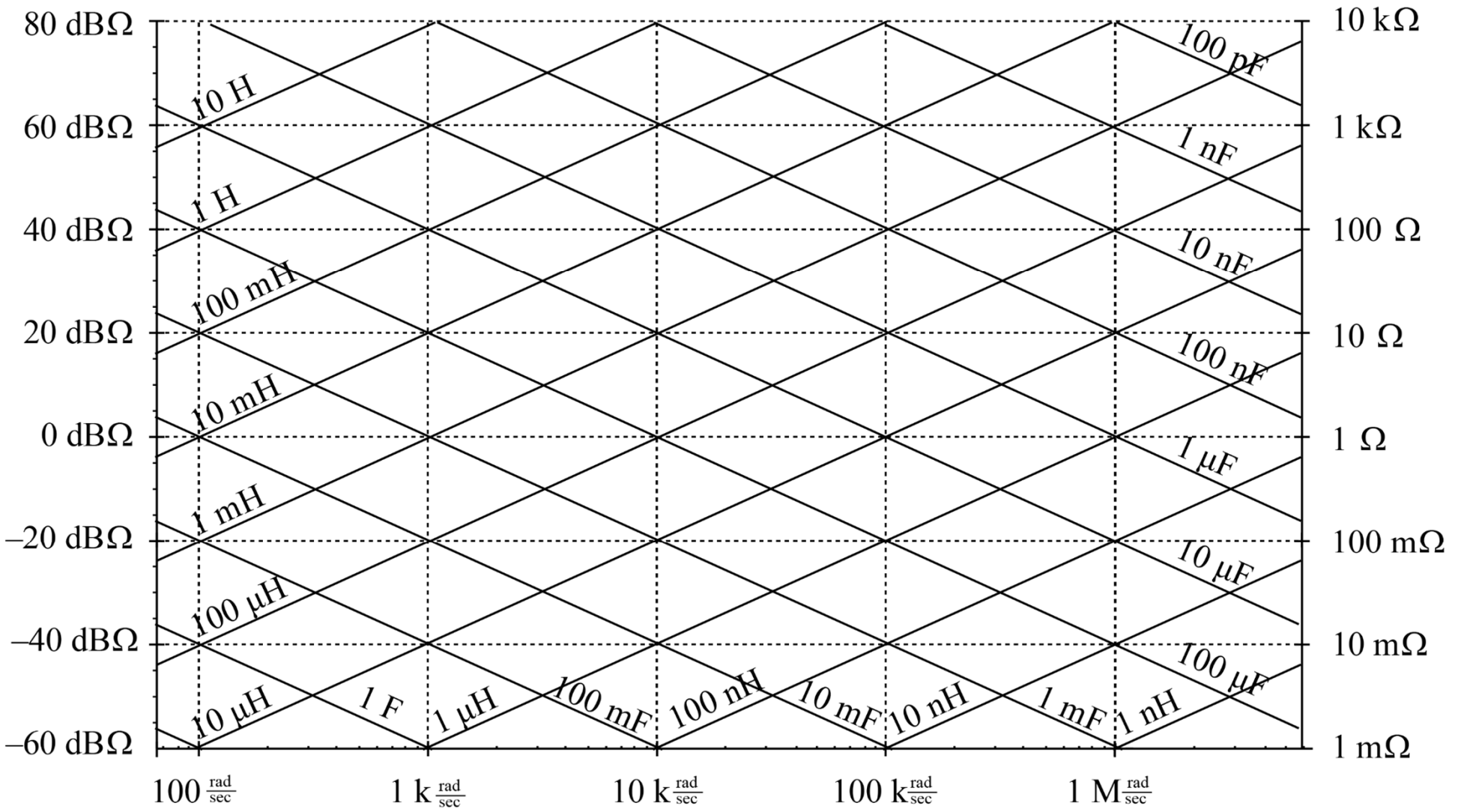
$$G_{g0} = \frac{-D}{D'} = 1.5 \quad \rightarrow \quad \| G_{g0} \|_{\text{dB}} = 3.5\ \text{dBV}$$

Control-to-output Transfer Function



Graphical Construction

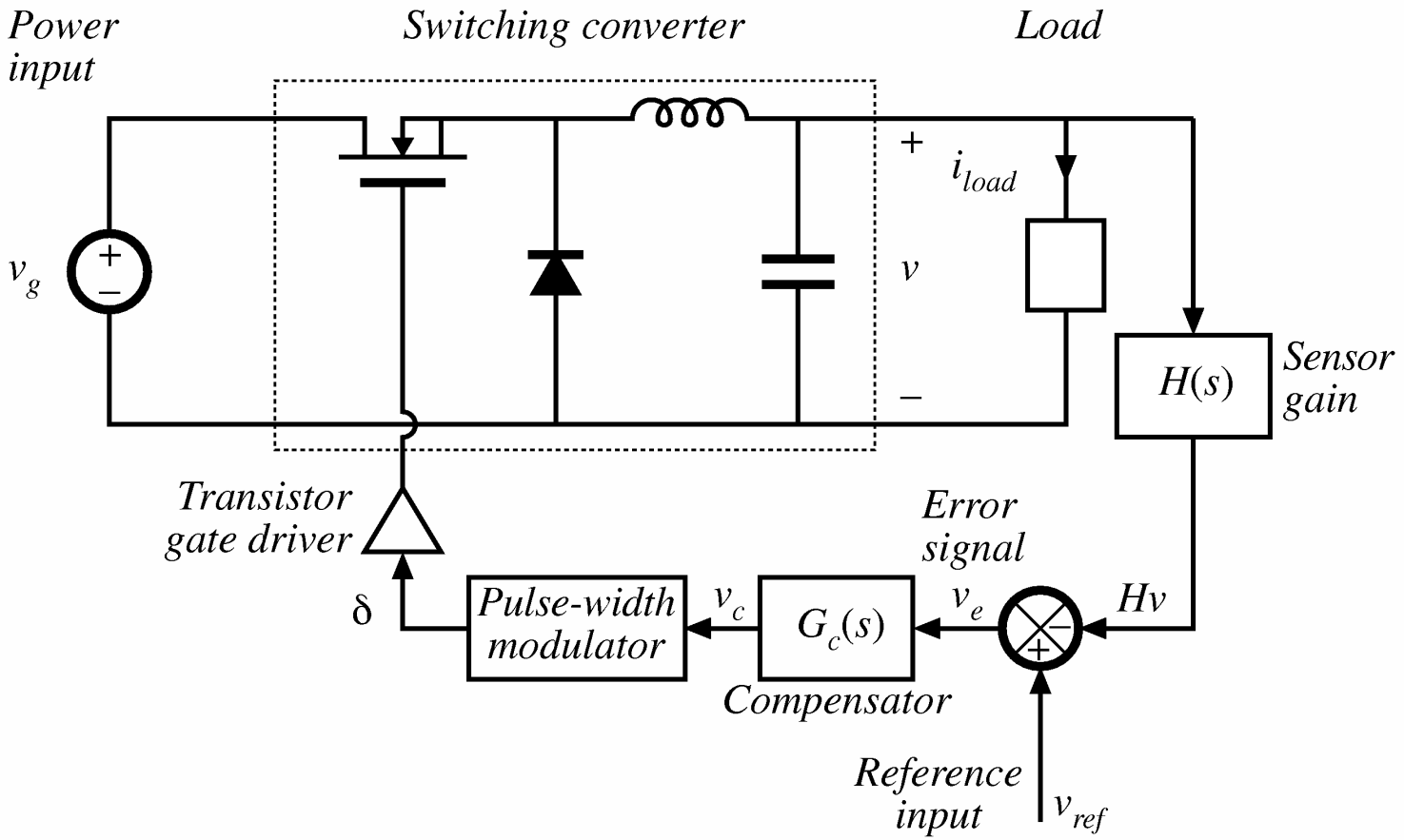
Reactance Paper



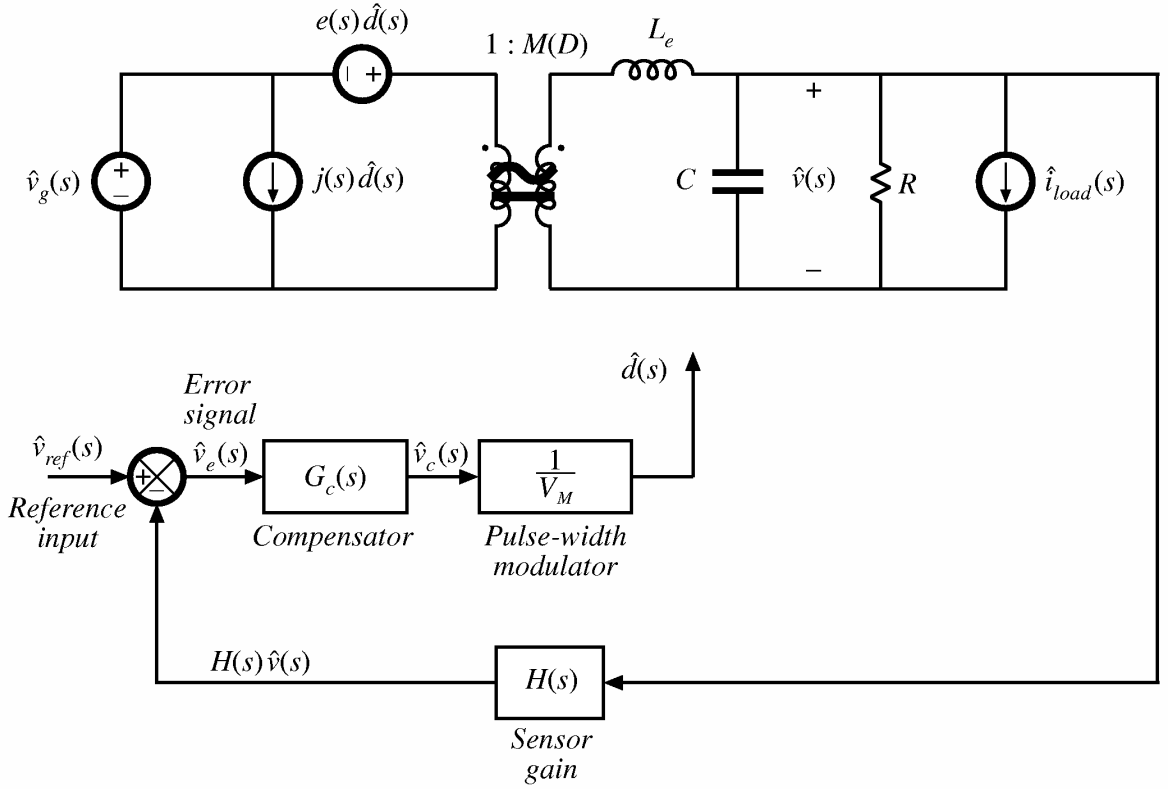
Chapter 9

CONTROLLER DESIGN

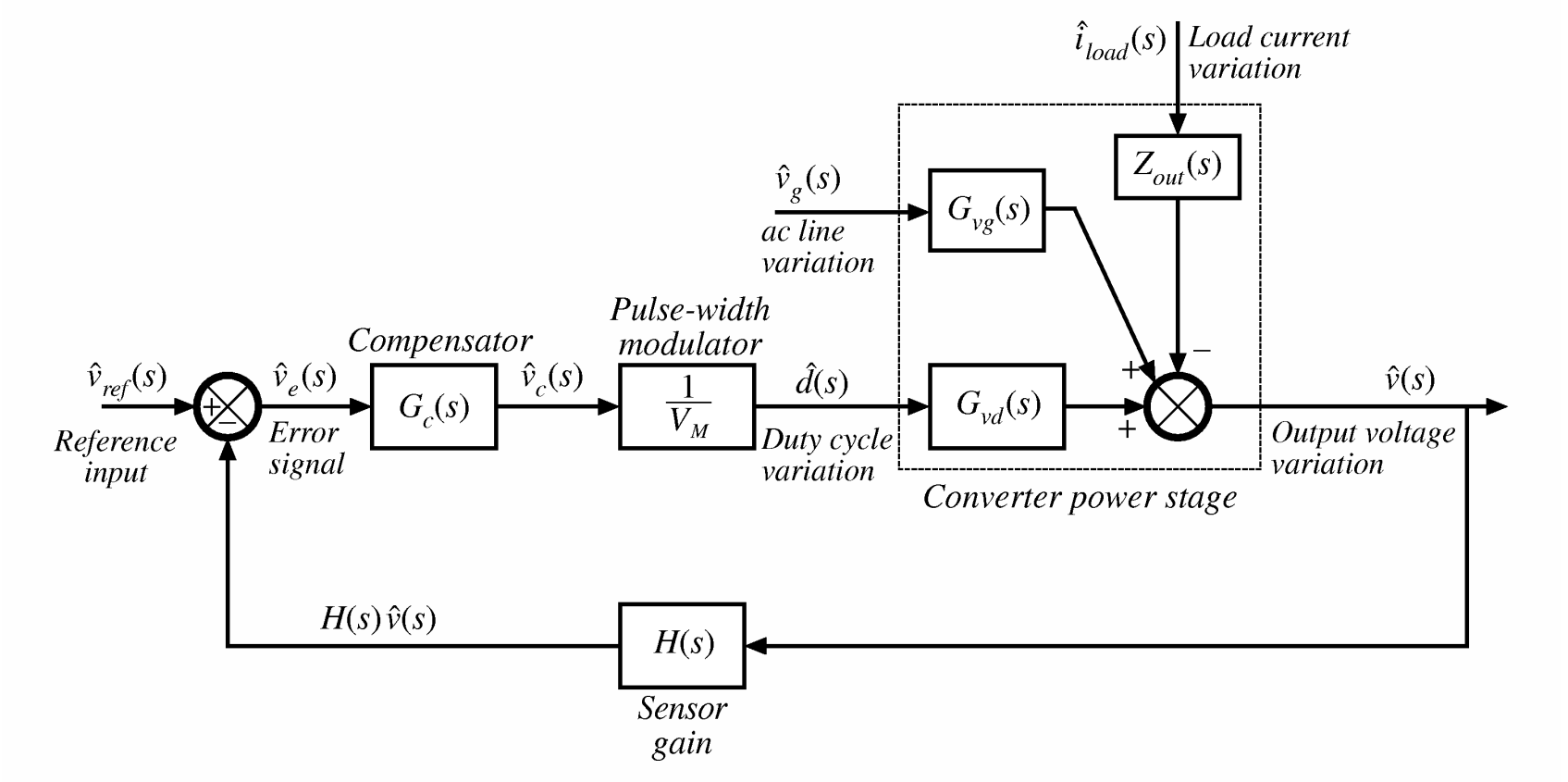
Closed-Loop Regulation



Small-Signal Closed-Loop Model



Block Diagram



Closed-Loop Transfer Functions