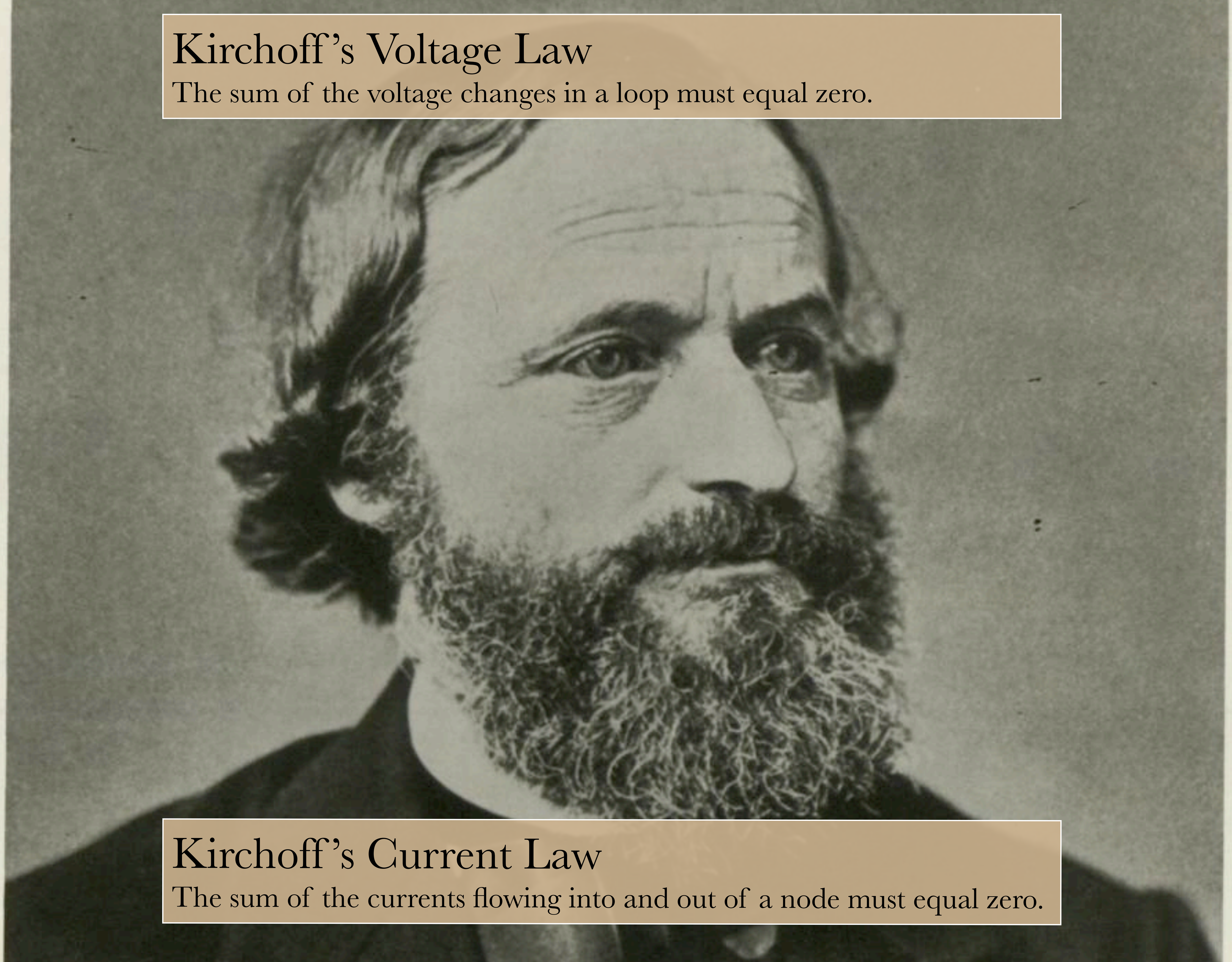
Analysis of Passive Circuits



Kirchoff's Voltage Law

The sum of the voltage changes in a loop must equal zero.

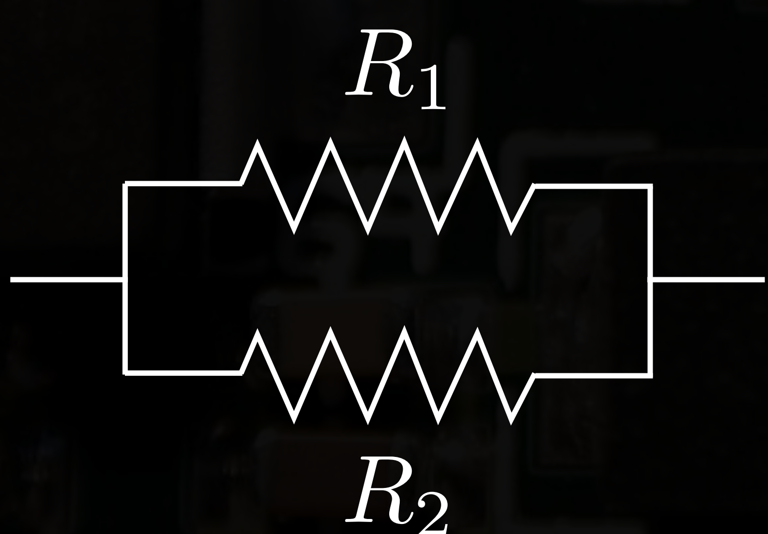
Kirchoff's Current Law

The sum of the currents flowing into and out of a node must equal zero.

series resistors

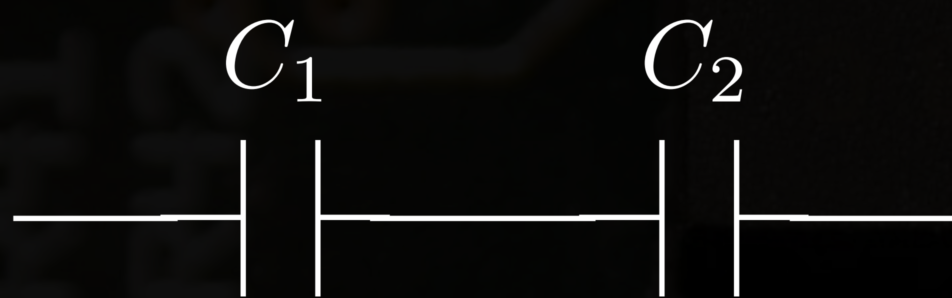
$$R = R_1 + R_2$$

parallel resistors



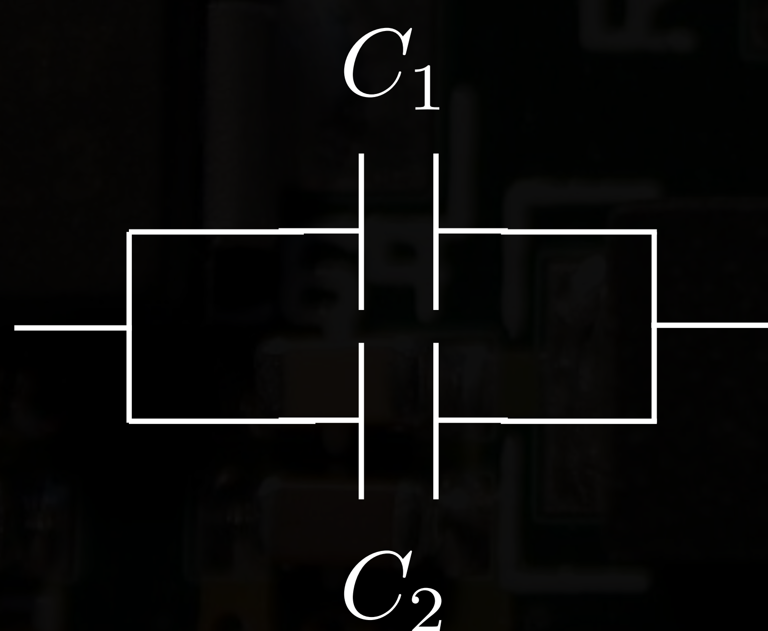
$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{R_1 R_2}{R_1 + R_2}$$

series capacitors



$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}} = \frac{C_1 C_2}{C_1 + C_2}$$

parallel capacitors

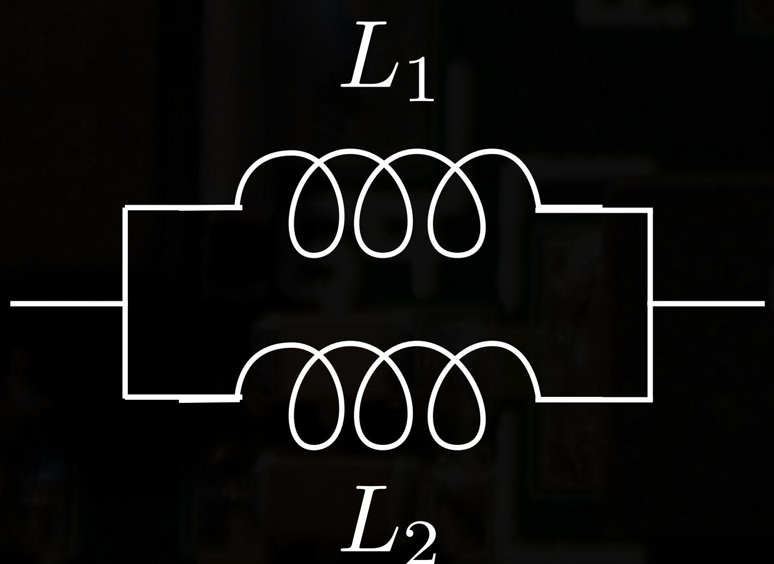


$$C = C_1 + C_2$$

series inductors

$$L = L_1 + L_2$$

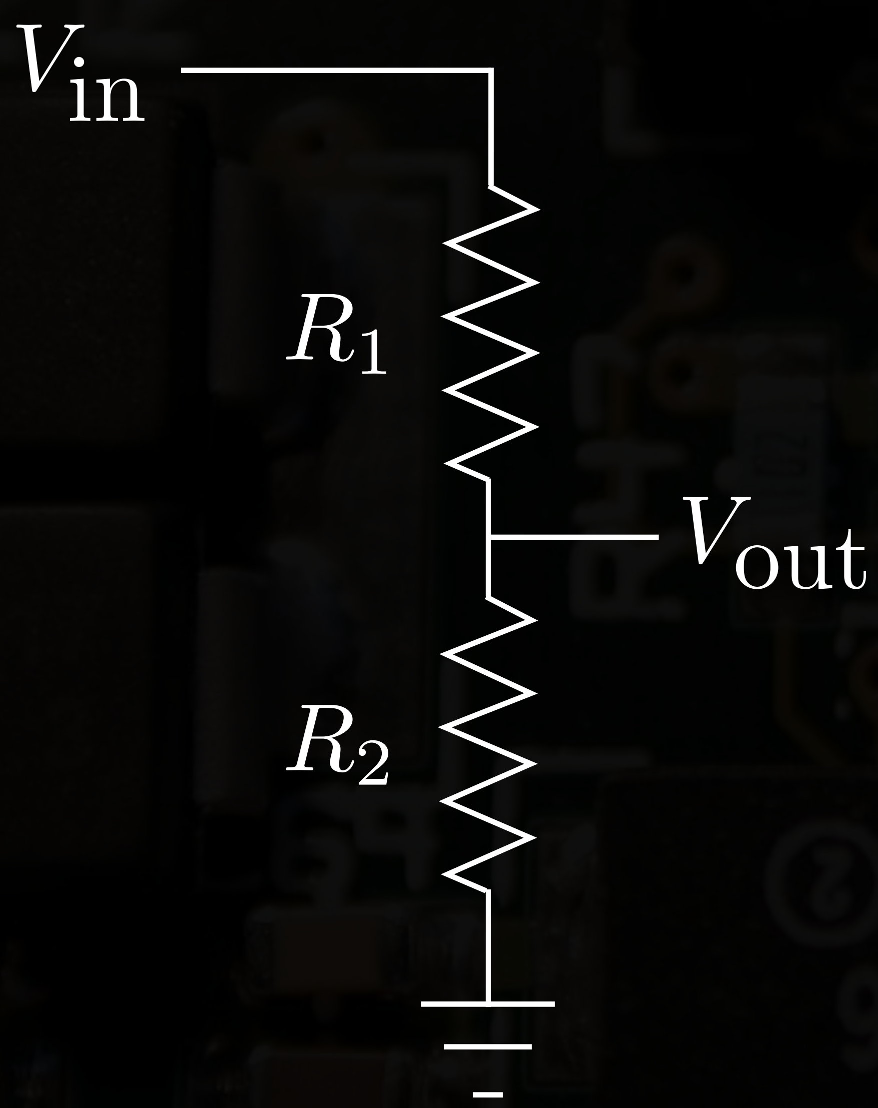
parallel inductors



$$L = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2}} = \frac{L_1 L_2}{L_1 + L_2}$$

Voltage Divider

Passive linear circuit that produces an output voltage that is a fraction of the input voltage.



$$V_{\text{out}} = \frac{R_2}{R_1 + R_2} V_{\text{in}}$$

assuming the output draws NO CURRENT

im•ped•ance |imˈpēdns|

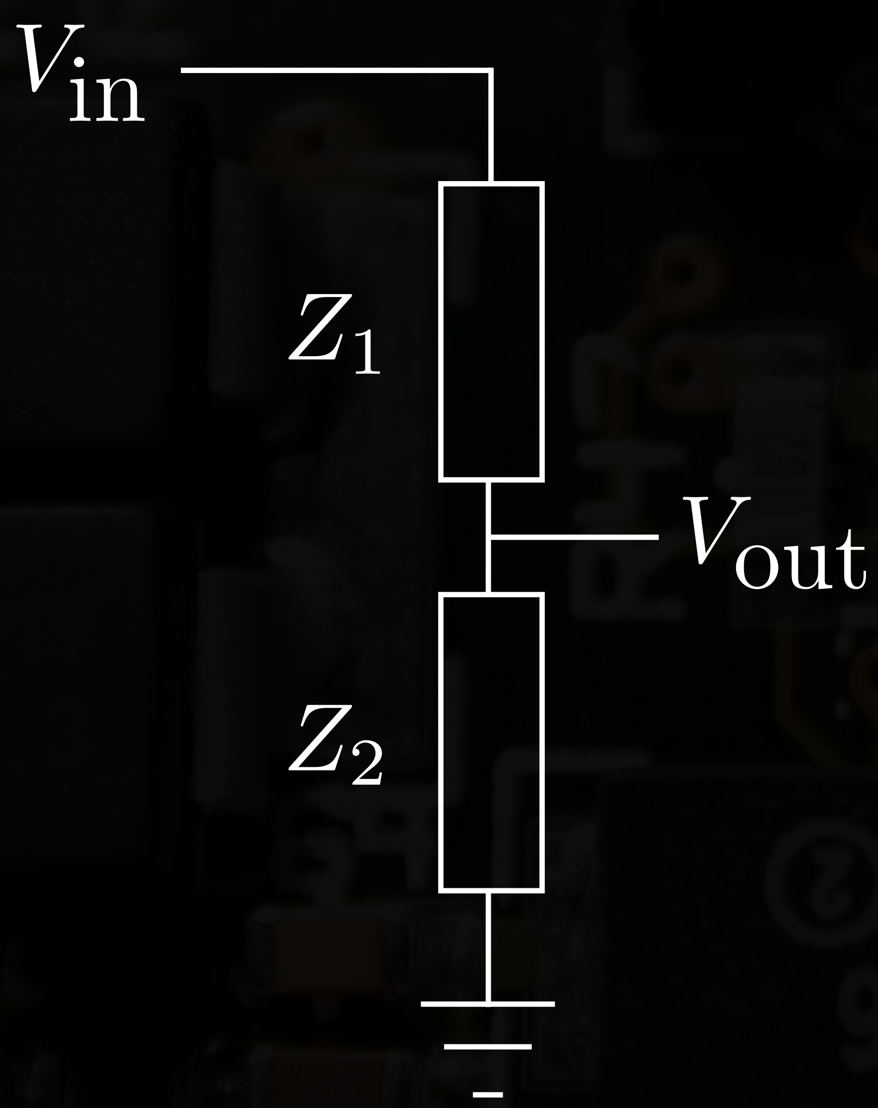
noun

the effective resistance of an electric circuit or component to alternating current, usually expressed as complex quantity Z = R + jX, where R is the resistance, and X is the reactance.

	time-domain	impedance	
resistor	$V = IR$	$Z_R = R$	
inductor	$V(t) = L\frac{dI}{dt}$	$Z_L = j\omega L$	
capacitor	$V(t) = \frac{1}{C}\int_0^t I(\tau)d\tau$	$Z_C = \frac{1}{j\omega C}$	

Voltage Divider

Passive linear circuit that produces an output voltage that is a fraction of the input voltage.

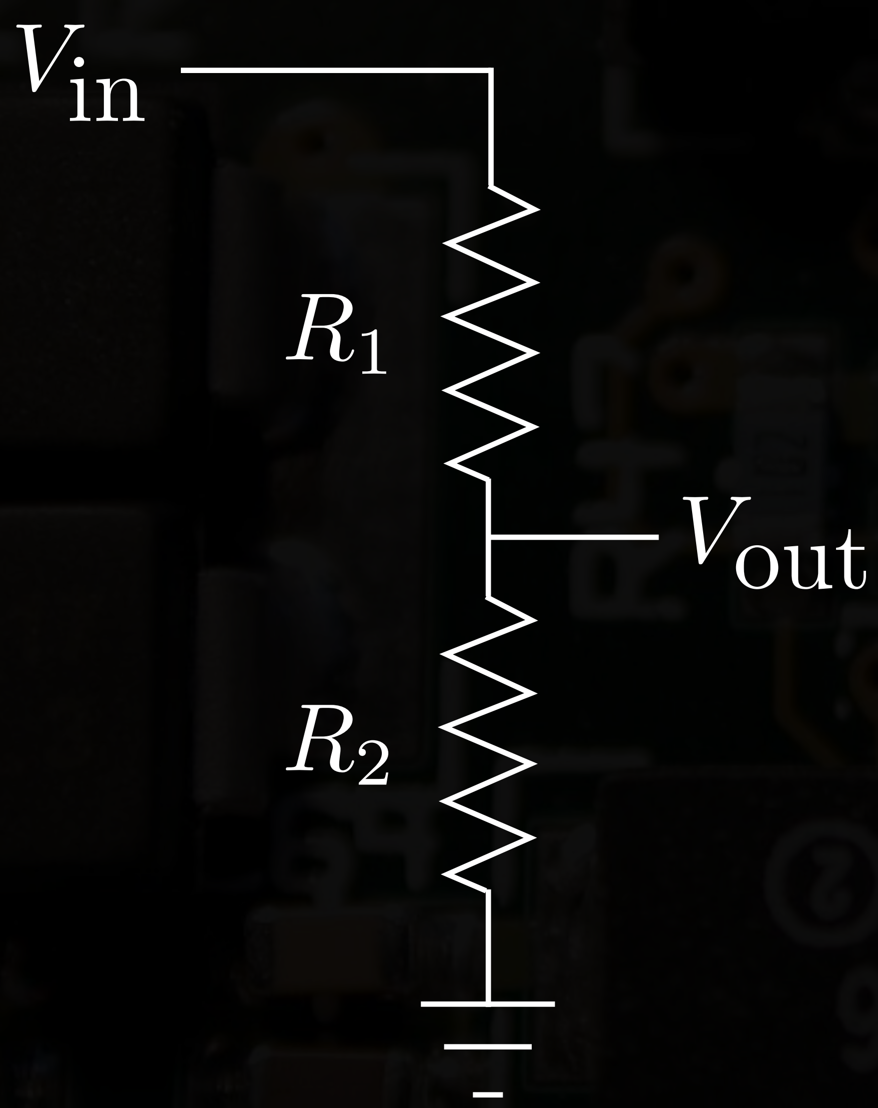


$$V_{\text{out}} = \frac{Z_2}{Z_1 + Z_2} V_{\text{in}}$$

assuming the output draws NO CURRENT

Voltage Divider

A passive linear circuit that produces an output voltage that is a fraction of the input voltage.

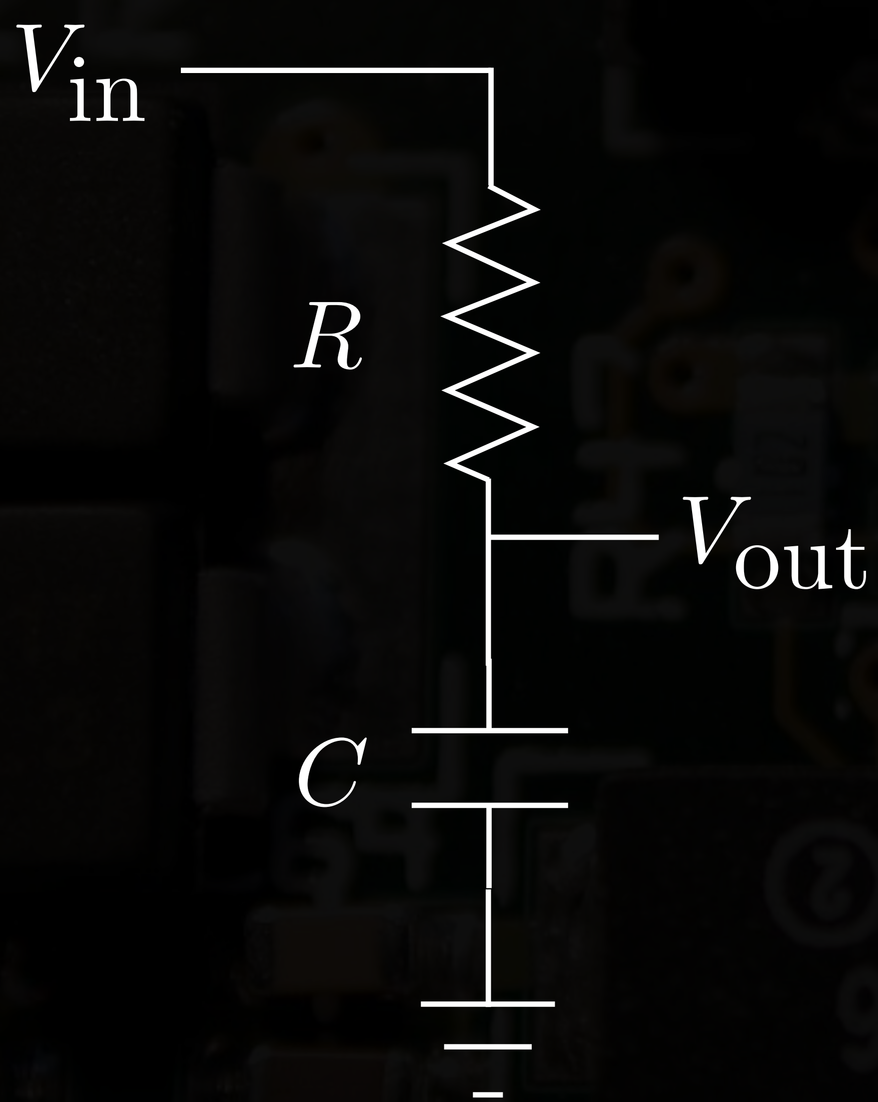


$$V_{\text{out}} = \frac{R_2}{R_1 + R_2} V_{\text{in}}$$

assuming the output draws NO CURRENT

Low-Pass Filter

A circuit in which lower-frequency signals are passed through, while higher-frequency signals are significantly attenuated.



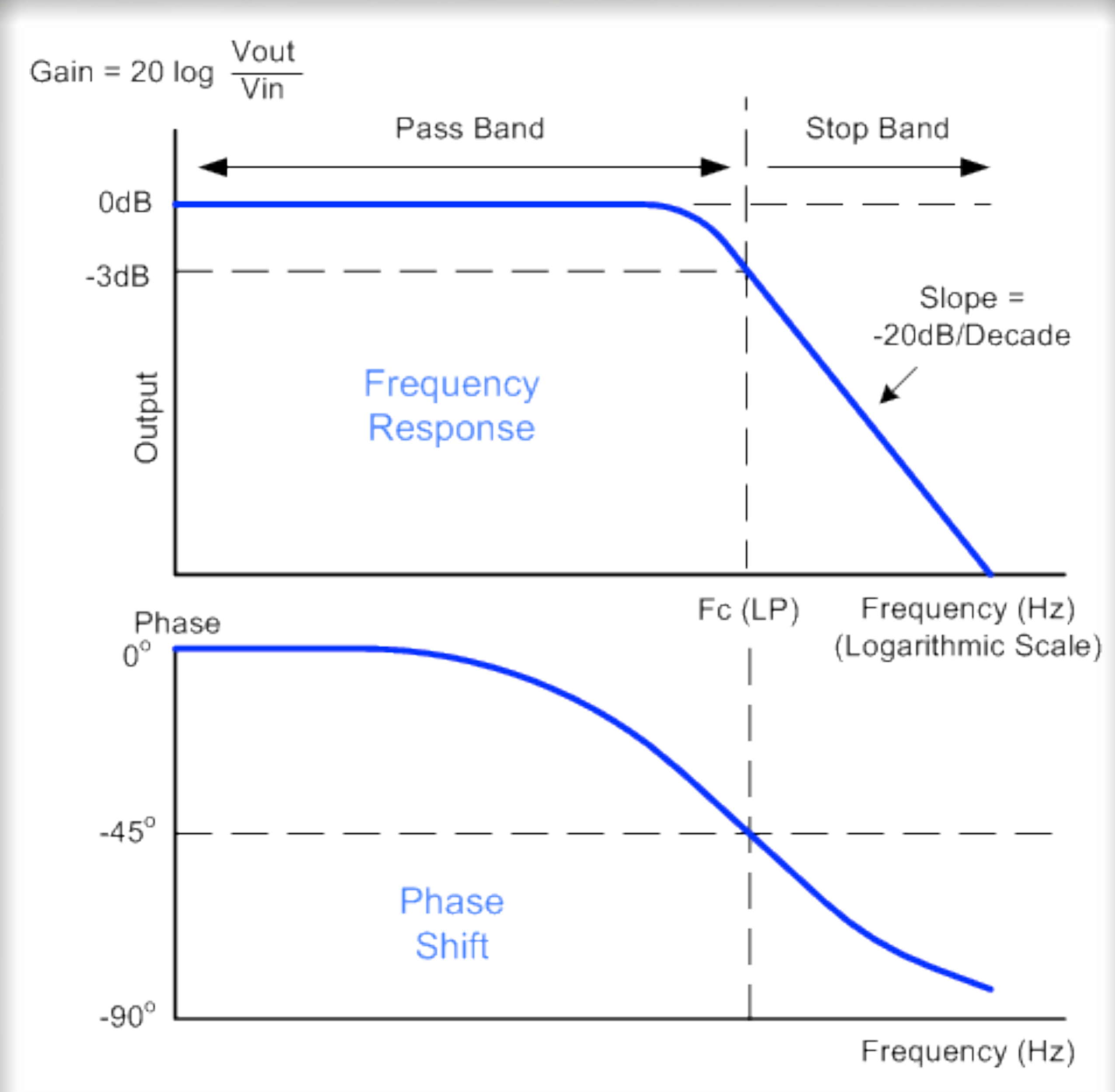
$$V_{out} = \frac{1}{j\omega RC + 1} V_{in}$$

$$\left| \frac{V_{out}}{V_{in}} \right| = \frac{1}{\sqrt{1 + (\omega RC)^2}}$$

assuming the output draws NO CURRENT

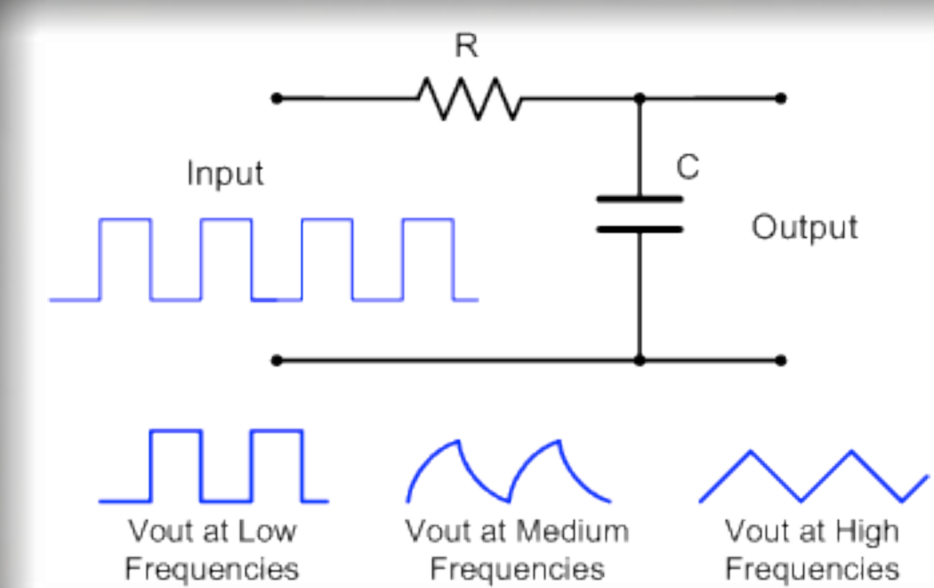
Low-Pass Filter

A circuit in which lower-frequency signals are passed through, while higher-frequency signals are significantly attenuated.



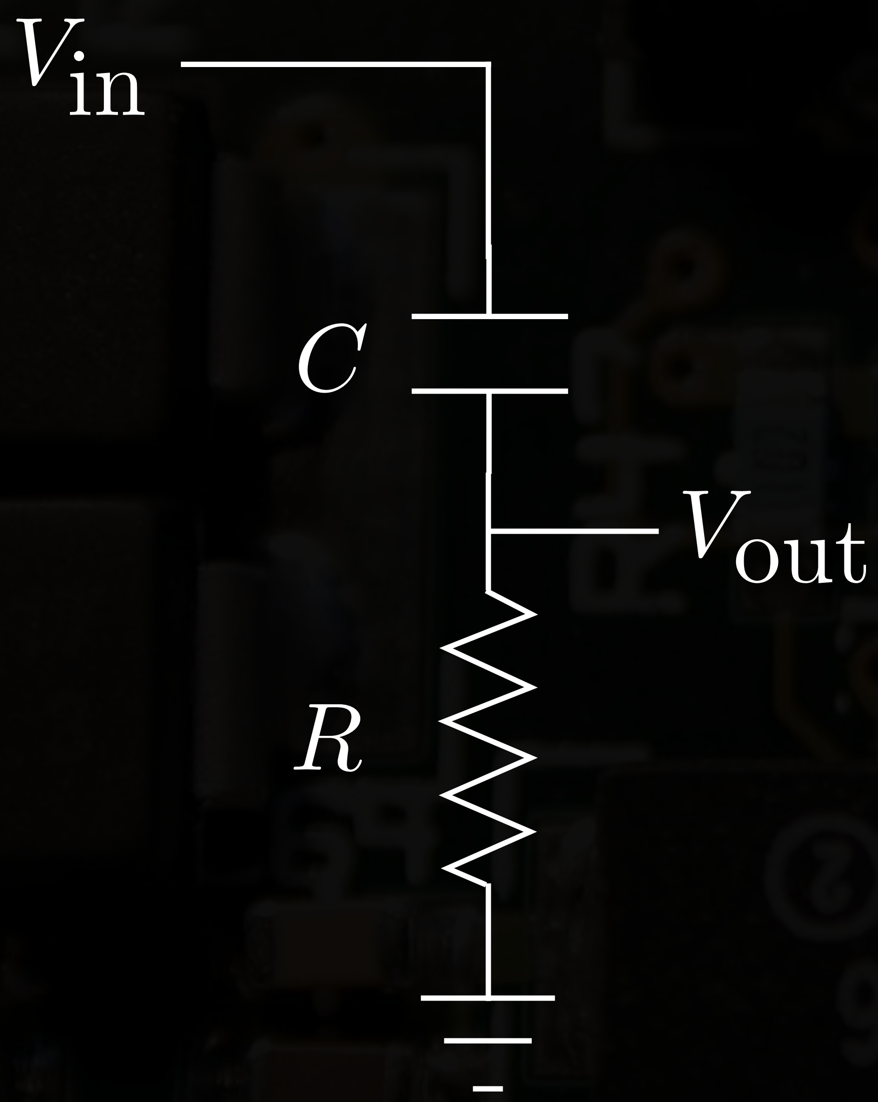
-3dB cutoff frequency at:

$$f_c = \frac{1}{2\pi RC}\ (\mathrm{Hz})$$



High-Pass Filter

a circuit in which higher-frequency signals are passed through, while lower-frequency signals are significantly attenuated.



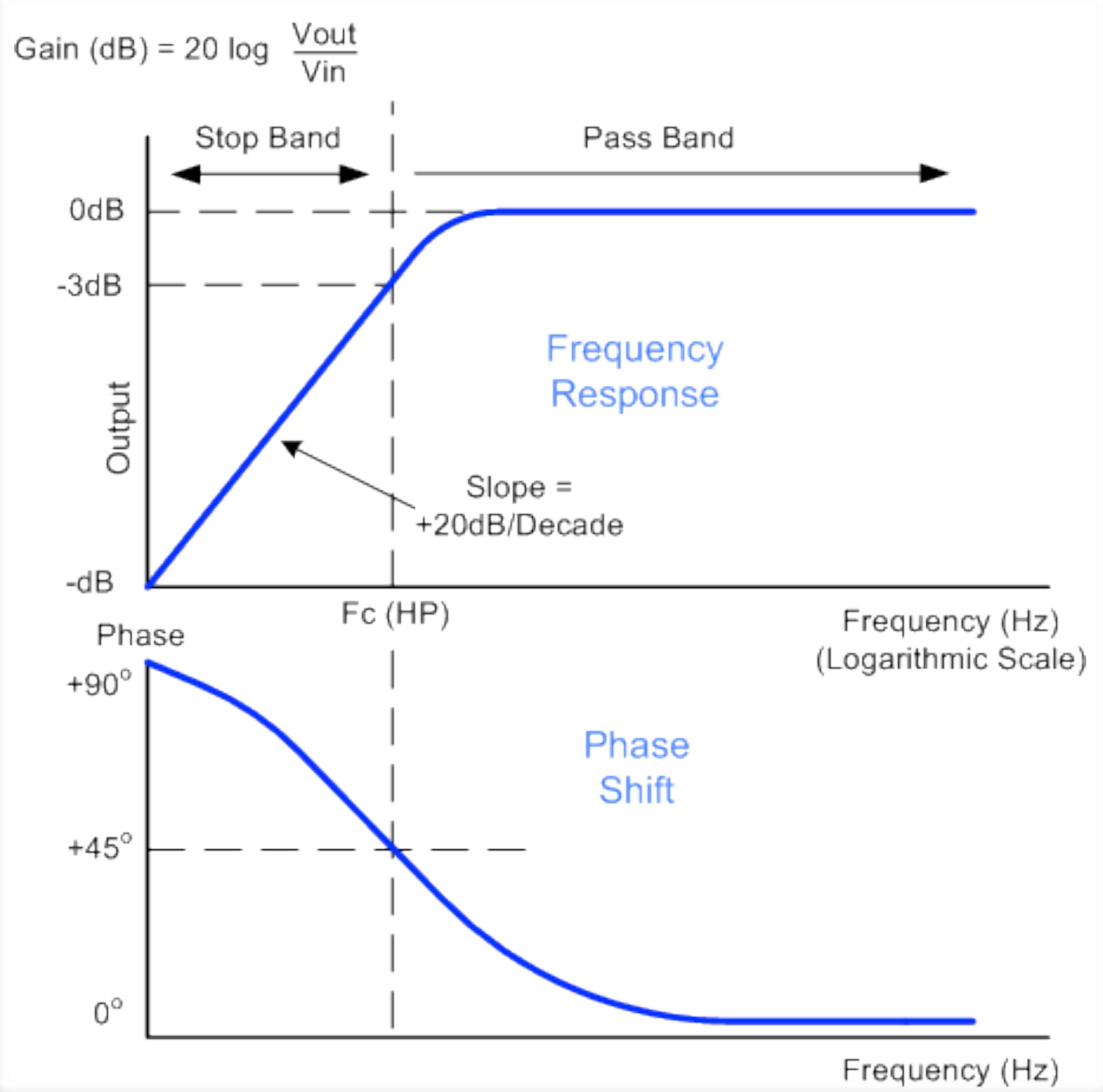
$$V_{\text{out}} = \frac{j\omega RC}{j\omega RC + 1} V_{\text{in}}$$

$$\left| \frac{V_{\text{out}}}{V_{\text{in}}} \right| = \frac{\omega RC}{\sqrt{1 + (\omega RC)^2}}$$

assuming the output draws NO CURRENT

High-Pass Filter

a circuit in which higher-frequency signals are passed through, while lower-frequency signals are significantly attenuated.



-3dB cutoff frequency at:

$$f_c = \frac{1}{2\pi RC} \text{ (Hz)}$$