

EE160 Lab Assignment-4

Lab section 1A

Power Factor Correction in Electrical Power System

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Objectives: Design and simulate a circuit in Simulink with an AC source connected to a series RLC branch and a series RLC load, and then convert the series RLC branch and RLC load to RL components for analysis.

Parameters for Circuit 1 (No Parallel capacitor):

Input voltage = 220V

Frequency = 50Hz

Series RL branch-

$R = 1 \, \Omega$

$L = 10^{-3} \, \text{H}$

Series RL Load-

Block Parameters: Series RLC Load

Series RLC Load (mask) (link)

Implements a series RLC load.

Parameters Load Flow

Nominal voltage Vn (Vrms): 155.6

Nominal frequency fn (Hz): 50

Active power P (W): 200

Inductive reactive power QL (positive var): 200

Capacitive reactive power Qc (negative var): 0

☐ Set the initial capacitor voltage

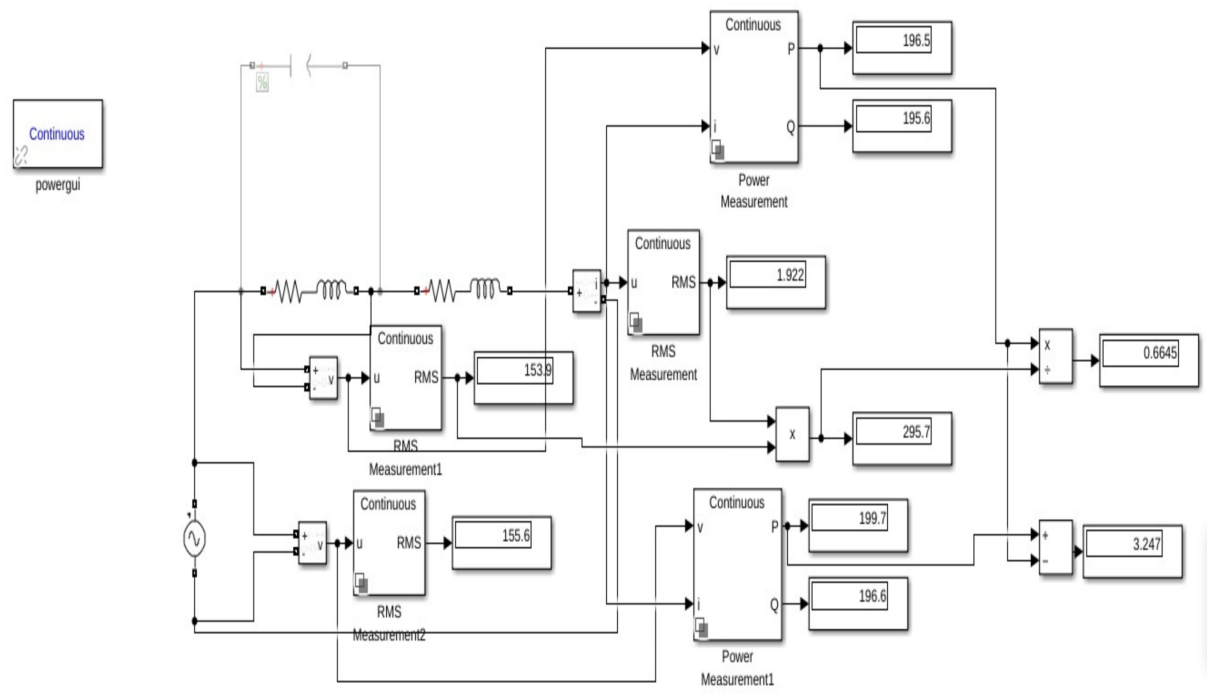
☐ Set the initial inductor current

Measurements: None

Name: CapacitiveP

OK Cancel Help Apply

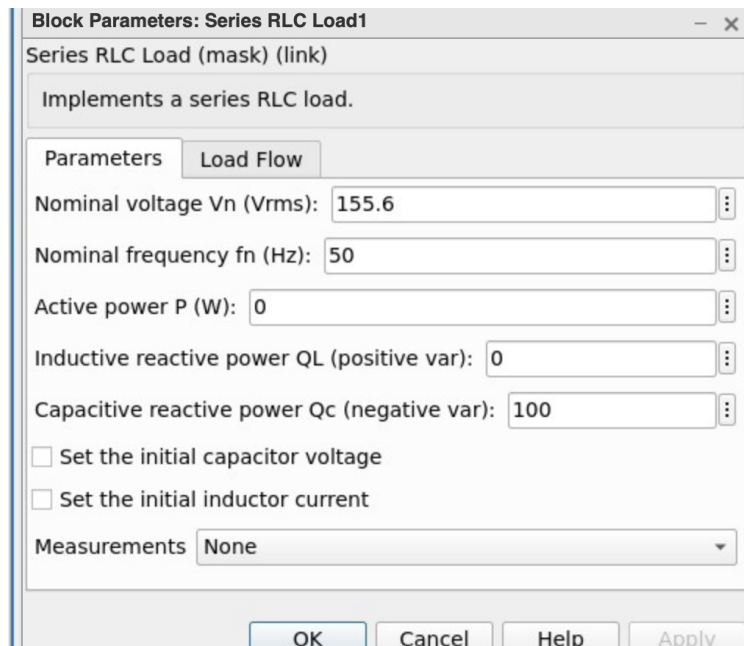
Circuit 1 :



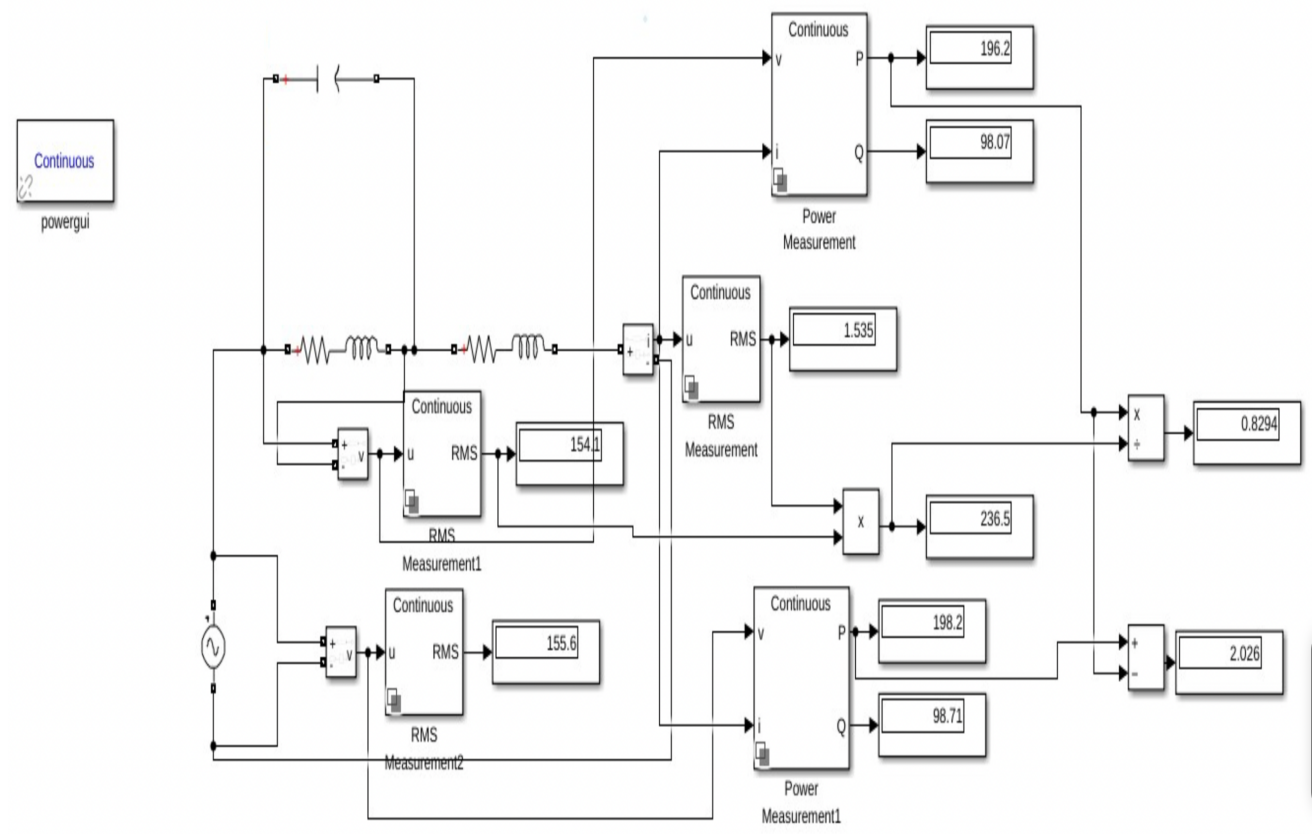
$$\begin{aligned}
 \text{Power Factor} &= \cos\Phi = \text{Real Power} / \text{Apparent Power} \\
 &= \text{Real Power} / (V_{\text{RMS}} \times I_{\text{RMS}}) \\
 &= 0.6645
 \end{aligned}$$

$$\begin{aligned}
 \text{Power Loss (Real Power)} &= \text{Source Power} - \text{Load Power} \\
 &= 3.247 \text{ W}
 \end{aligned}$$

Parameters for Circuit 2 :



Circuit 2:



Power Loss = 2.026 W

Block Parameters: Series RLC Load1 — ×

Series RLC Load (mask) (link)

Implements a series RLC load.

Parameters **Load Flow**

Nominal voltage V_n (Vrms): ⋮

Nominal frequency f_n (Hz): ⋮

Active power P (W): ⋮

Inductive reactive power Q_L (positive var): ⋮

Capacitive reactive power Q_c (negative var): ⋮

☐ Set the initial capacitor voltage

☐ Set the initial inductor current

Measurements None ▼

[illegible]

$$\text{Power Factor} = \cos\Phi = \text{Real Power} / \text{Apparent Power} \\ = 1$$

$$\text{Power Loss} = 1.624 \text{ W}$$

Formula :

$$\text{KVAR (capacitance reactive power in kilo)} = 2\pi f \times C \times V_{\text{RMS}} \times V_{\text{RMS}}$$

$$V_{\text{RMS}} = 154.9 \text{ V}, f = 50 \text{ Hz};$$

Observation (Capacitance and Capacitive load) :

Q_c (Capacitive Reactive Power)	C (Capacitance)	Power Factor
100	1.327×10^{-6}	0.8294
200	2.654×10^{-6}	1

For $Q_c = 200 \text{ VAR}$ and $Q_L = 200 \text{ VAR}$ the load and capacitor compensate for each other's effect and power factor comes out to be 1.

Conclusions:

1. A capacitor can offset the reactive power in the circuit and improve the power factor, thus increasing the efficiency of the system.
2. As reactive power increases, I_{load} increases.
3. When power factor is nearly equal to 1, $C = 11.94 \times 10^{-6} \text{ C}$, Inductive reactive power must be equal to capacitive reactive power.