TERM PROJECT REPORT

B TECH III-Year

Matlab Simulation of a 3 bus radial system

Course: EE304

Group 2

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Aim: **To design a 3 bus radial system with a transformer in between two buses, simulate it in matlab simulink by modeling the T-lines as short T-lines, and load as the static load. Plot the voltage waveforms at every bus of the system.**

Components used:

- Load flow bus
- Three phase series RL branch
- Three phase transformer
- Three phase V-I measurement
- Three phase series RL load(static load)
- Power gui(discrete)
- Triangle generator
- Saturation
- Controlled voltage source

Theory:

In a power system, a radial system refers to a distribution system where power flows from a single source, such as a substation or a power plant, to multiple endpoints, such as residential, commercial, and industrial consumers, through a series of interconnected feeders.

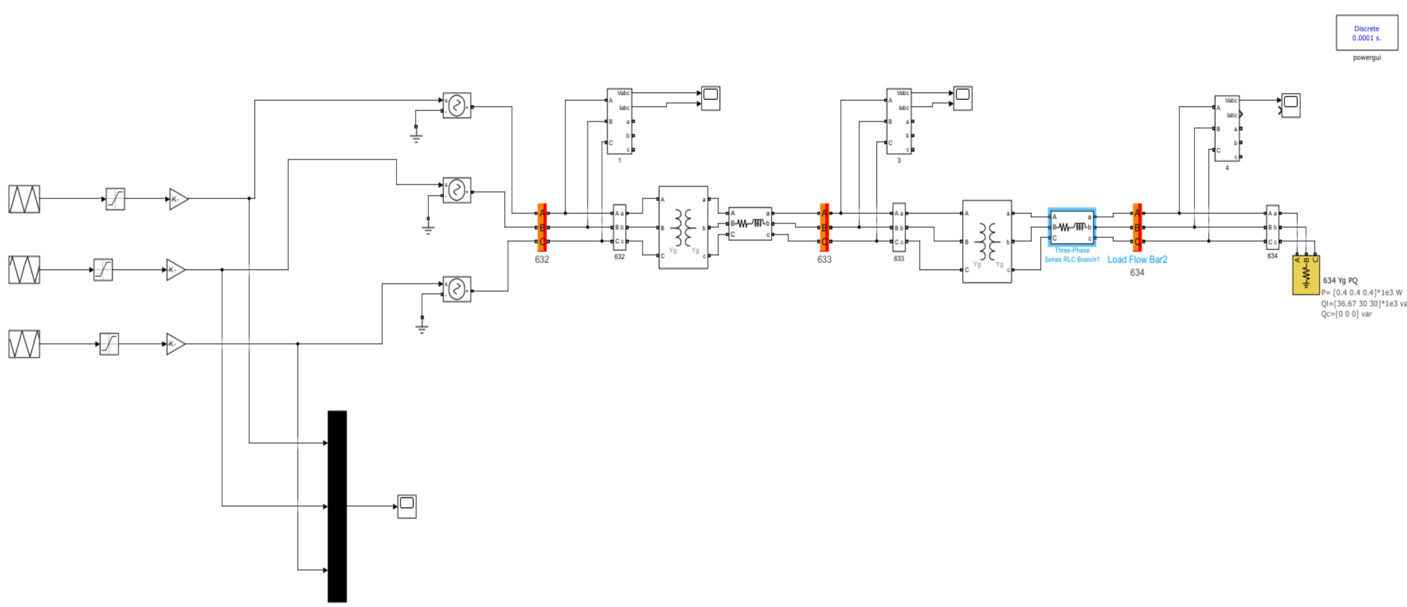
In a radial system, each endpoint is connected to the source through a single feeder, and there are no loops or alternative paths for power to flow. This design simplifies the operation and maintenance of the distribution network, as faults or outages can be easily localized and isolated.

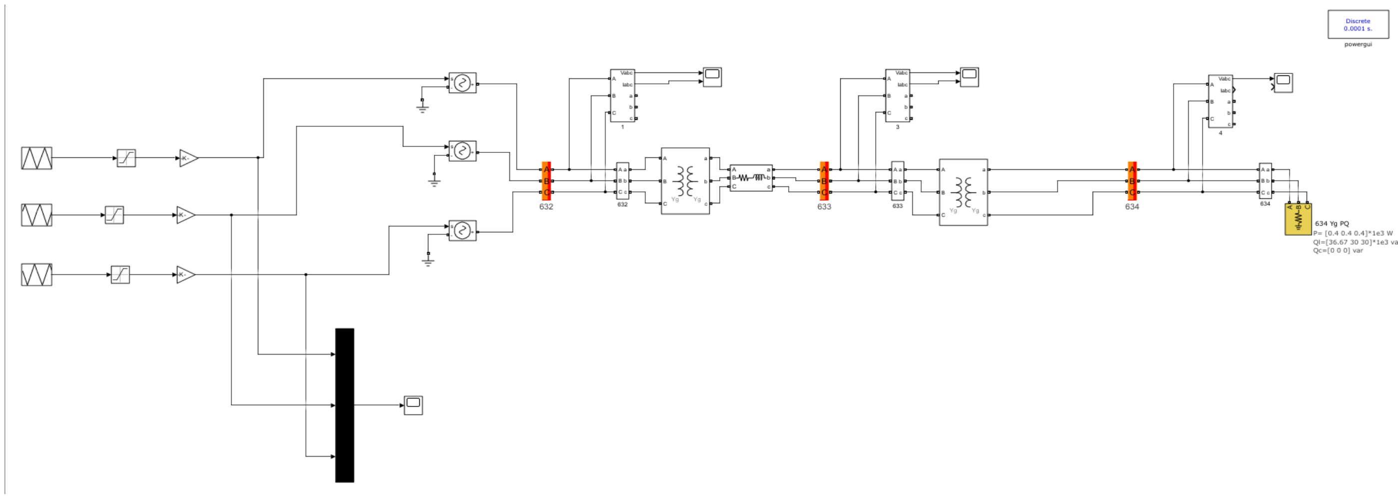
In a radial system, transformers are located at strategic points along the feeders to control the voltage levels and maintain a stable supply of power. For example, a distribution transformer can be installed near the substation to step down the voltage from the transmission level to the distribution level. Then, additional transformers can be placed along the feeders to further step down the voltage to the required level for each endpoint.

Procedure:

- Primarily, we have generated balanced three phase trapezoidal input by using triangle generator, saturaters.
- As we have taken load conditions as static load with power demand is 400W and voltage at load is 120V(RMS).
- In accordance with load conditions we have considered the transformers ratings as T1(170/850V) and T2(850/170V), as we have to take short transmission line(assumed length is 40km) so the parameters we have considered are R=6ohm(R=0.15 ohm/km) and inductance=53mH(L=1.323 mH/km).
- At last, we have provided the generated balanced three phase trapezoidal input to the load bus1 and thereby observed the voltage waveforms at each bus.

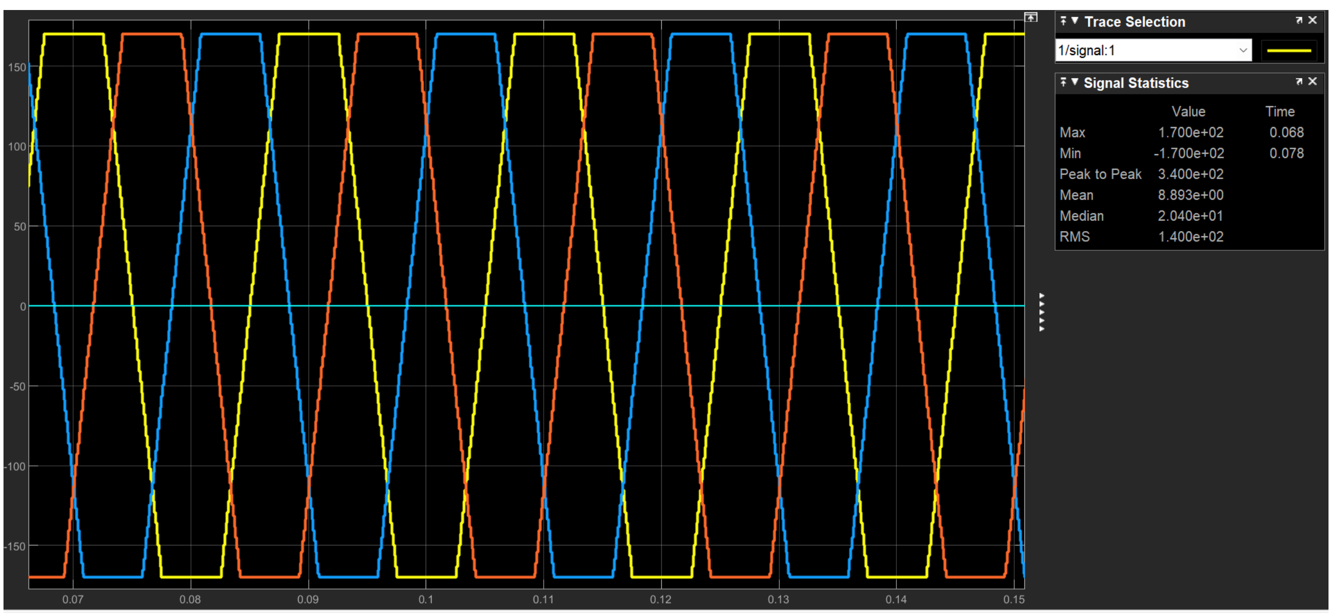
Circuit Diagram:



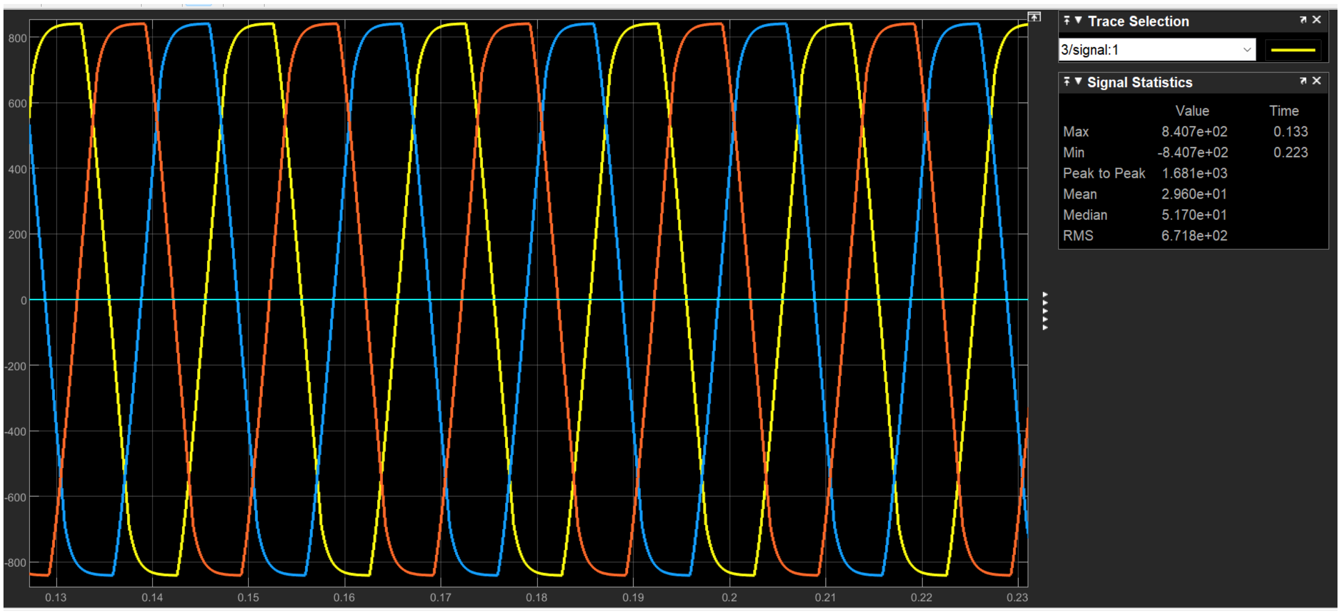


Matlab Simulation Results:

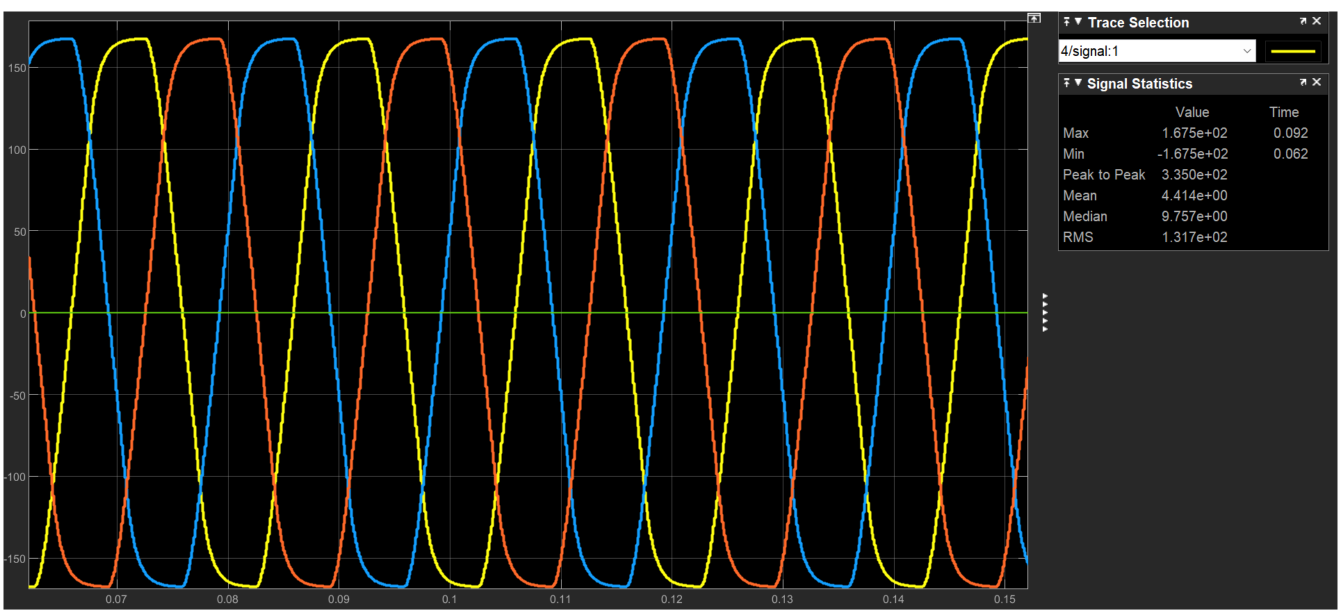
- Voltage at load bus 1



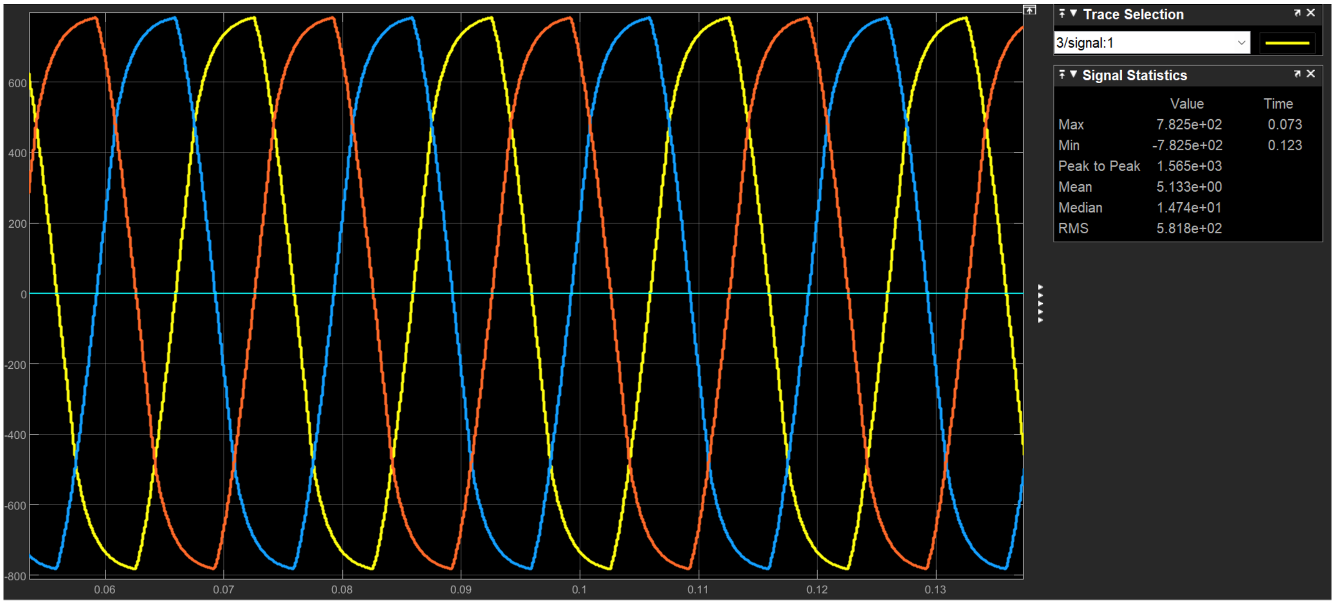
- Voltage at load bus 2



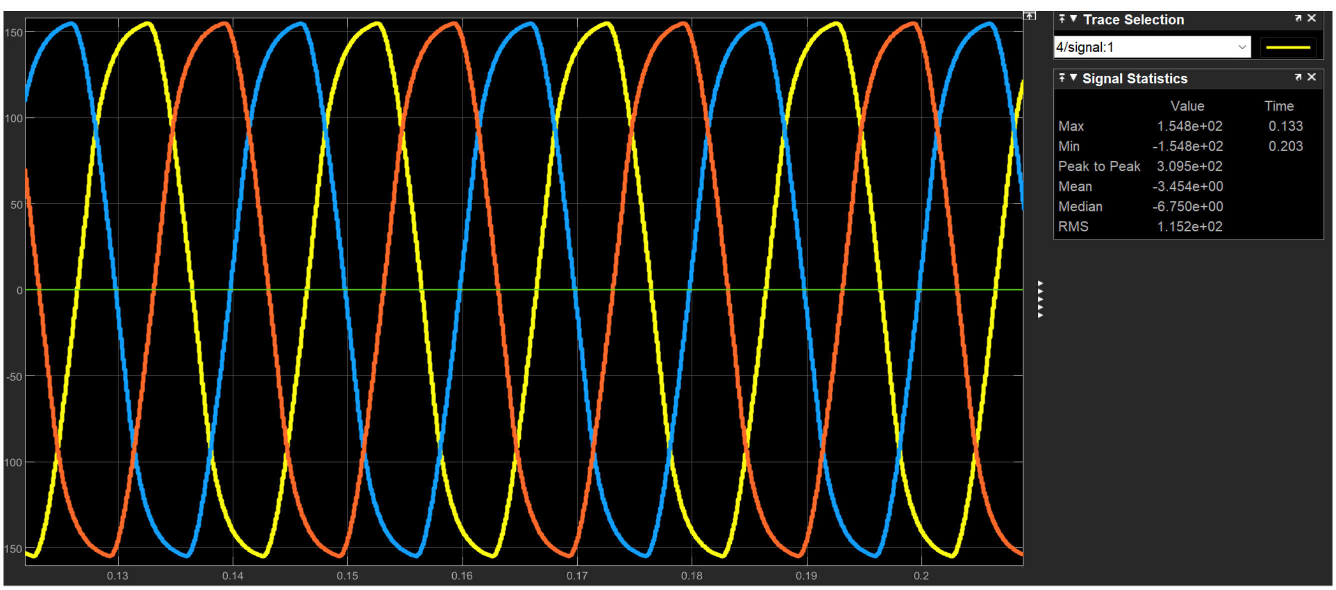
- Voltage at load bus 3(when there is no transmission line between transformer T2 & bus3 and load is 400w)



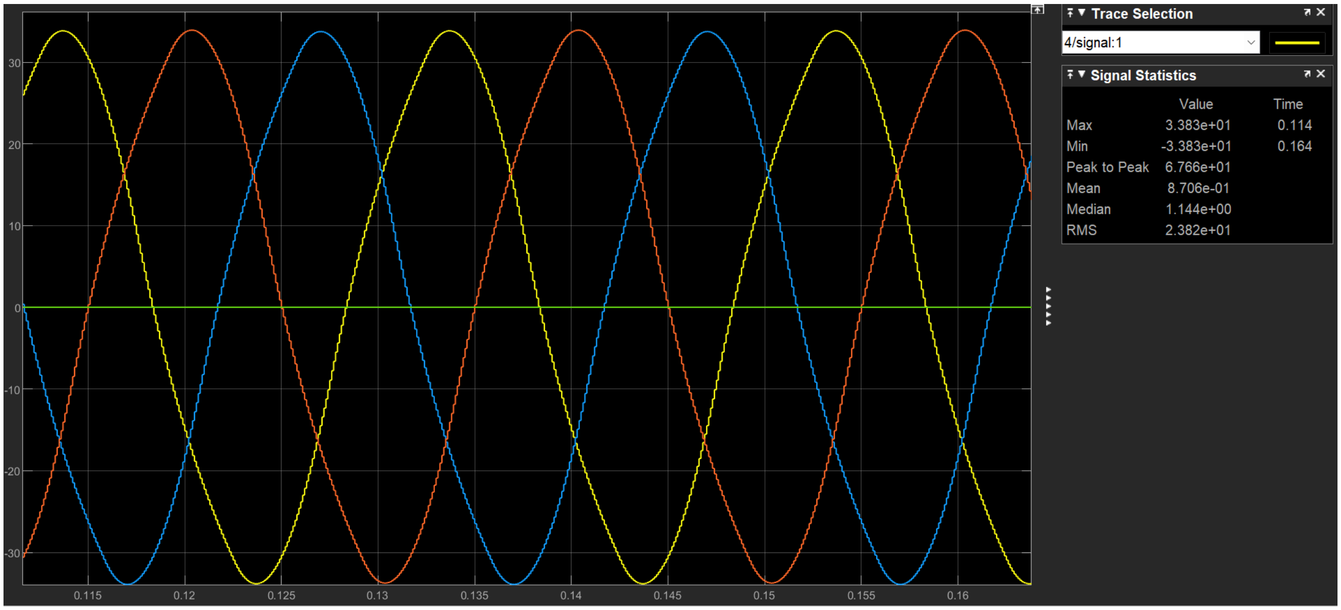
- Voltage at load bus 2(when load is 4000w)



- Voltage at load bus 3(when there is no transmission line between transformer T2 & bus3 and load is 4000w)



- Voltage at load bus 3(when there is a transmission line between transformer T2 & bus3)



Inference:

Since the input we are providing is a balanced three phase trapezoidal waveform, the voltage waveform and the amplitude of that waveform is the same as that of the input waveform(V=170V at bus1). We are using step up and step down transformers as per our need and the transmission line to transfer the power from input to the static load. When we set the static load as P=400W, then we have observed that we haven't got a perfect sine wave but we got the output voltage as 166.4V. whereas if we set the static load as P=4000W, then we have observed that the voltage at load bus is nothing but the three phase balanced sinusoidal wave form(more accurate for higher values of load and voltage at bus3 is 153.2V). This variation in waveforms for different amounts of load is, the waveform at the load bus may approach a sine wave with higher load demand because the impedance of the load is lower at higher power levels. The load impedance affects the shape of the waveform, and a lower load impedance can result in a smoother waveform that approaches a sine wave.One more observation that we have drawn from the simulation is that, when we have inserted a transmission line between bus3 and second transformer the output voltage obtained at bus3 is lesser in magnitude compared to that of without the transmission line, this may be due to resistive losses thus voltage drop takes place across the transmission line and hence the voltage obtained at bus 3 is 33.83V.

Conclusion:

The most important thing is that the trapezoidal input is gradually transforming to sinusoidal output due to the power components like transformers, transmission lines and load used which inherently has inductance and capacitance values that acts as filters in order to remove higher harmonics, so we ponder that it can be quoted as a system that is converting a kind of DC voltage into AC.Trapezoidal waveforms have a higher average value than sinusoidal waveforms with the same peak-to-peak voltage. This means that for the same peak voltage, a trapezoidal waveform can deliver more power to a load than a sinusoidal waveform, resulting in higher efficiency.

Overall, the simulation of a radial power system using a trapezoidal input waveform can be a useful tool for evaluating and optimizing the performance of the system, and can provide valuable insights for system designers, engineers, and researchers.