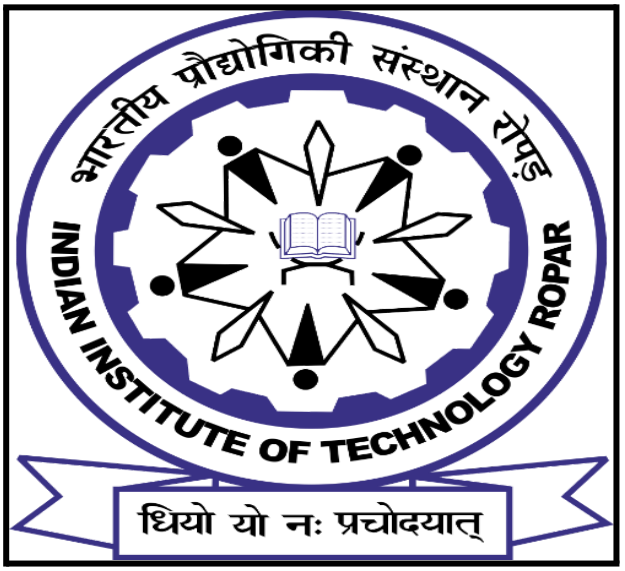
Department of Electrical Engineering

IIT Ropar

EE310-Term Project



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1) Problem statement:

Take a 3 bus radial system, with a transformer in between every two buses. SImulate it inPSCAD. Model the T-lines as short T-lines, and load as the static load. Provide a periodic input of trapezoidal shape at the first bus, and plot the voltage waveforms at every bus of the system.

2)Introduction: Transformers and transmission lines are present in 3 Bus Systems. A three-phase transformer typically performs the role of a transmission line transformer. In a three-phase power system, the transmission lines that carry the three-phase AC power are also three-phase, as are the transformers used to step up or step down the voltage of the power. In a three-bus system with a transformer, one of the load buses may be connected to the other load bus. The transformer allows for voltage transformation and isolation between the two buses. We will input a trapezoidal waveform on bus 1 and attached static load on the other buses in accordance with our project. and obtain the output current and voltage waveforms for each bus.

3)Theory: Transformers and transmission lines are present in 3 Bus Systems. A three-phase transformer typically performs the role of a transmission line transformer. In a three-phase power system, the transmission lines that carry the three-phase AC power are also three-phase, as are the transformers used to step up or step down the voltage of the power. In a three-bus system with a transformer, one of the load buses may be connected to the other load bus. The transformer allows for voltage transformation and isolation between the two buses. We will input a trapezoidal waveform on bus 1 and attached static load on the other buses in accordance with our project. and obtain the output current and voltage waveforms for each bus. It will be easier to assess the system's reaction to a non-sinusoidal waveform, which is frequently present in real-world systems, with the periodic input of trapezoidal shape. Overall, this project will provide valuable insights into the behavior of power systems.

4)Circuit diagram:

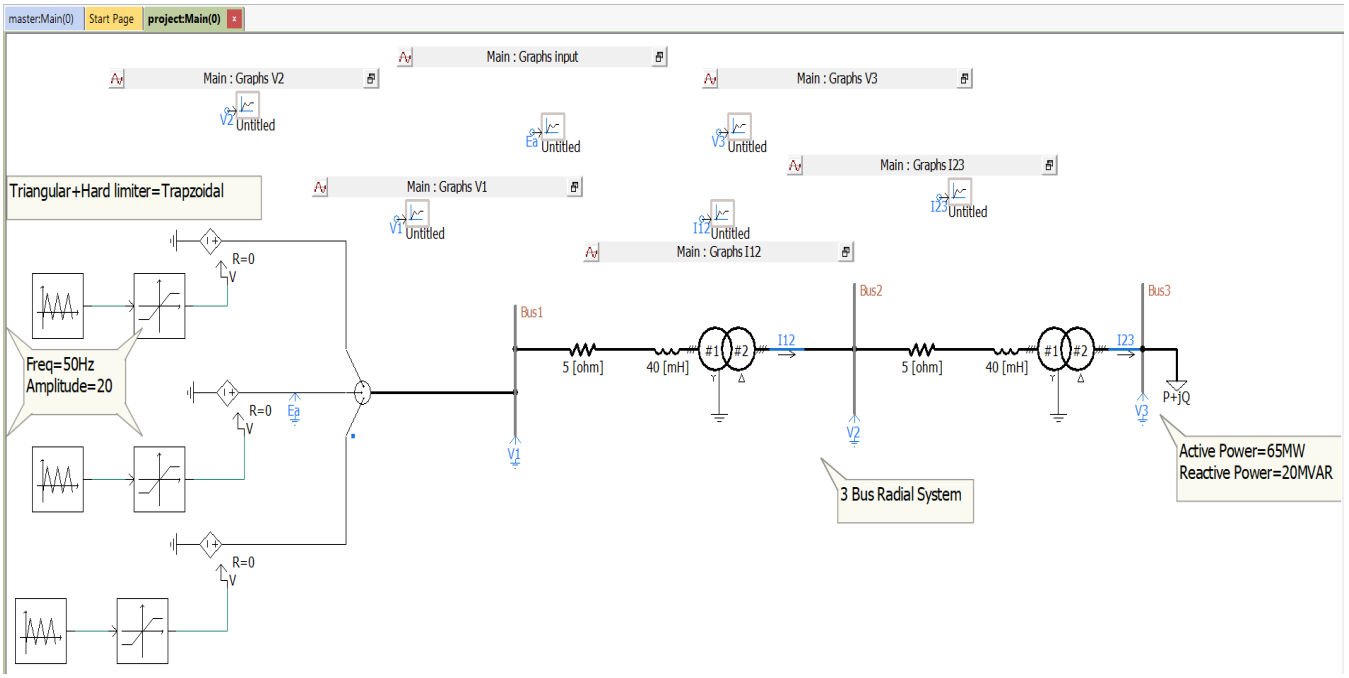
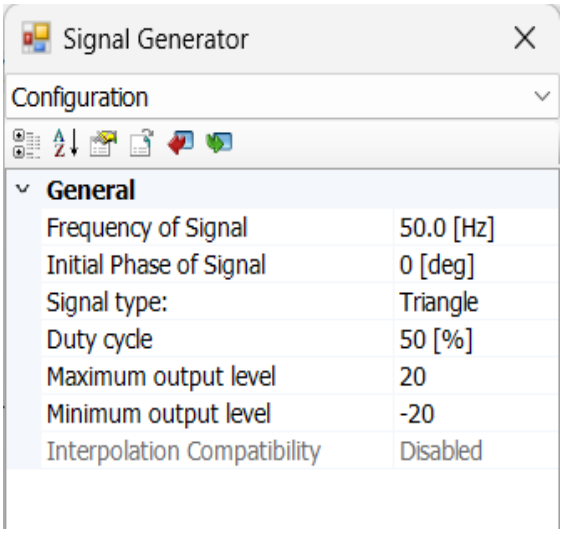
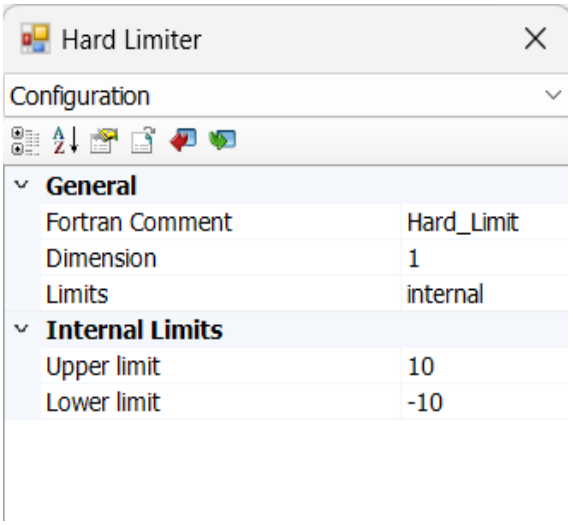


Fig: Circuit diagram of a radial 3 bus system in PSCAD

5)Component Parameters:





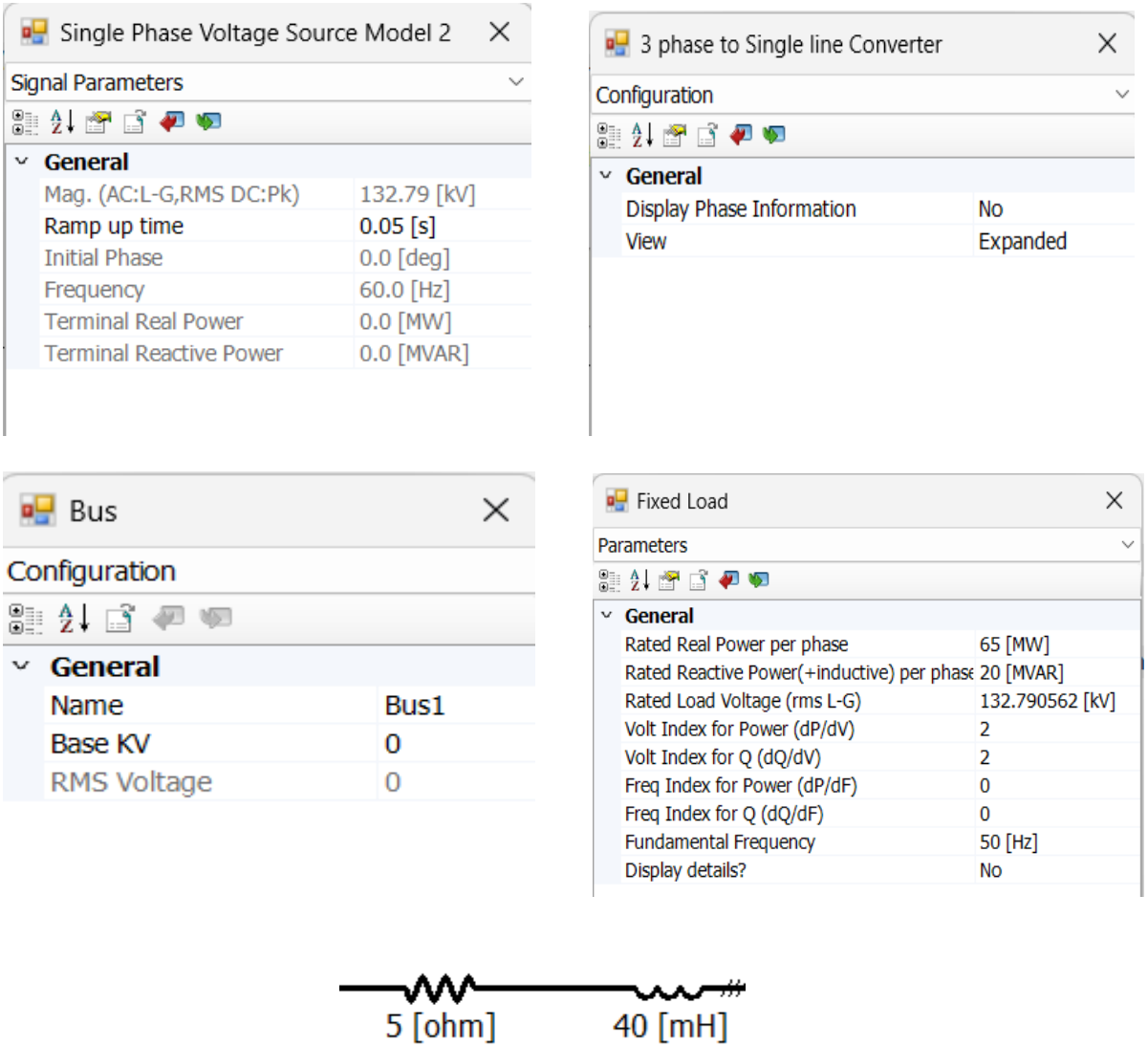


Fig: Transmission Line parameter

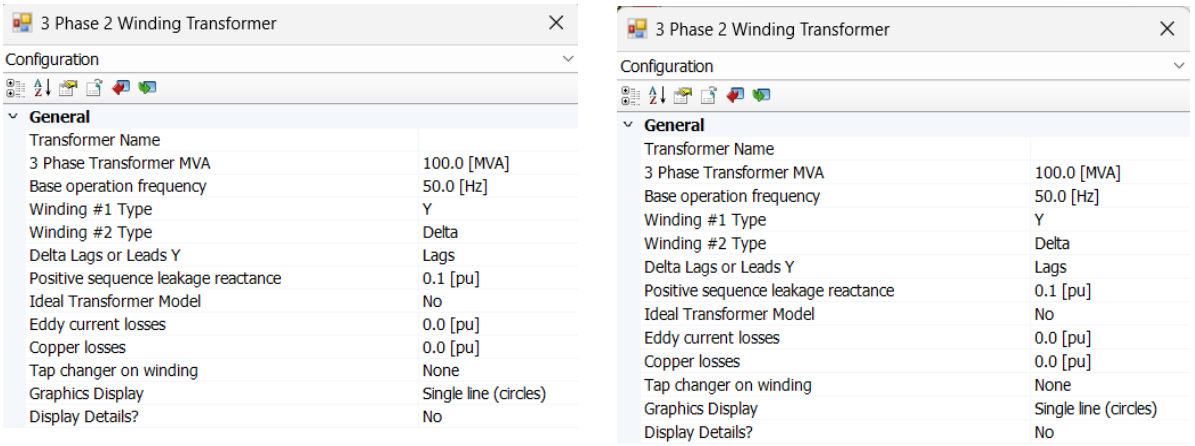


Fig:Transformer parameter

6)Waveforms:

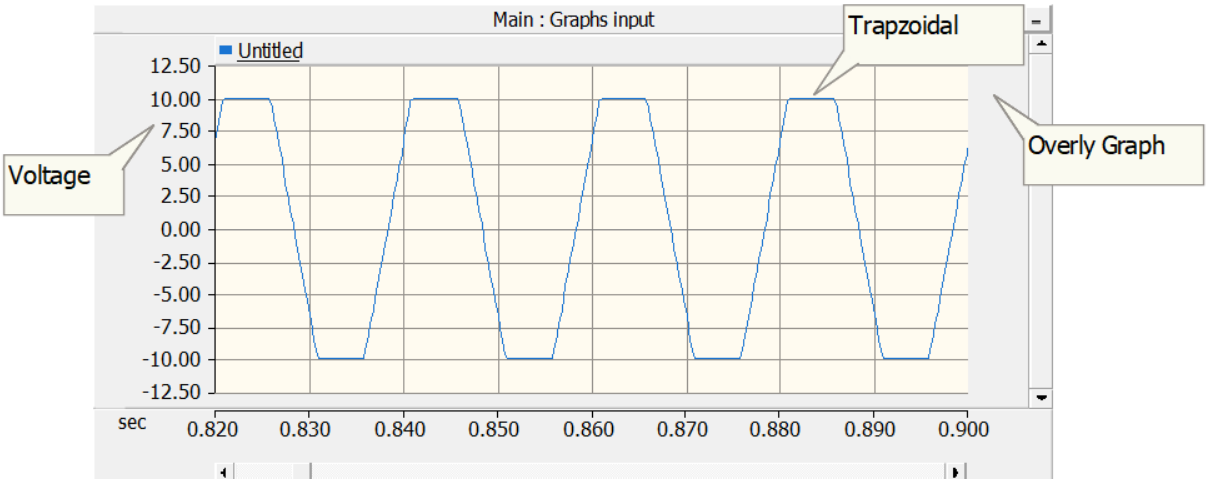


Fig:input Waveform of 3 bus system at bus 1

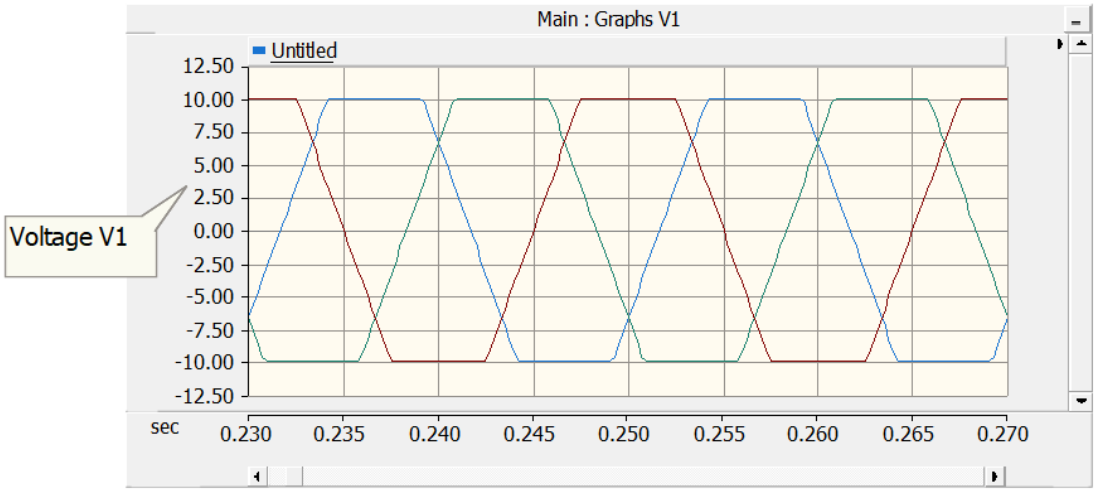


Fig:Waveform of V1 at bus1

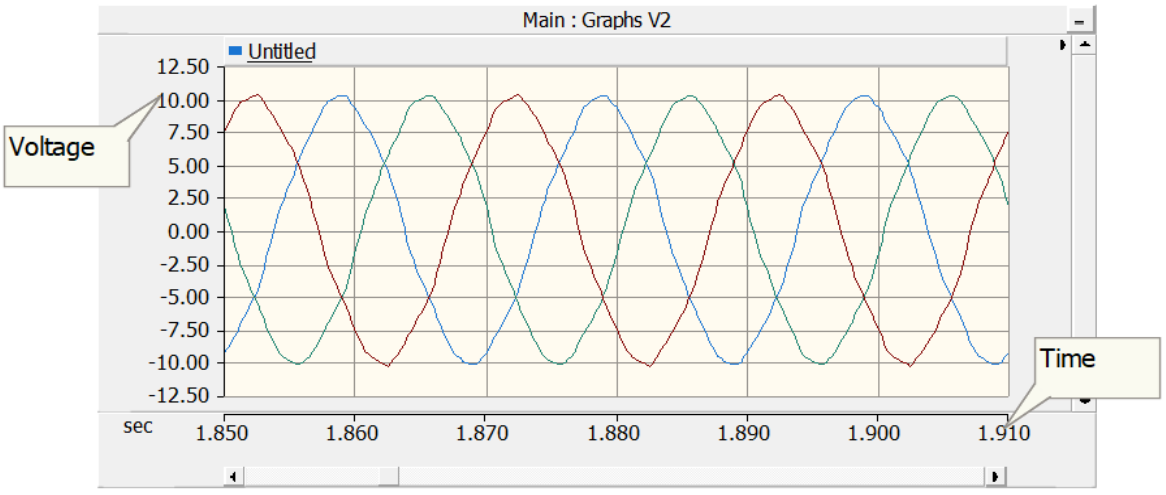


Fig:Waveform of V2 at bus2

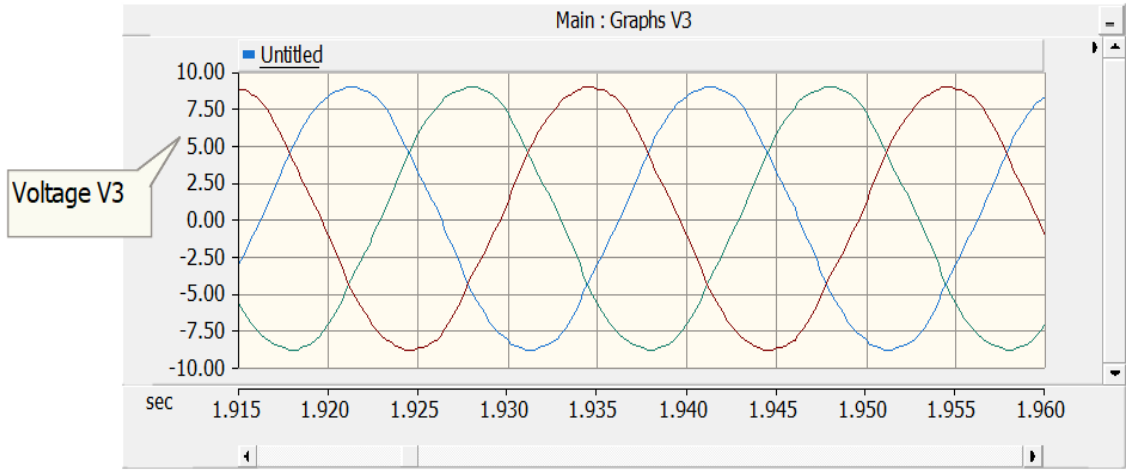


Fig:Waveform of V3 at bus3

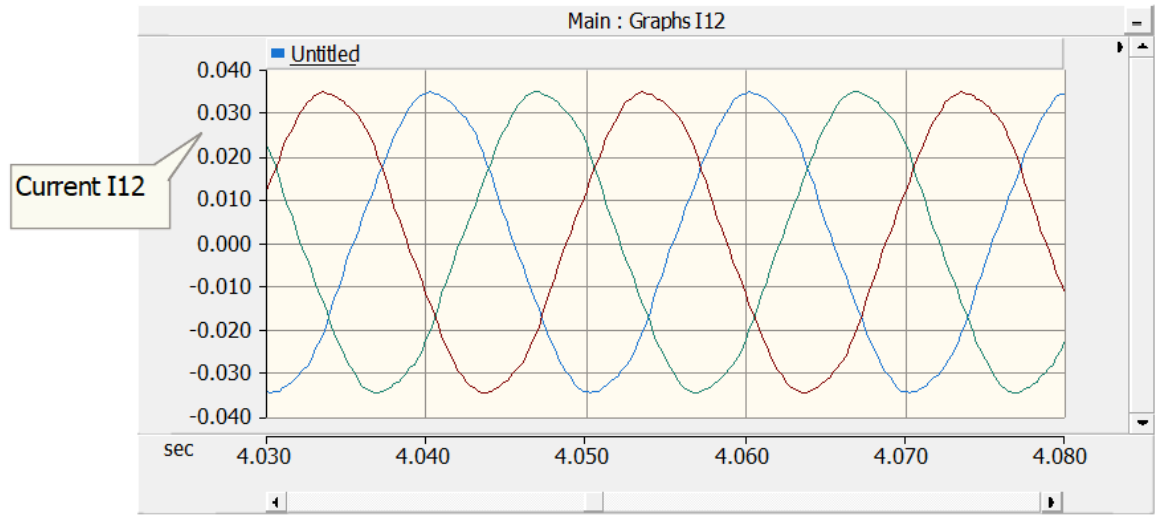


Fig:Waveform of I12 Which flow between Bus1 to Bus2

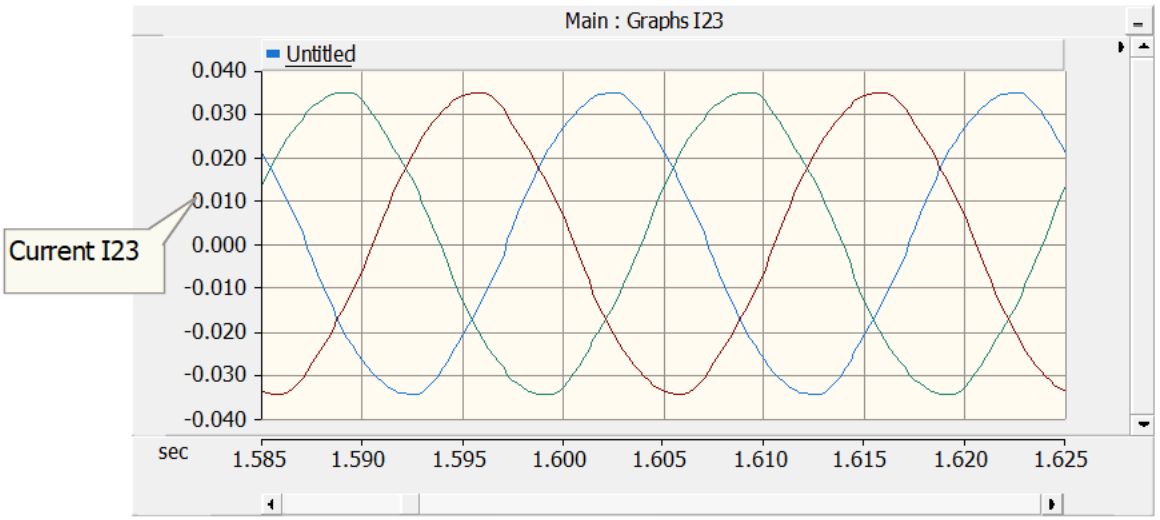


Fig:Waveform of I23 Which flow between Bus2 to Bus3

7)Observation:

1.we are given input as a trapezoidal wave on bus one (20 volt magnitude) and we get the output voltage on bus 2 and 3 as a sinusoidal wave with harmonics .

2.If the frequency of the trapezoidal waveform is low in comparison to the system's fundamental frequency, the waveform may be flat by the transmission lines and transformers, resulting in a waveform that is closer to a sinusoidal waveform according to the V2 and V3 above.

3.At lower frequencies, the frequency-dependent impedances of the system components may have less of an influence on the waveform.

4. When we give a magnitude of 10 voltage trapezoidal wave then we get output voltages V2 is 10 volt and V3 is approximately 8.75 volt (voltage at bus 3 is less than bus 2 because we use here star - delta transformer which is step down transformer).

5. The flow of current in bus 2 to bus 3 is approximately 35 mili ampere due to the specific characteristics of the system components, including their impedance and frequency response.

6.When a trapezoidal waveform is applied as input to a 3-bus radial system, the rationale behind the formation of harmonics is connected to the frequency-dependent impedances and transmission line characteristics of the system components, as well as the non-sinusoidal nature of the input waveform.

8)Conclusion:

1. The project includes simulating a 3-bus radial system with transformers using PSCAD software.A transformer will be placed between every pair of buses in the system, enabling isolation and voltage change.

2. The first bus will have a periodic input with a trapezoidal shape, allowing for the evaluation of the system's response to a sinusoidal waveform with harmonics.

3. Short T-lines, which have a common use in power system analysis, will be used to model the transmission lines. Static loads will be used to model the system's loads.

4.Plotting the voltage waveforms at each system bus will allow researchers to investigate the behavior of the power system.

5.When a trapezoidal waveform is supplied at the first bus of a 3-bus radial system, it produces a sinusoidal voltage at the other buses; however, the result depends on the parameters of the system and the input waveform, including frequency and impedance.

6.PSCAD software will offer a complete and accurate model of the system, allowing for more extensive study and comprehension.

7.The project's results will be a helpful reference for future power system studies and may contribute to the enhancement of power system designs and operation.