3-PHASE FULLY CONTROLLED RECTIFIER

Circuit Simulation done by
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Theory

A 3 phase uncontrolled rectifier converts 3 phase AC supply in to a DC quantity, but the output voltage available at the load cannot be changed unless the magnitude of supply voltage is changed. A 3 phase fully controlled rectifier may be used for applications requiring variable load voltage. The load voltage may be adjusted even without varying the supply voltage. In-order to control the output voltage across the load, controlled semiconductor switches may be used in all the phases. By adjusting the firing angle of the switches, the RMS value of voltage available at the load can be varied.

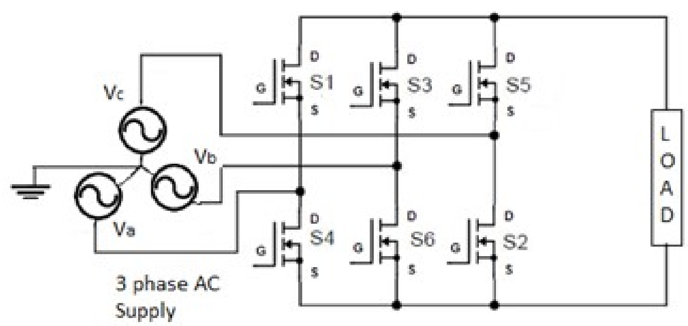

Figure 1: Circuit diagram of 3 phase fully controlled rectifier

Figure 1, shows a 3 phase fully controlled rectifier which uses MOSFET switches. The MOSFET switches are labelled as S1, S2, S3, S4, S5 & S6. Switches are labelled based on the order in which they are excited. Following table shows the triggering instance of the switches.

Table 1: Triggering instance

Switches	Triggering instant
S1	30+α
S2	90+α
S3	150+α
S4	210+α
S5	270+α
S6	330+α

This circuit has been simulated with a 3 phase AC source of 30V, the firing angle $\alpha=30^o$, conduction period of switches = 180^o and RL load (R=10 Ω, L=1mH)

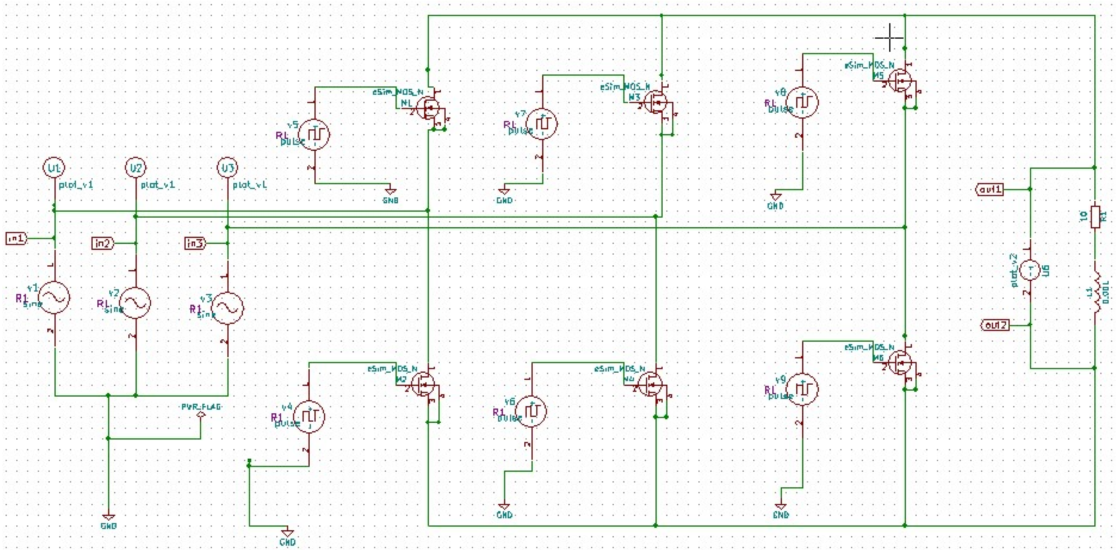

Figure 2: Schematic view of 3 phase fully controlled rectifier

Simulation results

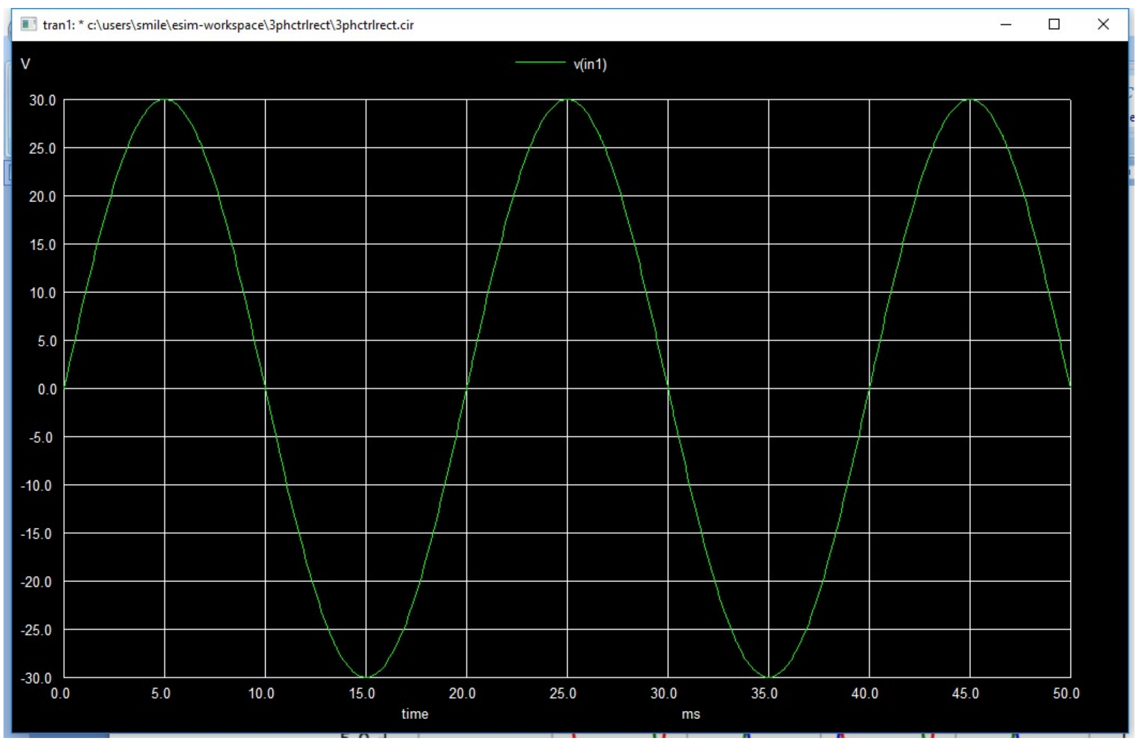

Figure 3: AC input with 0^o phase shift (A phase)

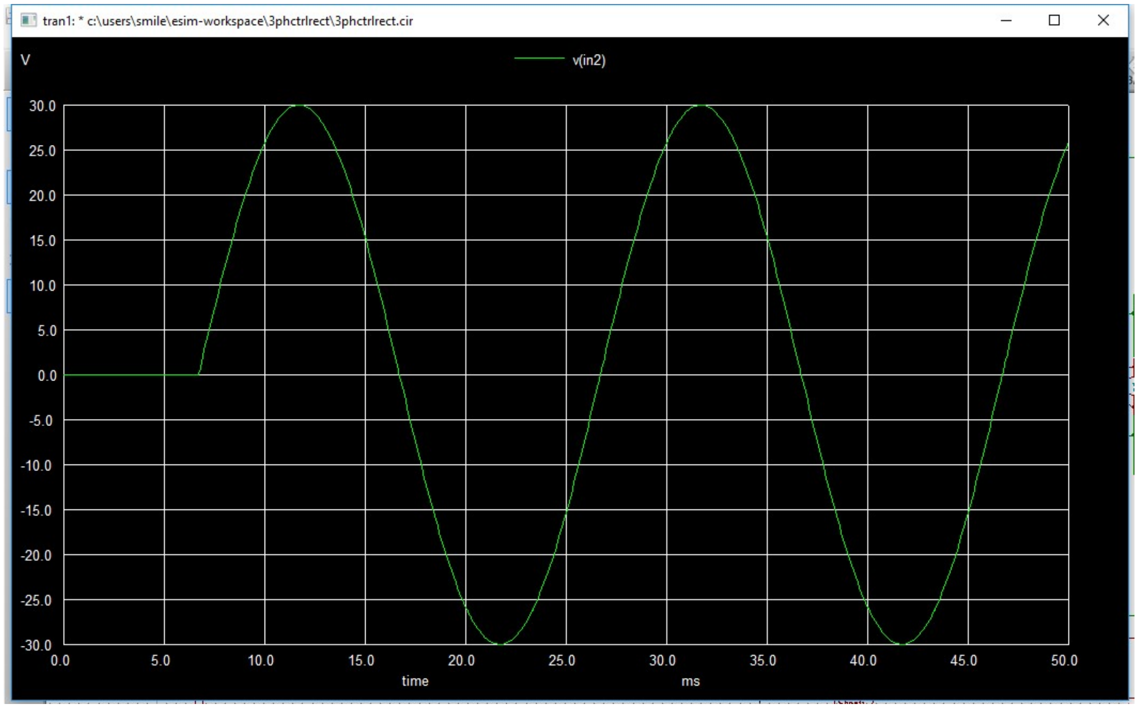

Figure 4: AC input with 120^{o} phase shift (B Phase)

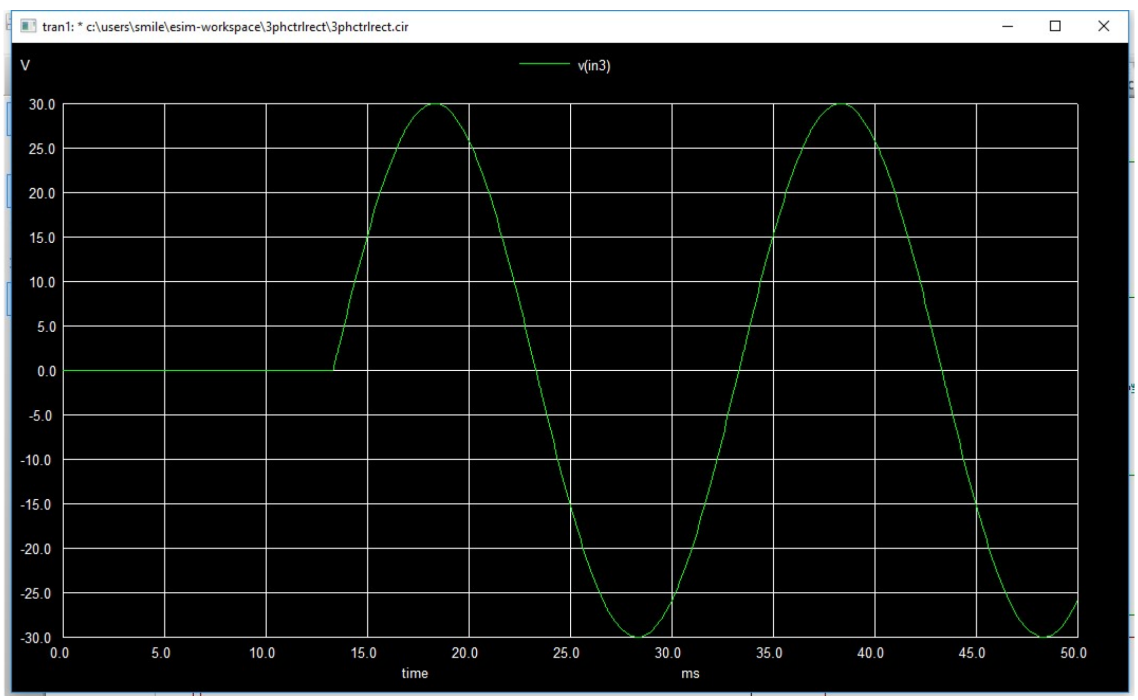

Figure 5: AC input with 240^{o} phase shift (C Phase)

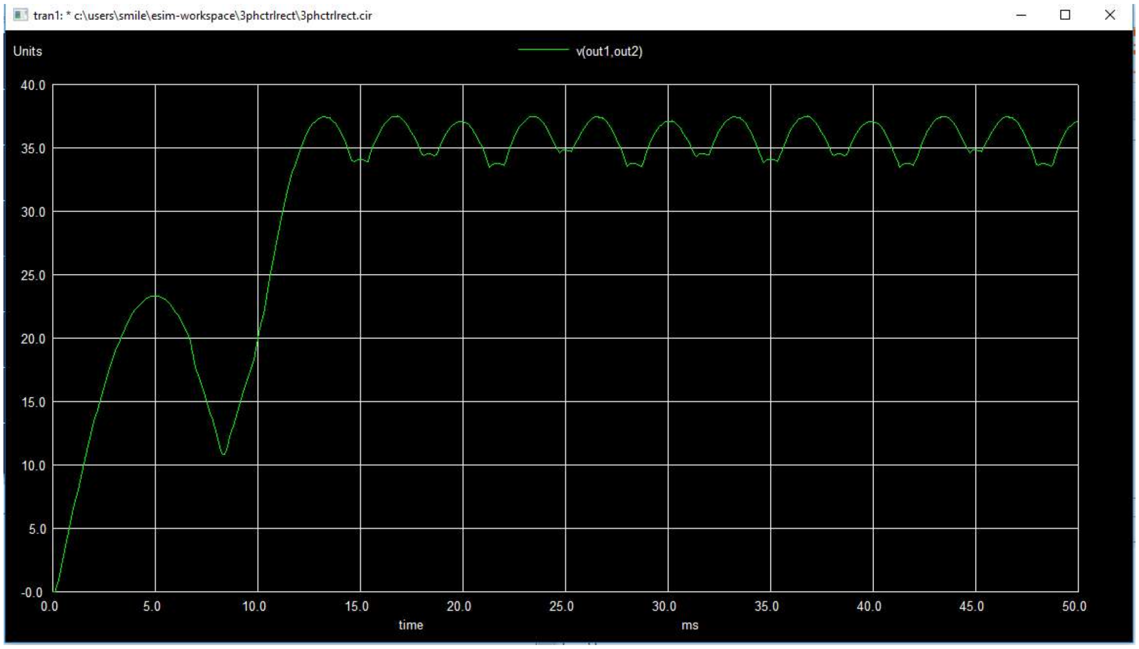

Figure 6: DC voltage available across the RL load

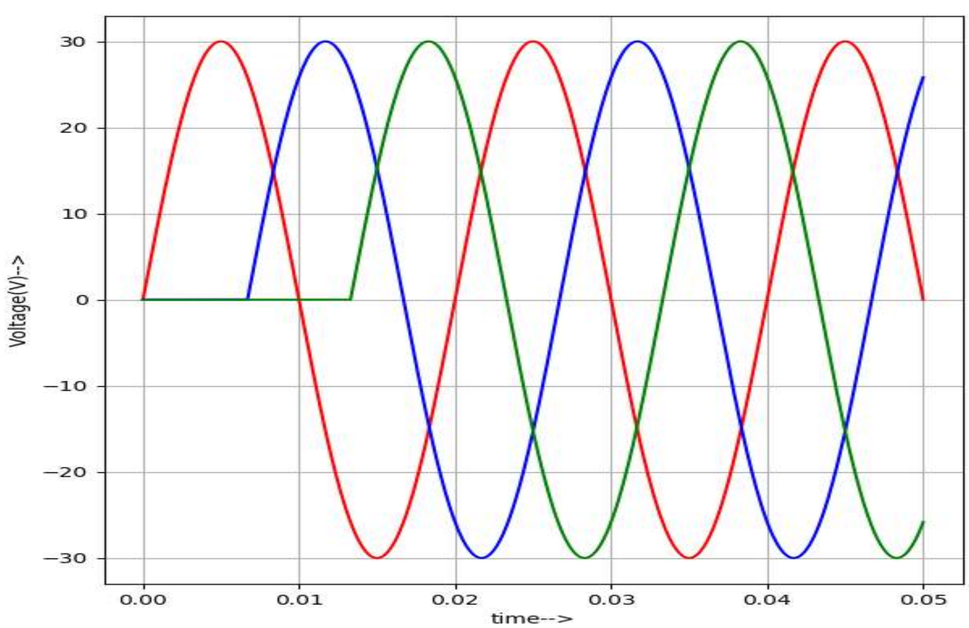

Figure 7: Python plot for 3 phase AC supply

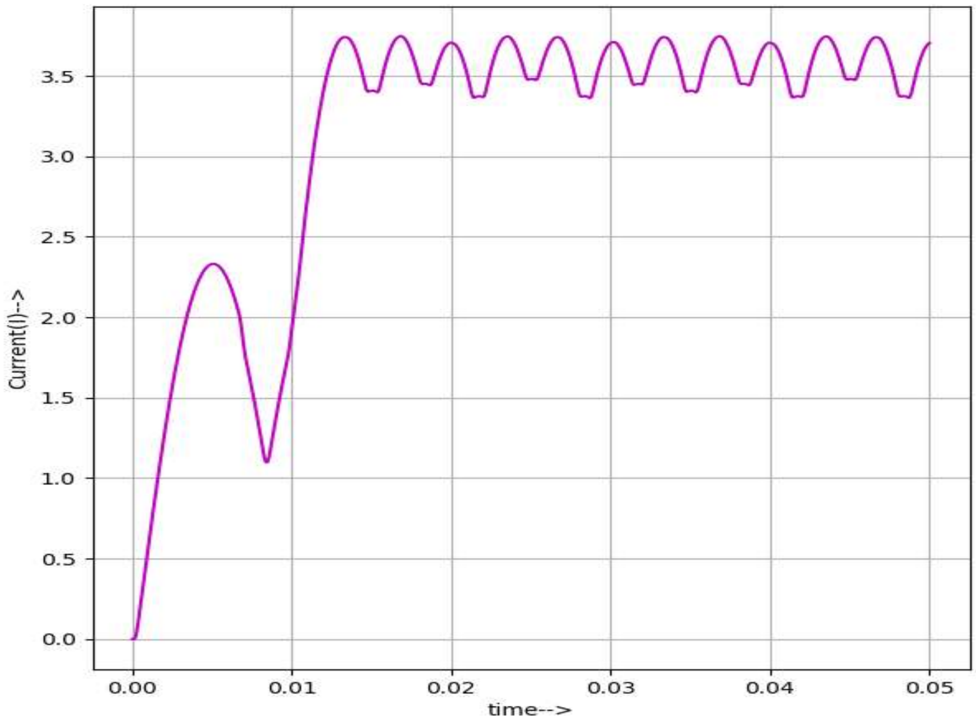

Figure 8: Python plot for current flowing through the load (I1 branch)

References

Power Electronic circuit, Devices and Applications, Muhammed H. Rashid, Third Edition, Pearson Publishers.