Experiment No.8

Single Phase Fully Controlled Converter Feeding different type of loads

Aim

To setup and simulate a single phase fully controlled bridge rectifier feeding a R, RL load and observe the wave forms and performance without freewheeling diode.

Theory

The circuit diagram of a single phase fully controlled bridge converter is shown in Fig.. The single phase fully controlled bridge converter is obtained by replacing all the diode of the corresponding uncontrolled converter by thyristors. Thyristors T_1 and T_2 are fired together while T_3 and T_4 are fired 180^o after T_1 and T_2.From the circuit diagram it is clear that for any load current to flow at least one thyristor from the top group (T_1, T_3) and one thyristor from the bottom group (T_2, T_4) must conduct. It can also be argued that neither T_1, T_3 nor T_2, T_4 can conduct simultaneously. For example, whenever T_3 and T_4 are in the forward blocking state and a gate pulse is applied to them, they turn ON and at the same time a negative voltage is applied across T_1 and T_2commutating them immediately. Similar argument holds forT_1 and T_2.For the same reasonT_1-T_4orT_2-T_3 cannot conduct simultaneously. Therefore, the only possible conduction modes when the current I_0 can flow areT_1-T_2 and T_3-T_4. Of course, it is possible that at a given moment none of the thyristors conduct. This situation will typically occur when the load current becomes zero in between the firings of T_1T_2 and T_3T_4. Once the load current becomes zero all thyristors remain off. In this mode the load current remains zero. Consequently, the converter is said to be operating in the discontinuous conduction mode (DCM).

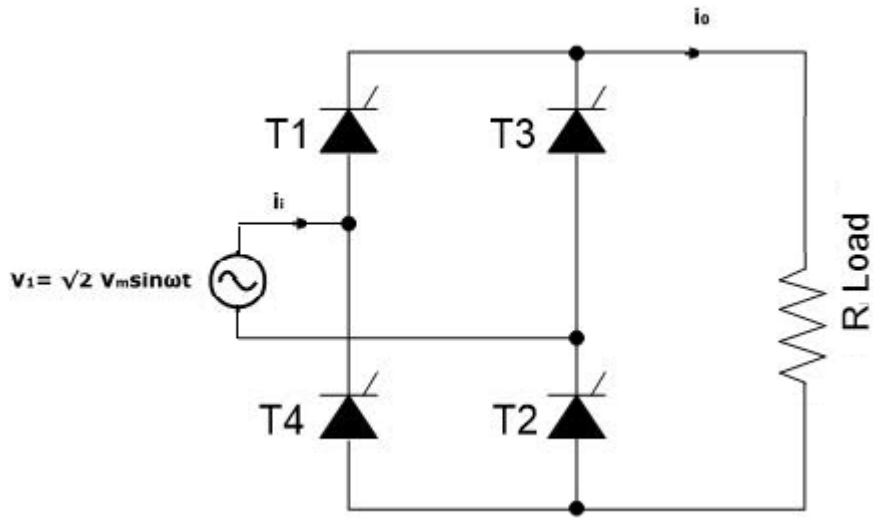


Figure6.1:Single Phase Fully Controlled rectifier with R Load

Figure 6.3 shows the voltage across different devices and the dc output voltage during each of these conduction modes. It is to be noted that whenever $T_1 - T_2$ conducts, the voltage across T_3 and T_4 becomes negative. Therefore, T_3 and T_4 can be fired only when v_i is negative i.e., over the negative half cycle of the input supply voltage. Similarly, T1 and T2 can be fired only over the positive half cycle of the input supply. The voltage across the devices when none of the thyristors conduct depends on the off-state impedance of each device. The values listed in Figure assume identical devices.

Under normal operating condition of the converter the load current may or may not remain zero over some interval of the input voltage cycle. If i_0 is always greater than zero then the converter is said to be operating in the continuous conduction mode. In this mode of operation of the converter T_1T_2 and T_3T_4 conducts for alternate half cycle of the input supply. However, in the discontinuous conduction mode none of the thyristors conduct over some portion of the input cycle. The load current remains zero during that period.

Procedure

Setup the circuit. Connect the power supply to the rectifier through isolation transformer to avoid any ground looping. Observe the wave forms using an oscilloscope with R load and RL load without freewheeling diode. Vary firing angle and observe the waveforms across the load and thyristors. Compare the

average output voltage obtained by computation.

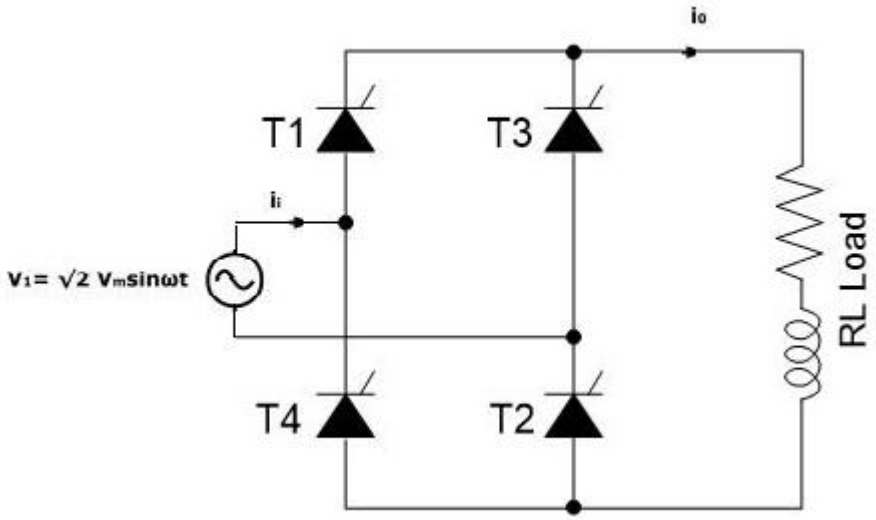


Figure 6.2: Single Phase Fully Controlled rectifier with RL Load

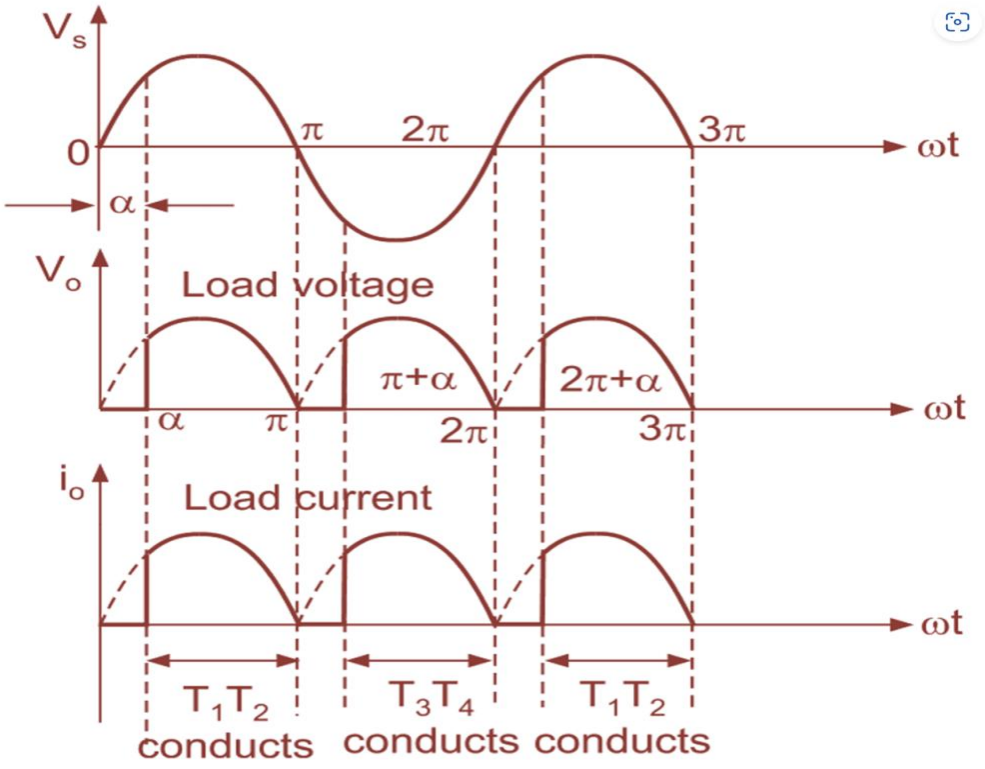


Figure 6.3:Waveform of Single Phase Fully Controlled Converter Feeding R load.

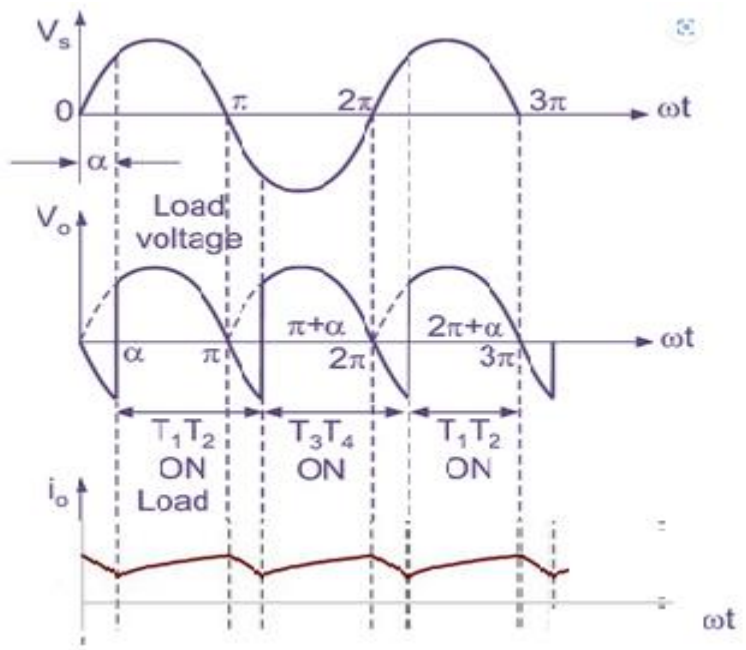
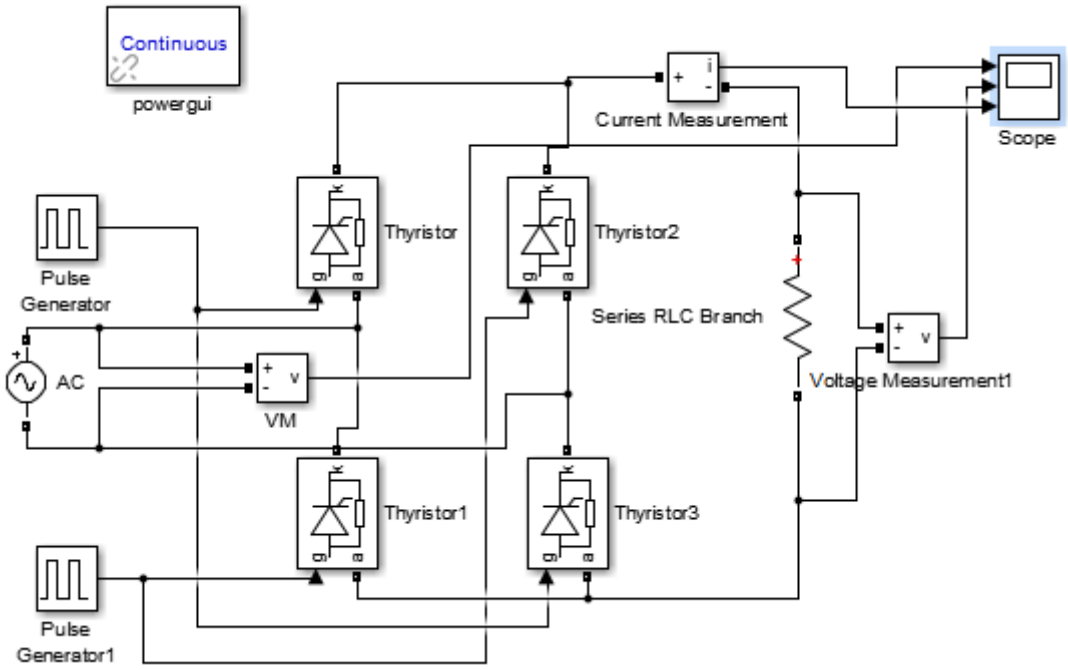


Figure 6.4: Waveform of Single Phase Fully Controlled Converter Feeding RL load.

Simulation Diagram

a)Single phase fully controlled rectifier with R load



$V_s = 240\sqrt{2}$ *volt*

Frequency of output waveform=50Hz

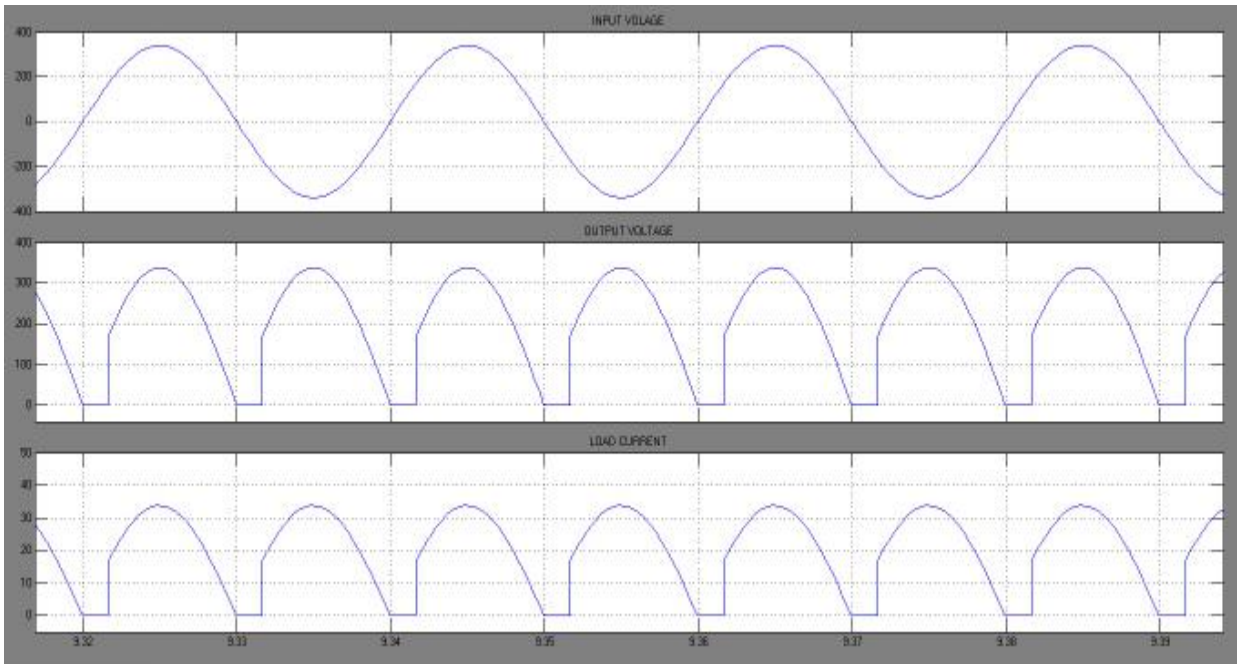
Time period=0.02 Sec

Phase Delay of

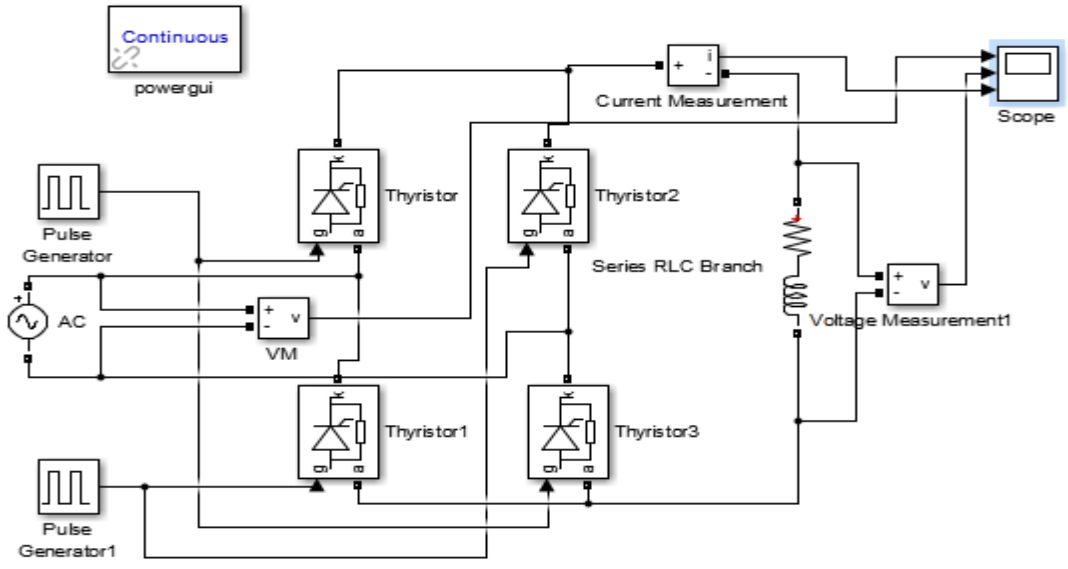
Pulse Generator 1 = a * 0.02 / 360

Pulse Generator 2 = 0.01 + (a * 0.02 / 360)

Whare a is the firing angle



b)Single phase fully controlled rectifier with RL load(Discontinuous conduction mode)



$V_s = 240\sqrt{2}$ *volt*

Frequency of output waveform=50Hz

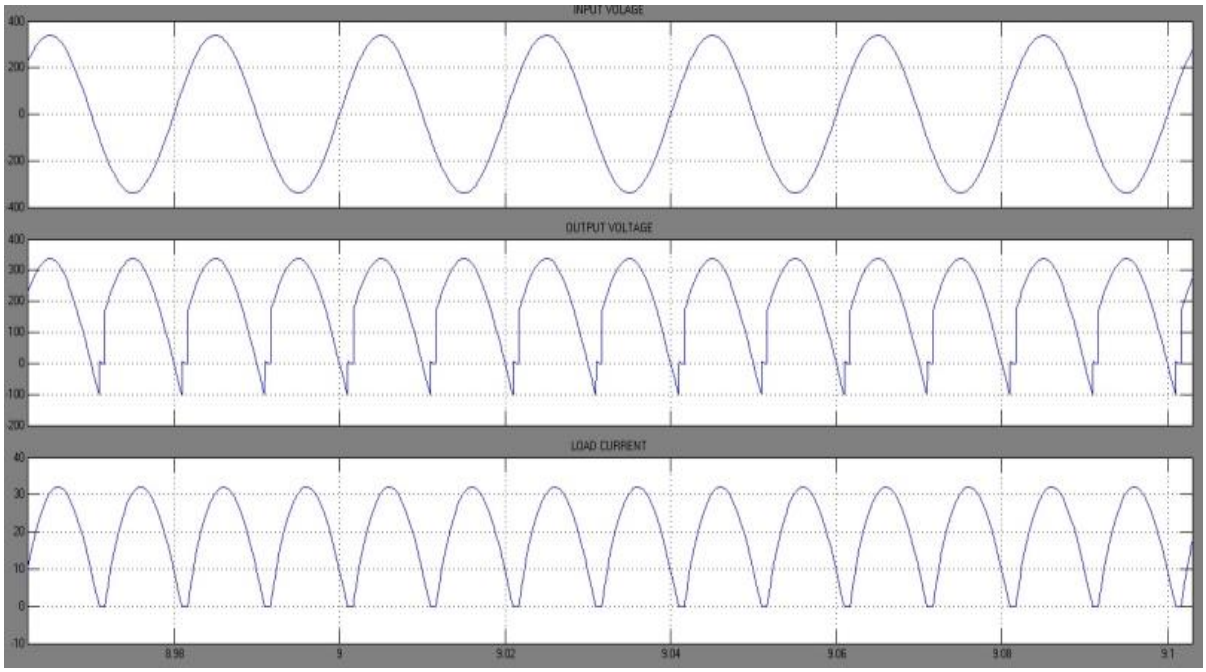
Time period=0.02 Sec

Phase Delay of

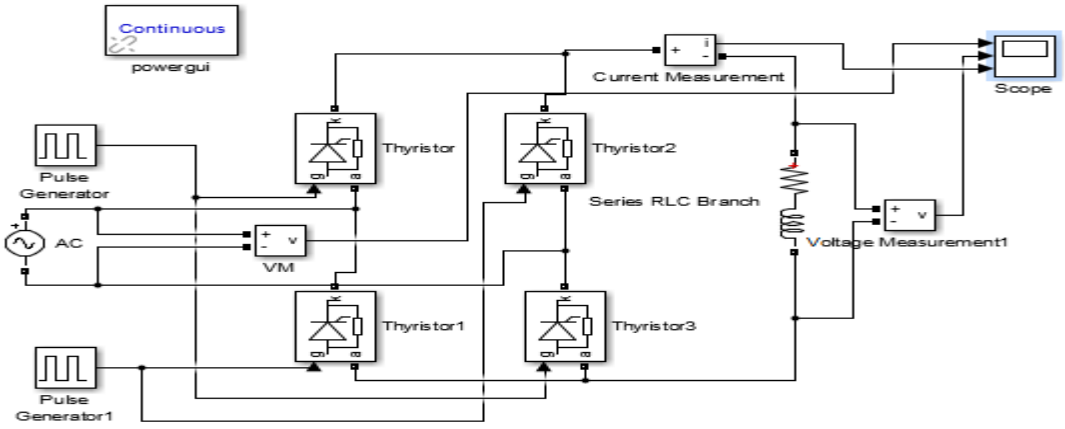
Pulse Generator 1 = a * 0.02 / 360

Pulse Generator 2 = 0.01 + (a * 0.02 / 360)

Whare a is the firing angle



b) Single phase fully controlled rectifier with RL load (Continuous conduction mode)



$V_s = 240\sqrt{2}$ *volt*

Frequency of output waveform=50Hz

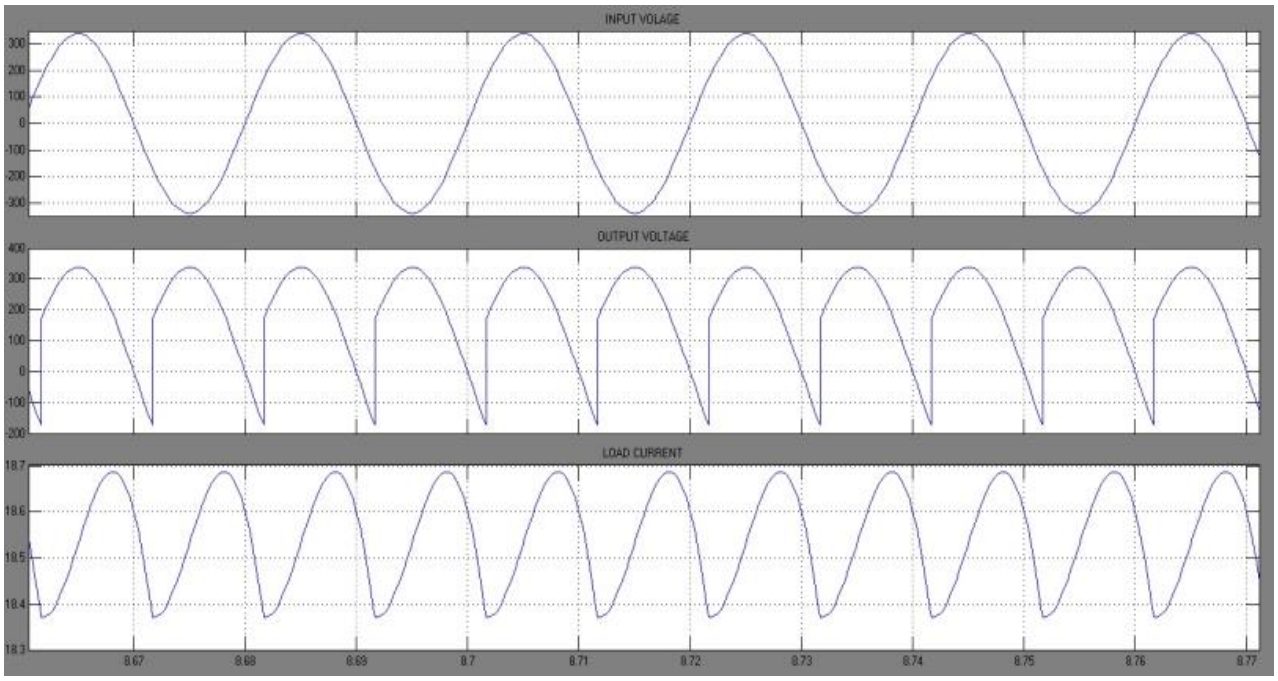
Time period=0.02 Sec

Phase Delay of

Pulse Generator 1 = a * 0.02 / 360

Pulse Generator 2 = 0.01 + (a * 0.02 / 360)

Whare a is the firing angle



Result

The circuit was setup and was fed to R and RL loads and the waveforms are observed.