Experiment 6: Single Phase Semi Controlled Converter R-L load (Asymmetrical and Symmetrical)

Introduction to the Experiment

This experiment is aimed to study the operation of single phase semi controlled (Asymmetrical and Symmetrical) converter using R-L load by observing the output waveforms. The circuit is implemented in simulation as well as hardware and the performance is studied.

Learning outcomes:

Circuit Diagram:

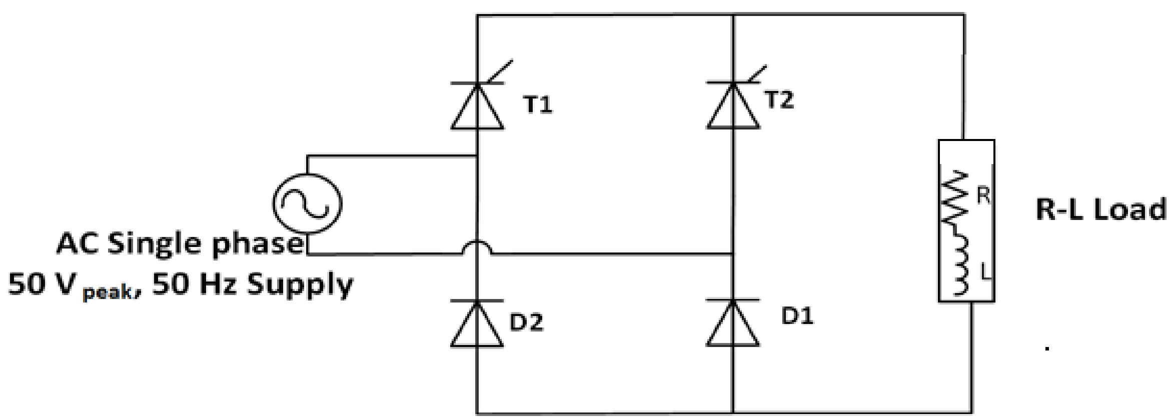


Figure 1 Circuit diagram of Symmetrical connection

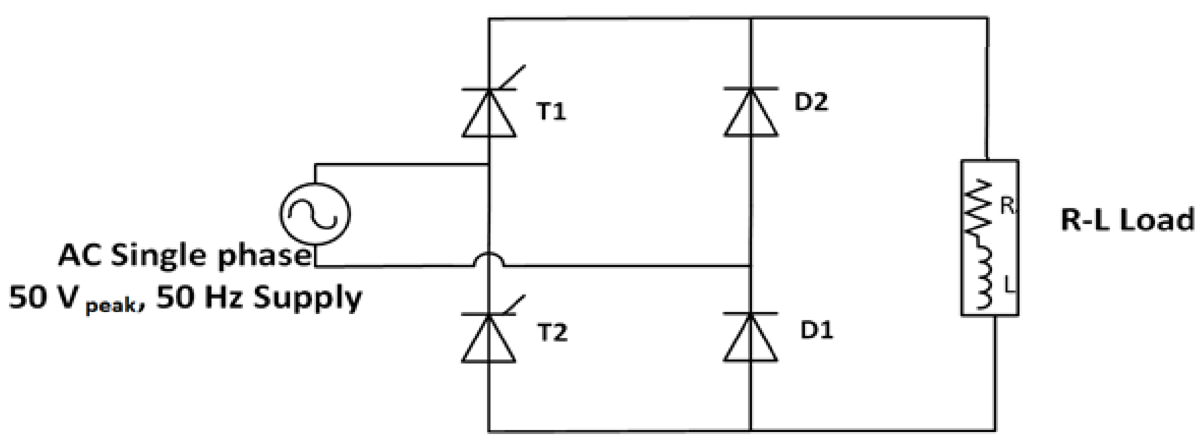


Figure 2 Circuit diagram of Asymmetrical connection

Theory:

In the period $0 < t \leq \pi/\omega$; the SCRs T1 and Diode D1 are forward biased and the SCR T2 and Diode D2 are reverse biased. Then current through the load and voltage drop across the load are zero. Let the SCR T1 be triggered at an angle of α ($0<\alpha<\pi/\omega$). As the Diode D1 is already conducting the supply terminals are connected to the load through the SCR and Diode, the current starts flowing through the load via SCR T1 and Diode D1. Therefore the supply voltage appears across the load, the voltage drop across the SCR and the Diode is zero when they are conducting (SCR, Diode are assumed ideal).

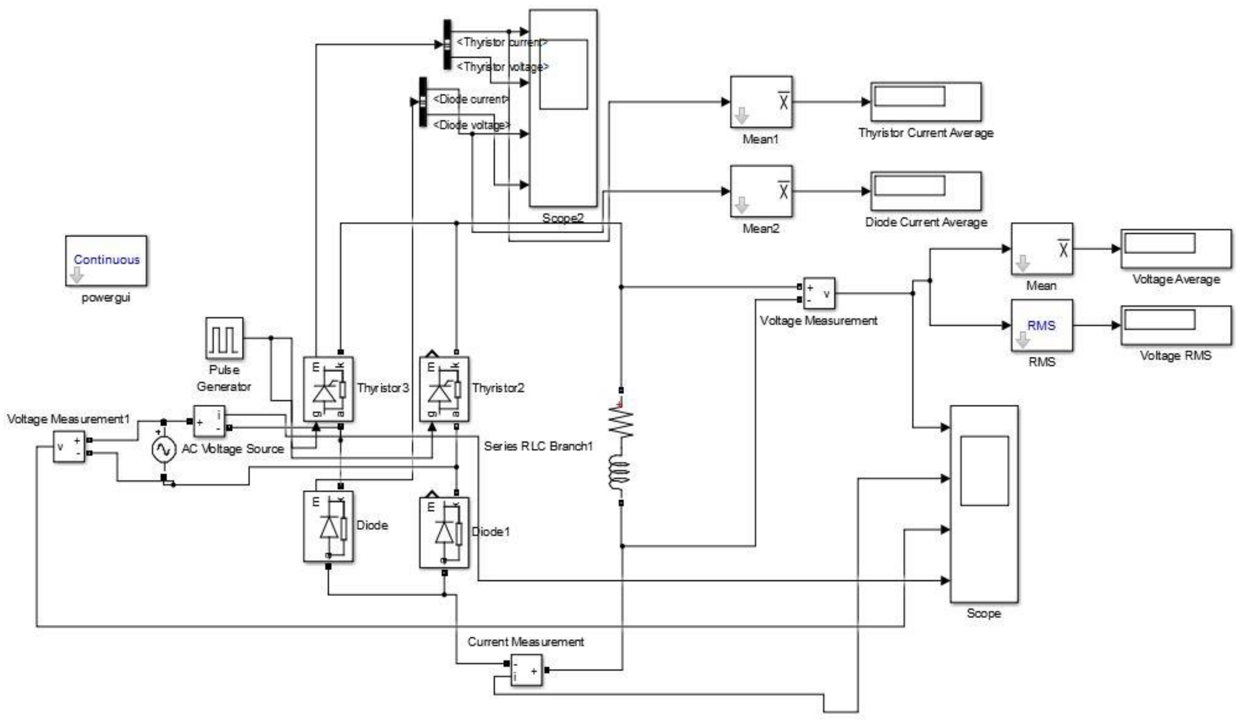
Soon after π/ω load voltage tends to reverse, Free- wheeling Diode gets forward biased and starts conducting. The load, or output current is transferred from T1, D1 to FWD. As SCR T1 is reverse biased at $t = \pi/\omega+$ current flows through FWD and T1 is turned off. The load terminals are short circuited through FWD therefore load voltage is zero during [π/ω<t< (π+α) /ω]. During the period (π/ω<t<2π/ω); T2 and Diode D2 are forward biased. When T2 is triggered at an angle of (π+α) /ω, [0< (π+α)/ω <2π/ω], then the FWD is reverse biased and is turned off. During this period supply terminals are connected to the load through the SCR and the Diode D2, the load current shifts from FWD to T2 and D2. Therefore the supply voltage appears across the load. The voltage drop across the SCR and Diode is zero when they are conducting (SCR, Diode are assumed ideal). SCR T2 and Diode D2 continue to conduct up to 2π/ ω. For the next half cycle the load current is transferred from T2 and D2 to the FWD and SCR T1 and Diode D1 are forward biased, if we give triggering SCR starts conducting and this cycle repeats.

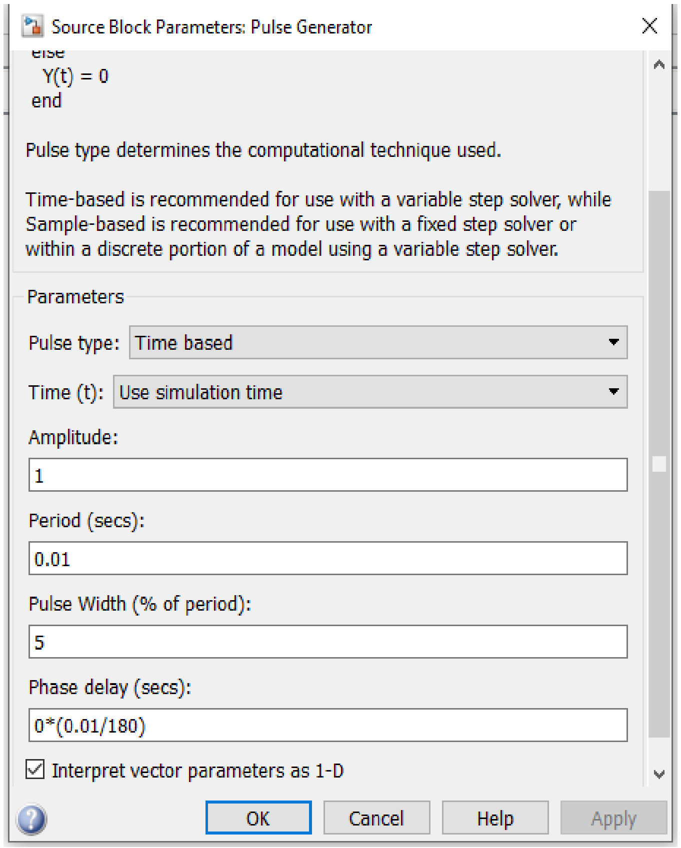
1a). Simulation of single phase Symmetrical semi-controlled converter with RL Load.

Aim: To simulate single phase Symmetrical semi-controlled converter with RL load.in MATLAB Simulink

PROBLEM 1:

a. Implement the 1-phase Symmetrical semi-controlled converter with **RL** load of R = **12.5 Ω** and L = **6mH** and observe the changes in the output voltage waveform at different firing angles. (Input voltage: 50V Peak = **35.35V (RMS) and 50Hz**)



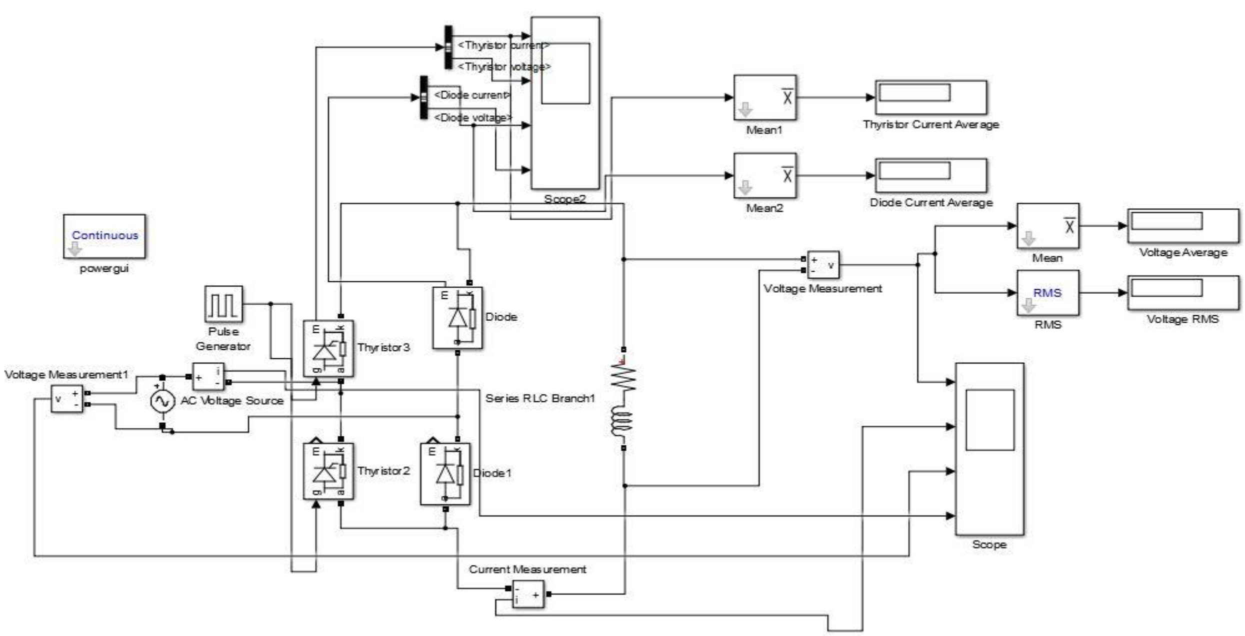


1b). Simulation of single phase Asymmetrical semi-controlled converter with RL Load.

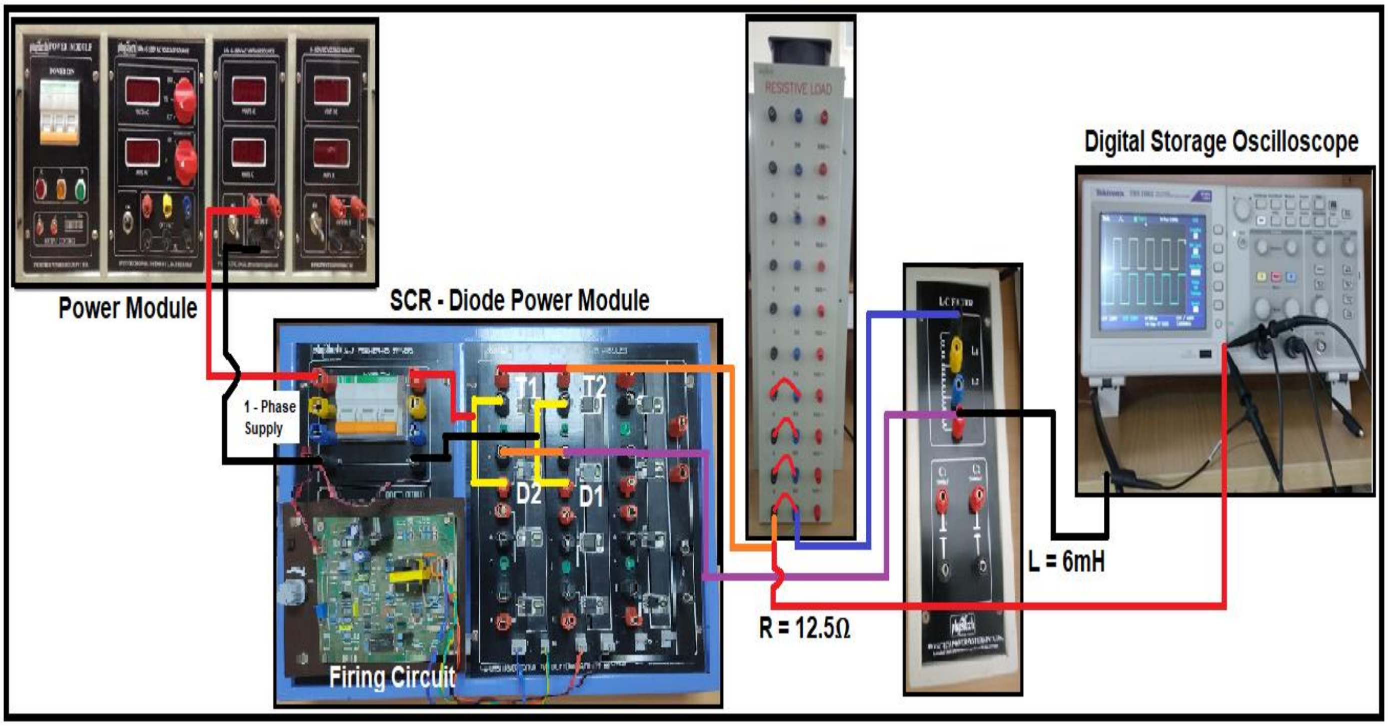
Aim: To simulate single phase Symmetrical semi-controlled converter with RL load.in MATLAB Simulink.

PROBLEM 2:

a. Implement the 1-phase Asymmetrical semi-controlled converter with **RL** load of R = **12.5 Ω** and L = **6mH** and observe the changes in the output voltage waveform at different firing angles. (Input voltage: 50V Peak = **35.35V (RMS) and 50Hz**)



1c). Hardware Implementation single phase Symmetrical semi-controlled Converter with RL Load.



Circuit diagram of symmetrical connection

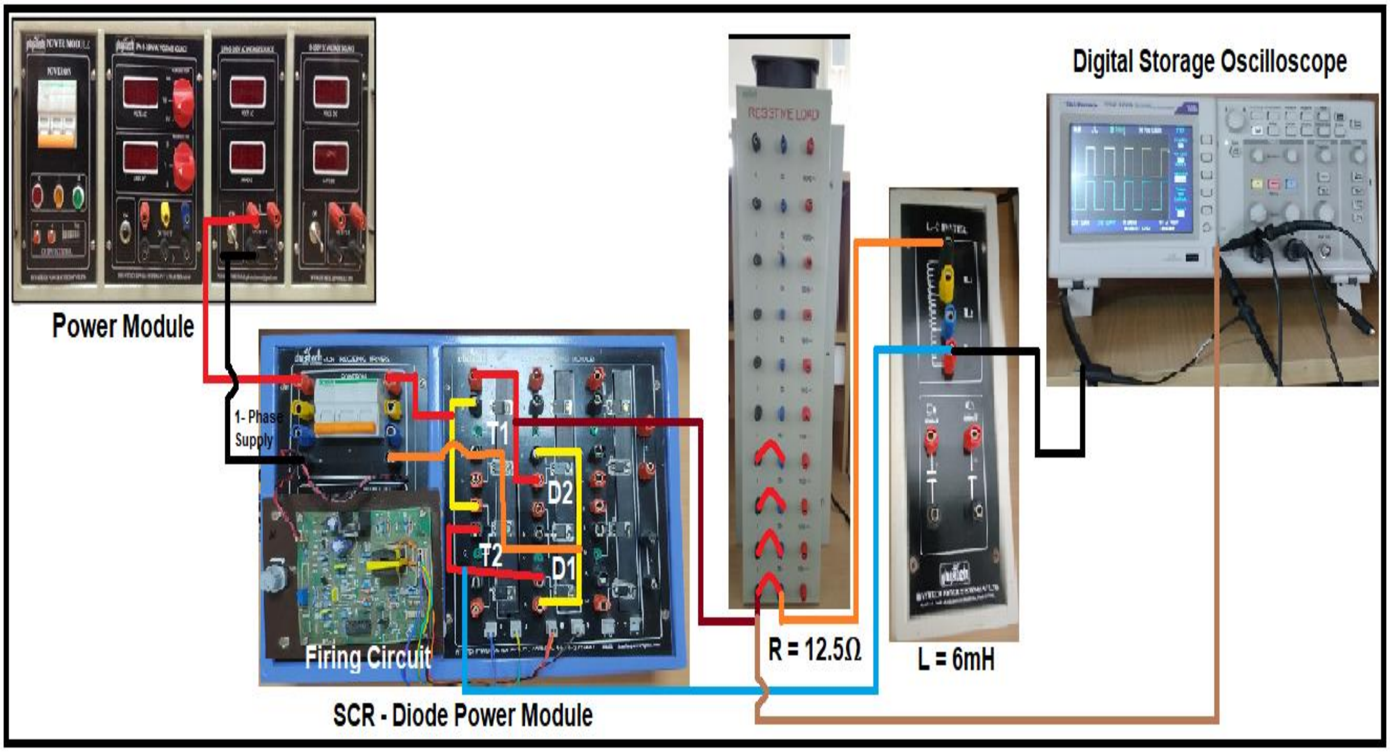
<u>Procedure</u>:

1. Connect the circuit as shown in above figure (with RL load (**R=12.5 ohms, L = 6mH**))
2. Switch ON the MCB of 3Ø supply on the Left hand side of your Experimental Table.
3. Switch ON the MCB on the POWER MODULE kit.
4. Switch ON the MCB on the SCR-Diode Power module and slowly increase the Voltage to reach up to 35.35 V in RMS using **+** symbol Push Button in the Power Module kit.

   Note: The Voltage Adjustment Controls are a pair of push buttons to finely adjust the voltage to required value.

5. Switch on the driver power switch
6. Connect CRO probes across the **RL** load to measure the output voltage
7. Vary the firing angle as mentioned in the “Exp6_Part B.doc” file.
8. Observe the Output voltage waveforms in the DSO.

1d). Hardware Implementation single phase Asymmetrical semi-controlled Converter with RL load.



Circuit diagram of Asymmetrical connection

Procedure:

1. Connect the circuit as shown in above figure (with RL load (**R=12.5 ohms, L = 6mH**))
2. Switch ON the MCB of 3Ø supply on the Left hand side of your Experimental Table.
3. Switch ON the MCB on the POWER MODULE kit.
4. Switch ON the MCB on the SCR-Diode Power module and slowly increase the Voltage to reach up to 35.35 V in RMS using **+** symbol Push Button in the Power Module kit.

   Note: The Voltage Adjustment Controls are a pair of push buttons to finely adjust the voltage to required value.

5. Switch on the driver power switch
6. Connect CRO probes across the **RL** load to measure the output voltage
7. Vary the firing angle as mentioned in the "Exp6_Part B.doc" file.
8. Observe the Output voltage waveforms in the DSO.

   .

Conclusion: Obtain the results as per "Exp5_Part B.doc" file.