1Ph_FW_AC-Controller_R-L_Load -- Overview

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1-PHASE FULL-WAVE AC CONTROLLER WITH R-L LOAD

Objective:

After performing this lab exercise, learner will be able to:

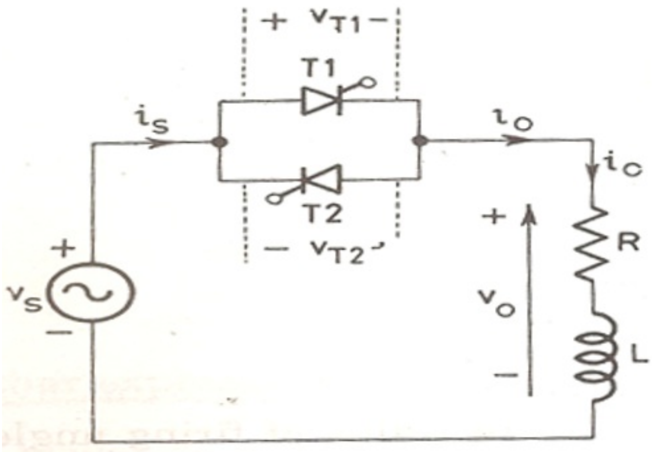
- Understand the working of AC-AC converter with R-L Load
- Learn the role of Power Electronics in utility related applications.
- Understand and design single-phase Full Wave AC voltage controller.
- Analyze and interpret results
- Work with digital oscilloscope to debug circuit and analyze signals

Equipment:

To carry out this experiment, you will need:

- Single phase AC Voltage Controller kit
- SCR firing circuit kit, 1-phase, 230V, 5A
- Patch chords
- Load
- Digital Oscilloscope

Circuit Diagram:

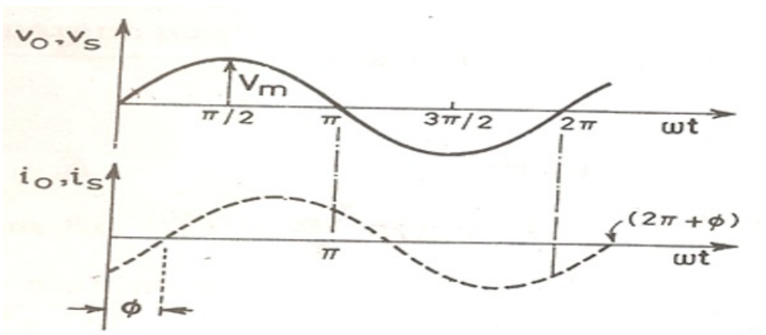


Theory:

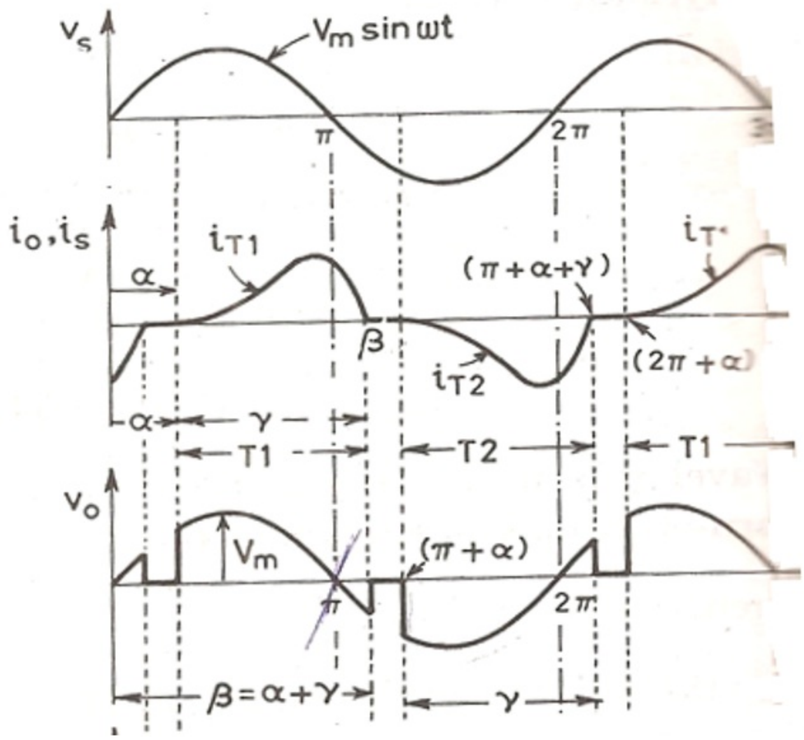
- Single phase full wave voltage controller consists of two SCRs connected in antiparallel.
- Thyristors T1 and T2 are forward biased during positive and

negative half cycles respectively.

- During positive half cycle, T1 is triggered at firing angle α, it conducts and i_o starts building up through load.
- At π, load and source voltages are zero but the current is not zero because of presence of inductance in load circuit.
- At β >π, load current reduces to zero. Angle β is called the extinction angle.
- Just after π, T1 has been reverse biased, but does not turn off because i_o is not zero.
- At β only, when i_o is zero, T1 is turned off as it is already reverse biased.
- After the commutation of T1 at β, a voltage magnitude (Vm sinβ) at once appears as a reverse bias across T1 and forward bias across T2.
- From β to π + α, no current exists in the power circuit, therefore output voltage is zero.
- Thyristor T2 is triggered at (π+ α) >β. Current i_o starts building in reverse direction through the load.
- At 2π input and output voltages are zero, but output current is not zero. At (π +α + γ) T2 turns off because it is already reverse biased.
- At (π +α + γ), Vm sin(π +α + γ) appears across as a forward bias across T1 and as a reverse bias across T2.
- From (π +α + γ) to (2π +α), no current exists in the power circuit. At (2π +α), T1 is turned on and current starts building up as before.
- The ideal waveform of the experimental setup is shown in Figure below:



For α < ϕ



For $\alpha > \phi$

1Ph_FW_AC-Controller_R-L_Load -- Procedures

Step 1

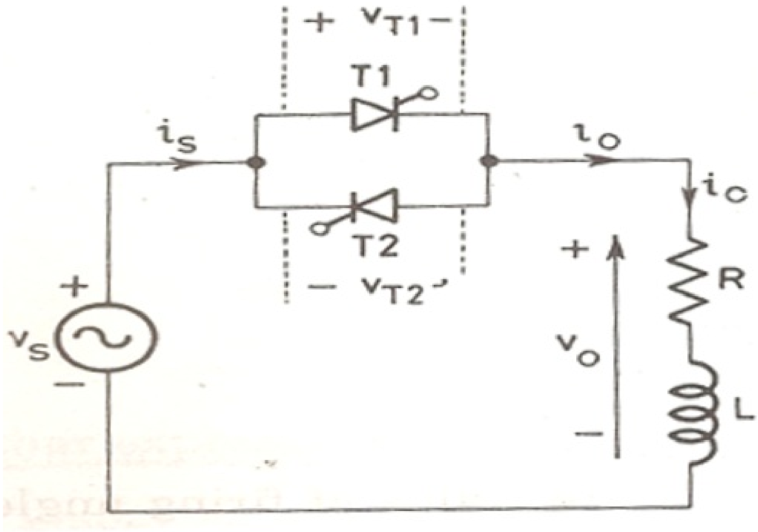
Precautions:

- A main switch should be included in whole circuit, so that in case of any emergency main supply can be disconnected from the circuit.
- Check all the connection before switching ON the power supply.
- Apply low voltages or low power to check the proper functionality of circuits.
- Load should be remained connected to the experimental setup for discharging the energy stored in the inductor or capacitor present in the circuit, if any.
- Don’t touch live wires.

Step 2

Circuit Setup:

Build the circuit as shown below:



Step 3

Probe across load resistance (V_0)

Step 4

Keep the multiplication factor of the CRO’s probe at the maximum position (10X or 100X - whichever is available)

Step 5

Switch on the experimental kit and firing circuit kit.

Step 6

- Set the firing angle to 0 degree
- Capture output waveform on oscilloscope

Step 7

- Measure the RMS value of the output
- Take screenshot of output waveform.

Step 8

- Set the firing angle to 30 degree
- Capture output waveform on oscilloscope

Step 9

- Measure the RMS value of the output
- Take screenshot of output waveform.

Step 10

Continue Step # 8 and 9 for different values of firing angle like 45, 60 and 90 degrees.

Step 11

Switch off the power supply and disconnect from the power source.