AC_Volt_RegulatorSCR -- Overview

OBJECTIVE

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

- Understand the concept of AC Voltage regulation by phase controlled switching
- Control switching of SCRs by gate voltage
- Design, construct and test a AC voltage regulator using SCR
- Capture and display the signal from given Device Under Test (DUT)
- Measure RMS, MEAN and AREA measurements for regulated AC waveforms

EQUIPMENT

To carry out this experiment, you will need:

- TBS1KB - Digital Oscilloscope from Tektronix
- Step-down Transformer
- Voltage probe (provided with oscilloscope) / BNC cables
- Breadboard and connecting wires
- Simple circuit components – Resistor , Capacitors, SCR, Diode-BY127

THEORY

- An SCR is a unidirectional device like diode, it allows current flow in only one direction but unlike diode, it has built-in feature to switch ON and OFF.
- The switching of SCR is controlled by gate and biasing condition. This switching property of SCR allows to controlling the ON periods thus controlling average power delivered to the load.
- If the SCR is connected to AC supply and load, the power flow can be controlled by varying the RMS value of AC voltage applied to the load and this type of power circuit is called as AC voltage regulator.
- Applications of AC voltage regulator are in heating on load transformers for changing light controls, speed controls and

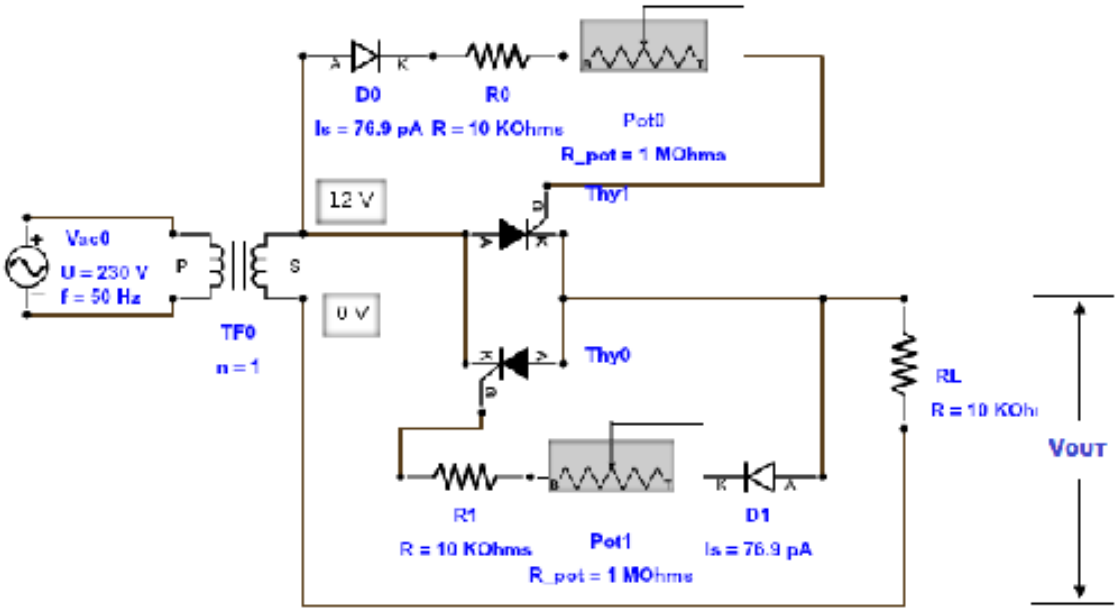
polyphase controls, induction motors and AC magnet controls for power transfer.

- Two types of power control are normally used.
  - ON-OFF control
  - Polyphase Angle control

- AC regulators are those converters which converts fixed ac voltage directly to variable ac voltage of the same frequency. The load voltage is regulated by controlling the firing angle of SCRs. AC voltage controllers are thyristor based devices.
- The most common circuit is the inverse parallel SCR pair in which two isolated gate signals are applied. Each of the two SCR's are triggered at alternate half cycles of the supply and the load voltage is part of input sine wave.

CIRCUIT DESIGN

- Triggering circuit for SCR:
  - 12 V ac is rectified by diode BY 127. SCR 2P4M is used to trigger. Let the current be 1mA. R=V/I=12V/1mA=12KΩ.



- In this circuit SCR1 is forward biased during positive half cycle and SCR2 is forward biased during negative half cycle. SCR1 is triggered at the firing angle ωt=α and supply voltage is impressed on the load resistance (RL). It conducts from the remaining positive half cycle, turning OFF when the anode voltage becomes zero at ωt=π.
- SCR2 is triggered at the firing angle ωt=α+π and conducts till ωt=2π. Hence the load is alternating in polarity and is part of sine wave. The firing angle of both SCRs is controlled by gate circuit. The conduction period of SCR is controlled by varying gate signals within specified values of maximum and minimum gate currents. For gate triggering the signal is applied between the gate and cathode of the device. AC sources are normally

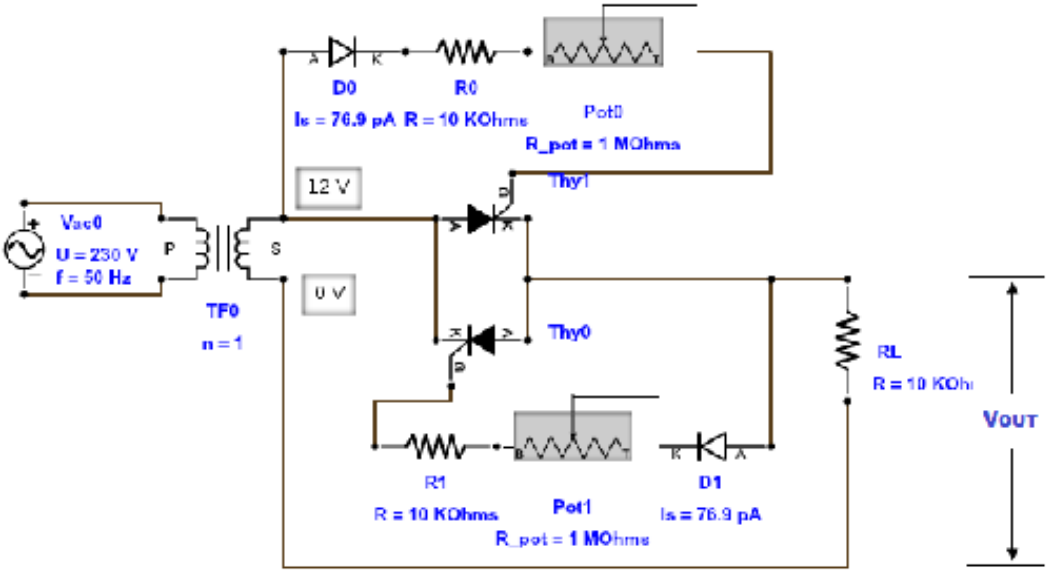
used as gate signals. This provides proper isolation between power.

AC_Volt_RegulatorSCR -- Procedures

Step 1

DUT / CIRCUIT SETUP:

- Make the connections as shown in the circuit diagram.
- The supply is given by means of step down transformer.
- Anode terminal of SCR1 is connected to the anode terminal of diode, it is connected to cathode of SCR1 by means of resistor as the load.



Step 2

MEASUREMENT / SCOPE SETUP

- Power ON the oscilloscope
- Connect the Channel 1 probe of the oscilloscope to Vin & channel 2 probe to Vout.
- Acquire the signal(s) from circuit on oscilloscope

Step 3

- Do the Auto-set on the scope to efficiently capture and view the signal.
- If AUTOSET feature is not enabled, then manually set the horizontal and vertical scale, and trigger condition to view 3-4 cycles of waveform without any clipping.

Step 4

MEASUREMENT CONFIGURATION

- From the measurement menu, configure RMS, AREA, MEAN measurement on acquired channels 1 and 2.

Step 5

- Vary the 1M Ohm potentiometer in the circuit to control the SCR gating (firing angle) and observe the variation in waveform shape plus measurement values.
- Record screenshot and measurement values for SCR firing angle of 30 degrees.

Step 6

- Vary the 1M Ohm potentiometer in the circuit to make the SCR gating (firing angle) at 45 degrees.
- Record screenshot and measurement values

Step 7

- Vary the 1M Ohm potentiometer in the circuit to make the SCR gating (firing angle) at 60 degrees.
- Record screenshot and measurement values

Step 8

- Vary the 1M Ohm potentiometer in the circuit to make the SCR gating (firing angle) at 90 degrees.
- Record screenshot and measurement values

Step 9

- Analyze the regulated voltage (RMS / Mean / Area) variation w.r.t. SCR firing angle