5.2 SINGLE-PHASE HALF-WAVE AC VOLTAGE CONTROLLER

- It consists of one thyristor in antiparallel with one diode.
- Then SCR is forward biased during positive half cycle, it is turned on at firing angle α.
- Load voltage at once jumps to Vm sinωt, likewise load current becomes Vm sinα.
- Thyristor get turned off at ωt = ∏ for R load. After ωt = ∏, negative half cycle forward biases diode Dl, therefore Dl conducts from ωt = ∏ to 2∏.
- Only positive half cycle onduction can be controlled, by varying firing angle. negative half cycle cannot be controlled. So single-phase half wave voltage controller is also called single phase unidirectional voltage controller. From the Figure it is understood that positive half cycle is not identical with negative half- cycle for both voltage and current waveforms. As a result, dc component is introduced in the supply and load circuits which is undesirable.

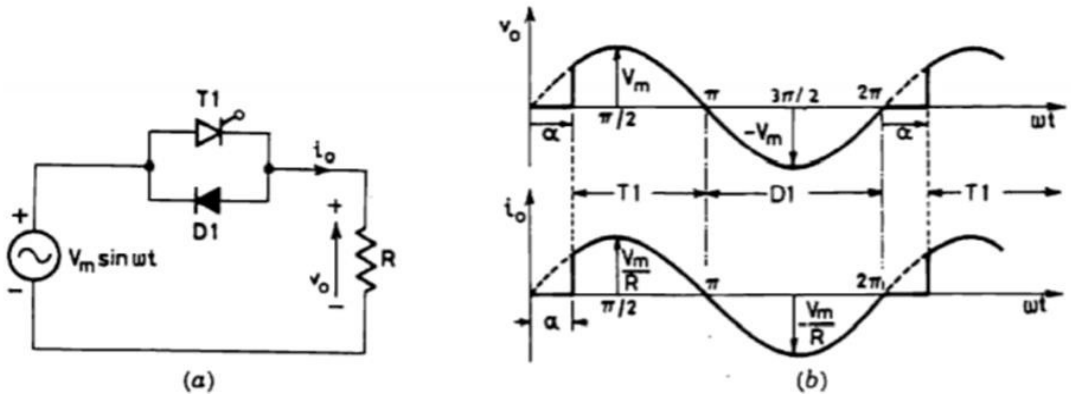

Figure 5.2.1 Single Phase AC voltage controller

[Source: "Power Electronics" *by* P.S.Bimbra*,* Khanna Publishers *Page: 396]*

RMS VALUE OF OUTPUT VOLTAGE OF SINGLE PHASE UNIDIRECTIONAL VOLTAGE CONTROLLER:

$$V_{or} = \pi\left[\frac{1}{2\pi}\int_{\alpha}^{2\pi} V_m^2 \sin^2 \omega t d(\omega t)\right]^{\frac{1}{2}}$$

$$V_{or}^2 = \frac{V_m^2}{4\pi}\int_{\alpha}^{2\pi}(1-\cos 2\omega t)d(\omega t)$$

$$V_{or}^2 = \frac{V_m^2}{4\pi}\left[(2\pi-\alpha)+\frac{\sin 2\alpha}{2}\right]$$

$$V_{or} = \frac{V_m}{2}\left[\frac{1}{\pi}\left[(2\pi-\alpha)+\frac{\sin 2\alpha}{2}\right]\right]^{\frac{1}{2}}$$

$$I_{or} = \frac{V_{or}}{R}$$

AVERAGE VALUE OF OUTPUT VOLTAGE:

$$V_o = \left[\frac{1}{2\pi}\int_{\alpha}^{2\pi} V_m \sin\ \omega t d(\omega t)\right]$$

$$V_o = \frac{V_m}{2\pi}\left(-\cos\omega o\right)_{\alpha}^{2\pi}$$

$$V_o = \frac{V_m}{2\pi}\left(\cos\alpha - 1\right)$$

SINGLE PHASE FULL WAVE AC VOLTAGE CONTROLLER

- It consists of two SCRs connected in antiparallel.
- During positive halfcycle T1 is triggered at firing angle , it conducts from wt = α to ∏ for R load.
- During negative half cycle,T2 is triggered at wt = ∏ + α, it conducts from rot = ∏

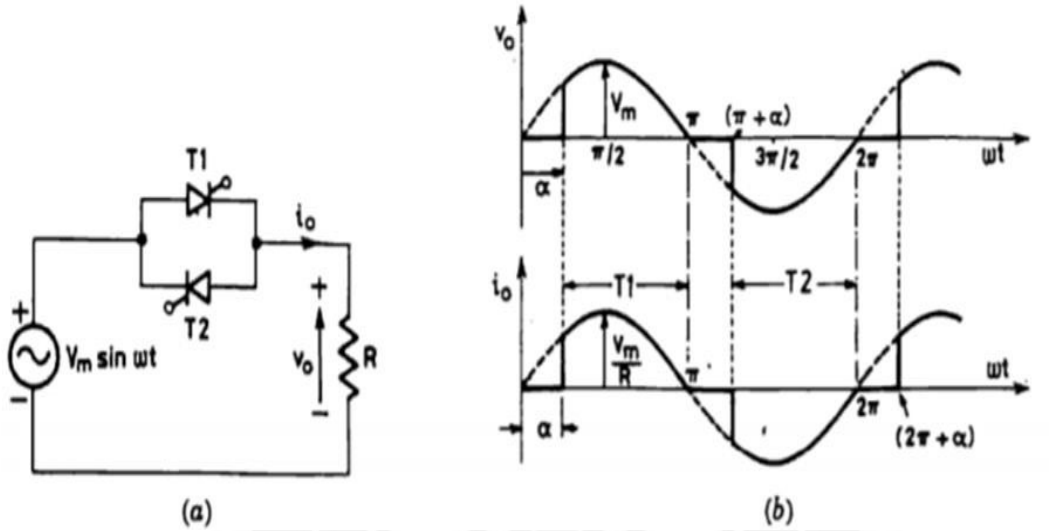

Figure 5.2.2 Single-phase full-wave ac voltage controller

[Source: "Power Electronics" *by* P.S.Bimbra*,* Khanna Publishers *Page: 397]*

- It has been stated above that ac voltage controllers are phase-controlled converters, the phase relationship between the start of load current and the supply voltage is controlled by varying the firing angle. These are called phase- controlled ac voltage controllers or ac voltage controllers. Single phase full-wave ac voltage controller is also called single phase bidirectional voltage-controller.