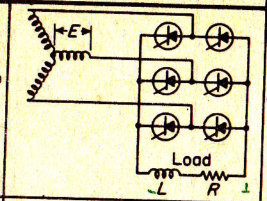
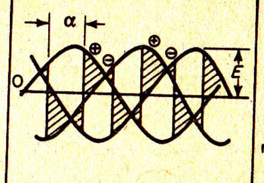
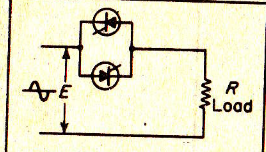
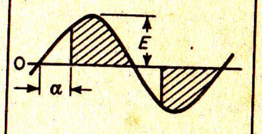
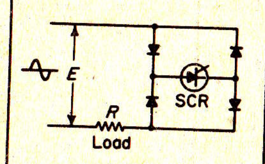
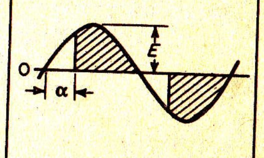
Chart 8.1 (cont.)

Circuit (a) Name	Circuit (b) Connections	(c) Load voltage waveforms	(d) Peak forward voltage on SCR	Peak reverse voltage (e) On SCR	Peak reverse voltage (f) On diode	(g) Max. load voltage ($\alpha = 0$) E_D = average d-c value; E_a = RMS a-c value
(14) Three-phase bridge with 6 SCR's with inductive load			$\sqrt{3}\,E$ (1.5E if SCR's shunted by resistance)	$\sqrt{3}\,E$	—	$E_D = \frac{3\sqrt{3}\,E}{\pi}$
(15) Inverse parallel SCR's with resistive load			E	E	—	$E_a = \frac{E}{\sqrt{2}}$
(16) SCR inside bridge with a-c resistive load			E	0	E	$E_a = \frac{E}{\sqrt{2}}$

During the positive half-cycle of the supply voltage, the SCR anode is positive with respect to its cathode, and the gate can exert control over the SCR conduction characteristics as described in detail in Sec. 5.2. Until the gate is triggered by a proper positive signal from the trigger circuit, the SCR blocks the flow of load current in the forward direction. At some arbitrary delay angle α, a positive trigger signal is applied between gate and cathode which initiates SCR current conduction. Immediately the full supply voltage, minus approximately one volt drop across the SCR, is applied to the load. With a zero reactance source and a purely resistive load, the current waveform after the SCR is triggered will be identical to the applied voltage wave, and of a magnitude dependent on the amplitude of the voltage and the value of load resistance R. As shown in Fig. 8.1(b), load current will flow until it is commutated by reversal of the supply voltage at $\omega t = \pi$. By controlling the trigger delay angle α with respect to the supply voltage by such means as described in Chap. 5 and later in this chapter, we may vary the phase relationship of the start of current flow to the supply voltage and control the load current from a maximum value down to zero—hence the term phase control.

Chart 8.1 (cont.)

(h) Load voltage vs trigger delay angle α	(j) Trigger angle range full ON to full OFF	Max. steady-state current in SCR (k) Average amp	Max. steady-state current in SCR (l) Cond. angle	Max. steady-state current in diode rectifier (m) Average amp	Max. steady-state current in diode rectifier (n) Cond. angle for max. current	(p) Ability to pumpback inductive load energy to supply line	(q) Fundamental frequency of load voltage (f = supply frequency)	(r) Notes and comments
$E_D = \frac{3\sqrt{3}\,E}{\pi}\cos\alpha$ (assuming continuous current in load	120°	$\frac{\sqrt{3}\,E}{\pi R}$	120°	—	—	Yes	$6f$	SCR's require two gate signals 60° apart each cycle, alternately a gate signal duration > 60°
$E_a = \frac{E}{\sqrt{2\pi}}(\pi - \alpha + \frac{1}{2}\sin 2\alpha)^{1/2}$	180°	$\frac{E_a}{2.2R}$ or $\frac{E}{\pi R}$	180°	—	—	—	f	With inductive load, load voltage and current depend on $\omega L/R$ as well as R and α.
$E_a = \frac{E}{\sqrt{2\pi}}(\pi - \alpha + \frac{1}{2}\sin 2\alpha)^{1/2}$	180°	$\frac{E_a}{1.1R}$ or $\frac{2E}{\pi R}$	360°	$\frac{E_a}{2.2R}$ or $\frac{E}{\pi R}$	180°	—	f	Inductance in d-c circuit must be minimum. Frequency limit determined by recovery characteristics of rectifiers and SCR's. With inductive load, load voltage and current depend on $\omega L/R$ as well as R and α.

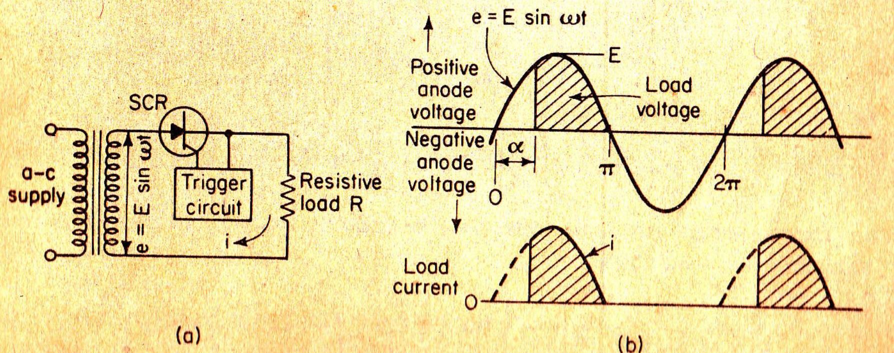


Fig. 8.1 Half-wave phase-controlled SCR with resistive load: