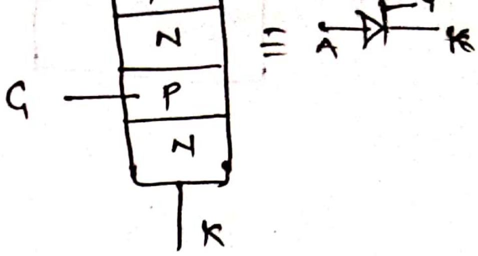
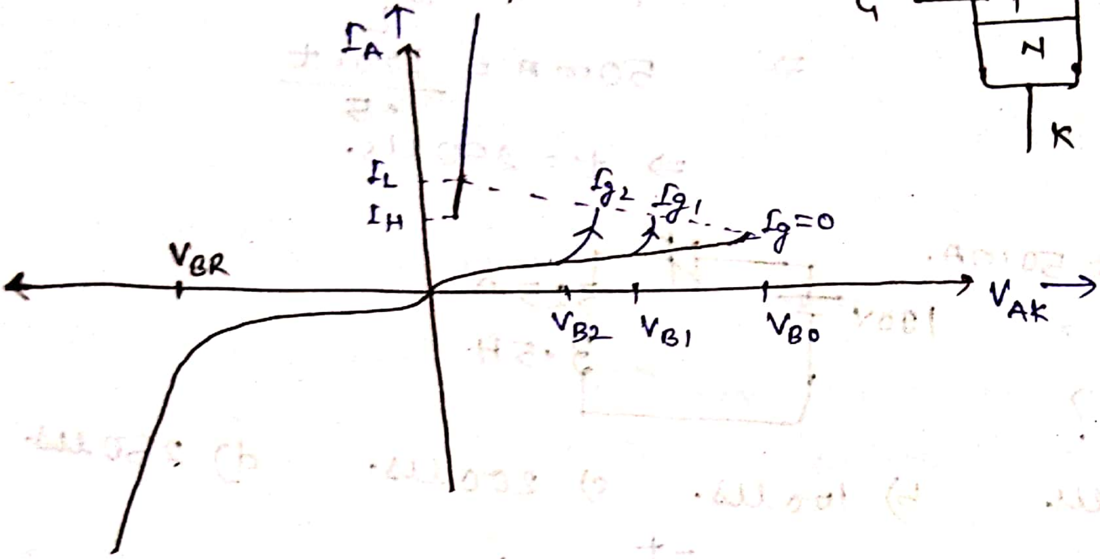
I-V. Characteristics of SCR:-





Significance of Latching current:-

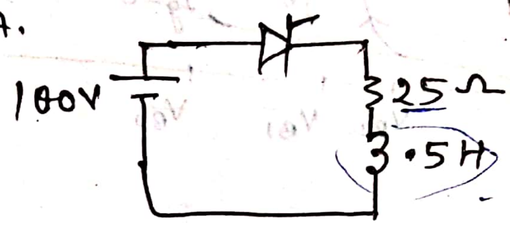
→ Latching current is related to the turn on process.

→ Gate signal initiates the turn on process, but once the SCR is in ON state gate losses control over the device. ~~Hen~~ therefore we remove the gate s/g when SCR becomes ON to avoid the cont. gate power loss.

→ If we remove the gate signal when anode current is lesser than the latching value then SCR fails to turn on. Therefore we must maintain the gate pulse width atleast for a period untill gate current reaches certain minm. value.

→ Latching current is specified to estimate the minm. gate pulse width requirement to turn on the SCR.

Q(2) $I_L = 50\,mA$.



$t_{on} = ?$

a) 250 μs. b) 100 μs. c) 200 μs. d) 250 μs.

Sol.

$$i_{L(t)} = (i_{0^+} - i_{\infty})\, e^{-\frac{t}{\tau}} + i_{\infty}$$

$$= (0 - 4)\, e^{-\frac{t \cdot R}{L}} + 4$$

$$= 4\left(1 - e^{-\frac{t \times 25}{.5}}\right)$$

~~$50 \times 10^{-3} = 4($~~ $50\,mA - 4 = -4 e^{-\frac{tR}{L}}$

$$\Rightarrow e^{-\frac{25t}{.5}} = \frac{1}{4}(4 - .05)$$

$$e^{-50} = \frac{1}{4}(3.95)$$

$$-50t = -0.0125$$

$$\therefore t = 250\,\mu s.$$

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Q. The i/p voltage given to 1-ϕ full wave conv. is

(2) $v_1 = 100\sqrt{2}\sin(100\pi t)$. The i drawn by conv. is

$i = 10\sqrt{2}\sin(100\pi t - \pi/3) + 5\sqrt{2}\sin(300\pi t + \pi/4)$
$+ 2\sqrt{2}\sin(500\pi t - \pi/6)$

(1) The i/pf of converter.

(2) The active power drawn by converter.

Soln:- (1) $\because CDF = \frac{I_{s1}}{I_{sr}}$, $\because$ I.P.f = CDF $\cdot$ DF.

$I_{sr1} = \frac{10\sqrt{2}}{\sqrt{2}} = 10\,A.$, $I_{sr} = \sqrt{10^2 + 5^2 + 2^2}$

$= \sqrt{129}$

$= 11{\cdot}36\,A$

$\therefore CDF = \frac{10}{11{\cdot}36}$

$D{\cdot}F = \cos \pi/3 = {\cdot}5$

$\therefore IPF = 5/11{\cdot}36 = {\cdot}440.$

(2) Active power delivered to load,

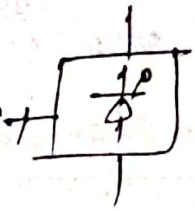
$P = V_{sr} \cdot I_{sr1} \cos\phi$

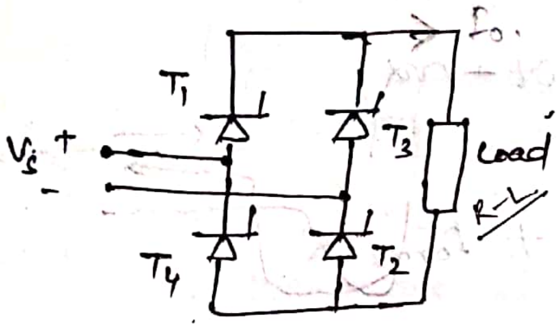
$= 100 \times 10 \times \frac{1}{2} = 500\,W.$

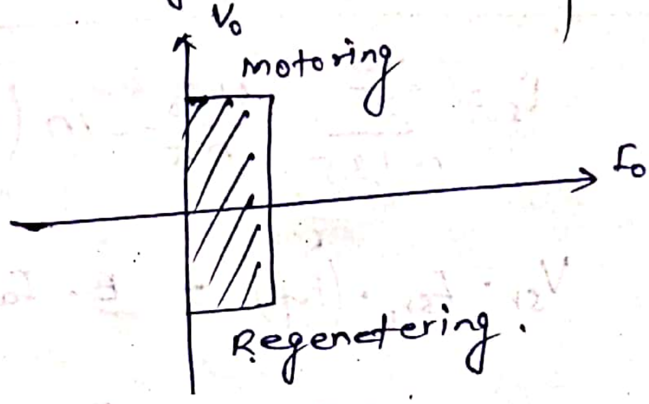
3) 1-Φ Full wave bridge converter:—

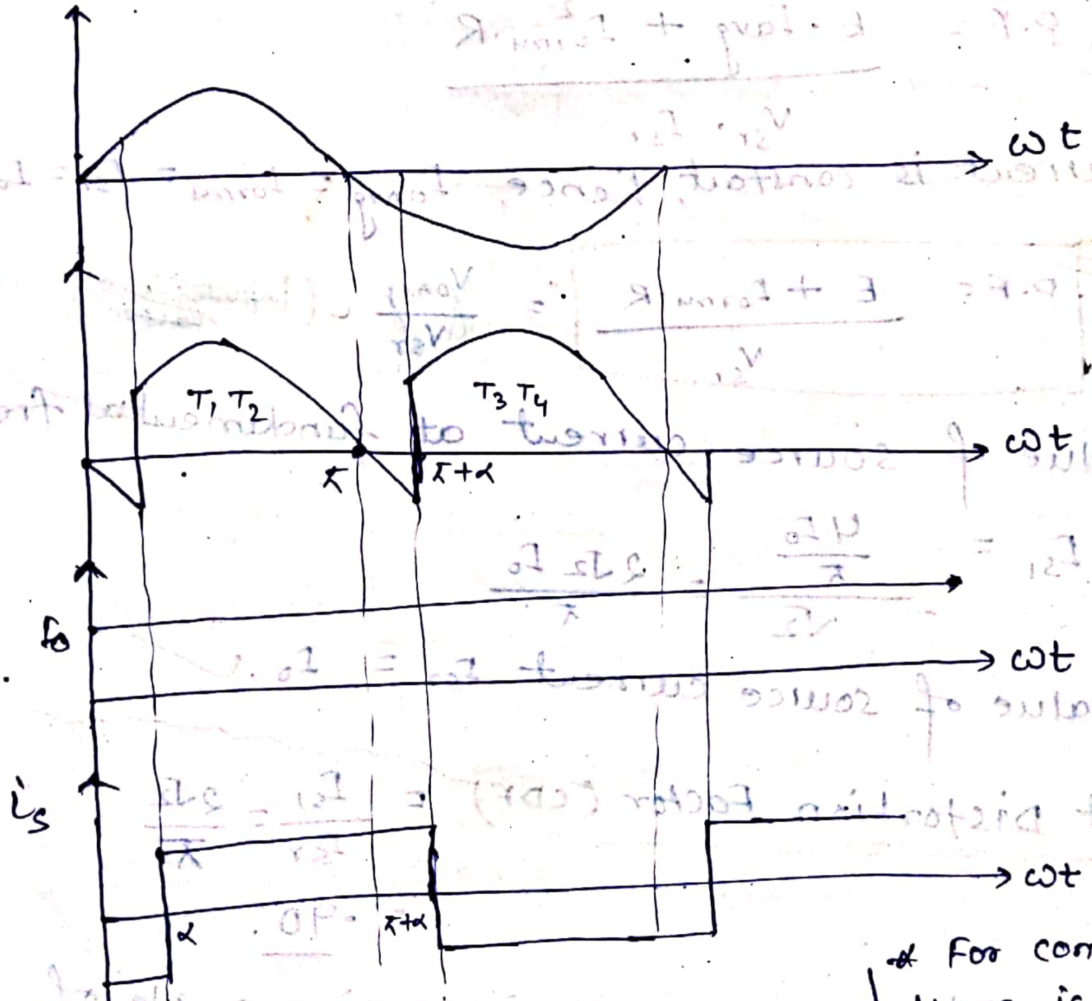
→ It is used for two quadrant operation.

→ Used for motoring and regenerating operation.









$$V_{OAvg} = \frac{1}{2\pi/2}\int_{\alpha}^{\pi+\alpha} V_m \sin\omega t \, d\omega t$$

$$\boxed{V_{OAvg} = \frac{2V_m}{\pi}\cos\alpha}$$

* For R-L-E load-

$V_{OAvg} = I_{OAvg}R + E$

$\therefore I_{OAvg} = \frac{V_{OAvg} - E}{R}$

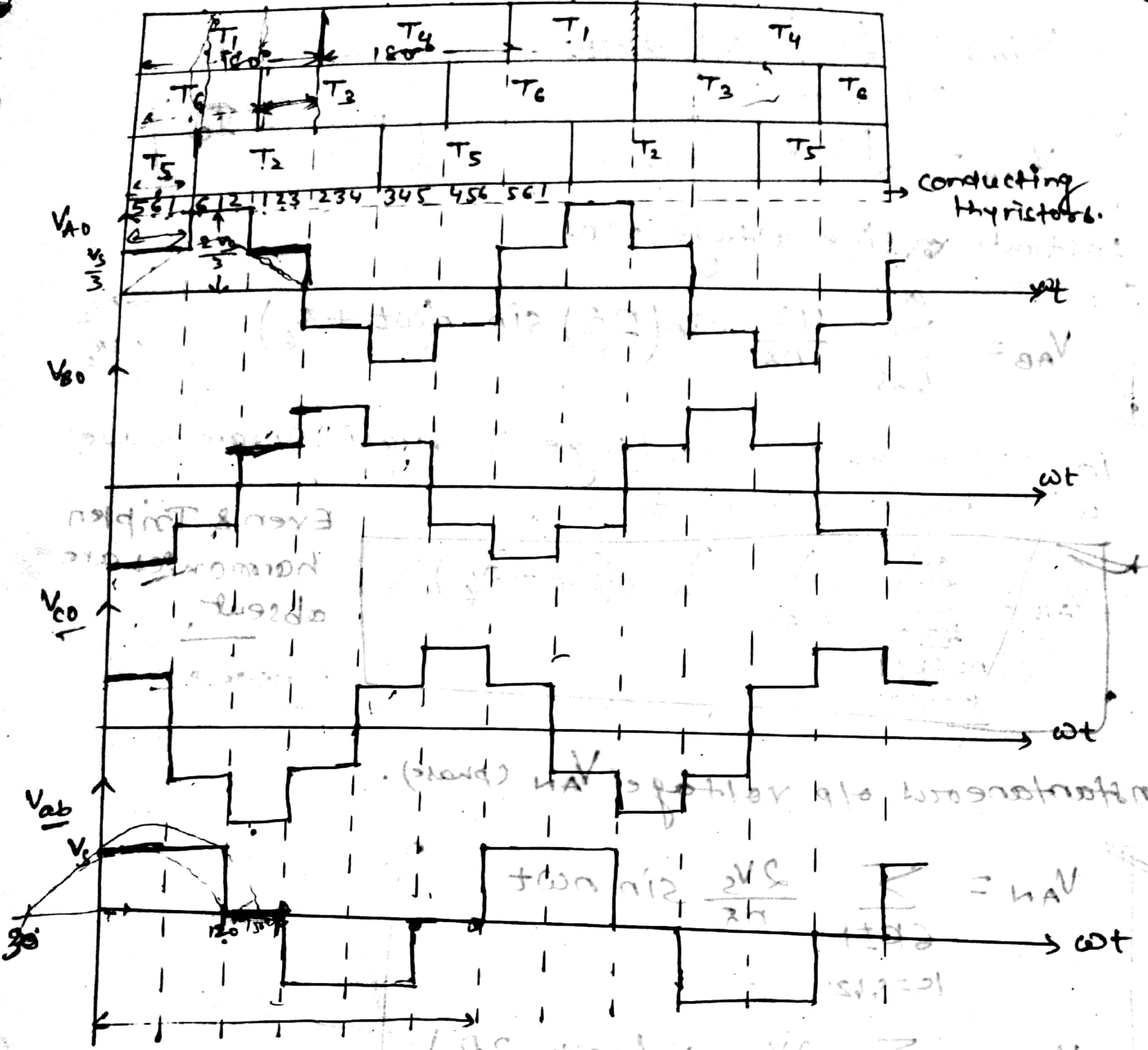
* For continuous conduction there is no effect of back emf in the o/p voltage.
* The cont. cond? wave form will remain same for R-L and R-L-E load.
* $\boxed{V_{OAvg} = \frac{2V_m}{\pi}\cos\alpha.}$

For both RL & RLE load.

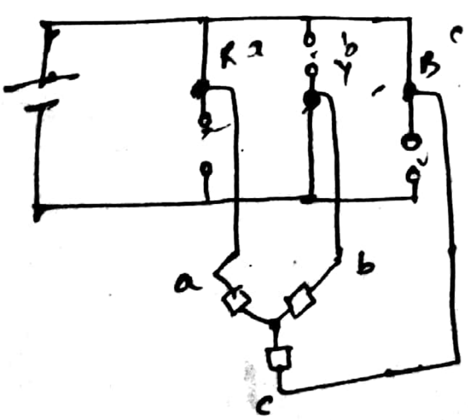
(3) (ii) (180°, 60°)

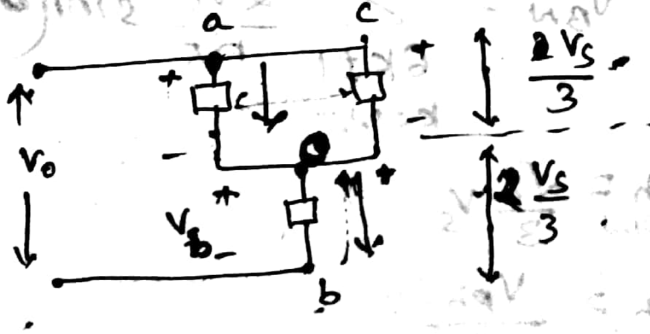
180° conduction mode :-

* Each T conducts for 180°
* The phase angle between one switching devices & other is 60°
* At any instant of time 3- switching devices are conducting.
* The phase voltage wave form is 3-stepped sq. wave.
* The line voltage ———— is quasi sq. wave.
* Commutation time for the same leg switching devices is zero. ⇒ Draw back.



0-60° → $T_1\ T_5\ T_6$ → ON.





$$V_{ao} = V_{co} = \frac{V_s}{3}$$

$$V_{bo} = -\frac{2V_s}{3}$$

$$V_{L\,rms} = \sqrt{\frac{1}{\pi}\int_0^{2\pi/3} (V_s)^2 \, d\omega t}$$

$$V_{L\,rms} = \sqrt{2/3}\, V_s$$

$$\left[I_{sr} = \sqrt{2/3}\, I_o \right]$$

Instant. line voltage o/p.

$$V_{AB} = \sum_{1,3,5}^{\infty} \frac{4V_s}{n\pi} \sin\left(\frac{n\pi}{3}\right) \sin n\left(\omega t + \pi/6\right)$$

$-\pi/2$

$+5\pi/6$

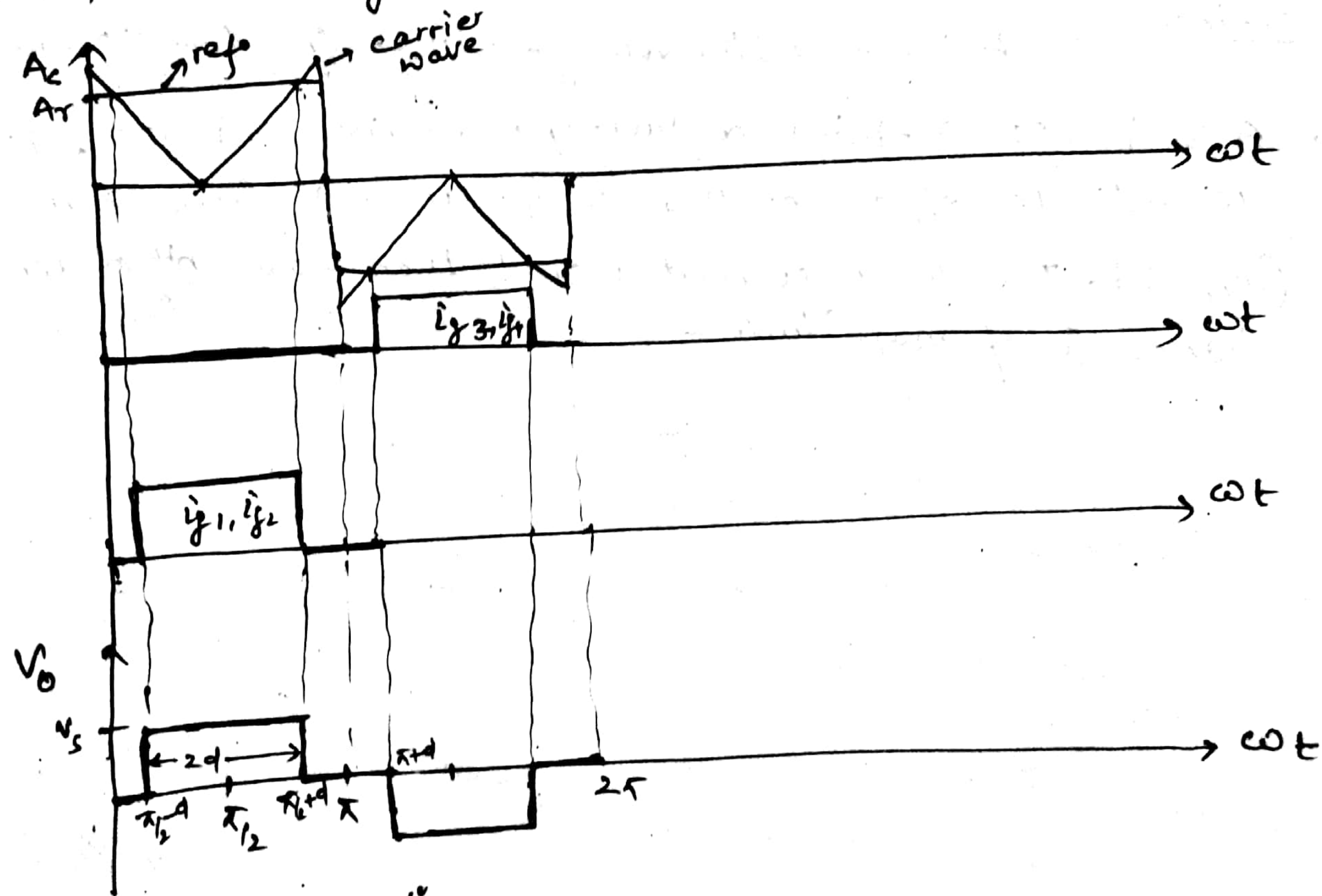
3(iii) Pulse width modulation Technique:—

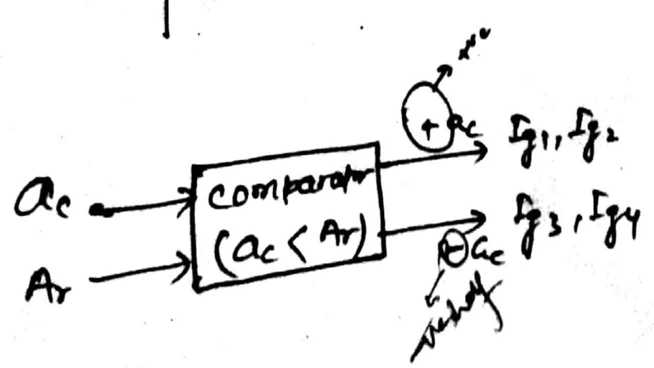
* Instead of applying gate pulse $T/2$ or 180° period, vary the pulse width 0 to $T/2$ or 0 to 180°, so that the o/p voltage is controllable.
* We can control the voltage within the inverter itself without increasing the no. of stages.
* We can also eliminate some of the lower harmonics & we can easily filter higher order harmonics using small size filter.

Types—

① Single pulse modulation Technique:—

For 1-ϕ full bridge inverter:—





O/P RMS voltage,

$$V_{orms} = \sqrt{\frac{1}{\pi}\int_{\pi/2-d}^{\pi/2+d} V_s^2 \cdot d\omega t}$$

$$\boxed{V_{orms} = V_s \cdot \sqrt{\frac{2d}{\pi}}} \Rightarrow \left[V_{orms} = V_s \cdot \sqrt{\frac{\text{pulse width}}{\pi}} \right]$$

HARMONIC ANALYSIS:-

+1 (+ve volt) or −1 (−ve volt), = 0 for n = even

$$V_0 = \sum_{n=1,3,5}^{\infty} \frac{4V_s}{n\pi} \sin\left(\frac{n\pi}{2}\right) \cdot \sin(nd) \cdot \sin n\omega t$$

$$V_{on} = \frac{4V_s}{n\pi} \sin\left(\frac{n\pi}{2}\right) \cdot \sin(nd) \cdot \sin(n\omega t).$$

To eliminate n^{th} harmonic,

$V_{on} = 0 \Rightarrow \sin nd = 0$

$nd = \pi$

$d = \frac{\pi}{n} \Rightarrow \boxed{2d = \frac{2\pi}{n}}$ pulse width.

Ex. To eliminate 5^{th} harmonic,

$\sin 5d = 0$

$5d = \pi$

$d = \pi/5 \Rightarrow \boxed{2d = 2\pi/5.}$

72° pulse width for elimination of 3rd. harmonic