# output voltage equation of Cycloconverter

The output voltage waveform for an m-phase converter with firing delay angle $\alpha$, is shown in Fig.          With the time origin, $PP'$ taken at the peak value of the supply voltage, the instantaneous phase voltage is given by $e = E_m \cos \omega t = \sqrt{2} E_{ph} \cos \omega t$

where, $E_{ph}$ = Supply voltage per phase (rms).

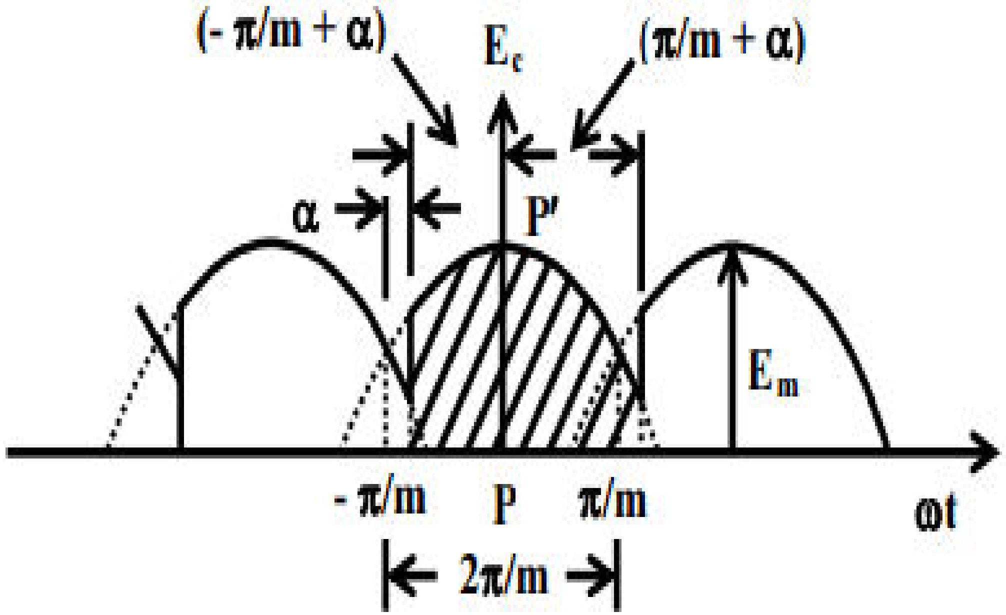


**Fig.          Output voltage waveform for m-phase converter with firing angle α**

From Fig.  , it can be observed that the conduction period is from $(-\pi/m)$ to $(\pi/m)$, if the firing delay angle is $\alpha = 0°$. For the firing delay angle $\alpha$, the conduction period is from $(-(\pi/m)+\alpha)$ to $((\pi/m)+\alpha)$. From the above cases, the total conduction period is $((2\cdot\pi)/m)$.

The average value of the output voltage is,

$$E_{dc} = \left(\frac{m}{2\cdot\pi}\right)\cdot\int_{(-(\pi/m)+\alpha)}^{((\pi/m)+\alpha)} \sqrt{2}\,E_{ph}\cos\omega t\, d(\omega t) = \sqrt{2}\,E_{ph}\cdot\left(\frac{m}{\pi}\right)\cdot\sin\left(\frac{\pi}{m}\right)\cdot\cos\alpha$$

This expression is obtained for dc to ac converter in module 2, and also available in text book.

When the firing delay angle is $\alpha = 0°$, $E_{dc}$ has the maximum value of

$$E_{d0} = \sqrt{2} \cdot E_{ph} \cdot \left(\frac{m}{\pi}\right) \cdot \sin\left(\frac{\pi}{m}\right)$$

If the delay angle in the cyclo-converter is slowly varied as given earlier, the output phase voltage at any point of the low frequency cycle may be calculated as the average voltage for the appropriate delay angle. This ignores the rapid fluctuations superimposed on the average low frequency waveform. Assuming continuous conduction, the average voltage is $E_{dc} = E_{d0} \cdot \cos\alpha$.

If $E_{0r}$ is the fundamental component of the output voltage (rms) per phase for the cyclo-converter, then the peak output voltage for firing angle of 0° is,

$$\sqrt{2} \cdot E_{0r} = E_{d0} = \sqrt{2} \cdot E_{ph} \cdot \left(\frac{m}{\pi}\right) \cdot \sin\left(\frac{\pi}{m}\right)$$

or, $E_{0r} = E_{ph} \cdot \left(\frac{m}{\pi}\right) \cdot \sin\left(\frac{\pi}{m}\right)$