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$$I = \frac{\omega}{2\pi}\int_0^{2\pi/\omega} |Z||U|^2 \cos(\omega t+\beta+\theta)\cos(\omega t+\beta)\,dt$$

$$= |Z||U|^2\frac{\omega}{2\pi}\int_0^{2\pi/\omega}\left(\cos(\omega t+\beta)\cos\theta - \sin(\omega t+\beta)\sin\theta\right)\cos(\omega t+\beta)\,dt$$

$$= |Z||U|^2\left\{\frac{\omega}{2\pi}\int_0^{2\pi/\omega}\cos^2(\omega t+\beta)\cos\theta\,dt - \frac{\omega}{2\pi}\int_0^{2\pi/\omega}\cancelto{0}{\sin(\omega t+\beta)\cos(\omega t+\beta)}\sin\theta\,dt\right\}$$

odd over even region

$$= |Z||U|^2\frac{\omega}{2\pi}\cos\theta\int_0^{2\pi/\omega}\cos^2(\omega t+\beta)\,dt = |Z||U|^2\frac{\omega}{2\pi}\cos\theta\int_0^{2\pi/\omega}\left(\frac{1}{2}+\frac{1}{2}\cos(2(\omega t+\beta))\right)dt$$

$$= |Z||U|^2\frac{\omega}{2\pi}\cos\theta\left(\frac{2\pi}{\omega}\cdot\frac{1}{2}+\int_0^{2\pi/\omega}\cos(2\omega t+2\beta)\,dt\right)$$

$$= |Z||U|^2\frac{\omega}{2\pi}\cos\theta\left(\frac{\pi}{\omega}+\right.$$

$u = 2\omega t + 2\beta$

$du = 2\omega t$: take the indefinite integral

$$\frac{1}{2\omega}\int_0^{u-2\beta}\frac{1}{2}\cos u\,du = \frac{1}{4\omega}\int_0^{u-2\beta}\cos u\,du$$

$$= \frac{1}{4\pi}\sin(2\omega t+2\beta)\Big|_0^{2\pi/\omega}$$

$$= \frac{1}{4\pi}\left(\sin(4\pi+2\beta)-\sin 2\beta\right)$$

$$= \frac{1}{4\pi}\left(\cancelto{0}{\sin 4\pi\cos 2\beta} + \cos 4\pi\sin 2\beta - \sin 2\beta\right)$$

$$= \frac{1}{4\pi}\left(1\sin 2\beta - \sin 2\beta\right)$$

$$= 0$$

$$= |Z||U|^2\left(\frac{\omega}{2\pi}\cos\theta\right)\frac{\pi}{\omega} = \underline{\frac{1}{2}\cos\theta\,|Z||U|^2}$$