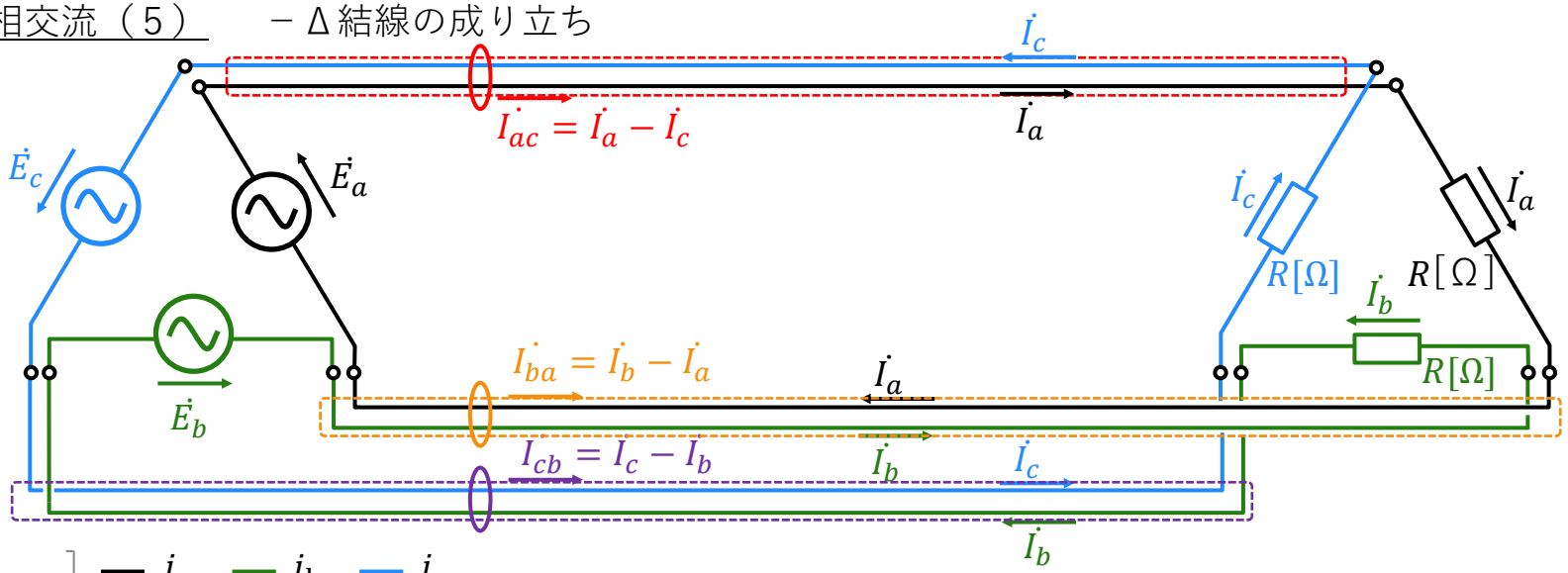
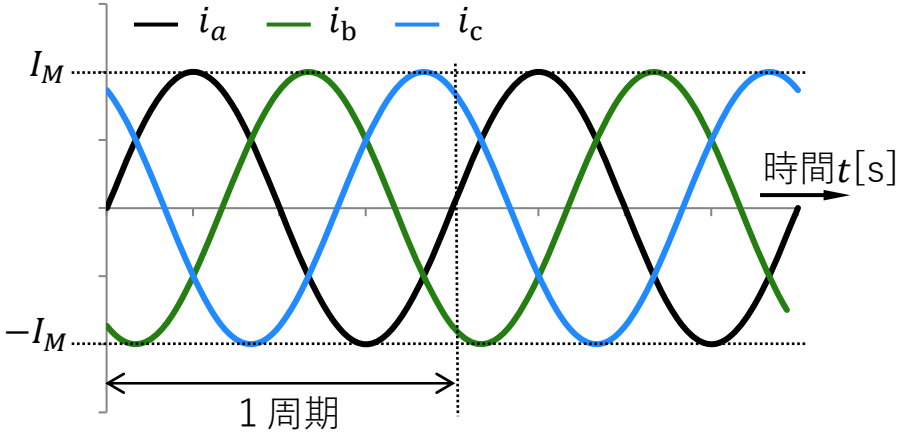
三相交流（５）　－Δ結線の成り立ち



$$\dot{E}_a = E\angle 0$$

$$\dot{E}_b = E\angle\left(-\frac{2\pi}{3}\right)$$

$$\dot{E}_c = E\angle\left(-\frac{4\pi}{3}\right)$$



$$i_a(t) = I_M \sin\omega t$$

$$i_b(t) = I_M \sin\left(\omega t - \frac{2\pi}{3}\right)$$

$$i_c(t) = I_M \sin\left(\omega t - \frac{4\pi}{3}\right)$$

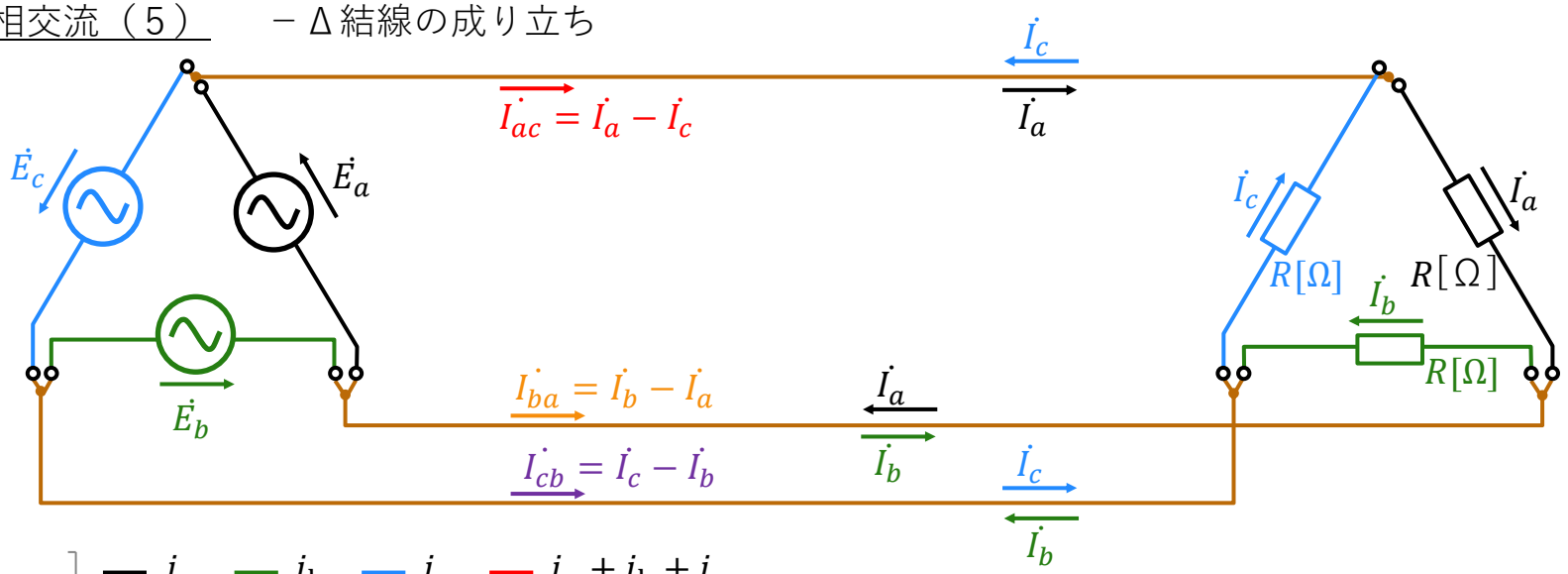
$$\dot{I}_a = I\angle 0$$

$$\dot{I}_b = I\angle\left(-\frac{2\pi}{3}\right)$$

$$\dot{I}_c = I\angle\left(-\frac{4\pi}{3}\right)$$

但し、 $I = \frac{I_M}{\sqrt{2}}$

三相交流（５）　－Δ結線の成り立ち

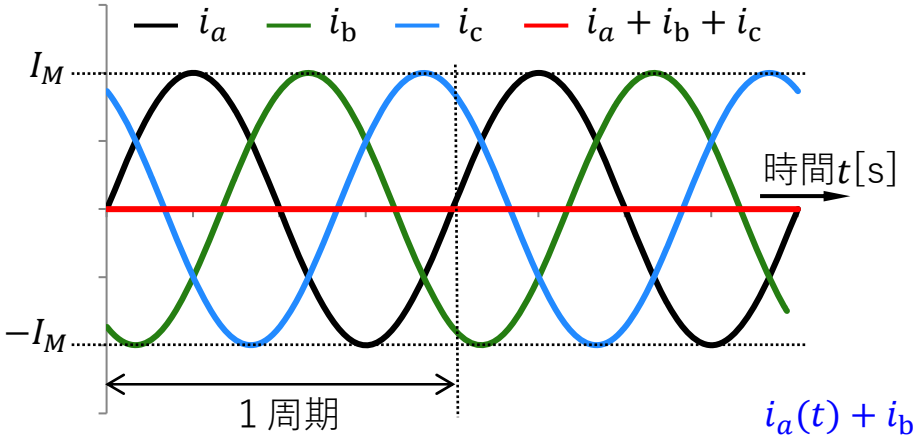


$$\dot{E}_a = E\angle 0$$

$$\dot{E}_b = E\angle\left(-\frac{2\pi}{3}\right)$$

$$\dot{E}_c = E\angle\left(-\frac{4\pi}{3}\right)$$

Δ結線



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$$\dot{I}_a = I\angle 0$$

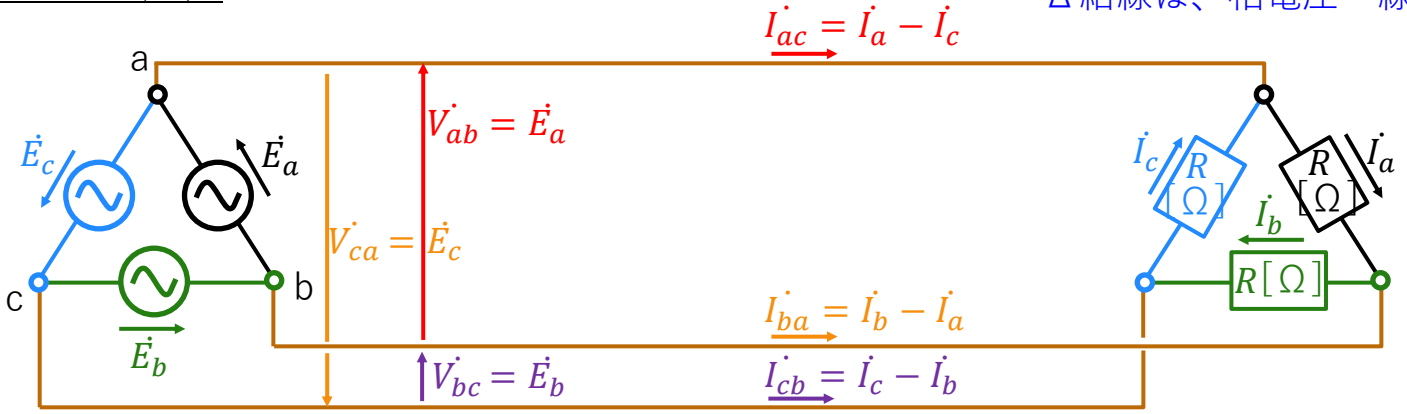
$$\dot{I}_b = I\angle\left(-\frac{2\pi}{3}\right)$$

$$\dot{I}_c = I\angle\left(-\frac{4\pi}{3}\right)$$

但し、 $I = \frac{I_M}{\sqrt{2}}$

$i_a(t) + i_b(t) + i_c(t)$は、どの瞬間もゼロ[V]

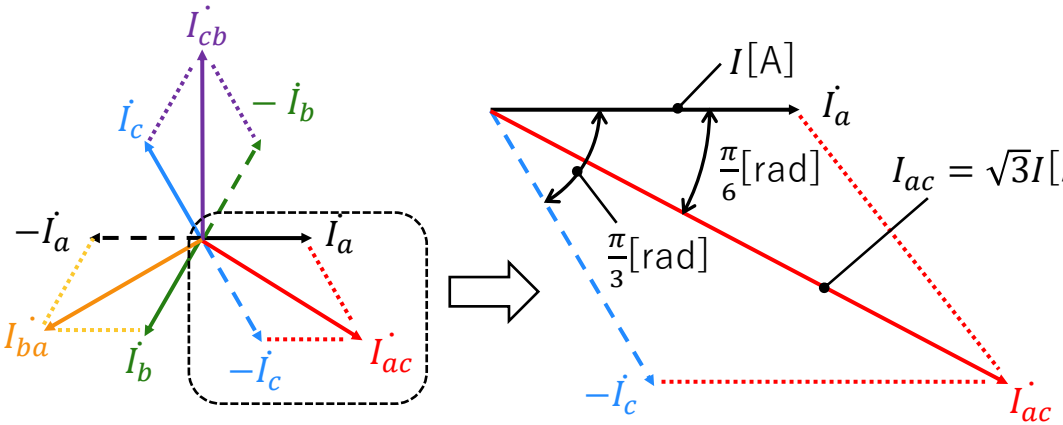
三相交流（６）　－Δ結線の線間電圧・相電圧



Δ結線は、相電圧＝線間電圧

相電圧
$$\dot{E}_a = E\angle 0$$
$$\dot{E}_b = E\angle\left(-\frac{2\pi}{3}\right)$$
$$\dot{E}_c = E\angle\left(-\frac{4\pi}{3}\right)$$

線間電圧
$$\dot{V}_{ab} = \dot{E}_a$$
$$\dot{V}_{bc} = \dot{E}_b$$
$$\dot{V}_{ca} = \dot{E}_c$$

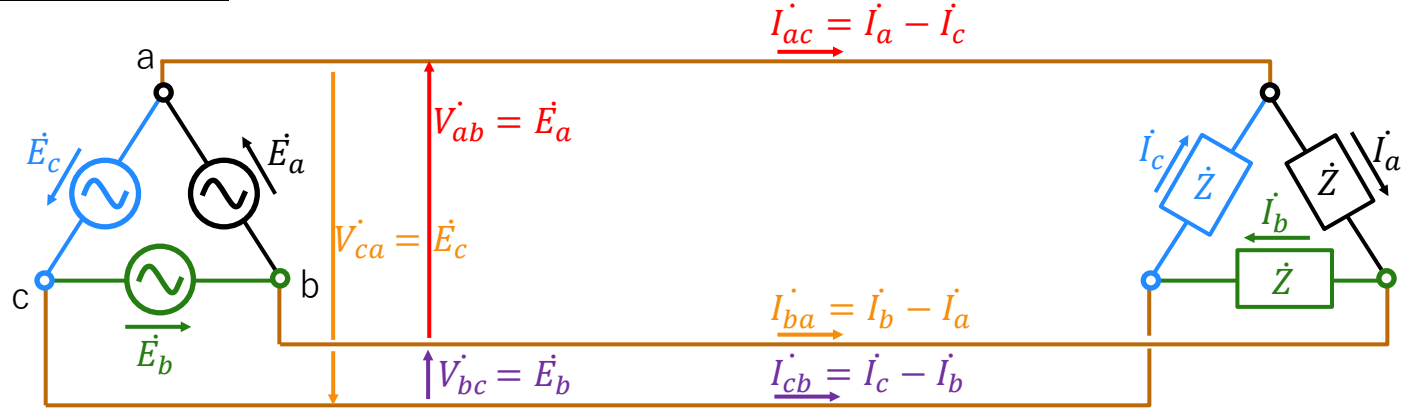


相電流
$$\dot{I}_a = I\angle 0$$
$$\dot{I}_b = I\angle\left(-\frac{2\pi}{3}\right)$$
$$\dot{I}_c = I\angle\left(-\frac{4\pi}{3}\right)$$

線電流
$$\dot{I}_{ac} = \sqrt{3}I\angle\left(0-\frac{\pi}{6}\right) = \sqrt{3}E\angle\left(-\frac{\pi}{6}\right)$$
$$\dot{I}_{ba} = \sqrt{3}I\angle\left(-\frac{2\pi}{3}-\frac{\pi}{6}\right) = \sqrt{3}E\angle\left(-\frac{5\pi}{6}\right)$$
$$\dot{I}_{cb} = \sqrt{3}I\angle\left(-\frac{4\pi}{3}-\frac{\pi}{6}\right) = \sqrt{3}E\angle\left(-\frac{3\pi}{2}\right)$$

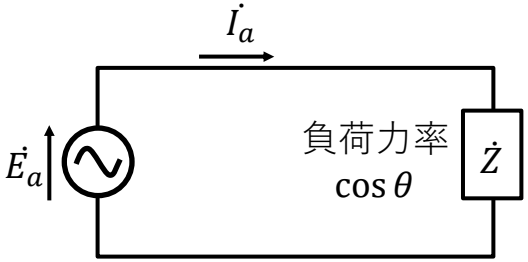
線電流＝$\sqrt{3}$ ×相電流　　相電流＝$\frac{\text{線電流}}{\sqrt{3}}$　　線電流は相電流に対し、位相が$\frac{\pi}{6}$[rad]遅れている

三相交流（７）　－Δ結線の一相等価回路



$|\dot{V}_{ab}| = |\dot{V}_{bc}| = |\dot{V}_{ca}| = |\dot{E}_a| = |\dot{E}_b| = |\dot{E}_c| = V$ [V]　　$|\dot{I}_{ac}| = |\dot{I}_{ba}| = |\dot{I}_{cb}| = I$ [A]　　$|\dot{I}_a| = |\dot{I}_b| = |\dot{I}_c| = \dfrac{I}{\sqrt{3}}$ [A]

【a相等価単相回路】



有効電力[W]：

$$P = |\dot{E}_a||\dot{I}_a|\cos\theta = \frac{VI}{\sqrt{3}}\cos\theta$$

無効電力[var]：

$$Q = |\dot{E}_a||\dot{I}_a|\sin\theta = \frac{VI}{\sqrt{3}}\sin\theta$$

三相分だと
3倍なので

有効電力[W]：

$$P = 3 \cdot \frac{VI}{\sqrt{3}}\cos\theta = \sqrt{3}VI\cos\theta$$

無効電力[var]：

$$Q = 3 \cdot \frac{VI}{\sqrt{3}}\sin\theta = \sqrt{3}VI\sin\theta$$