BWW Ex 11.7

3-fasig diodlikriktare med RL-last 10Ω, $50\,mH$

Nätspänning $415V$, $50\,Hz$

i) Medelspänning och ström

Medelspänningen fås genom att integrera

$\hat{U}_{LL}\cos(\omega t)$ över $-\frac{\pi}{6} \le \omega t \le \frac{\pi}{6}$

$$V_{dc} = \frac{1}{T/6}\int_{T/6} \hat{U}_{LL}\cos(\omega t)\,dt = \frac{1}{T/6}\int_{T/6} \hat{U}_{LL}\cos(\omega t)\,dt\cdot\omega\cdot\frac{1}{\omega} =$$

$$= \frac{1}{\omega T/6}\int_{-\pi/6}^{\pi/6} \hat{U}_{LL}\cos(\omega t)\,d(\omega t) = \frac{6}{\omega T}\Big[\hat{U}_{LL}\sin(\omega t)\Big]_{-\pi/6}^{\pi/6} = \{\omega T = 2\pi\} =$$

$$= \frac{\hat{U}_{LL}6}{2\pi}\left(\sin\frac{\pi}{6} - \sin\left(-\frac{\pi}{6}\right)\right) = \frac{\hat{U}_{LL}\cdot 6}{2\pi}\,2\underbrace{\sin\frac{\pi}{6}}_{1/2} =$$

$$= \frac{\hat{U}_{LL}\cdot 6}{2\pi} = \frac{3\cdot\sqrt{2}\cdot U_{LL}}{\pi} = 1{,}35\cdot U_{LL} = \underline{\underline{560{,}45V}}$$

Medelspänningen över L är noll. Alltså ligger hela medelspänningen över R. $\Rightarrow I_{LOAD} = \frac{V_{dc}}{R_{LOAD}} = \underline{\underline{56{,}05A}}$

ii) RMS-spänningen fås som: $V_{RMS} = \sqrt{\frac{1}{T}\int v^2(t)\,dt}$

Alltså måste $U_{LL}^2(t)$ integreras

$$U_{LL}^2(t) = \left(\hat{U}_{LL}\cos(\omega t)\right)^2 = \hat{U}_{LL}^2\cdot\cos^2(\omega t) = \{\cos 2\alpha = 2\cos^2\alpha - 1\}$$

$$= \frac{\hat{U}_{LL}^2}{2}\left(1+\cos(2\omega t)\right)$$

$$V_{dc_{RMS}} = \sqrt{\frac{1}{T/6}\int_{T/6}\frac{\hat{U}_{LL}^2}{2}\left(1+\cos(2\omega t)\right)dt} =$$

$$= \sqrt{\frac{1}{\omega T/6}\int_{-\pi/6}^{\pi/6}\frac{\hat{U}_{LL}^2}{2}\left(1+\cos(2\omega t)\right)d(\omega t)} =$$

$$= \sqrt{\frac{3\hat{U}_{LL}^2}{\omega T}\left[\omega t + \frac{1}{2}\sin(2\omega t)\right]_{-\pi/6}^{\pi/6}} =$$

$$= \sqrt{\frac{3\hat{U}_{LL}^2}{\omega T}\left(\frac{\pi}{6} - \left(-\frac{\pi}{6}\right) + \frac{1}{2}\left(\sin\frac{\pi}{3} - \sin\left(-\frac{\pi}{3}\right)\right)\right)} =$$

$$= \sqrt{\frac{3\hat{U}_{LL}^2}{2\pi}\left(\frac{\pi}{3} + \sin\frac{\pi}{3}\right)} = \sqrt{\frac{3\hat{U}_{LL}^2}{2\pi}\left(\frac{\pi}{3} + \frac{\sqrt{3}}{2}\right)} =$$

$$= \hat{U}_{LL}\sqrt{\frac{1}{2} + \frac{3\sqrt{3}}{4\pi}} = U_{LLRms} \cdot \sqrt{2}\sqrt{\frac{1}{2} + \frac{3\sqrt{3}}{4\pi}} =$$

$$= U_{LLRms}\sqrt{1 + \frac{3\sqrt{3}}{2\pi}} = U_{LLRms} \cdot 1{,}35166 = \underline{\underline{560{,}94\,V}}$$

$$V_{dcRms} = \sqrt{V_{acRms}^2 + V_{dcAVG}^2} \Rightarrow$$

$$V_{acRms} = \sqrt{V_{dcRms}^2 - V_{dcAVG}^2} = \sqrt{560{,}94^2 - 560{,}45^2} = \underline{\underline{23{,}45\,V}}$$

U. Förlusterna i en diod kan beräknas mha. medelström och Rms-ström enligt:

$$P_D = \frac{1}{3}\left(V_{T0} \cdot \bar{I}_0 + R_T \cdot \bar{I}_0^2\right)$$ ← Detta kommer att visas senare i kursen!

← varje diod leder bara 1/3 av tiden

$$V_{T0} \cdot \underline{\frac{\bar{I}_0}{3}} + R_T\left(\frac{\bar{I}_0}{\sqrt{3}}\right)^2 = V_{T0} \cdot \underline{I_{DAVG}} + R_T \cdot I_{DRms}^2 \Rightarrow$$

$$I_{DAVG} = \frac{\bar{I}_0}{3} = \frac{56{,}045}{3} = \underline{\underline{18{,}7\,A}}$$

$$I_{DRms} = \frac{\bar{I}_0}{\sqrt{3}} = \frac{56{,}045}{\sqrt{3}} = \underline{\underline{32{,}4\,A}}$$ (Fel i boken)