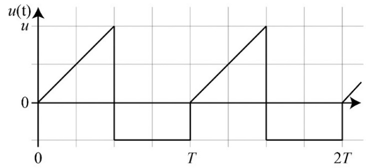
BSP 1

Bestimmen Sie für die gezeigte Spannung

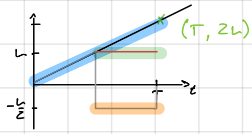
- Mittelwert $\bar{u}$
- Gleichrichtwert $|\bar{u}|$
- Effektivwert U
- Spitze-Spitze-Wert u_{ss}



MITTELWERT $\quad \bar{u} = \frac{1}{T}\int_{t_0}^{t_0+T} u(t)\,dt = \frac{1}{T}\int_0^T u(t)\,dt = \frac{1}{T}\left[\int_0^{T/2} \frac{2u}{T} t\,dt + \int_{T/2}^{T} \frac{-u}{2}\,dt\right]$

$$= \frac{1}{T}\left[\left[\frac{u t^2}{T}\right]_0^{T/2} - \frac{uT}{4}\right]$$

$$= \frac{1}{T}\left[\frac{uT}{4} - \frac{uT}{4}\right] = \underline{\underline{0}}$$



GLEICHRICHTWERT $\quad |\bar{u}| = \frac{1}{T}\left[\int_0^{T/2} \frac{2u}{T} t\,dt + \int_{T/2}^{T} \frac{+u}{2}\,dt\right] = \ldots = \underline{\underline{\frac{u}{2}}}$

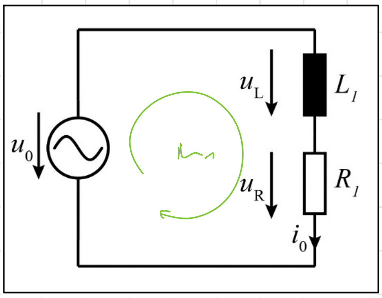
EFFEKTIVWERT $\quad U \;(= U_{eff}) = \sqrt{\frac{1}{T}\int_0^T u^2(t)\,dt} = \sqrt{\frac{1}{T}\left(\int_0^{T/2} \frac{4u^2t^2}{T^2}\,dt + \int_{T/2}^{T} \frac{u^2}{4}\,dt\right)}$

$$= \sqrt{\frac{1}{T}\left(\left[\frac{4u^2t^3}{3T^2}\right]_0^{T/2} + \left[\frac{u^2 t}{4}\right]_{T/2}^{T}\right)} = \sqrt{\frac{1}{T}\left(\frac{4u^2T}{24} + \frac{u^2T}{4} - \frac{u^2T}{8}\right)}$$

$$= \sqrt{\frac{1}{\cancel{T}}\left(\frac{u^2\cancel{T}}{6} + \frac{u^2\cancel{T}}{8}\right)} = \underline{\underline{u\sqrt{\frac{7}{24}}}}$$

SPITZE - SPITZE - WERT $\quad u_{ss} = \underline{\underline{\frac{3}{2}u}} \quad$ (ABLESEN)

Bsp 2



Gegeben:
$i(t) = \hat{i}\cos(\omega t)$, $\hat{i} = 1A$, $\omega = 1000Hz$, $R = 2\Omega$, $L = 1mH$

Basic, aber wichtig: $\omega = 2\pi f = \frac{2\pi}{T}$

Wir wissen:

- $u_R(t) = R\cdot i(t) = R\cdot\hat{i}\cos(\omega t) = 2\cdot\cos(1000t)$ ✓

- $u_L(t) = L\cdot\frac{d}{dt}i(t) = -\underbrace{L\cdot\omega}_{=1}\cdot\hat{i}\cdot\sin(\omega t) = -1\cdot\sin(1000t) = 1\cdot\cos(1000t + \frac{\pi}{2})$ ✓

Im Bildbereich:

$\underline{\hat{i}} = \hat{i}\cdot e^{j\varphi_i} e^{j\omega t}$

$\underline{\hat{u}}_R = \hat{u}_R e^{j\varphi_{u_R}} e^{j\omega t} = R\cdot\hat{i}\cdot e^{j\varphi_{u_R}} e^{j\omega t}$

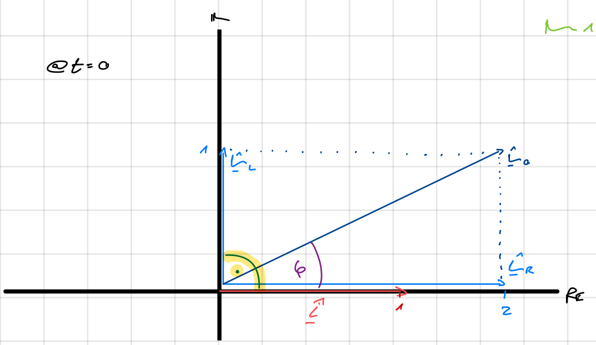
$\underline{\hat{u}}_L = \hat{u}_L e^{j\varphi_{u_L}} e^{j\omega t} = L\omega\hat{i}\, e^{j\frac{\pi}{2}} e^{j\omega t}$

$\varphi_i = 0$, da es so in Cosinus gegeben ist.
$\varphi_{u_R} = 0$, "
$\varphi_{u_L} = +\frac{\pi}{2}$

@ $t=0$: $i(t=0) = Re\{\underline{\hat{i}}\} = Re\{\hat{i}\cdot e^{j\varphi_i} e^{j\omega 0}\} = \hat{i}\cdot\cos(\underbrace{\varphi_i}_{=0}) = \hat{i}\cdot\cos(0) = \hat{i} = 1A$

$u_R(t=0) = Re\{\underline{\hat{u}}_R\} = Re\{\hat{u}_R e^{j\varphi_{u_R}} e^{j\omega 0}\} = R\hat{i}\cos(\varphi_{u_R}) = R\hat{i} = 2V$

- @$t=0$



M1: $\underline{\hat{u}}_0 = \underline{\hat{u}}_R + \underline{\hat{u}}_L$ $\forall t$, also auch für $t = 0$ ... [V]

($\varphi_{u_R} = 0$)

$\underline{\hat{u}}_0 = R\cdot\hat{i}\cdot e^{j\varphi_{u_R}} + L\omega\hat{i}\, e^{j\frac{\pi}{2}}$

$= 2 + j = a + jb$

$= \sqrt{5}\, e^{j\,26.6^\circ} = r e^{j\varphi}$

- Aus $\omega = 1000\,Hz$ folgt direkt: $T = \frac{2\pi}{\omega} = 6.28\cdot 10^{-3}\,s \longrightarrow \frac{T}{8} = 7.85\cdot 10^{-4}\,s$

Somit ist: $u_0(T/8) = |\underline{\hat{u}}_0|\cdot\cos(\omega\frac{T}{8} + \varphi)$

φ = Phasenverschiebung

$= \arctan\left(\frac{Im\{\underline{\hat{u}}_0\}}{Re\{\underline{\hat{u}}_0\}}\right) = \arctan\left(\frac{1}{2}\right) \hat{=} 26.6^\circ$

⟶ Diese Phasenverschiebung φ bleibt konstant.

$= \sqrt{2^2 + 1^2}\cdot\cos(\omega\frac{T}{8} + 26.6^\circ)$

$=$ [TR] $= 0.71\,A$

$i(\frac{T}{8}) = \hat{i}\cos(\omega\frac{T}{8}) =$ [TR] $= 0.71\,A$