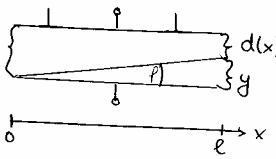
Blindleistung - Wirkleistung

$\boxed{Q = \frac{\omega_L}{R}} \Rightarrow \omega_L = Q \cdot R$

$\boxed{\tan\alpha = \frac{R}{\omega L} = \frac{P_\omega}{P_B}} \Rightarrow \boxed{P_\omega = \frac{P_B}{Q}}$

Winkelkondensator



$C(x) = \frac{\varepsilon \cdot A}{d} = C_0 \frac{1}{1-\alpha x}$

$\frac{dC}{dx} = C_0 \alpha \cdot \frac{1}{(1-\alpha x)^2}$

$\Rightarrow dc = -C_0 \alpha \frac{1}{(1-\alpha x)^2} dx$

$\tan\rho = \frac{y}{x}$

$\Delta C_{ges} = -C_0 \int_0^l -\frac{\alpha}{(1-\alpha x)^2} dx$

$\Rightarrow y = x \cdot \tan\rho$

$= \left[C_0 \frac{1}{1-\alpha x}\right]_0^l$

$d_x = d_0 - x \cdot \tan\rho$

$\boxed{\alpha = \frac{\tan\rho}{d_0}}$ $\boxed{\Delta C_{ges}(\rho) = C_0\left(\frac{1}{1-\alpha l} - 1\right)}$

Ringspule

$\frac{\partial}{\partial r} \times \underline{B} = \mu j$ Stoke'scher Integrals. $\oint \underline{B} dr = \boxed{\underbrace{\iint_A \frac{\partial}{\partial r} \times B d^2 r}_{\mu j}}$

$\underbrace{\iint_A \mu j d^2 r}_{\mu \cdot I} \Rightarrow \oint \underline{B} dr$ Stromdichte $\boxed{j = \frac{I}{A}}$

$\Rightarrow$

$\mu I = \oint_{umfang} \underline{B} dr$ Magnetfeld $\boxed{B = \frac{\mu \cdot N \cdot I}{2\pi r}}$ N = Windanzahl

Induktivität $\boxed{L = \frac{N\phi}{I}}$ ϕ magn. Fluß

$\phi = \iint B d^2 r$, wenn Dicke der Spule const

$\Rightarrow \phi = \int_a^b B h dr$ b = Außenradius, a = Innenradius

einsetzen von B

$\Rightarrow \phi = \int_a^b \frac{\mu N I h}{2\pi} \frac{1}{r} dr$

$\boxed{\phi = \frac{\mu N I h}{2\pi} \ln\frac{b}{a}}$ magn Fluß

einsetzen in L

$\boxed{L = \frac{\mu \cdot N^2 h}{2\pi} \ln\frac{b}{a}}$ Induktivität

Schichtwiderstand

$\boxed{R_S = \frac{1}{e\mu \int_0^{x'} N(x) dx}}$ $\boxed{N(x) = a(x'-x)^n = a(x-x')^n}$ $N(0) = ax'^n = N_0$ $\boxed{a = \frac{N_0}{x'^n}}$

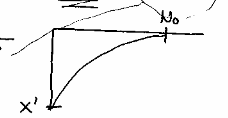
$\boxed{\int_0^{x'} N(x) dx = \frac{N_0 x'}{n+1}}$ n = Ordnung der Fkt.

$\Rightarrow a = \frac{N_0}{x'^2}$

Bsp: $x^2 \Rightarrow n = 2$

$\int_0^{x'} \frac{a(x-x')^2}{N(x)} dx = \left[\frac{a}{3}(x-x')\right]_0^{x'} = \frac{a}{3} x'^3 = \frac{N_0 x'}{3} = \frac{5 \cdot 10^{18} \cdot 3{,}5}{3}$

$R_S = \frac{1 \cdot 3}{1{,}6022 \cdot 10^{-19} \cdot 400 \cdot 10^{-4} \cdot 5{,}83 \cdot 10^{18}}$



$R_S = 26{,}74 \frac{\Omega}{\square}$

elektr. Zollstock

Bsp: $f = 18\,MHz$
$N_Z = 6$ Taktzykl.

$f_Z = \frac{f}{N_Z}$; $\Delta t_Z = \frac{1}{f_Z}$

Ortsauflösung $\boxed{\Delta x_{min}(T) = v(T)_{schall} \cdot \Delta t}$

1) $\boxed{V_n(T_n) = v_0 \sqrt{1 + \frac{T}{273{,}15°C}}}$ $v_0 = 331{,}5\ m/s$
T in °C

$V_1 = \ldots$
$V_2 = \ldots$
$V_3 = \ldots$

2) $\Delta x_1 = \ldots$
$\Delta x_2 = \ldots$
$\Delta x_3 = \ldots$

Abstandsabmessung:

$\boxed{a = v_{T_{20}} \cdot \Delta t(T)}$ mit $\Delta t = \frac{200}{v(T)}$

3) $v =$ z.B 343,2 $\quad s =$ z.B. 200m

$v = \frac{2s}{t}$ $\qquad t = \frac{2s}{v}$

$t_1 = \frac{2s}{v_1} = \ldots$
$t_2 = \frac{2s}{v_2} = \ldots$
$t_3 = \frac{2s}{v_3} = \ldots$

4) $s_1 = \frac{v_1 t_1}{2}$
$s_2 = \frac{v_2 t_2}{2}$
$s_3 = \frac{v_3 t_3}{3}$

Drehoperator

$\boxed{\underline{v} = \underline{v}' + \underline{\omega} \times \underline{r}}$ mit $\underline{v} = D\underline{r}$; $v' = D'\underline{r}'$; $r = r'$

$\Rightarrow D\underline{r} = D'\underline{r}' + \underline{\omega} \times \underline{r}$

$\boxed{D = D' + \omega \times}$

$D\underline{r} = D'\underline{r}' + \underline{\omega} \times \underline{r}$ mit $\underline{\omega} = \underline{\omega}(t)$

$\Rightarrow D\underline{\omega} = D'\underline{\omega}' + \underbrace{\underline{\omega} \times \underline{\omega}}_{=0} = D'\underline{\omega}'$ mit $\underline{v} = \underline{v}(t)$

$\Rightarrow D\underline{v} = D'\underline{v} + \underline{\omega} \times \underline{v}$ mit $\boxed{\underline{v} = v' + \underline{\omega} \times \underline{r}}$

$\Rightarrow D\underline{v} = D'\underline{v}' + D'(\underline{\omega} \times \underline{r}) + \underline{\omega} \times \underline{v}' + \underline{\omega} \times (\underline{\omega} \times \underline{r})$

$\boxed{D'v' = a'}$ (die gemessene Beschl. von einem bewegten Bezugssystem)

mit $D'(\underline{\omega} \times \underline{r}) = \underbrace{(D'\underline{\omega})}_{\underline{\omega}} \times \underline{r} + \underline{\omega} \times \underbrace{D'\underline{r}}_{\underline{v}'}$

$\boxed{D\underline{v} = a}$ (Die gemessene Beschl. von einem ruhenden Bezugssystem)

$\Rightarrow \underline{a} = a' + 2\underline{\omega} \times \underline{v}' + \underline{\omega} \times (\underline{\omega} \times \underline{r}) + \underline{\omega} \times \underline{r}$

mit $m \cdot a = F$

$\Rightarrow F' = m \cdot \underline{a}' = F \underbrace{\underbrace{-2m \cdot \underline{\omega} \times \underline{v}'}_{\text{Corioliskr.}} \underbrace{- m \cdot \underline{\omega} \times (\underline{\omega} \times \underline{r})}_{\text{Zentrifugalkr.}} \underbrace{- m \cdot \underline{\omega} \times \underline{r}}_{\text{Winkelbeschl.}}}_{\text{Rotationskraft}}$

Maxwellgleichung

$$\boxed{\frac{\partial}{\partial \underline{r}} \cdot \underline{E}(\underline{r}) = \frac{\rho(\underline{r})}{\varepsilon}}$$

Gauß'sche Integralsatz ansetzen

$$\iiint_V \underbrace{\frac{\partial}{\partial \underline{r}} \cdot \underline{E}(\underline{r})}_{\frac{\rho(\underline{r})}{\varepsilon}} \, d^3r = \oiint \underline{E}(\underline{r}) \, d^2r$$

$$\Rightarrow \frac{1}{\varepsilon} \iiint_V 1 \, d^3r = \oiint \underline{E}(\underline{r}) \, d^2r = \frac{Q}{\varepsilon} \qquad Q = \rho \cdot V$$

$$\boxed{Q = \varepsilon \oiint \underline{E}(\underline{r}) \, d^2r}$$

$$\frac{\partial}{\partial \underline{r}} \times \underline{E}(\underline{r}) = 0 \Leftrightarrow \underline{E}(\underline{r}) = -\frac{\partial}{\partial \underline{r}} \phi(\underline{r})$$

$$\underline{E}(\underline{r}) \cdot \partial \underline{r} = -\partial \phi \quad \Big| \int$$

$$\boxed{\int_s \underline{E}(\underline{r}) \, dr = -\int_{d_1}^{d_2} 1 \, d\phi = U}$$

allgem. Gleichung der Kap.berechnung

$$C = \frac{Q}{U} = \frac{\varepsilon \oiint \underline{E}(\underline{r}) \, d^2r}{\int \underline{E}(\underline{r}) \, dr}$$

Plattenkondensator

$$C_{Pl} = \varepsilon \frac{\oiint_A \underline{E}(\underline{r}) \, d^2r}{\int_s \underline{E}(\underline{r}) \, dr} = \varepsilon \frac{\underline{E}(\underline{r}) \cdot \oiint_A 1 \, d^2r}{\underline{E}(\underline{r}) \cdot \int_s 1 \, dr}$$

$$\Rightarrow \boxed{C_{Pl} = \varepsilon \frac{A}{d}}$$

Kugelkondensator

$$C_{Kugel} = \varepsilon \frac{\oiint_A \underline{E}(\underline{r}) \, d^2r}{\int_s \underline{E}(\underline{r}) \, dr}$$

$$\Rightarrow Q = \varepsilon \oiint_A \underline{E}(\underline{r}) \, d^2r = \varepsilon \underline{E}(\underline{r}) \underbrace{\oiint_A 1 \, d^2r}_{\text{Kugeloberfl. } (A = 4\pi r^2)}$$

$$= \underbrace{\varepsilon \cdot \underline{E}(\underline{r}) \, 4\pi r^2}_{\text{der radiale Anteil (Radius)}} \qquad \Rightarrow E_{Kugel} = \frac{Q}{4\pi\varepsilon} \cdot \frac{1}{r^2}$$

$$d = -\int_{r_i}^{r_a} \frac{Q}{4\pi\varepsilon} \cdot \frac{1}{r^2} \, dr = -\frac{Q}{4\pi\varepsilon} \left(\frac{1}{r_a} - \frac{1}{r_i} \right)$$

$$= -\frac{Q}{4\pi\varepsilon} \cdot \frac{r_i - r_a}{r_a \cdot r_i}$$

$$C_{Kugel} = 4\pi\varepsilon \left(\frac{r_a \cdot r_i}{r_a - r_i} \right)$$

$\varepsilon_r = 8{,}86 \cdot 10^{-12}$

$\varepsilon = \varepsilon_r \cdot \varepsilon_0$

$\varepsilon_0 = 1$ bei Luft

Zylinderkondensator

$$C_Z = \varepsilon \cdot \frac{\oiint \underline{E}(\underline{r}) \, d^2r}{\int \underline{E}(\underline{r}) \, dr}$$

$$\Rightarrow Q = \varepsilon \oiint_A \underline{E}(\underline{r}) \, d^2r = \varepsilon \underline{E}(\underline{r}) \underbrace{\oiint_A 1 \, d^2r}_{\text{Zylinderoberfl. } (A = 2\pi r \ell)}$$

$$= \varepsilon \underline{E}(\underline{r}) \cdot 2\pi r \ell$$

$$\Rightarrow E_Z = \frac{Q}{2\pi\varepsilon r \ell} = E(r)$$

$$U_{AB} = \int_{r_i}^{r_a} E \, dr = \frac{Q}{2\pi\varepsilon\ell} \int_{r_i}^{r_a} \frac{1}{r} \, dr$$

$$\Rightarrow \boxed{C_{Zyl.} = \frac{2\pi\varepsilon\ell}{\ln\left(\frac{r_a}{r_i}\right)} = \frac{Q}{U_{AB}}}$$

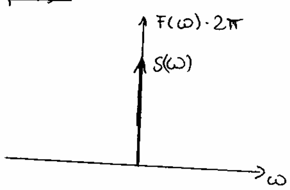
Nicht-zeitbegrenzte Fkt $f(t)$

$f(t) = A$

$$F(\omega) = \int_{-\infty}^{\infty} f(t) \cdot e^{-i\omega t} \, dt$$

$$F(\omega) = \underbrace{\int_{-\infty}^{\infty} A \, e^{-i\omega t} \, dt}_{2\pi \, \delta(\omega)}$$

$$F(\omega) = \delta(\omega) \, 2\pi$$



zeitbegrenzte Fkt $f(t)$

$f(t) = A$

$$\boxed{F(\omega) = \int_{-T_0}^{T_0} f(t) \cdot e^{-i\omega t} \, dt}$$

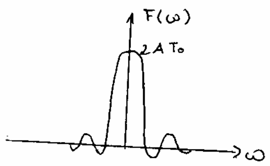
$$= \left[-\frac{A}{i\omega} e^{-i\omega t} \right]_{-T_0}^{T_0}$$

$$= \frac{A}{i\omega} \left[e^{i\omega T_0} - e^{-i\omega T_0} \right] \quad \Big| \cdot \frac{2}{2}$$

$$= \frac{2A}{\omega} \underbrace{\frac{e^{i\omega T_0} - e^{-i\omega T_0}}{2i}}_{\sin(\omega T_0)}$$

$$= \frac{2A}{\omega} \sin(\omega T_0) \quad \Big| \frac{T_0}{T_0}$$

$$= 2AT_0 \frac{\sin(\omega T_0)}{\omega T_0}$$



Nicht-zeitbegrenzte Fkt $f(t)$

$f(t) = A \cdot \sin(\omega_1 t)$

$$\boxed{F(\omega) = \int_{-\infty}^{\infty} f(t) \cdot e^{-i\omega t} \, dt}$$

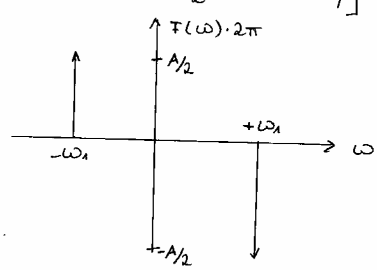
$$F(\omega) = \int_{-\infty}^{\infty} A \sin(\omega_1 t) \, e^{-i\omega t} \, dt$$

$$= \frac{A}{2i} \int_{-\infty}^{\infty} \left(e^{i\omega_1 t} - e^{-i\omega_1 t} \right) e^{-i\omega t} \, dt$$

$$= \frac{A}{2i} \left[\underbrace{\int_{-\infty}^{\infty} e^{-i(\omega - \omega_1)t} \, dt}_{2\pi \, \delta(\omega - \omega_1)} - \underbrace{\int_{-\infty}^{\infty} e^{-i(\omega + \omega_1)t} \, dt}_{2\pi \, \delta(\omega + \omega_1)} \right]$$

$$= \frac{A}{2i} \left[\delta(\omega - \omega_1) - \delta(\omega + \omega_1) \right] \cdot 2\pi \quad \Big| \frac{i}{i}$$

$$= \left[-i \frac{A}{2} \, \delta(\omega - \omega_1) + i \frac{A}{2} \, \delta(\omega + \omega_1) \right] \cdot 2\pi$$



Nicht-zeitbegrenzte Fkt f(t)

$$f(t) = A\cos(\omega_1 t)$$

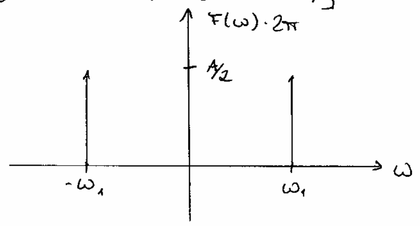
$$\boxed{F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-i\omega t}\, dt}$$

$$F(\omega) = \int_{-\infty}^{\infty} A\cos(\omega_1 t)\, e^{-i\omega t}\, dt$$

$$= \frac{A}{2}\int_{-\infty}^{\infty} \left(e^{i\omega_1 t} + e^{-i\omega_1 t}\right) e^{-i\omega t}\, dt$$

$$= \frac{A}{2}\left[\underbrace{\int_{-\infty}^{\infty} e^{-i(\omega-\omega_1)t}\, dt}_{2\pi\,\delta(\omega-\omega_1)} + \underbrace{\int_{-\infty}^{\infty} e^{-i(\omega+\omega_1)t}\, dt}_{2\pi\,\delta(\omega+\omega_1)}\right]$$

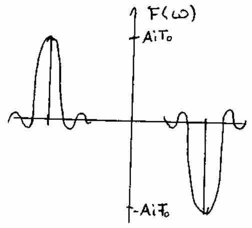
$$= \frac{A}{2}\left[\delta(\omega-\omega_1) + \delta(\omega+\omega_1)\right]\cdot 2\pi$$



zeitbegrenzte Fkt f(t)

$$f(t) = A\sin(\omega_1 t)$$

$$\boxed{F(\omega) = \int_{-T_0}^{T_0} f(t)\, e^{-i\omega t}\, dt}$$



$$F(\omega) = \int_{-T_0}^{T_0} A\sin(\omega_1 t)\, e^{-i\omega t}\, dt$$

$$= \frac{A}{2i}\int_{-T_0}^{T_0} \left(e^{i\omega_1 t} - e^{-i\omega_1 t}\right) e^{-i\omega t}\, dt$$

$$= \frac{A}{2i}\left[\int_{-T_0}^{T_0} e^{-i(\omega-\omega_1)t}\, dt - \int_{-T_0}^{T_0} e^{-i(\omega+\omega_1)t}\, dt\right]$$

$$= \frac{A}{2i}\left(\left[\frac{e^{-i(\omega-\omega_1)t}}{-i(\omega-\omega_1)}\right]_{-T_0}^{T_0} - \left[\frac{e^{-i(\omega+\omega_1)t}}{-i(\omega+\omega_1)}\right]_{-T_0}^{T_0}\right)$$

$$= \frac{A}{2i}\left[\frac{e^{-i(\omega-\omega_1)T_0} - e^{i(\omega-\omega_1)T_0}}{-i(\omega-\omega_1)} - \frac{e^{-i(\omega+\omega_1)T_0} - e^{i(\omega+\omega_1)T_0}}{-i(\omega+\omega_1)}\right]$$

$$= \frac{A}{2i}\left[\frac{e^{i(\omega-\omega_1)T_0} - e^{-i(\omega+\omega_1)T_0}}{i(\omega-\omega_1)} - \frac{e^{i(\omega+\omega_1)T_0} - e^{-i(\omega+\omega_1)T_0}}{i(\omega+\omega_1)}\right]$$

$$\frac{A}{i(\omega-\omega_1)}\underbrace{\frac{e^{i(\omega-\omega_1)T_0} - e^{-i(\omega+\omega_1)T_0}}{2i}}_{\sin(\omega-\omega_1)T_0} - \frac{A}{i(\omega+\omega_1)}\underbrace{\frac{e^{i(\omega+\omega_1)T_0} - e^{-i(\omega+\omega_1)T_0}}{2i}}_{\sin(\omega+\omega_1)T_0}$$

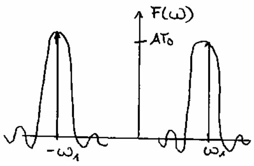
$$= \frac{-iAT_0}{(\omega-\omega_1)T_0}\sin(\omega-\omega_1)T_0 + \frac{iAT_0}{(\omega+\omega_1)T_0}\cdot\sin(\omega+\omega_1)T_0$$

$$= -iAT_0\,\frac{\sin(\omega-\omega_1)T_0}{(\omega-\omega_1)T_0} + iAT_0\,\frac{\sin(\omega+\omega_1)T_0}{(\omega+\omega_1)T_0}$$

Zeitbegrenzte Fkt f(t)

$$f(t) = A\cdot\cos(\omega_1 t)$$

$$\boxed{F(\omega) = \int_{-T_0}^{T_0} f(t)\cdot e^{-i\omega t}\, dt}$$



$$F(\omega) = \int_{-T_0}^{T_0} A\cos(\omega_1 t)\, e^{-i\omega t}\, dt$$

$$= \frac{A}{2}\int_{-T_0}^{T_0} \left(e^{i\omega_1 t} + e^{-i\omega_1 t}\right) e^{-i\omega t}\, dt$$

$$= \frac{A}{2}\left[\int_{-T_0}^{T_0} e^{-i(\omega-\omega_1)t}\, dt + \int_{-T_0}^{T_0} e^{-i(\omega+\omega_1)t}\, dt\right]$$

$$= \frac{A}{2}\left(\left[\frac{e^{-i(\omega-\omega_1)t}}{-i(\omega-\omega_1)}\right]_{-T_0}^{T_0} + \left[\frac{e^{-i(\omega+\omega_1)t}}{-i(\omega+\omega_1)}\right]_{-T_0}^{T_0}\right)$$

$$= \frac{A}{2}\left[\frac{e^{-i(\omega-\omega_1)T_0} - e^{i(\omega-\omega_1)T_0}}{-i(\omega-\omega_1)} + \frac{e^{-i(\omega+\omega_1)T_0} - e^{i(\omega+\omega_1)T_0}}{-i(\omega+\omega_1)}\right]$$

$$= \frac{A}{2}\left[\frac{e^{i(\omega-\omega_1)T_0} - e^{i(\omega+\omega_1)T_0}}{-i(\omega-\omega_1)} + \frac{e^{-i(\omega-\omega_1)T_0} - e^{-i(\omega+\omega_1)T_0}}{i(\omega+\omega_1)}\right]$$

$$= \frac{A}{(\omega-\omega_1)}\underbrace{\frac{e^{i(\omega-\omega_1)T_0} - e^{-i(\omega+\omega_1)T_0}}{2i}}_{\sin(\omega-\omega_1)T_0} + \frac{A}{(\omega+\omega_1)}\underbrace{\frac{e^{i(\omega+\omega_1)T_0} - e^{-i(\omega+\omega_1)T_0}}{2i}}_{\sin(\omega+\omega_1)T_0}$$

$$= AT_0\,\frac{\sin(\omega-\omega_1)T_0}{(\omega-\omega_1)T_0} + AT_0\,\frac{\sin(\omega+\omega_1)T_0}{(\omega+\omega_1)T_0}$$

Diskrete Fourier-Transformation

$f_0 =$ $\quad f_1 =$ $\quad f_2 =$ $\quad f_3 =$

$N =$ $\quad ; T_a =$

$$\boxed{F_d(\omega_K) = \sum_{n=0}^{N-1} f_n \cdot e^{-i\frac{2\pi n K}{N}}}$$

$$\boxed{\begin{matrix} 1 = e^{\pm i 2\pi n} \\ -1 = e^{\pm i\pi n} \end{matrix}} \begin{matrix} \text{ger.} \\ \text{unger.} \end{matrix}$$

$$\boxed{\begin{matrix} -i = e^{\pm n{,}5\cdot 2\pi} \\ i = e^{\pm n{,}5\cdot\pi} \end{matrix}}$$

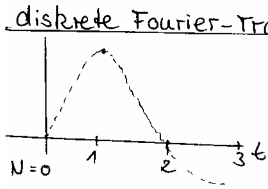
$F_d(\omega_0) = \ldots$

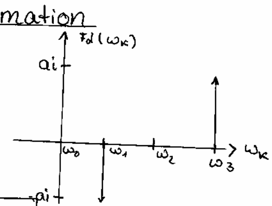
$F_d(\omega_1) = \ldots$

$F_d(\omega_2) = \ldots$

$F_d(\omega_3) = \ldots$

diskrete Fourier-Transformation



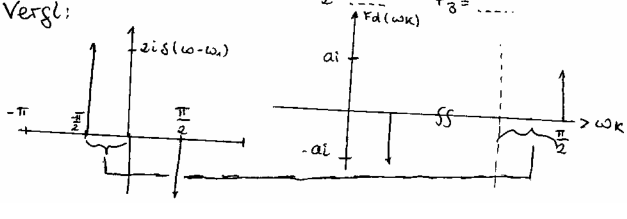


$$\boxed{\omega_K = \frac{2\pi}{N\cdot T_a}\cdot K}$$

wird bei $F_d(\omega_K)$ der Vorfaktor: $\frac{1}{N}$ berücksichtigt

folgt $F_0 = \ldots$ $\quad F_1 = \ldots$ $\quad F_2 = \ldots$ $\quad F_3 = \ldots$

Vergl:



Amplitudenspektrum

$$\boxed{|F(\omega)| = \sqrt{Re(F(\omega))^2 + Im(F(\omega))^2}}$$

$$F(\omega) = Re|F(\omega)| \pm i\, Im(F(\omega))$$
$$= \int_{-\infty}^{\infty} f(t)\cos(\omega t)\,dt - i\int_{-\infty}^{\infty} f(t)\sin(\omega t)\,dt$$
$$= |F(\omega)|\, e^{-i\omega \varphi(\omega)}$$

Phasenspektrum

$$\boxed{\varphi(\omega) = \text{arct.}\ \frac{Im|F(\omega)|}{Re|F(\omega)|}}$$

Euler-Formel

$$\boxed{\begin{aligned} e^{-i\omega t} &= \cos(\omega t) - i\sin(\omega t) \\ e^{+i\omega t} &= \cos(\omega t) + i\sin(\omega t) \end{aligned}}$$

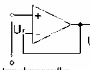
Gegenüberstellung FT - DFT

$$F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-i\omega t}\, dt \quad \text{FT}$$

$$f(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} F(\omega)\cdot e^{i\omega t}\, d\omega \quad \text{FT}^{-1}$$

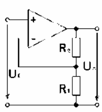
$$F_d(\omega_K) = \sum_{n=0}^{N-1} f(n\cdot T_a)\, e^{-i\omega_K n\cdot T_a} \quad \text{DFT}$$

$$f(n\cdot T_a) = \frac{1}{N}\sum_{n=0}^{N-1} F_d(\omega_K)\, e^{i\omega_K n T_a} \quad \text{DFT}^{-1}$$



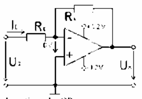
Impedanzwandler

$U_A = U_E$



Nichtinvertierender OP:

$U_A = \left(1 + \frac{R_2}{R_1}\right)\cdot U_E$



Invertierender OP:

$U_A = -\frac{R_2}{R_1}\cdot U_E$

Halleffekt

Hallkoeffizient: $\boxed{R_H = \frac{1}{|e|n} = \frac{\mu}{\sigma_s}}$ $\boxed{\sigma_s = -|e|n\mu}$

n = Ladungsstr. dichte

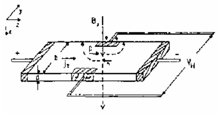
Hallwinkel: $\boxed{\begin{aligned} \tan\varphi &= \mu\cdot B \\ \varphi &= \arctan(\mu\cdot B) \end{aligned}}$

Hallspannung $\boxed{U_H = R_H\cdot\frac{I\,B}{d}}$

B = Magnetfeld $\left[\frac{Vs}{m^2} = T\right]$

d = Schichtdicke

I = Strom



Bsp: Schweißstrom: $\boxed{\mu\cdot I = 2\pi r\cdot B}$ r = Hallsensor abstand

$$\Rightarrow B = \mu\,\frac{I_{schweißstrom}}{2\pi r}$$

einsetzen in U_H

$$\Rightarrow \boxed{I_{schweißstr} = \frac{U_H\, d\cdot 2\pi r}{\mu\, I_{Hall}\cdot R_H}}$$

Widerstand temp. abhängig

$$\boxed{R(\vartheta) = R_{20}\cdot(1 + \alpha T)}$$

Ultraschall

Öffnungswinkel: $\boxed{\alpha = \arctan\left(\frac{0{,}51\cdot\lambda}{D}\right)}$

$$\boxed{\lambda = \frac{v_{schall}}{f_{ultraschallfrequenz}}}$$

$$\varphi_{Öffnungswinkel} = 2\cdot\alpha$$