TSKS21 Signaler, information & bilder

Föreläsning 3
Labförberedelse
Växelströmsteori
– avslutning passiva filter
– effektbegrepp (effektanpassning)

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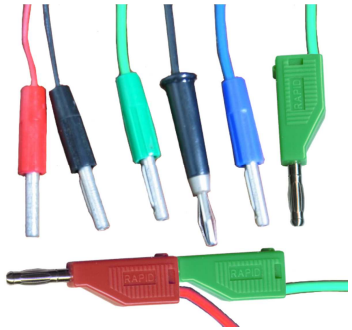
Labutrustningen – Kontakter

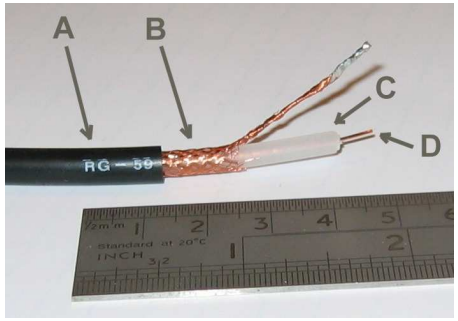
Banankontakter



BNC-kontakter

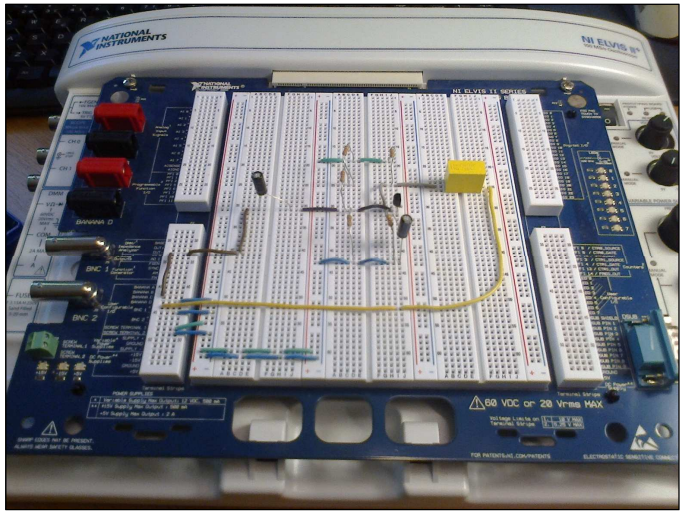
Källa: Wikipedia

Labutrustningen – Koaxialkablar

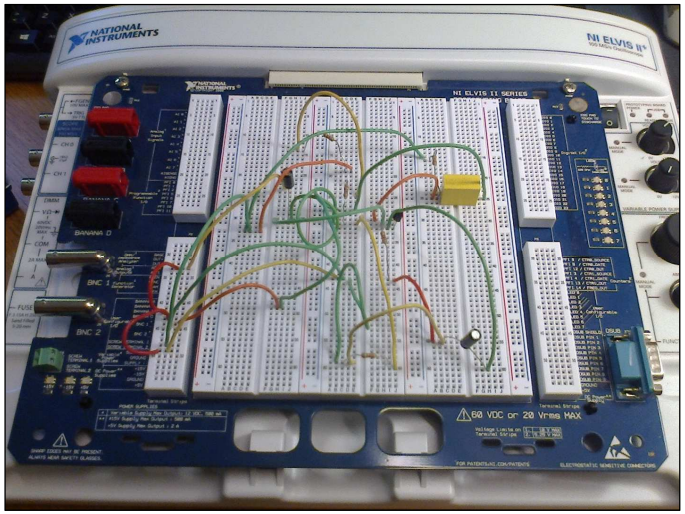


Källa: Wikipedia

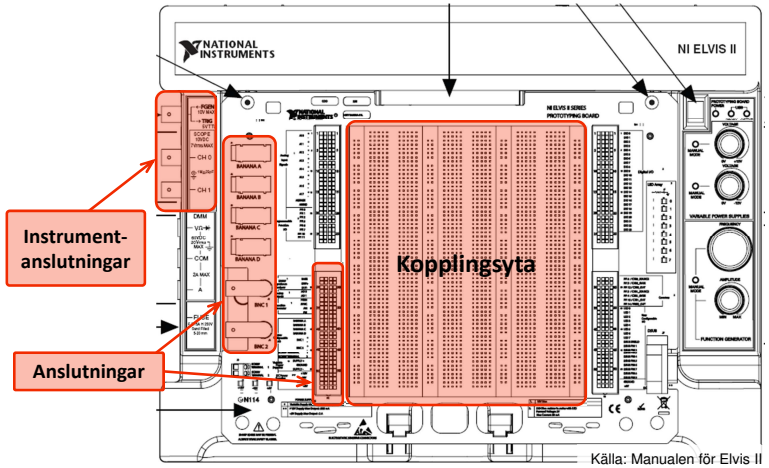
Labutrustningen – Elvis II – Prydlig uppkoppling



Elvis II – Mindre prydlig uppkoppling

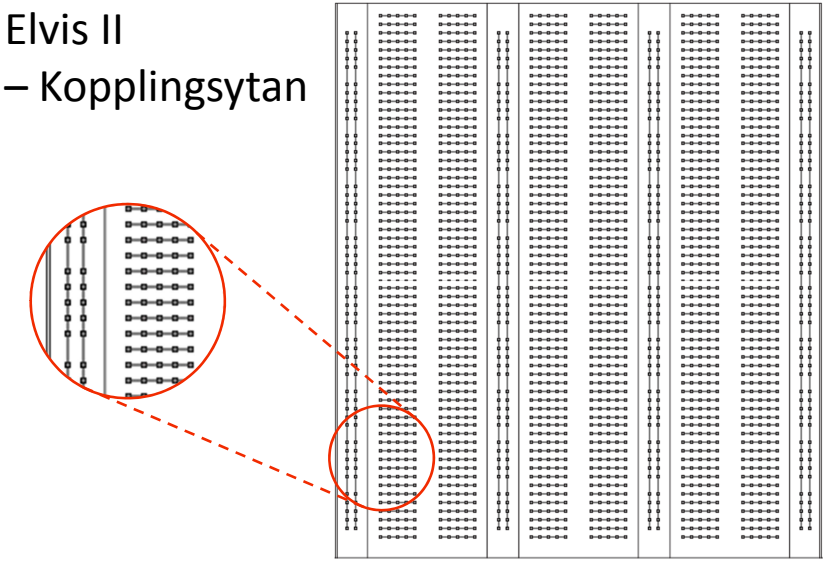


Elvis II – Översikt

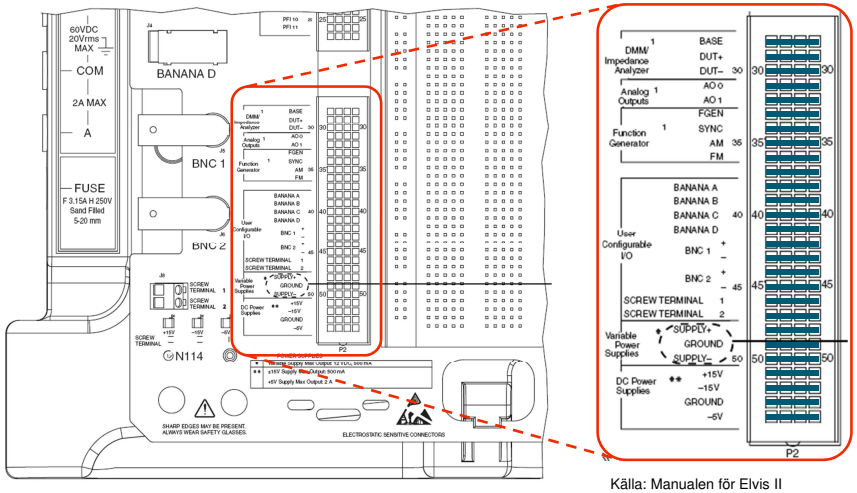


Källa: Manualen för Elvis II

Elvis II – Kopplingsytan

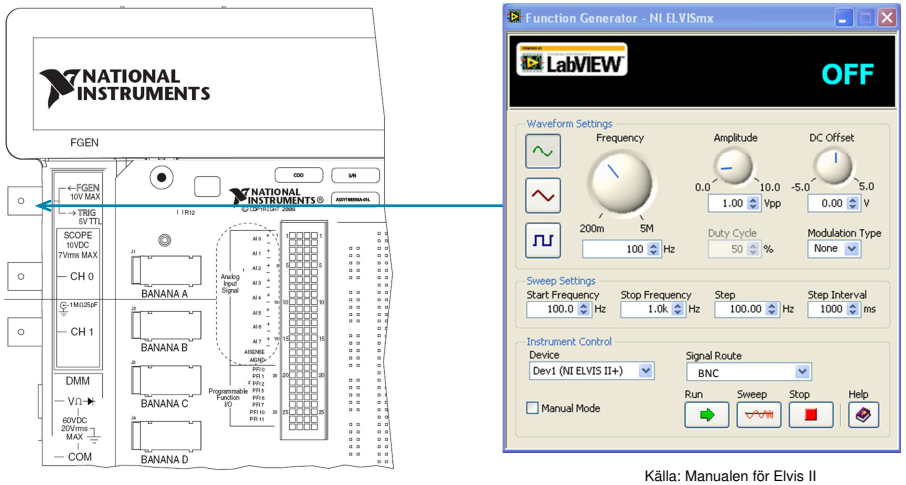


Elvis II – Nedre vänstra hörnet



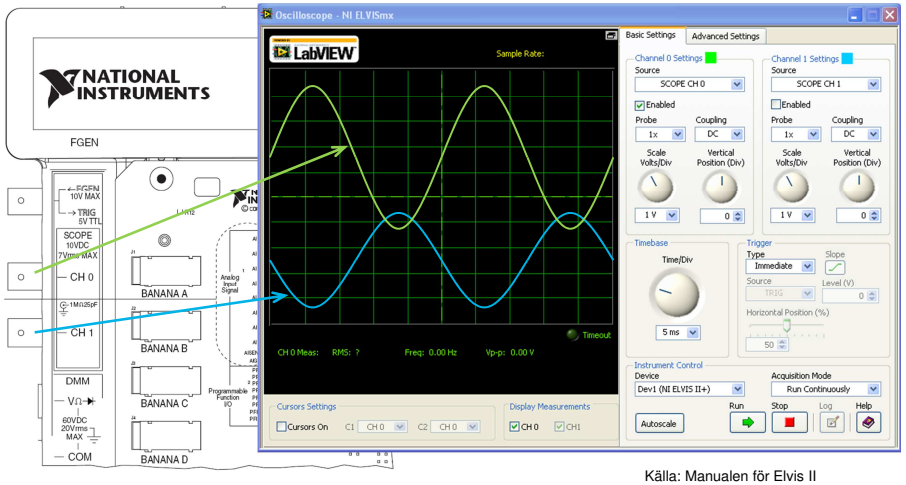
Källa: Manualen för Elvis II

Elvis II – Funktionsgeneratorn



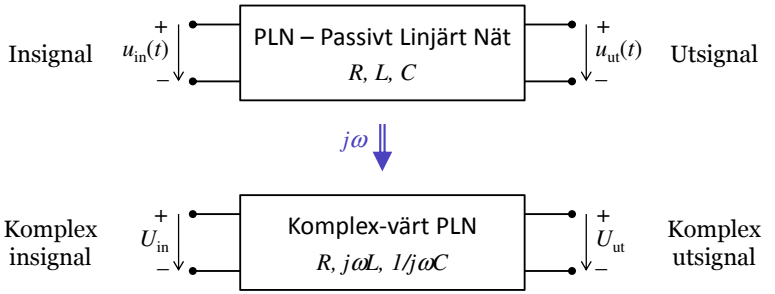
Källa: Manualen för Elvis II

Elvis II – Oscilloskopet



Källa: Manualen för Elvis II

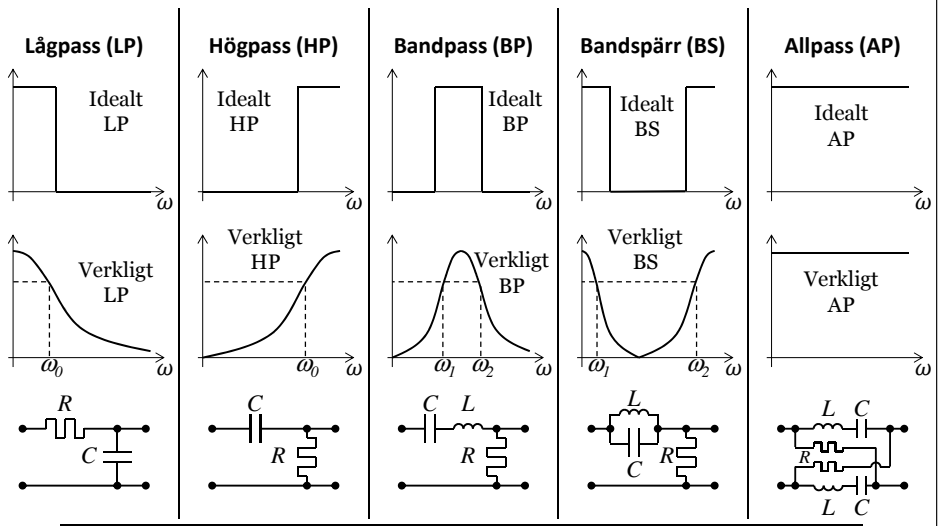
Passiva filter – Introduktion



Samband: $U_{ut} = H(\omega)\, U_{in}$ $\quad H(\omega) = |H(\omega)| \cdot e^{j\arg\{H(\omega)\}} = U_{ut}/U_{in}$

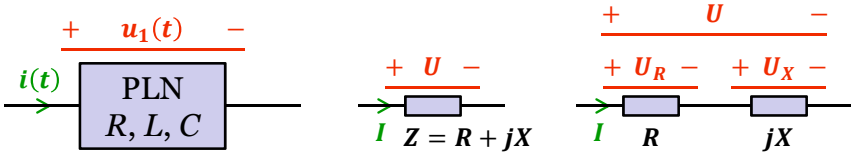
Frekvensfunktion — Amplitudkarakteristik — Faskarakteristik

Olika frekvensselektiva filter



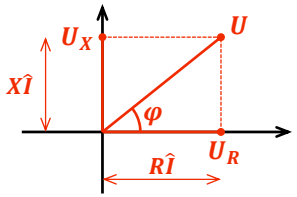
Effektbegrepp 1(4)

Passivt Linjärt Nät – PLN



$i(t) = \hat{I}\sin(\omega t)$ $\quad I = \hat{I}$ $\quad U_R = RI$ $\quad U_X = jXI$

$u(t) = \hat{U}\sin(\omega t + \varphi)$ $\quad U = \hat{U}e^{j\varphi}$ $\quad U = U_R + U_X = (R + jX)I = ZI$



Amplituder

$$\left.\begin{aligned} R\hat{I} &= \hat{U}\cos(\varphi) \\ X\hat{I} &= \hat{U}\sin(\varphi) \end{aligned}\right\} *$$

Effektivvärden

$$\left.\begin{aligned} U_e &= \hat{U}/\sqrt{2} \\ I_e &= \hat{I}/\sqrt{2} \end{aligned}\right\} **$$

$$u(t) = R\hat{I}\sin(\omega t) + X\hat{I}\sin(\omega t + \pi/2)$$

Effektbegrepp 2(4)

$$\left.\begin{aligned} R\hat{I} &= \hat{U}\cos(\varphi) \\ X\hat{I} &= \hat{U}\sin(\varphi) \end{aligned}\right\} * \qquad \left.\begin{aligned} U_e &= \hat{U}/\sqrt{2} \\ I_e &= \hat{I}/\sqrt{2} \end{aligned}\right\} **$$

$$i(t) = \hat{I}\sin(\omega t)$$

$$u(t) = R\hat{I}\sin(\omega t) + X\hat{I}\sin(\omega t + \pi/2)$$

Momentan effekt:

$$p(t) = u(t)i(t) = R\hat{I}^2\sin^2(\omega t) + X\hat{I}^2\sin(\omega t)\sin(\omega t + \pi/2)$$

$$= \underbrace{\frac{R\hat{I}^2}{2}(1 - \cos(2\omega t))}_{p_R(t)} + \underbrace{\frac{X\hat{I}^2}{2}sin(2\omega t)}_{p_X(t)}$$

Utnyttja $*$, $**$ och $\omega = 2\pi/T$:

$$p_R(t) = U_e I_e\cos(\varphi)(1 - \cos(2\omega t)) = U_e I_e\cos(\varphi)(1 - \cos(4\pi t/T))$$

$$p_X(t) = U_e I_e\sin(\varphi)\,sin(2\omega t) = U_e I_e\sin(\varphi)\,sin(4\pi t/T)$$

Effektbegrepp 3(4)

$$\left.\begin{aligned} R\hat{I} &= \hat{U}\cos(\varphi) \\ X\hat{I} &= \hat{U}\sin(\varphi) \end{aligned}\right\} * \qquad \left.\begin{aligned} U_e &= \hat{U}/\sqrt{2} \\ I_e &= \hat{I}/\sqrt{2} \end{aligned}\right\} **$$

$$p_R(t) = U_e I_e\cos(\varphi)(1 - \cos(4\pi t/T))$$

$$p_X(t) = U_e I_e\sin(\varphi)\,sin(4\pi t/T)$$

Aktiv effekt:

$$P = \frac{1}{T}\int_0^T p(t)\,dt = \frac{1}{T}\int_0^T p_R(t)\,dt + \frac{1}{T}\int_0^T p_X(t)\,dt$$

$$= \frac{1}{T}(TU_e I_e\cos(\varphi) + 0) + \frac{1}{T}0 = U_e I_e\cos(\varphi) = RI_e{}^2$$

$*$, $**$

Enhet: W

Reaktiv effekt:

$*$, $**$

$$Q = U_e I_e\sin(\varphi) = XI_e{}^2$$

Enhet: VAr

Effektbegrepp 4(4)

$$P = RI_e{}^2 \qquad Z = R + jX$$

$$Q = XI_e{}^2 \qquad \varphi = \arg(Z)$$

Komplex effekt:

$$S = P + jQ = (R + jX)I_e{}^2 = ZI_e{}^2 = \frac{UI^*}{2} = \frac{U_e{}^2}{Z^*}$$

Enhet: VA

Skenbar effekt:

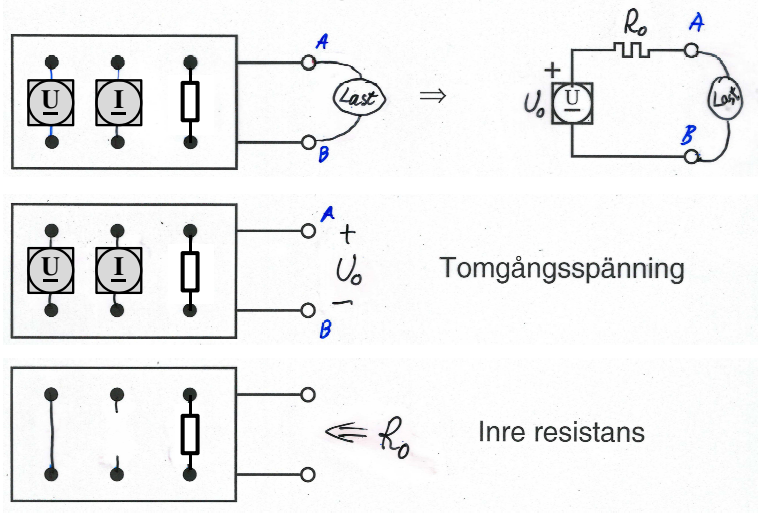
$$P_S = U_e I_e = |S| = \sqrt{P^2 + Q^2} = |Z|I_e{}^2 = \frac{U_e{}^2}{|Z|}$$

Enhet: VA

Effektfaktor:

$$\cos(\varphi) = \frac{P}{P_S} = \frac{R}{|Z|}$$

Tvåpolssatsen (Thevenins tvåpolsekvivalent)



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Nortons teorem