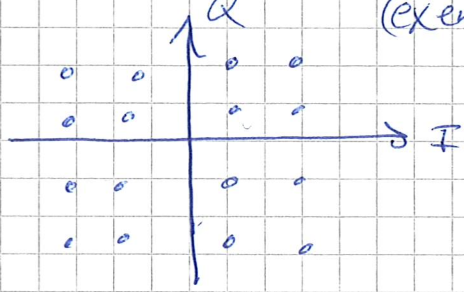
RRY011 Telekommunikation | Korta svar/lösn.
Tentamen 14/1 2020

(1) a) Se kurslitt.

(exempel 16-QAM)



b) Se kurslitt + lab 3-4

DSB-FC & ASK signaler kan demoduleras

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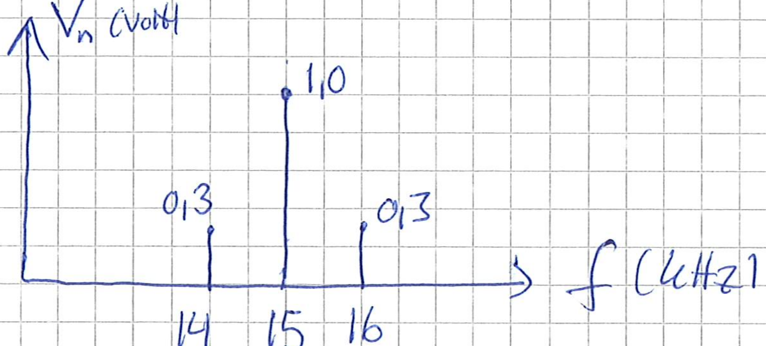
(2)

$$\left.\begin{array}{l} V_c + V_m = V_{max} \\ V_c - V_m = V_{min} \end{array}\right\} \Rightarrow \begin{array}{l} V_c = 1{,}0\ V \\ V_m = 0{,}6\ V \end{array}$$

$$\left.\begin{array}{l} T_m = 1\ ms \\ T_c = \frac{1}{15} T_m = \frac{1}{15}\ ms \end{array}\right\} \Rightarrow \begin{array}{l} f_m = 1\ kHz \\ f_c = 15\ kHz \end{array}$$



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(3)

$$\left.\begin{array}{l} f_c + \Delta f_c = f_{max} \\ f_c - \Delta f_c = f_{min} \end{array}\right\} \Rightarrow \Delta f_c = \frac{f_{max} - f_{min}}{2} = 10\ kHz$$

$$\Rightarrow \beta = \frac{\Delta f_c}{f_m} = 1{,}0$$

$$B \simeq 2 f_m \cdot (1+\beta) = \underline{\underline{40\ kHz}}$$

4)

a) CDMA (se kursblitt/anteck.)

b) <u>Meddelandet</u>: 10 kHz ⇒ $T_{bit} = 0{,}1$ ms

⇒ studera de två första bitarna (01...)

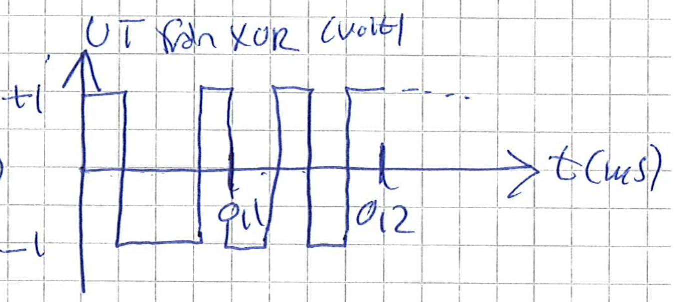
<u>Kodgenerator</u>: 40 kHz ⇒ 4 × medd. bithalt.

⇒ 8 första bitarna i koden

(10011010...) beaktas

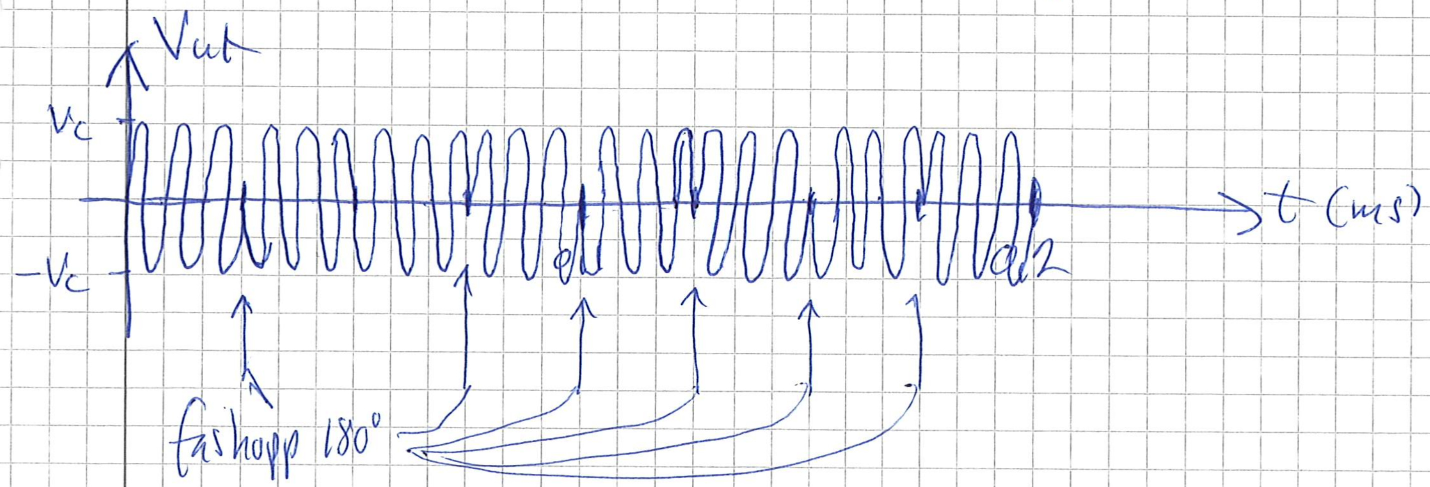
medd.	0	1
kod.	1001	1010
XOR	1001	0101

⇒



1:a repr. av +1 V
0:a — " — −1 V

<u>Multiplikator</u>: $f_c = 3 \times$ kodfrekv. ⇒ 3 bärvågsperioder per kodbit.

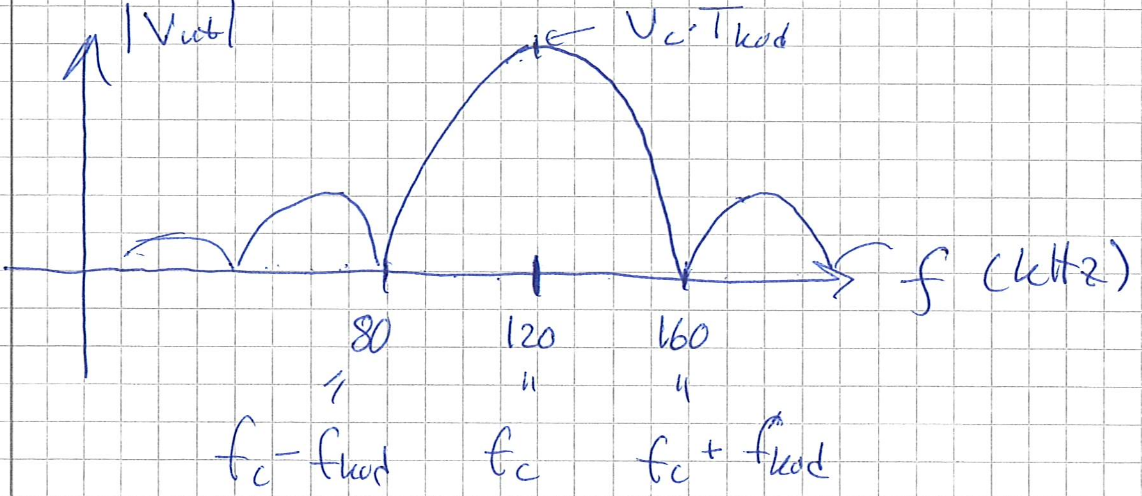


binär-PSK med 180° fashopp vid övergång mellan 0:a & 1:a (samt 1:a & 0:a...)

c) Amplitudspektrumet blir sinc-format med

$T = T_{kod} = \frac{1}{40 \cdot 10^3}$ s. $\Rightarrow \frac{1}{T_{kod}} = 40$ kHz $= f_{kod}$

Modulationen $\Rightarrow$ spektrumets center translateras till f_c



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(5) $v_{in} = v_1 \cdot \cos(\omega_c t) + v_2 \sin(\omega_c t)$

<u>Efter övre blandaren:</u>

$v_A = v_{in} \cdot \cos(\omega_c t + \Delta\omega_c t) =$

$= v_1 \cdot \frac{1}{2} \left\{ \cos(-\Delta\omega_c t) + \cos(2\omega_c t + \Delta\omega_c t) \right\} +$

$+ v_2 \frac{1}{2} \left\{ \sin(-\Delta\omega_c t) + \sin(2\omega_c t + \Delta\omega_c t) \right\}$

LP-Filtrera $\Rightarrow v_{ut,A} = \frac{1}{2} \left\{ v_1 \cdot \cos(\Delta\omega_c t) - v_2 \sin(\Delta\omega_c t) \right\}$

<u>Efter nedre blandaren:</u>

$v_B = v_{in} \cdot \sin(\omega_c t + \Delta\omega_c t) =$

$= v_1 \frac{1}{2} \left\{ \sin(\Delta\omega_c t) + \sin(2\omega_c t + \Delta\omega_c t) \right\} +$

$+ v_2 \frac{1}{2} \left\{ \cos(\Delta\omega_c t) - \cos(2\omega_c t + \Delta\omega_c t) \right\}$

LP-filtrera $\Rightarrow v_{ut,B} = \frac{1}{2} \left\{ v_1 \cdot \sin(\Delta\omega_c t) + v_2 \cdot \cos(\Delta\omega_c t) \right\}$

$$\therefore \quad v_{ut,A} = \frac{1}{2}\left\{v_1 \cdot \cos(\Delta\omega_c t) - v_2 \cdot \sin(\Delta\omega_c t)\right\}$$

$$v_{ut,B} = \frac{1}{2}\left\{v_1 \cdot \sin(\Delta\omega_c t) + v_2 \cos(\Delta\omega_c t)\right\}$$

I båda fallen är meddelandena nu modulerade med signal på $\Delta\omega_c$, samt både v_1 & v_2 bidrar till båda utgångarna, dvs. "stör".

$$\left(\Delta\omega_c = 0 \text{ skulle ge: } \begin{array}{l} v_{ut,A} = \frac{1}{2} v_1 \\ v_{ut,B} = \frac{1}{2} v_2 \end{array}\right)$$

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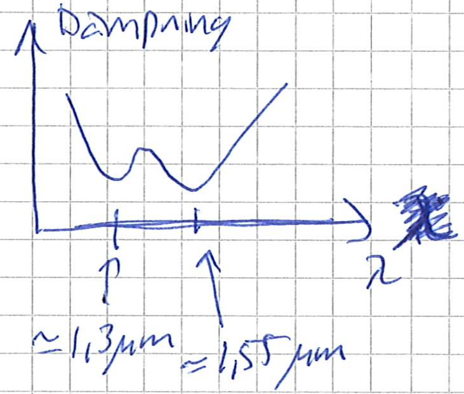
(6) a)



Grafen visar dämpningen som fkn. av λ.

b) $NA = n_0 \sin\theta_a \Rightarrow \theta_a = \arcsin NA \approx 0{,}1405$ rad $\approx \underline{8{,}0°}$

Sätt $n_0 = 1$

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(7) Använd Smithdiagr.

a) $Z_{in} \approx 180 - j130\ \Omega$

b) Enda minimat inträffar $0{,}328\lambda$ från lasten.

$|V|_{min} = |V_0^+| \cdot (1 + |\Gamma|) = 4 \cdot (1 - 0{,}7) = \underline{1{,}2 \text{ volt}}$

c) $\lambda/4$-transf.: $Z_{0,tr.} \approx 115\ \Omega$, ansluts $0{,}078\lambda$ från last.
parallellkopp., kortsluten stubbe: Längd $0{,}08\lambda$, ansluts $0{,}262\lambda$ från last.

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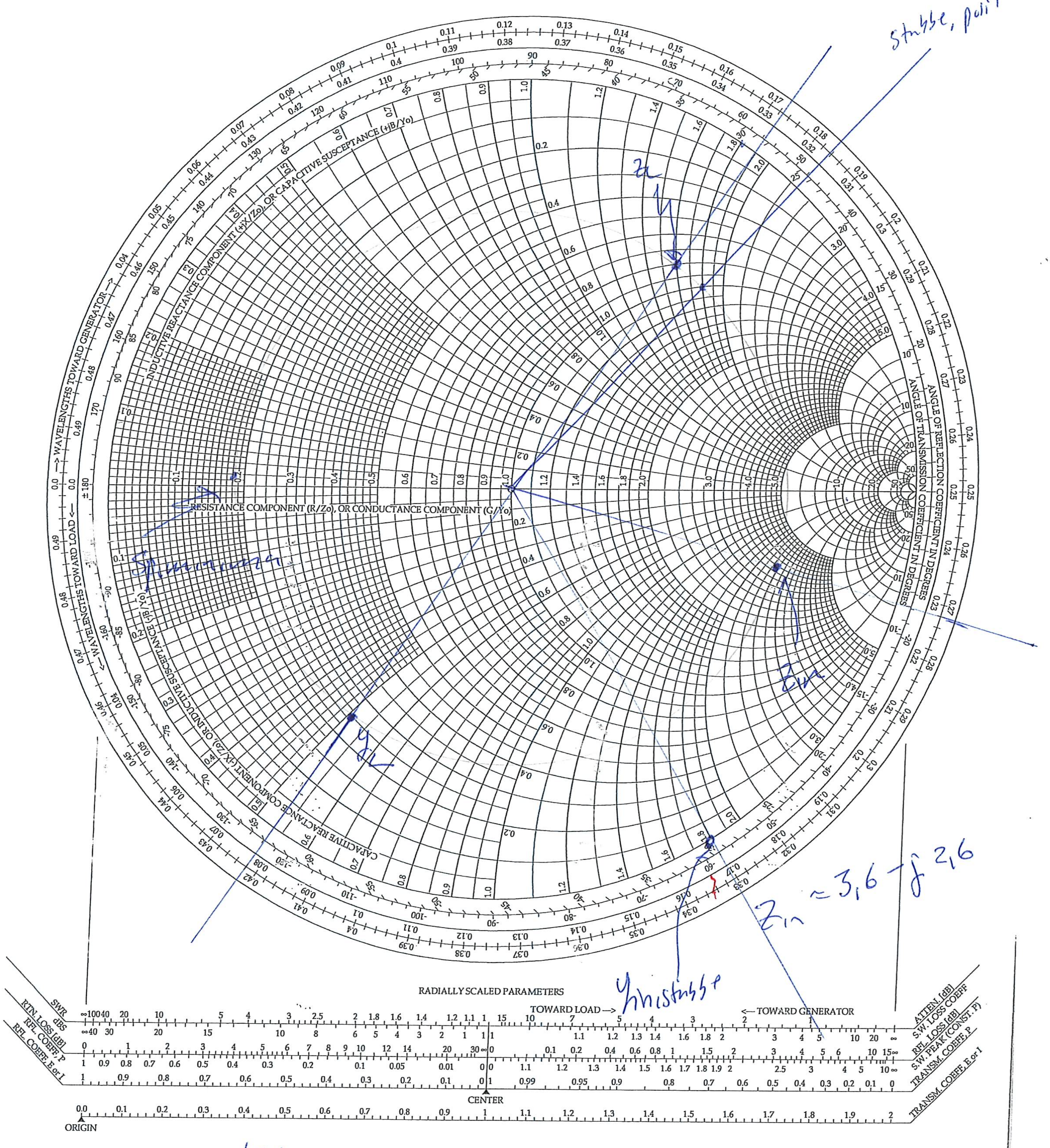
$z_L = \frac{4}{5} + j\frac{8}{5} = 0{,}8 + j1{,}6$

uppg. 7 RRY011

uppg. 6 RRY010

Smith Chart



$|\Gamma| \approx 0{,}7$

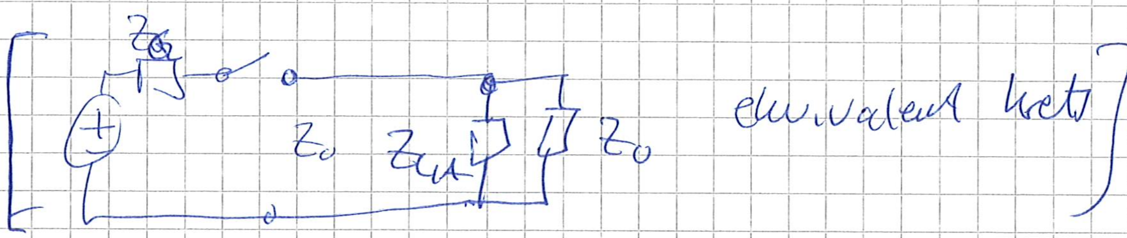
⑧ a) $Z_{L,A} \to \infty \Rightarrow$ påverkar ej.

$Z_{L,B} = Z_0 \Rightarrow \Gamma_{L,B} = 0 \Rightarrow$ inga reflexer

$$V_0^+ = \frac{Z_0 V_G}{Z_0 + Z_G} \simeq 6{,}857 \simeq \underline{\underline{6{,}9 \text{ volt}}}$$

$$\tau_A = \frac{l_A + l_B}{v_{våg}} = 25 \text{ ns}.$$

b) $$\Gamma_{L,A} = \frac{Z_{L,A} // Z_0 - Z_0}{Z_{L,A} // Z_0 + Z_0} = \frac{50-100}{50+100} = -\frac{1}{3}$$



$\tau_B = 15$ ns

$$\Gamma_G = \frac{Z_G - Z_0}{Z_G + Z_0} = \frac{75-100}{75+100} = -\frac{1}{7}$$

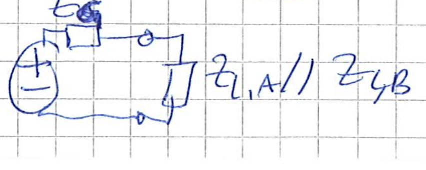
$\underline{t = 0:}$ $V_{ingång} = V_0^+ \simeq \underline{\underline{6{,}9 \text{ volt}}}$

$\underline{t = 40 \text{ ns}:}$ En last- & en gen.reflex har skett

$$V_{ingång} = V_0^+ + V_0^- + V_1^+ = V_0^+ \cdot (1 + \Gamma_{L,A} + \Gamma_{L,A}\Gamma_G)$$

$$\simeq \underline{\underline{4{,}9 \text{ volt}}}$$

$\underline{t \to \infty}$!



$\Rightarrow V_{ing.} = \underline{\underline{4{,}8 \text{ volt}}}$

(9)

$$Z_0 = \frac{87}{\sqrt{\varepsilon_r + 1{,}41}} \ln\left(\frac{5{,}98h}{0{,}8W}\right)$$

$\Rightarrow W \simeq$ ~~6,75 mm~~ 4,71 mm

$$v_{faz} = \frac{c_0}{\sqrt{\varepsilon_{eff}}}$$

$$\varepsilon_{eff} = 0{,}475\,\varepsilon_r + 0{,}67$$

$$\Rightarrow \lambda = \frac{v_{faz}}{f} \approx 0{,}021668\,m$$

$$l = \frac{\lambda}{4} = 0{,}00542\,m = 5{,}42\,mm$$