RF Tasarım

Modulation Concepts, PAPR, ACPR, EVM, MER

Orijinal not: Ders-8.pdf

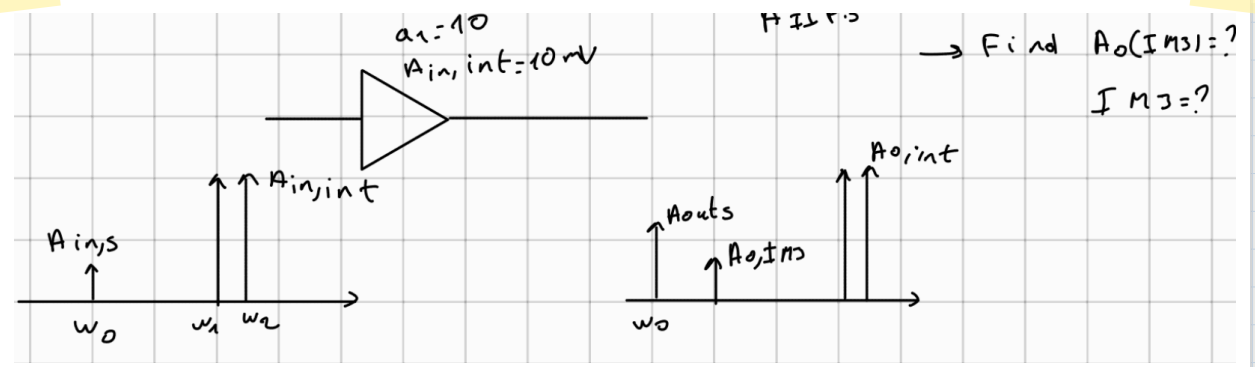
UYARI Bu belge, el yazısı ders notlarından Claude (Anthropic) yardımıyla dijitale aktarılmıştır. Yardımcı kaynak olarak hazırlanmıştır; hata veya eksik içerebilir. Lütfen orijinal notları ve ders kaynaklarını esas alın.

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orj. s. 1

Ders 6'daki ? çözüm

Ex:



orijinal çizim, s. 1

$A_{IIP3} = 80\,\text{mV} \rightarrow$ Find $A_o(IM3) = ?$ $\quad IM3 = ?$

$$IM3 = \frac{\frac{3}{4}a_3 A_{int}^3}{a_1 A_{int}} = \frac{A_o(IM3)}{A_{o,int}}$$

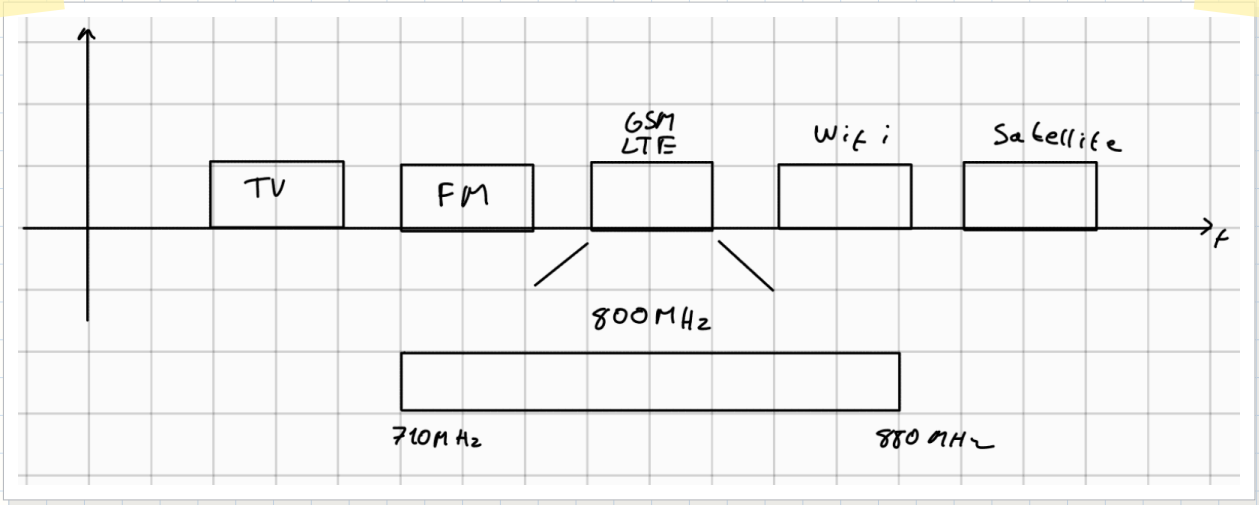
$$A_{IIP3}^2 = \frac{A_{out}(\omega_1, \omega_2)}{A_{out}(IM3)} A_{int}^2$$

$$\Rightarrow A_{out}(IM3) = \frac{\overbrace{A_{out}(\omega_1, \omega_2)}^{a_1 A_{in,int}} A_{in,int}^2}{A_{IIP3}^2} = \frac{a_1 \overbrace{A_{in,int}}^{10\,\text{mV}}{}^3}{A_{IIP3}^2}$$

$$A_{out}(IM3) = 1{,}56 \cdot 10^{-3}\ \text{V}$$

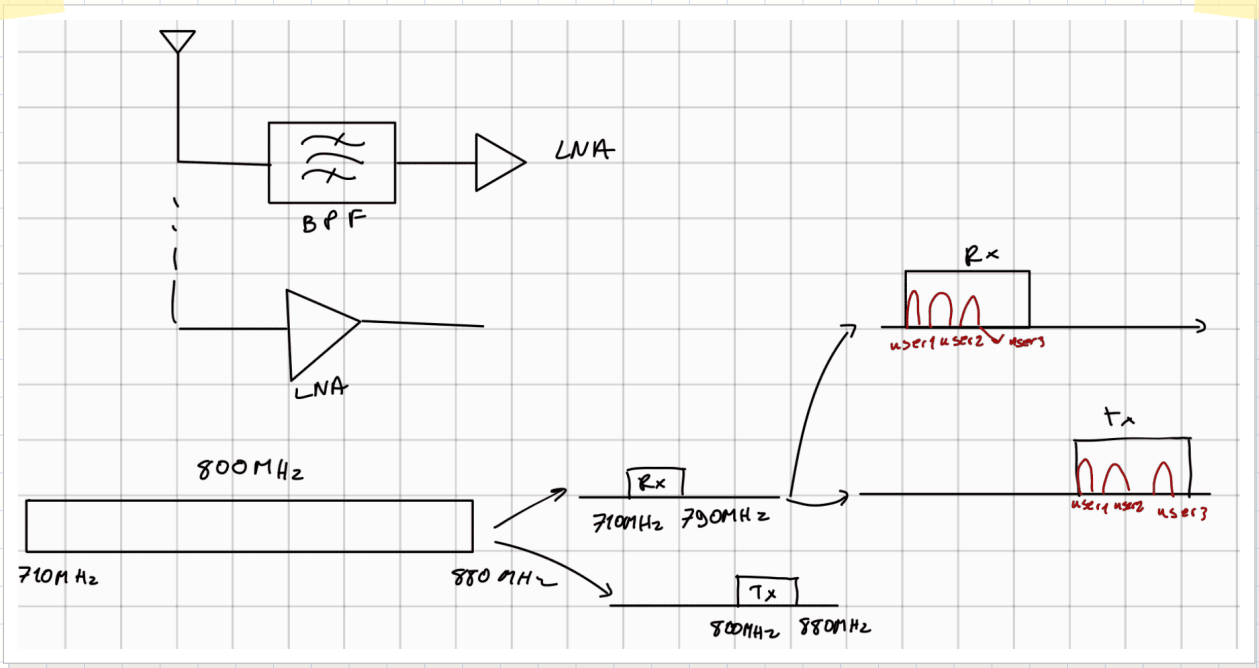
$$IM3 = \underbrace{\frac{1{,}56 \cdot 10^{-3}}{10 \cdot 10 \cdot 10^{-3}}}_{a_1 \cdot A_{in,int}} = 0{,}0156$$

Modulation Concepts:

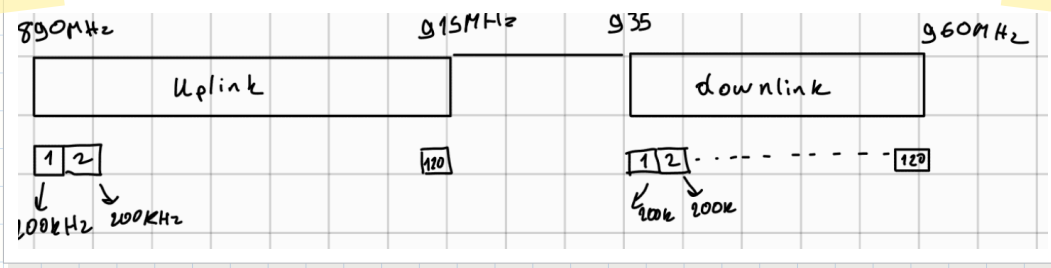


orijinal çizim, s. 1

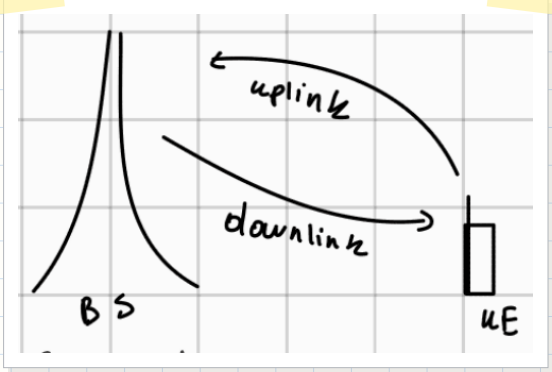
orj. s. 2



orijinal çizim, s. 2



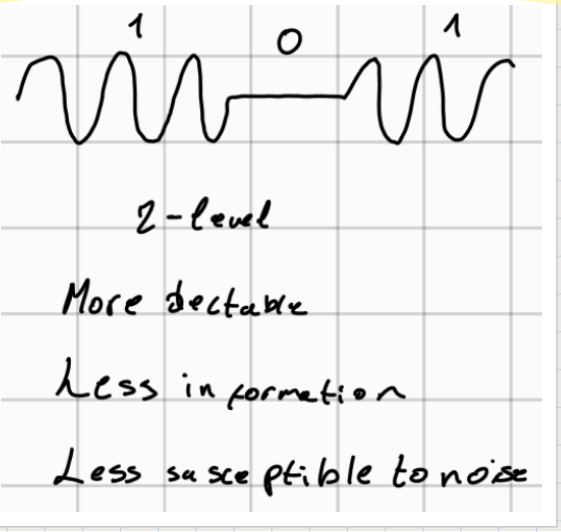
orijinal çizim, s. 2



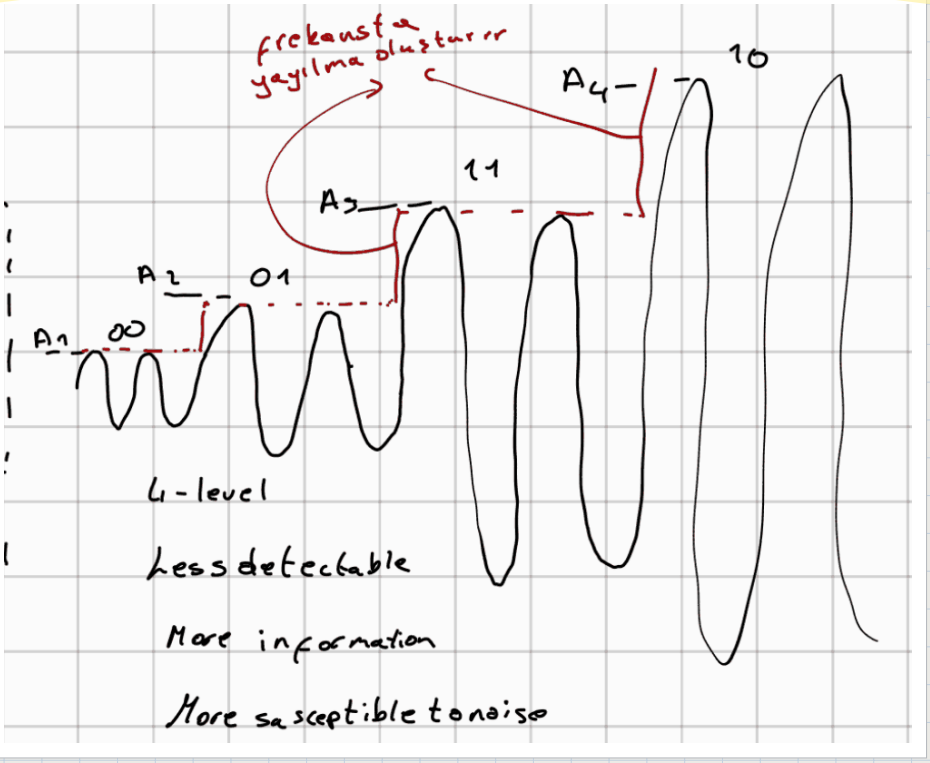
orijinal çizim, s. 2

Modulation Concepts:

1-Detectability



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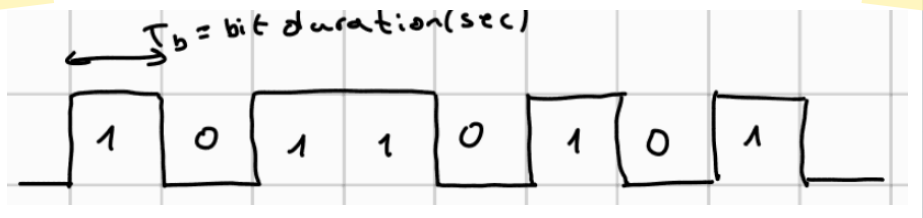


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orj. s. 3

2) Band width Efficiency

$$\eta = \frac{\text{transmission bitrate (bps)}}{\text{transmission BW (Hz)}} = \frac{\text{bit/sec}}{\text{Hz}}$$



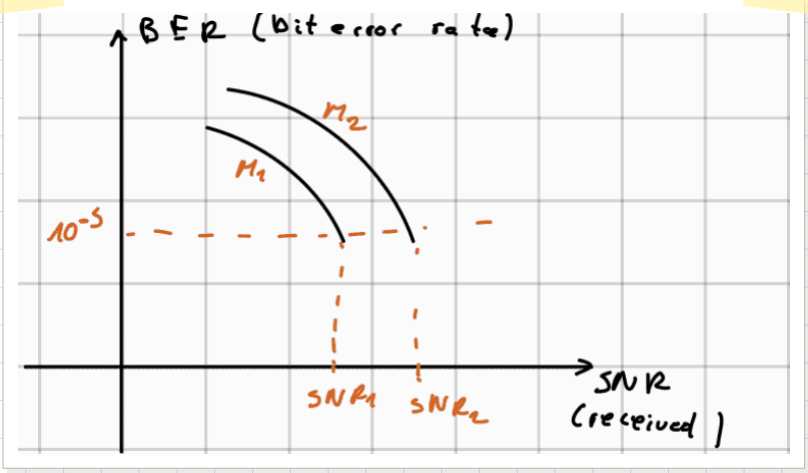
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$$R_b = \frac{1}{T_b} = \text{data rate (1/sec) bps}$$

3) Max channel capacity (Shannon)

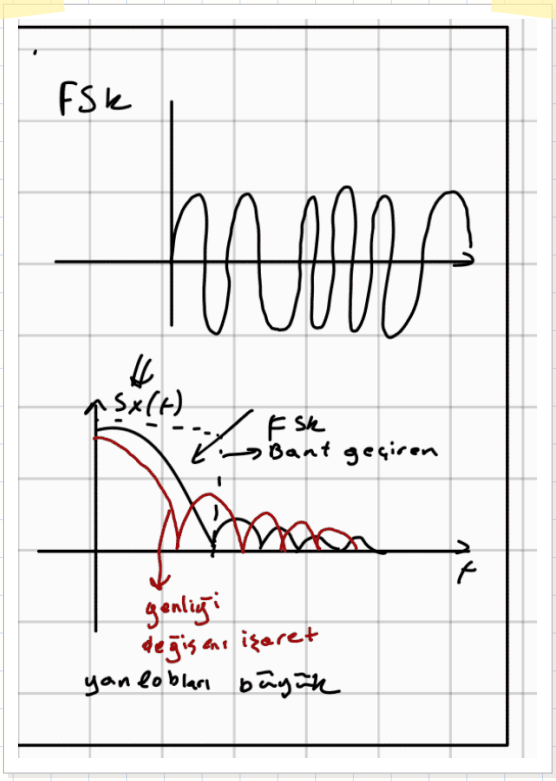
$$C = \overset{(\omega)}{B} \cdot \log_2 \left(1 + \underbrace{SNR}_{\text{received}}\right)$$

4) Power Efficiency



orijinal çizim, s. 3

$SNR_1 < SNR_2$
M_1 power efficient



orijinal çizim, s. 3

5) Peak to Average Ratio

(tepe gücünün ortalama güce oranı)

$$PAPR = \frac{\text{Power of signal when carrier is at } \overbrace{\text{peak}}^{\text{maksimum güç}}}{\text{average power of the carrier}}$$

$$PAPR_{AM} = 4{,}26\ dB$$
$$PAPR_{FM} = 3\ dB$$

6) Adjacent channel interference (ACI)

→ komşu kanalda girişimi
Adjacent channel Power Ratio (ACPR)

$$ACPR = \frac{\text{Power in adjacent channel}}{\text{Power in main channel}}$$

Ne kadar küçükse o kadar iyi

orj. s. 4

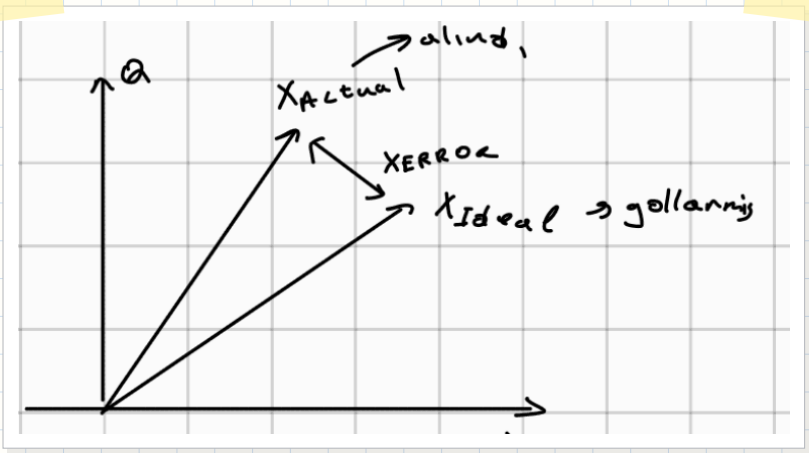


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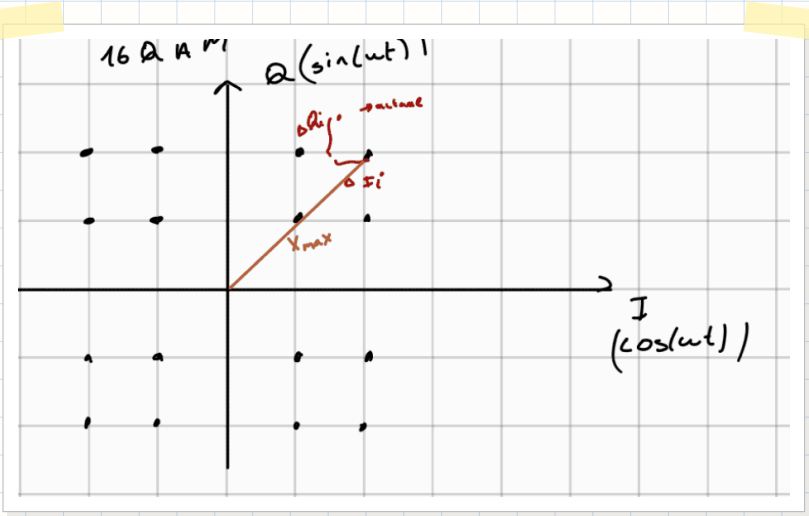
7) Implementation Margin

Theoretically to achive any BER required SNR = A
practically " " A + k → implementing margin

8) Error vector Magnitude (EVM)



orijinal çizim, s. 4



orijinal çizim, s. 4

$$EVM = \sqrt{\frac{\frac{1}{N}\sum_{i=1}^{N}\left(\Delta I_i^2 + \Delta Q_i^2\right)}{X_{max}^2}}$$

9) Modulation Error Rate (MER)

$$MER = \frac{\frac{1}{N}\sum_{i=1}^{N}\left(I_i^2 + Q_i^2\right)}{\frac{1}{N}\sum_{i=1}^{N}\left(\Delta I_i^2 + \Delta Q_i^2\right)} = \frac{\text{Average signal power}}{\text{Average error power}}$$