Informationsübertragung

Testataufgaben

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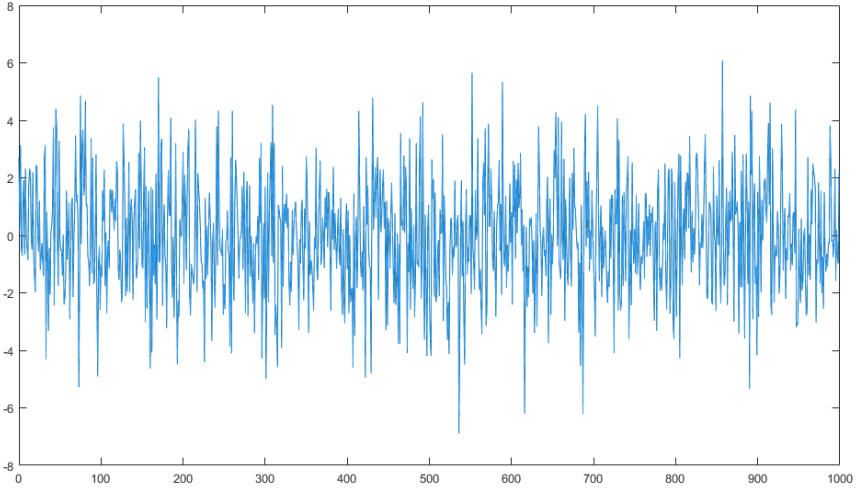
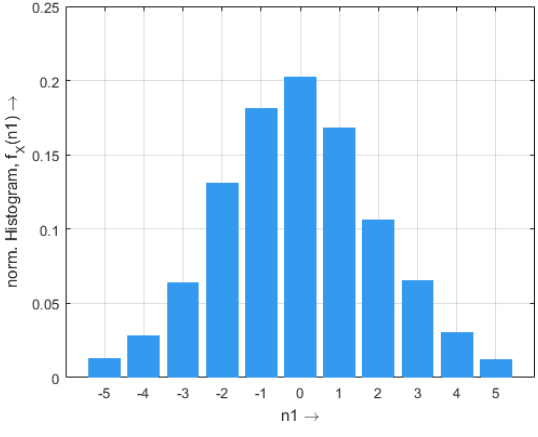
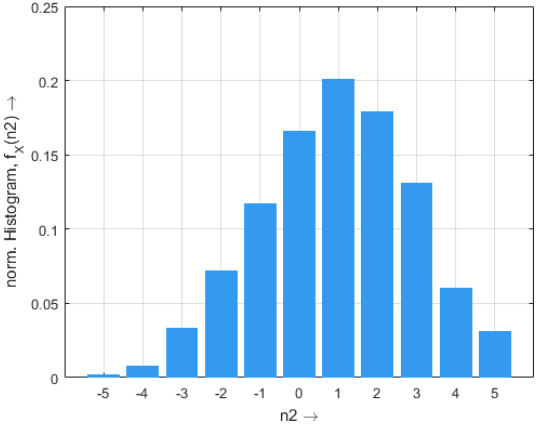
Aufgabe 1: Rauschanalyse



Aufgabe 1: Rauschanalyse



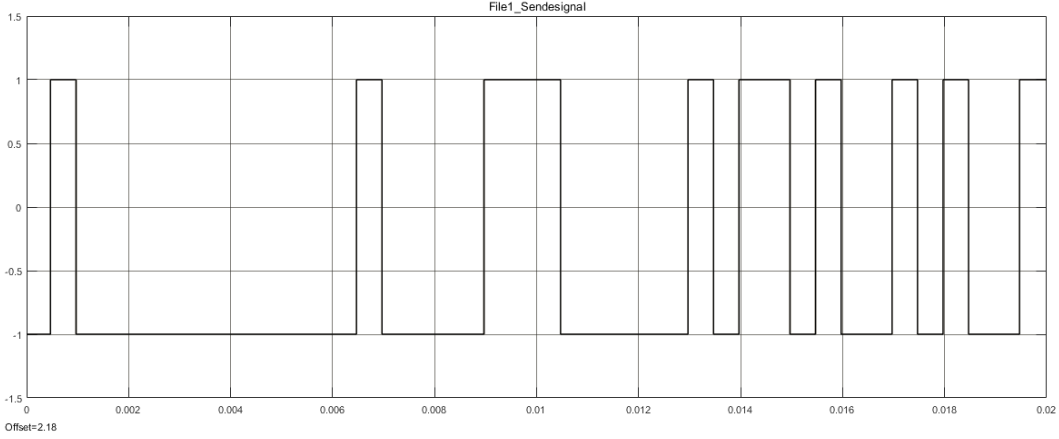


Aufgabe 1: Rauschanalyse

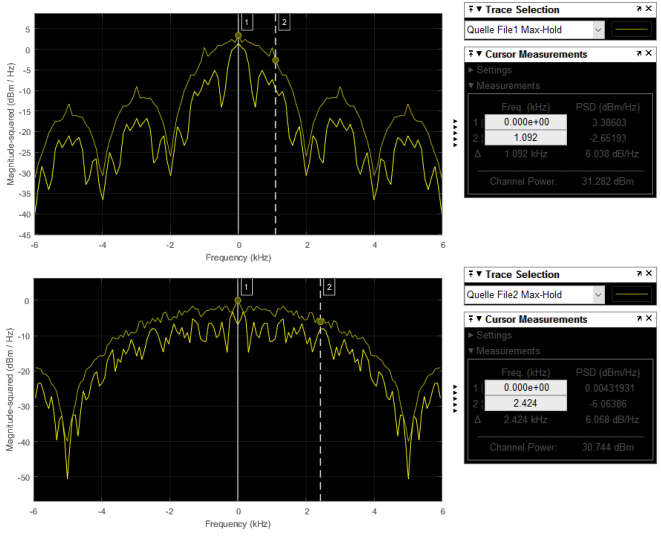
```
...
xmue1 = mean(n1)
var1  = var(n1)
...
```

Signal	Mittelwert	Varianz
$n_1(t)$	-0.06	4.00
$n_2(t)$	0.96	3.94

Aufgabe 2: Basisband I



Aufgabe 2: Basisband I



Aufgabe 2: Basisband I

Signal	Datenrate (BR)	Bandbreite ($6\,$dB (B))
File 1	$2.001\,\text{kbit}\,\text{s}^{-1}$	$1.092\,\text{kHz}$
File 2	$5.006\,\text{kbit}\,\text{s}^{-1}$	$2.424\,\text{kHz}$

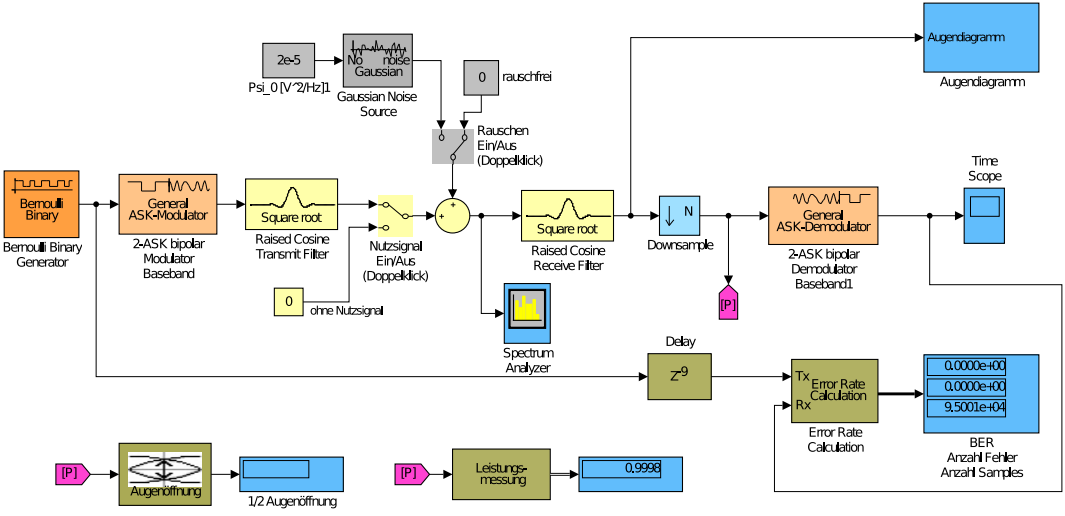
Inetwa linearer Zusammenhang:

$$B \approx \frac{1}{2} \cdot BR = \frac{1}{2} \cdot \frac{1}{T_S}$$

$\rightarrow$ Bandbreite bei $1\,\text{kbit}\,\text{s}^{-1}$:

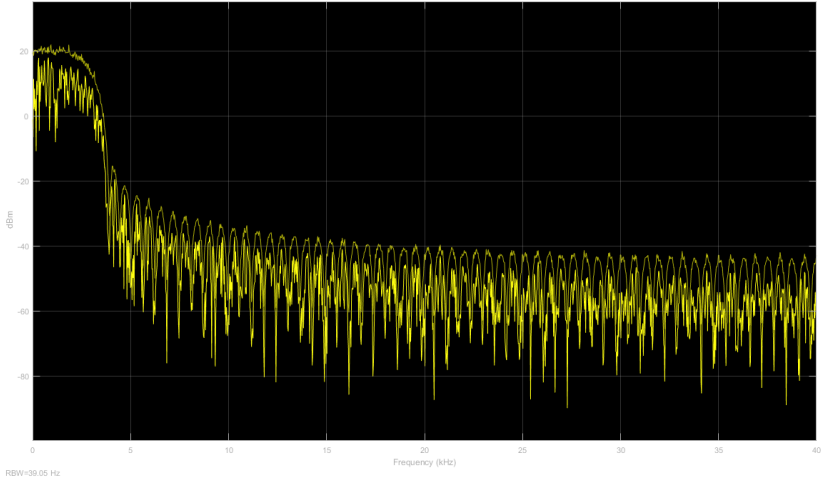
$$B \approx \frac{1}{2} \cdot 1000\,\text{kbit}\,\text{s}^{-1} = 500\,\text{Hz}$$

Aufgabe 3: Basisband II



Aufgabe 3: Basisband II

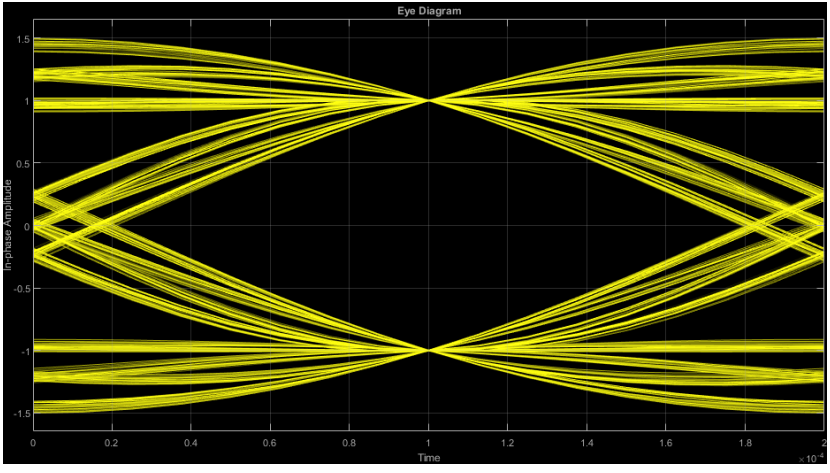
$B \approx 2.76\,\text{kHz}$



Aufgabe 3: Basisband II

$U_A \approx 0.9965\,\mathrm{V}$

$P_R \approx 0.1\,\mathrm{V}^2$



Aufgabe 3: Basisband II

$$\mathrm{BER} = \frac{1}{\log_2 s} \cdot \frac{s-1}{s} \cdot \mathrm{erfc}\left(\sqrt{\frac{\rho}{2}}\right),\ s = 2$$

$$\mathrm{BER} = 0.5 \cdot \mathrm{erfc}\left(\sqrt{\frac{9.93}{2}}\right) = 8.1303 \cdot 10^{-4}$$

gemessen:

$$\mathrm{BER}_g = 8.86315 \cdot 10^{-4}$$

Aufgabe 4: Änderung des Empfangsfilters

$$B = 2.76\,\text{kHz}$$

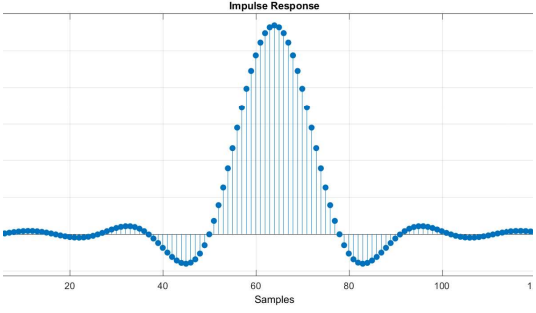
$$U_\text{A} = 0.8651\,\text{V}$$

$$P_\text{R} = 0.09861\,\text{V}^2$$

$$\rho = \frac{U_\text{A}^2}{P_\text{R}} = 7.59$$

$$\text{BER} = 2.9 \cdot 10^{-3}$$

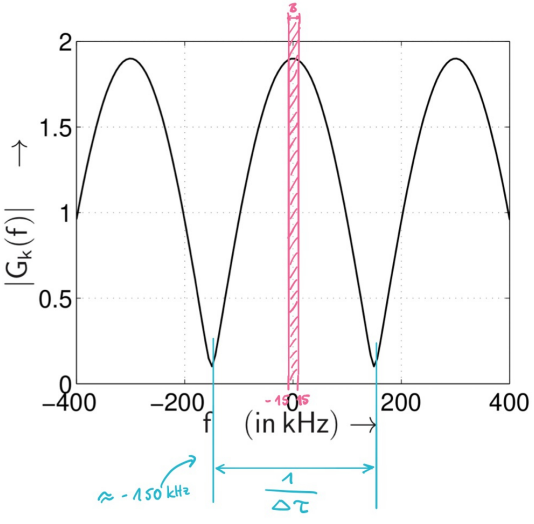
$$\text{BER}_g = 1.7036 \cdot 10^{-3}$$

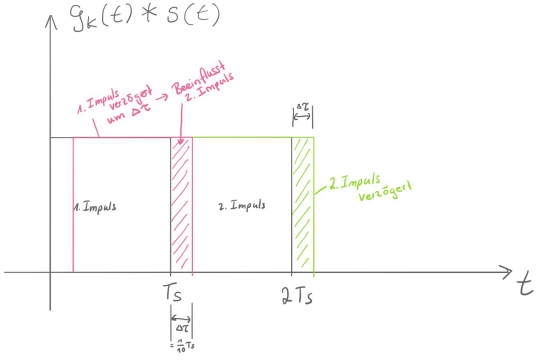


Aufgabe 4: Änderung des Empfangsfilters

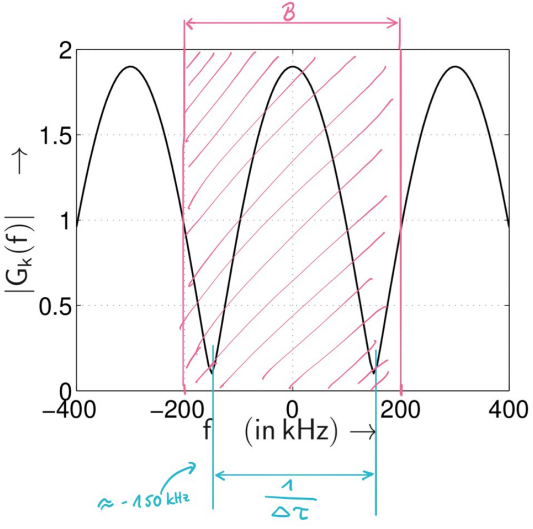
$$g_{\text{ef}}(t) \neq g_{\text{s}}(-t)$$

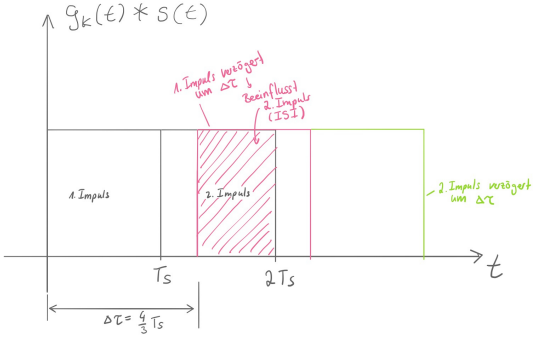
Aufgabe 5: Nichtfrequenzselektive Bedingungen



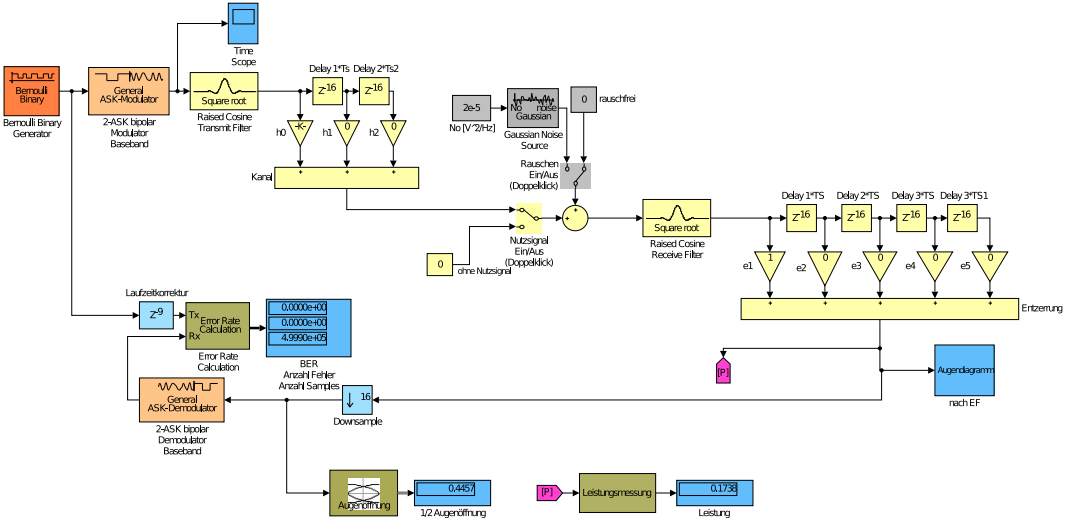


Aufgabe 6: Frequenzselektive Bedingungen





Aufgabe 7


Time Scope
Bernoulli Binary
Bernoulli Binary Generator
General ASK-Modulator
2-ASK bipolar Modulator Baseband
Square root
Raised Cosine Transmit Filter
Delay 1*Ts
Delay 2*Ts2
z-16
h0
h1
h2
Kanal
2e-5
No [V^2/Hz]
No
noise
Gaussian
Gaussian Noise Source
0
rauschfrei
Rauschen Ein/Aus (Doppelklick)
Nutzsignal Ein/Aus (Doppelklick)
ohne Nutzsignal
Square root
Raised Cosine Receive Filter
Delay 1*TS
Delay 2*TS
Delay 3*TS
Delay 3*TS1
e1
e2
e3
e4
e5
Entzerrung
Laufzeitkorrektur
z-9
Tx
Rx
Error Rate Calculation
Error Rate Calculation
0,0000e+00
0,0000e+00
4,9990e+05
BER
Anzahl Fehler
Anzahl Samples
General ASK-Demodulator
2-ASK bipolar Demodulator Baseband
16
Downsample
[P]
Augendiagramm
nach EF
Augenöffnung
0,4457
1/2 Augenöffnung
[P]
Leistungsmessung
0,1738
Leistung

Aufgabe 7

$$g_{\mathrm{k}}(t) = \frac{1}{\sqrt{5}} \cdot \delta(t)$$

Kenngröße	AWGN-Wert	A7-Wert
U_{A}	$0.9965\,\mathrm{V}$	$0.4457\,\mathrm{V}$
U_{R}^2	$0.1\,\mathrm{V}^2$	$0.1047\,\mathrm{V}^2$
ρ	9.93	1.897
BER, berechnet	$8.1303 \cdot 10^{-4}$	$8.42 \cdot 10^{-2}$
BER, gemessen	$8.6315 \cdot 10^{-4}$	$8.024 \cdot 10^{-2}$

Aufgabe 8

Kenngröße	Wert ohne Entzerrer	Wert mit Entzerrer
U_A	$0.4442\,\mathrm{V}$	$0.9581\,\mathrm{V}$
U_R^2	$0.09136\,\mathrm{V}^2$	$0.1452\,\mathrm{V}^2$
ρ	2.1597	6.3220
BER, berechnet	$7.08 \cdot 10^{-2}$	$6.0 \cdot 10^{-3}$
BER, gemessen	$3.9887 \cdot 10^{-2}$	$7.3382 \cdot 10^{-3}$

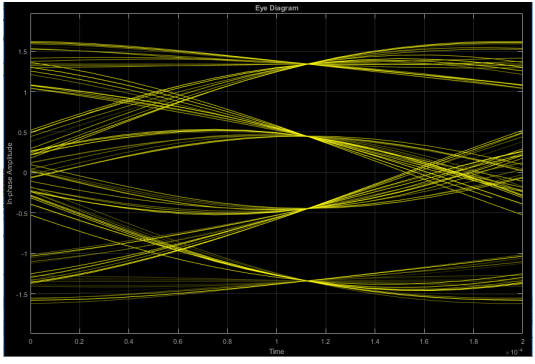
Aufgabe 8: Nyquistvektor

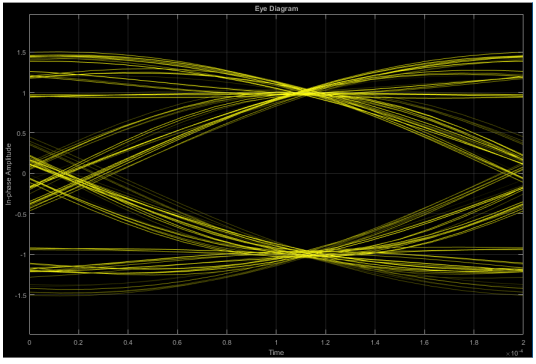
Veränderung der Position der 1 im Nyquistvektor

Qualitätskriterium: $\rightarrow$Summe der quadratischen Abweichungen der Faltung $h(k) * f(k)$ zu dem Nyquistvektor $z(k)$

$$\sum (h(k) * f(k) - z(k))^2 \rightarrow min$$

Aufgabe 8: Augendiagramme





Aufgabe 8: Rauschleistungsanhebung

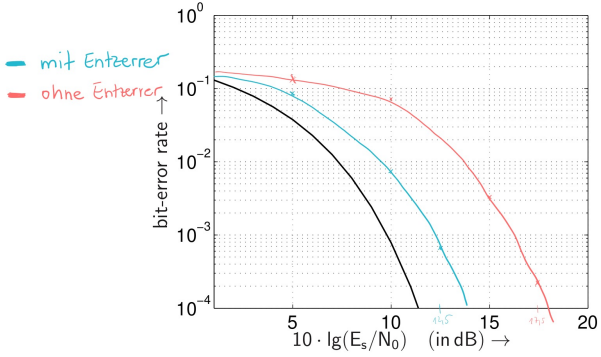
$$\sum f_i^2 = 1.654$$

Aufgabe 8: BER-Vergleich

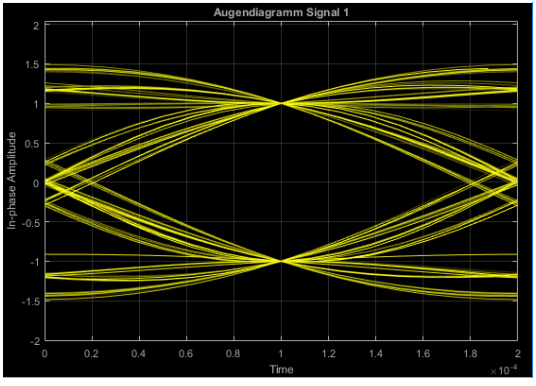
Einstellung von N_0 im SIMULINK-Modell

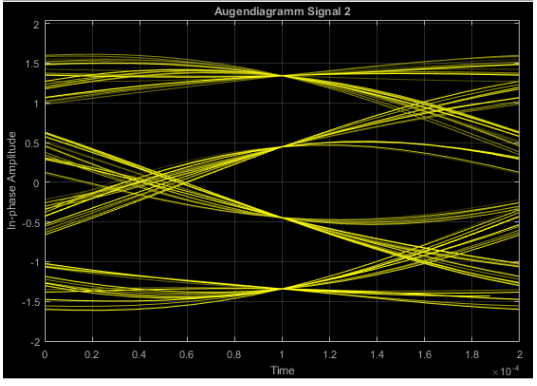
$$\mathrm{SNR}_{\mathrm{dB}} = 10 \cdot \log_{10} \frac{E_\mathrm{s}}{N_0}$$

$$N_0 = \frac{E_\mathrm{s}}{10^{\frac{\mathrm{SNR}}{10}}}$$



Aufgabe 9


Augendiagramm Signal 1
In-phase Amplitude
Time
×10^-4


Augendiagramm Signal 2
In-phase Amplitude
Time
×10^-4