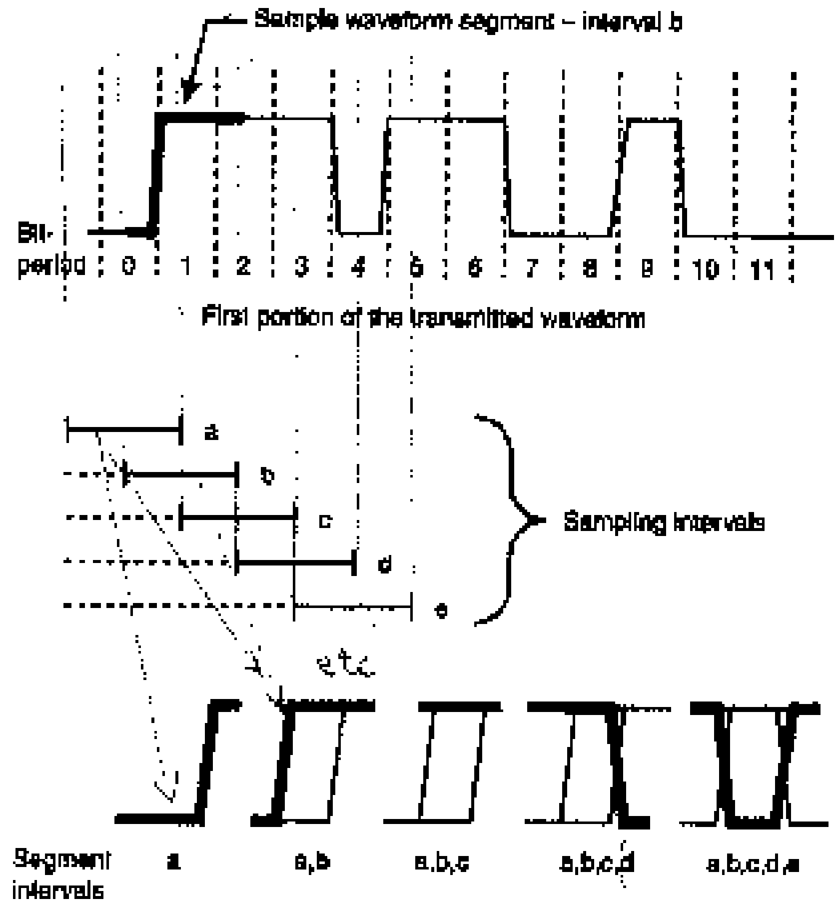
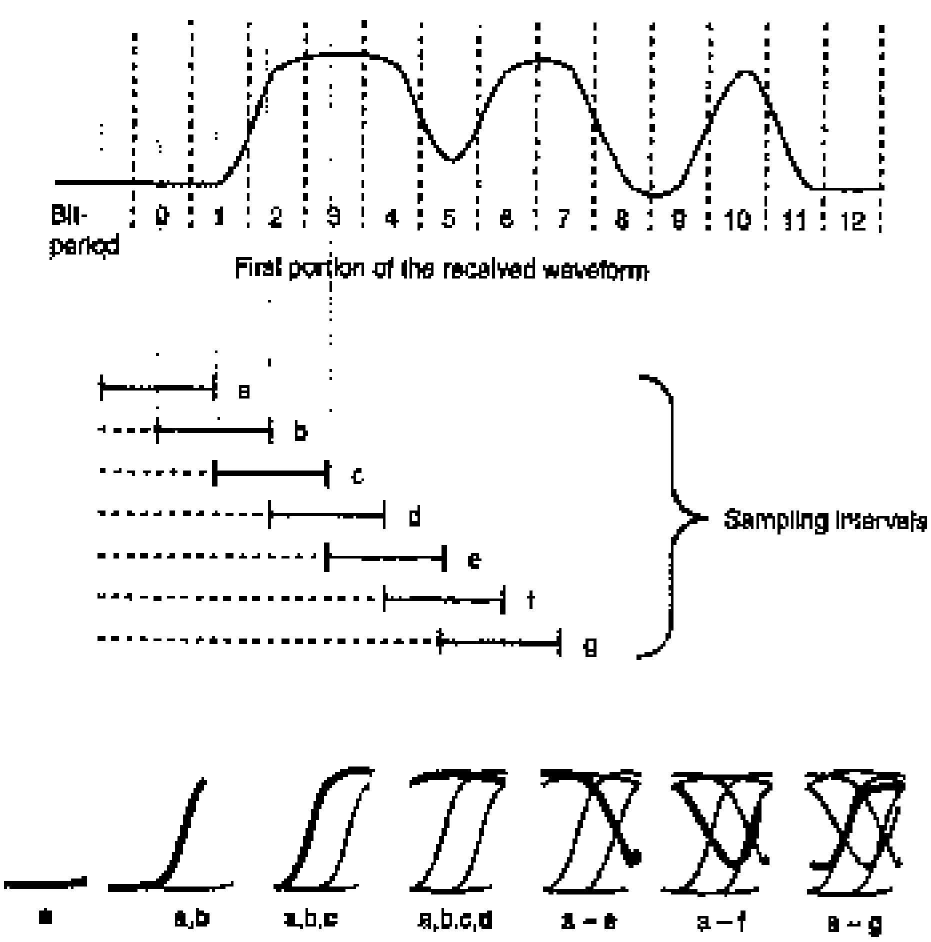
Formation of the Eye Diagram

Figure 5.9 Formation of the Transmit Eye Diagram **Case 1 - Rather Ideal Pulses**



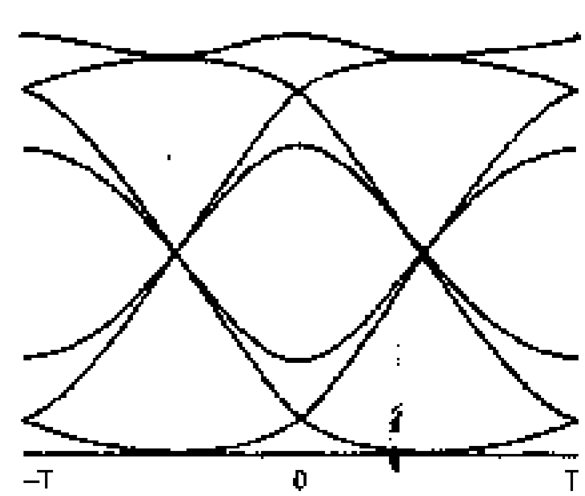
Superimposed waveform segments, last segment shown in bold

Formation of the Receive Eye Diagram **Case II - Distored Pulses**

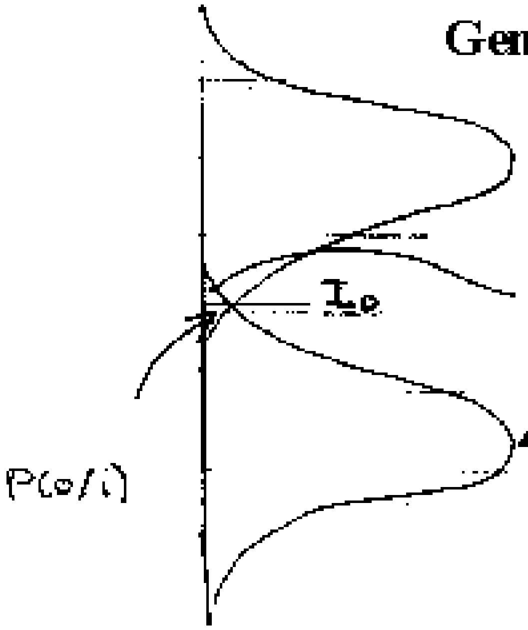


Superimposed waveform segments, last segment shown in bold

Completed Receive Eye Diagram Plotted in the Interval (–T,T) About the Eye Center



Generalization for Different Noise Contributions



$$P(1/0) = \frac{1}{\sigma_0\sqrt{2\pi}} \int_{I_D - I_0}^{\infty} e^{-\frac{(I-I_0)^2}{2\sigma_0^2}} \, d(I-I_0)$$

$$= \frac{1}{\sigma_0\sqrt{2\pi}} \int_{I_D - I_0}^{\infty} e^{-(k)^2/2\sigma_0^2} \, dk$$

$$= \frac{1}{2}\,\mathrm{erfc}\left(\frac{I_D - I_0}{\sigma_0\sqrt{2}}\right)$$

$$P(0/1) = \frac{1}{\sigma_1\sqrt{2\pi}} \int_{-\infty}^{I_D - I_1} e^{-\frac{(I-I_1)^2}{2\sigma_1^2}} \, d(I-I_1)$$

$$\sigma_1^2 \rightarrow 2eIB + \frac{4kT}{R}B$$

$$= \frac{1}{2}\,\mathrm{erfc}\,\frac{I_1 - I_D}{\sigma_1\sqrt{2}}$$

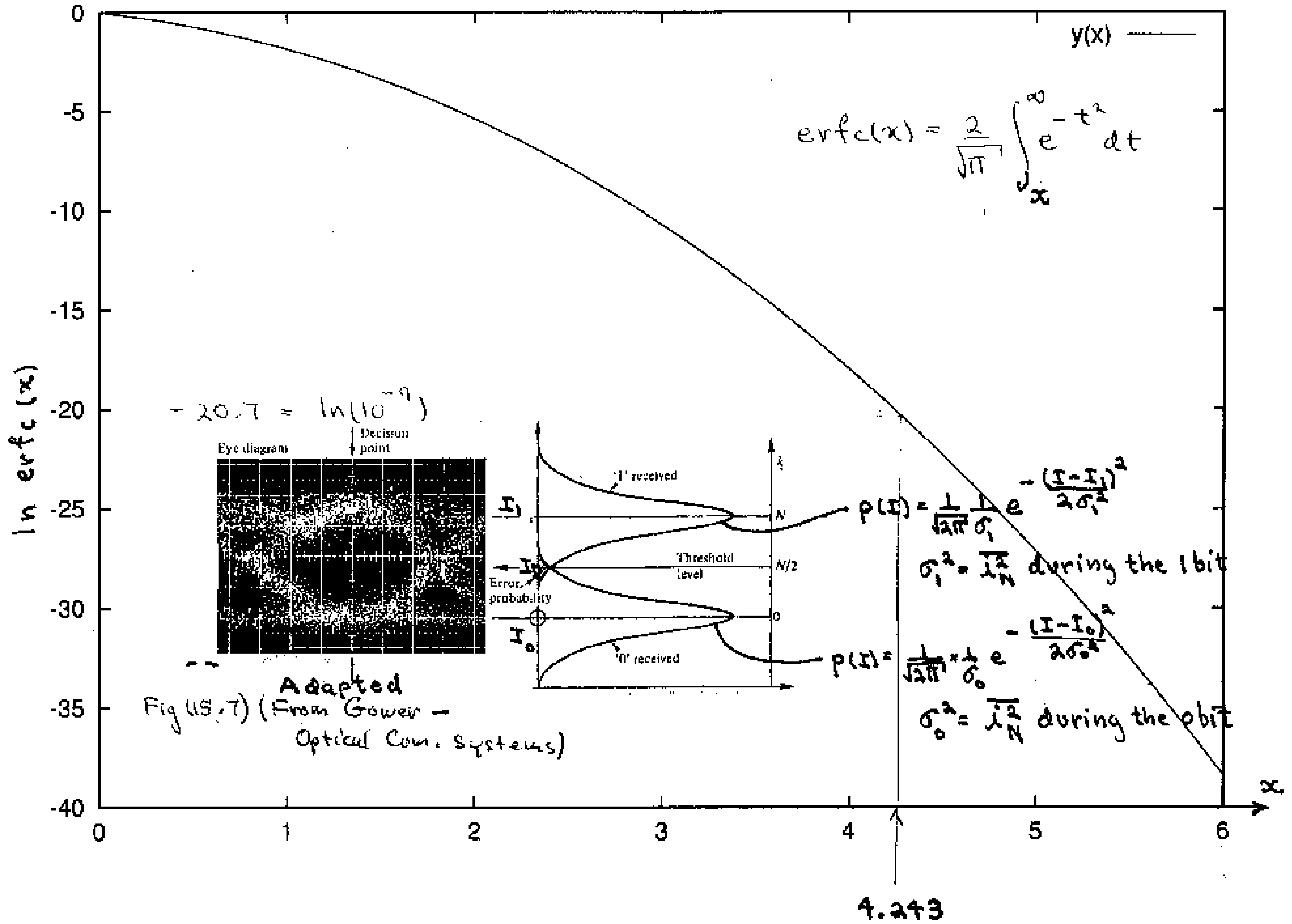
$$P.E. = \frac{1}{2}\left[P(0/1) + P(1/0)\right] = \mathrm{erfc}\,\frac{I_1 - I_0}{2\sqrt{2}\,\sigma_1}$$

Error Minimum for $\frac{I_D - I_0}{\sigma_0\sqrt{2}} = \frac{I_1 - I_D}{\sigma_1\sqrt{2}}$

$$I_D = \frac{I_1\sigma_0 + \sigma_1 I_0}{\sigma_1 + \sigma_0}$$

For $\sigma_0 = \sigma_1$, $I_D = \frac{I_1 + I_0}{2}$ and $P.E. = \mathrm{erfc}\left(\frac{I_1 - I_0}{2\sqrt{2}\,\sigma_0}\right)$

For $BER = 10^{-9}$ $\quad \frac{I_1 - I_0}{2\sqrt{2}\,\sigma_0} = 4.24$



y(x)
ln erfc (x)
x
0
-5
-10
-15
-20
-25
-30
-35
-40
0
1
2
3
4
5
6
erfc(x) = 2/√π ∫x∞ e^(-t²) dt
-20.7 = ln(10^-9)
Eye diagram
Decision point
'1' received
Threshold level
Error probability
'0' received
I1
I0
N
N/2
0
p(I) = 1/√2π · 1/σ1 · e^(-(I-I1)²/2σ1²)
σ1² = i²N during the 1 bit
p(I) = 1/√2π · 1/σ0 · e^(-(I-I0)²/2σ0²)
σ0² = i²N during the 0 bit
Adapted
Fig 11.5.7 (From Gower - Optical Com. Systems)
4.243