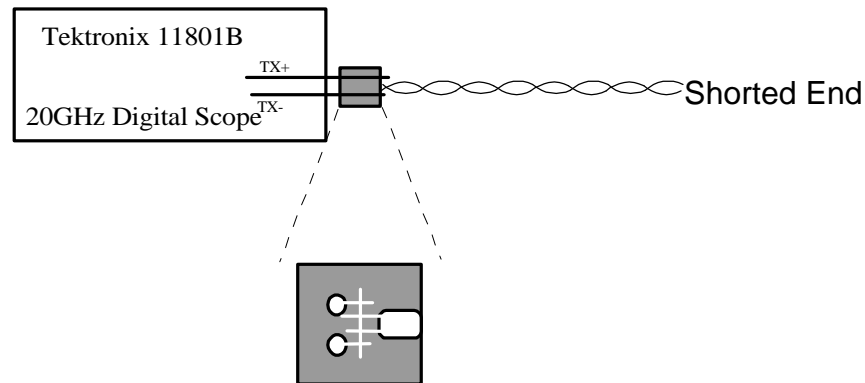
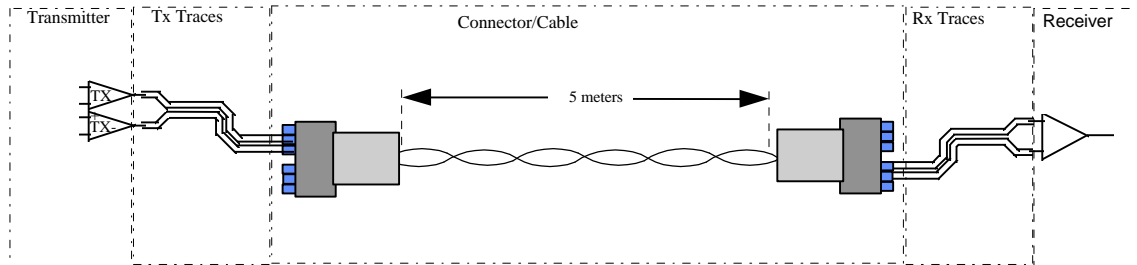




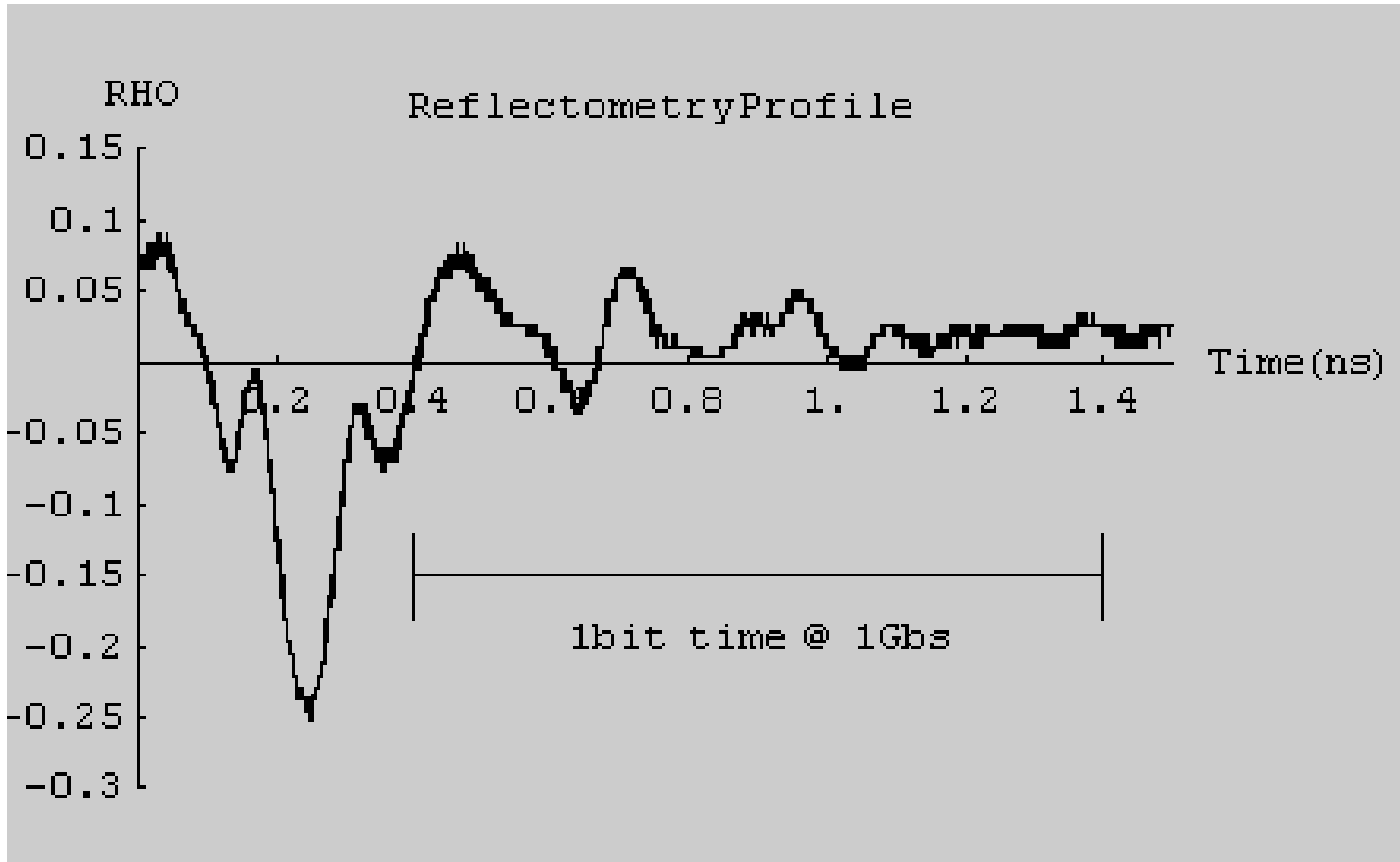
# 1394 Connector and Cable Studies

# Experimental Setup



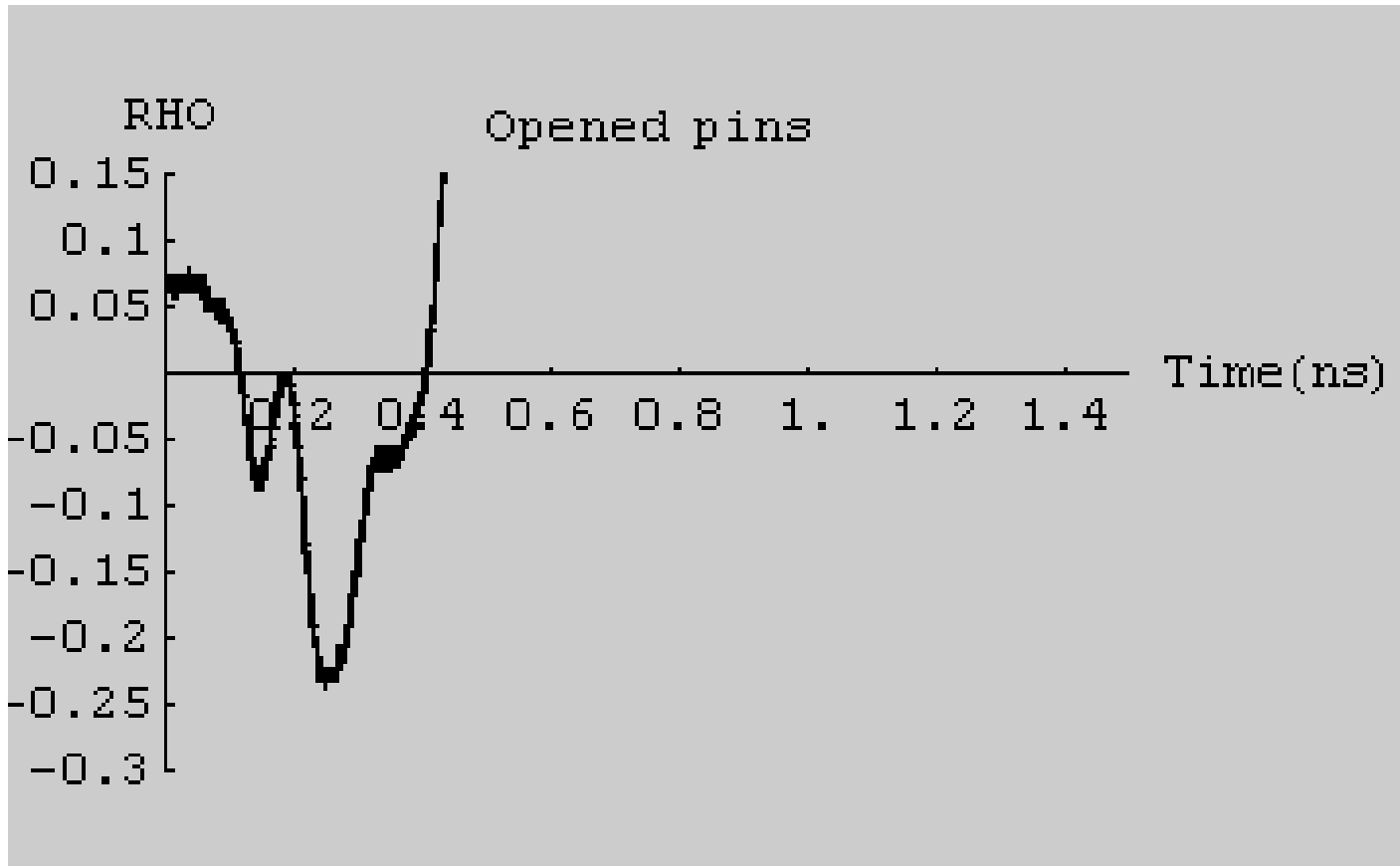


# Connector TDR Data



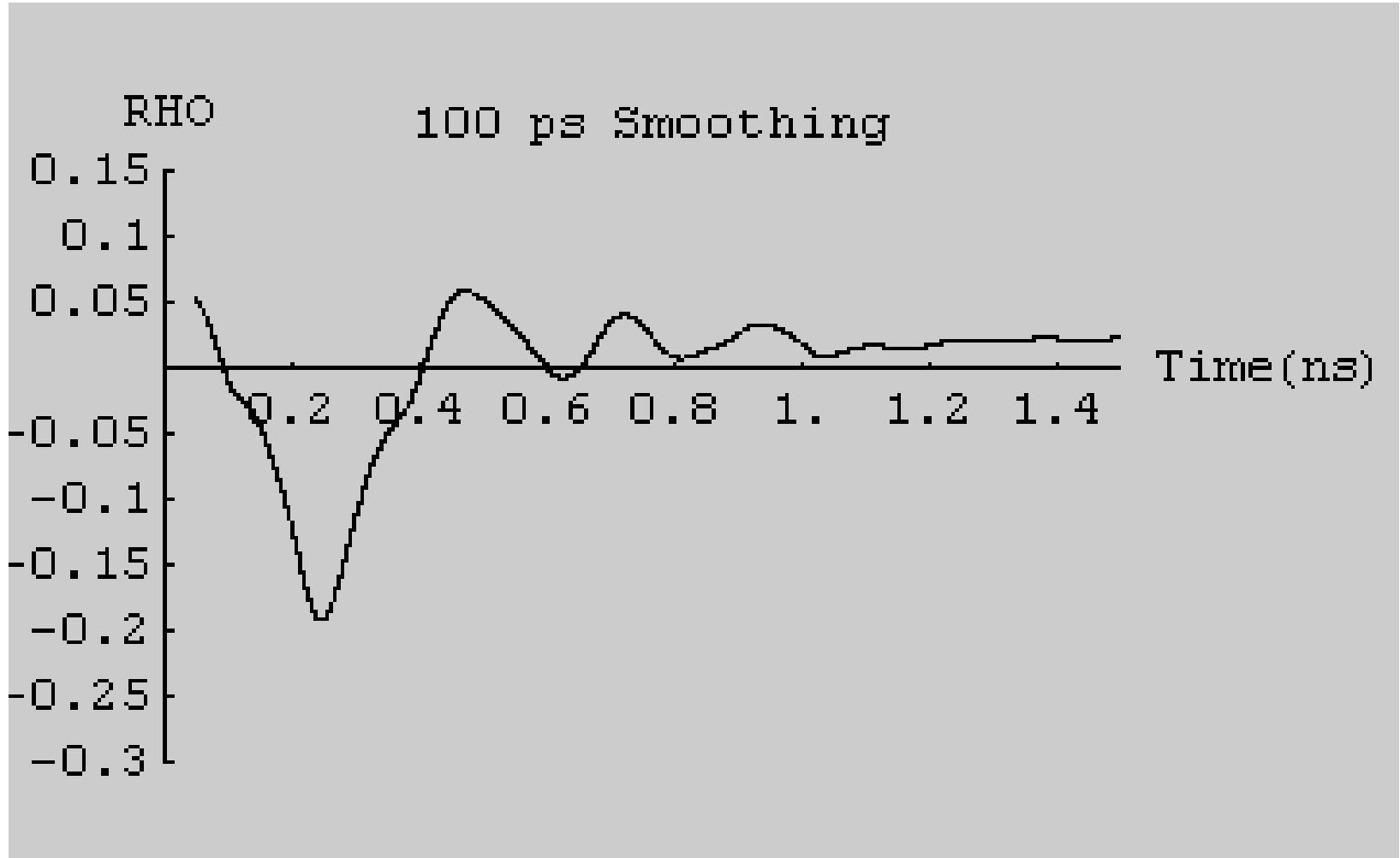


# Opened Pins



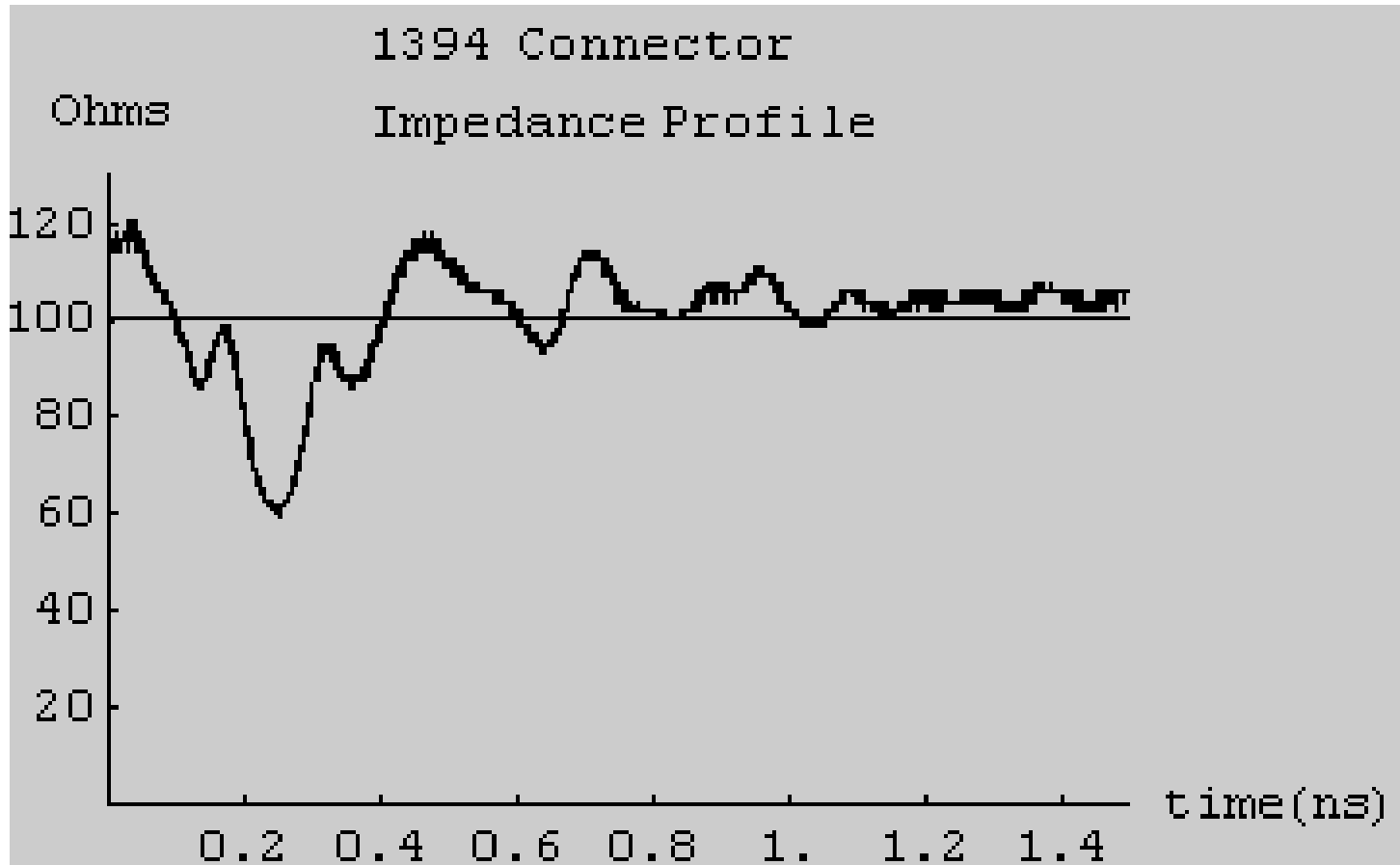


# 100 ps Smoothing



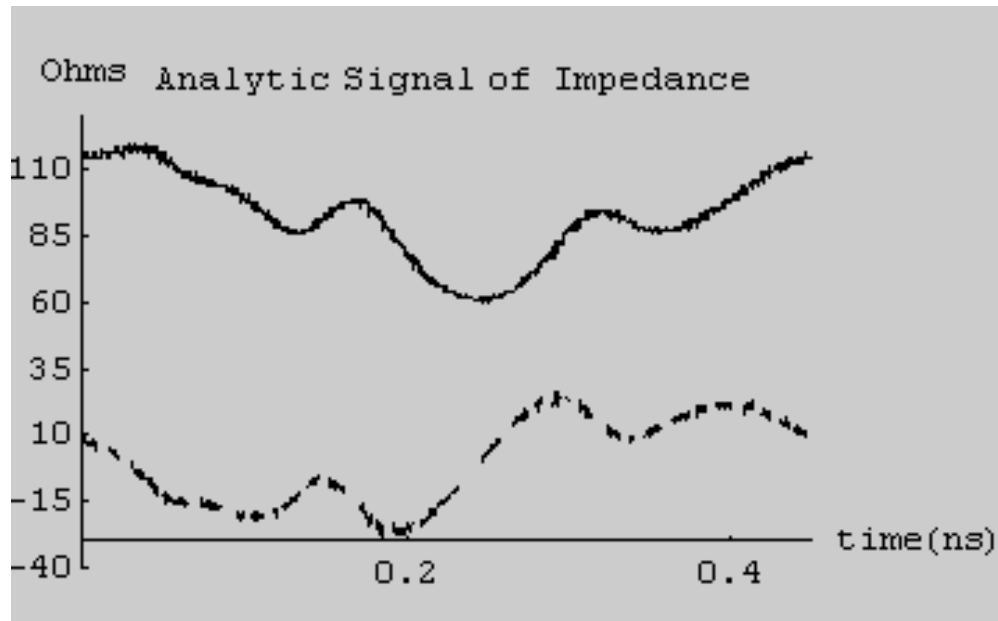


# Impedance Profile





# Complex Impedance Profile



The definition of the transmission coefficient ( $S_{12}$ ) is :

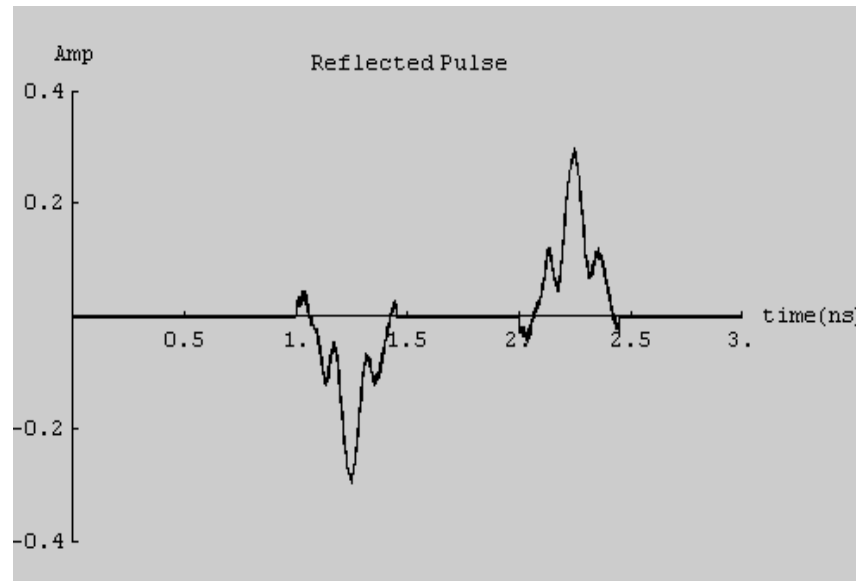
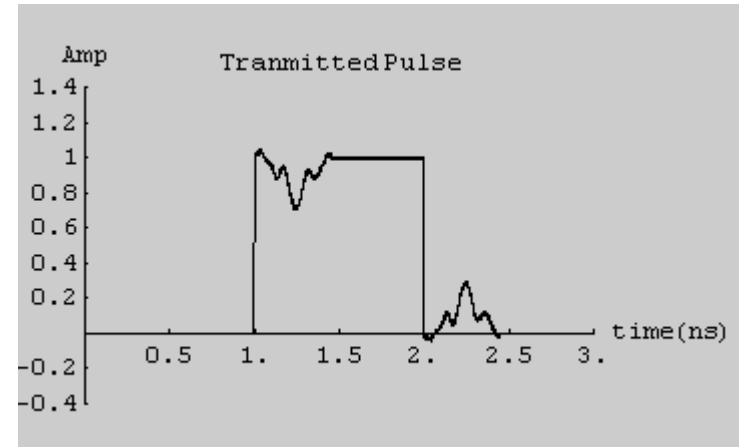
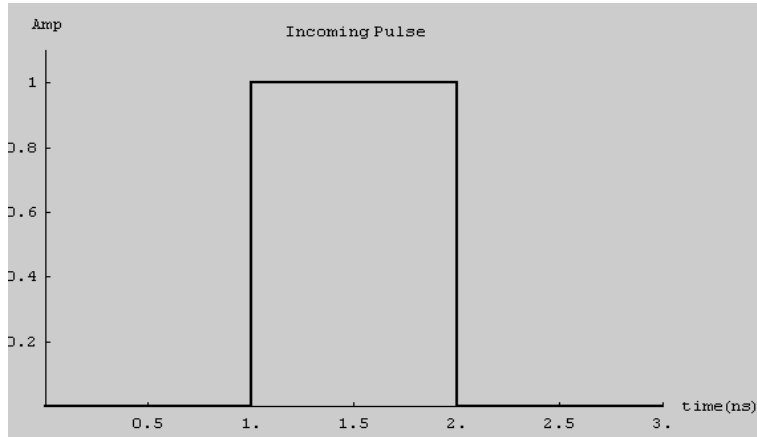
$$S_{12}^{\text{HWL}} = T^{\text{HWL}} = \frac{2 Z_{\text{load}}^{\text{HWL}}}{Z_{\text{load}}^{\text{HWL}} + Z_0^{\text{HWL}}}$$

Similarly the definition of the reflection coefficient ( $S_{11}$ ) is :

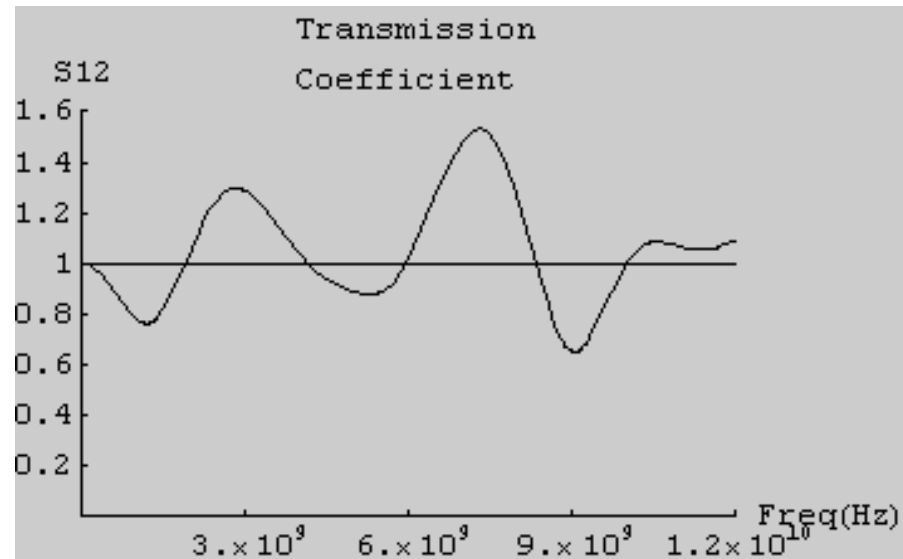
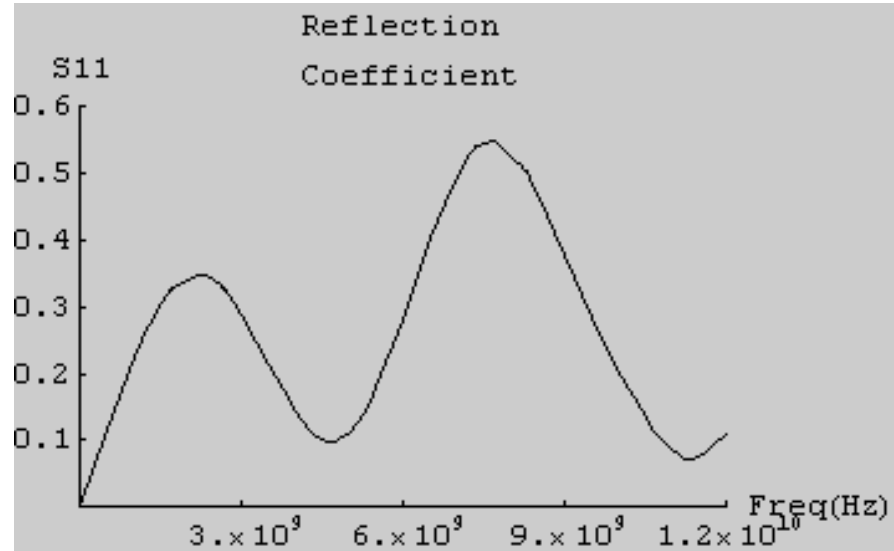
$$S_{11}^{\text{HWL}} = R^{\text{HWL}} = \frac{Z_{\text{load}}^{\text{HWL}} - Z_0^{\text{HWL}}}{Z_{\text{load}}^{\text{HWL}} + Z_0^{\text{HWL}}}$$



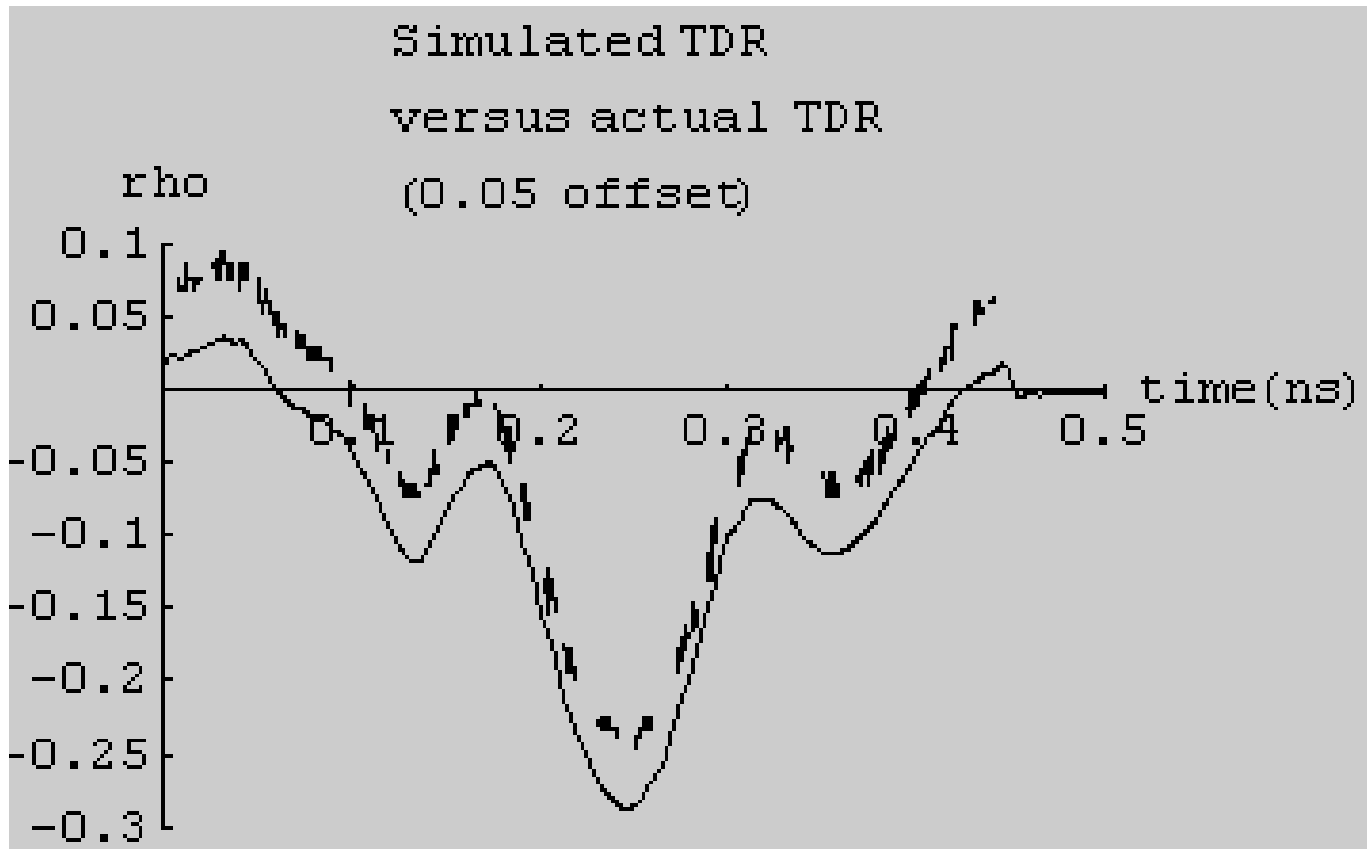
# S Parameters Calculation



# S Parameters



# Back Calculation of TDR

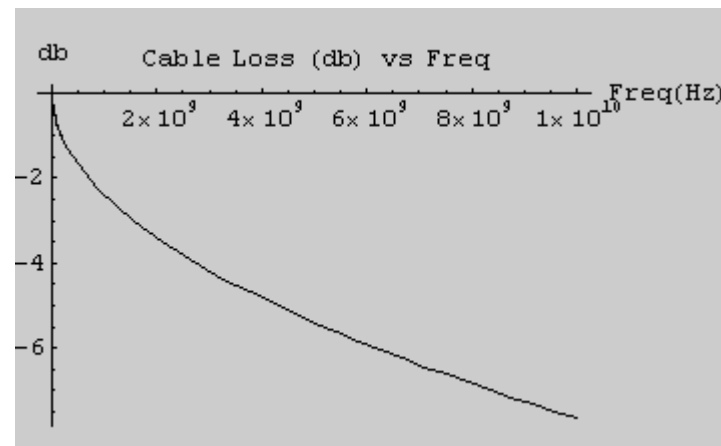


# Cable Model

$$\nabla_z v@z, tD == -r i@z, tD - 1 \nabla_t i@z, tD$$

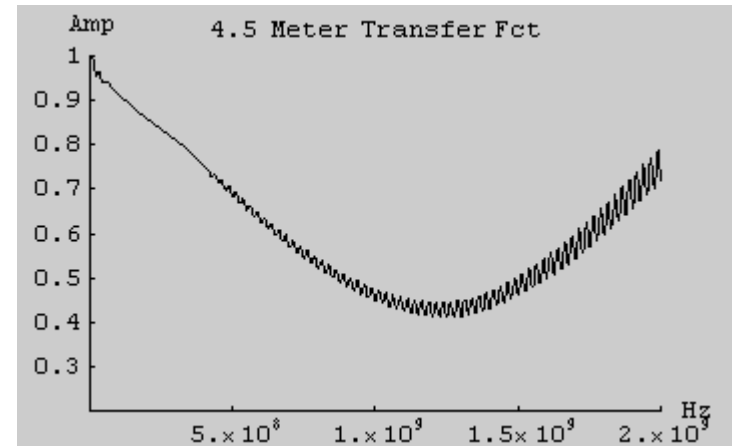
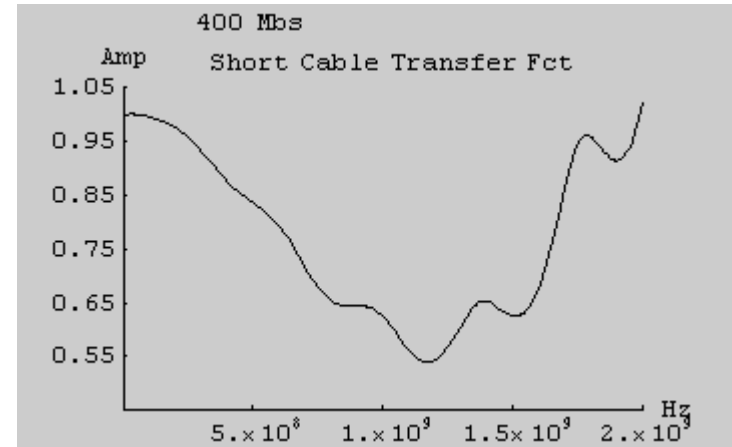
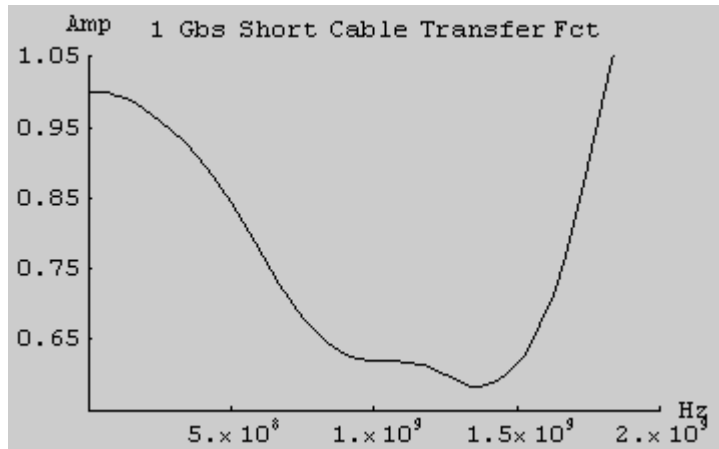
$$\nabla_z i@z, tD == -g v@z, tD - c \nabla_t v@z, tD$$

$$r_{\text{internal}} = \begin{cases} r_{dc} \left( 1 - i \frac{f}{f_0} \right), & f \leq f_0 \\ r_{dc} \sqrt{\frac{f}{f_0}} (1 - i), & f > f_0 \end{cases}$$





# Simulated Cable/Connector Transfer Amplitudes



$$S_{\neq} = \frac{H_{HwL} T^2 H_{wL}}{1 - R^2 H_{wL} H^2 H_{wL}}$$



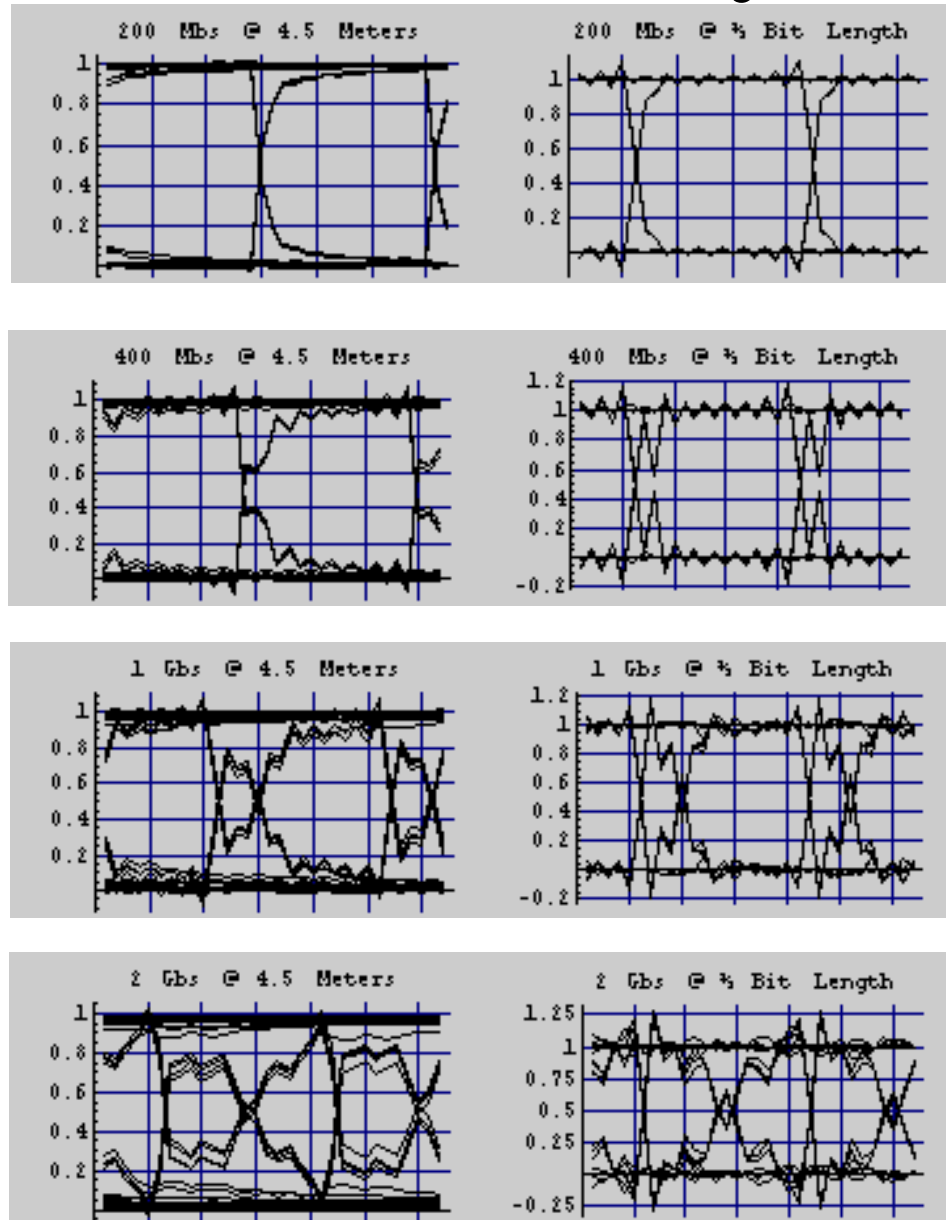
# Bit Test Pattern

11000001010011111010100000000000000000000000

00000101111111111111111111111111111110 ... repeating

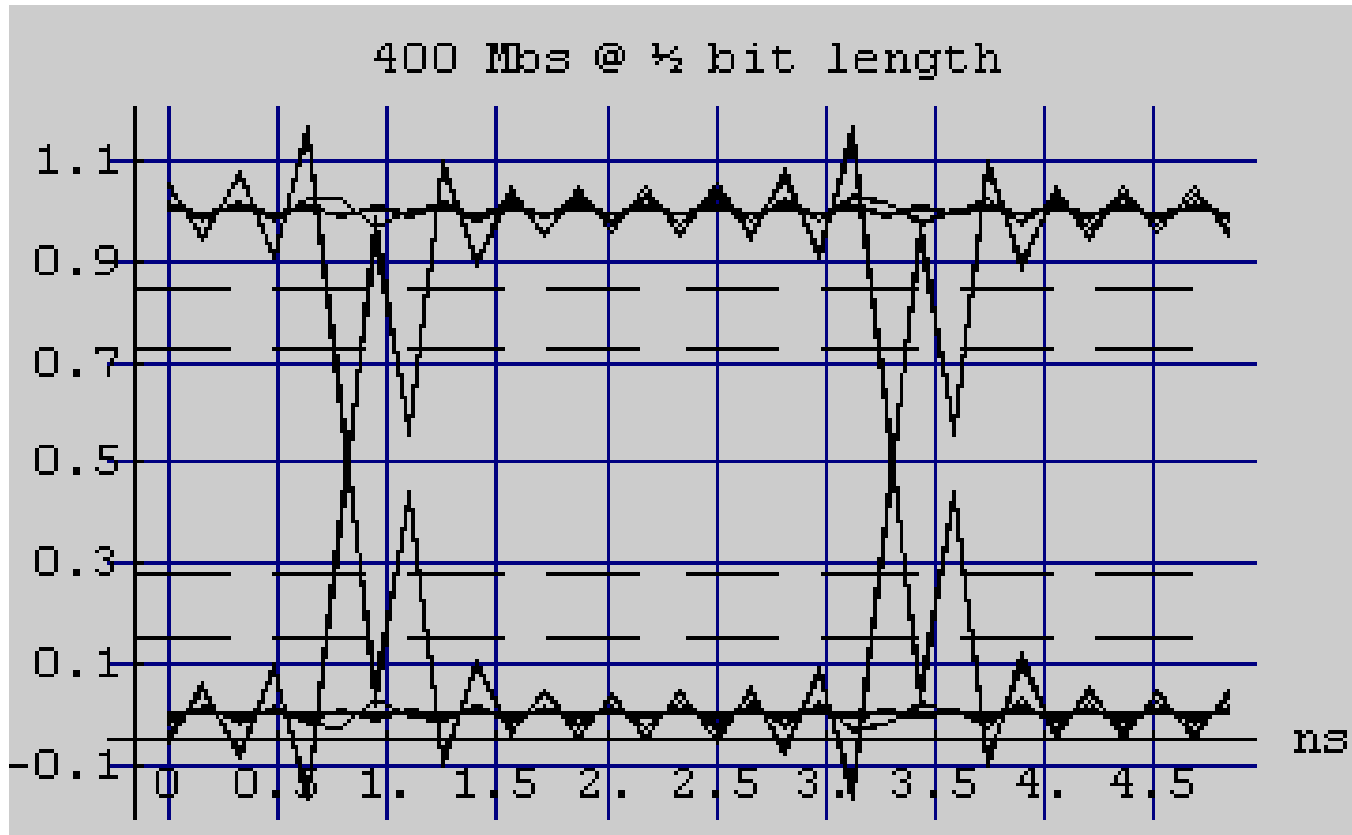


# Simulated Eye Diagrams



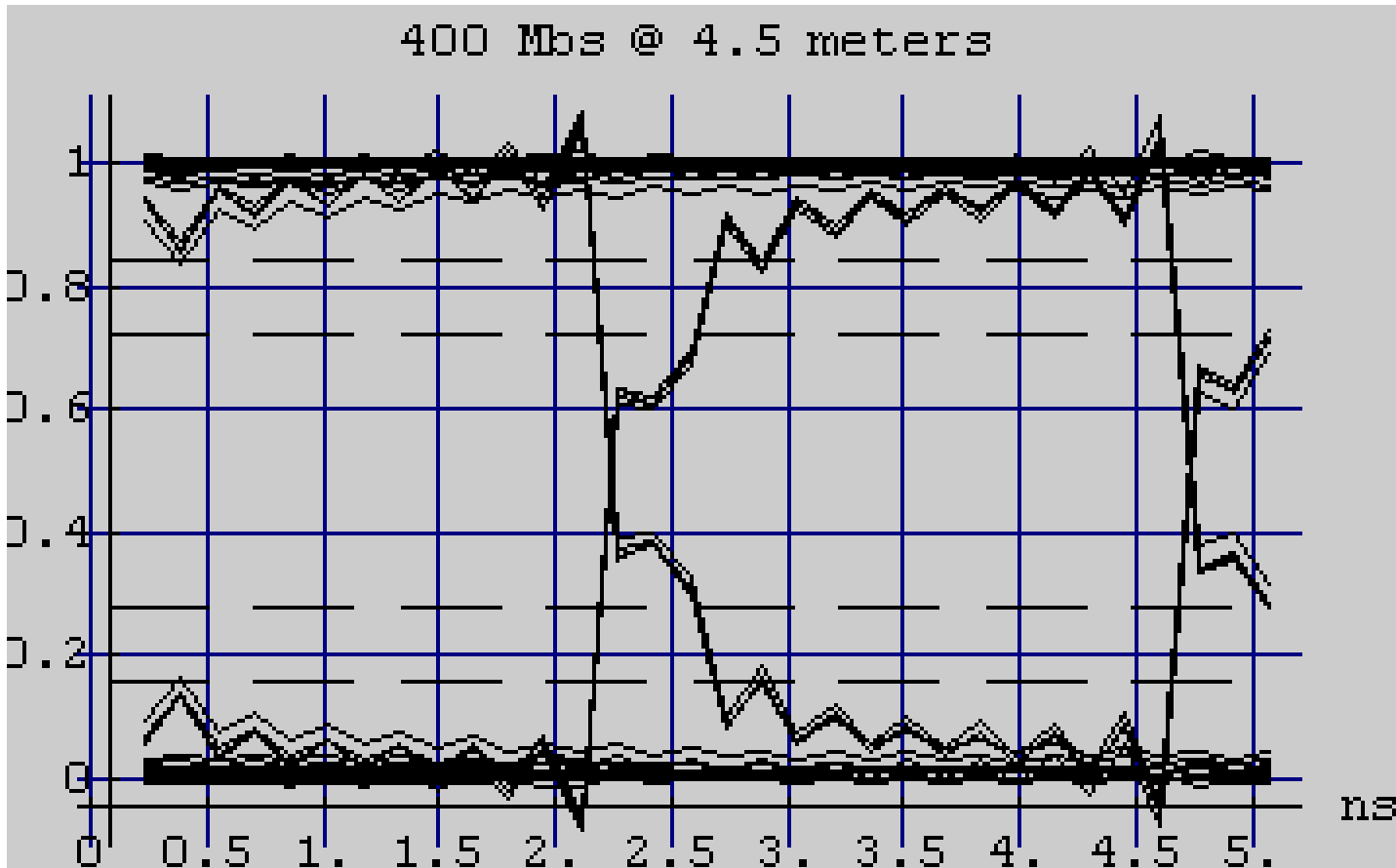


# 400 Mbs Short Cable Simulation



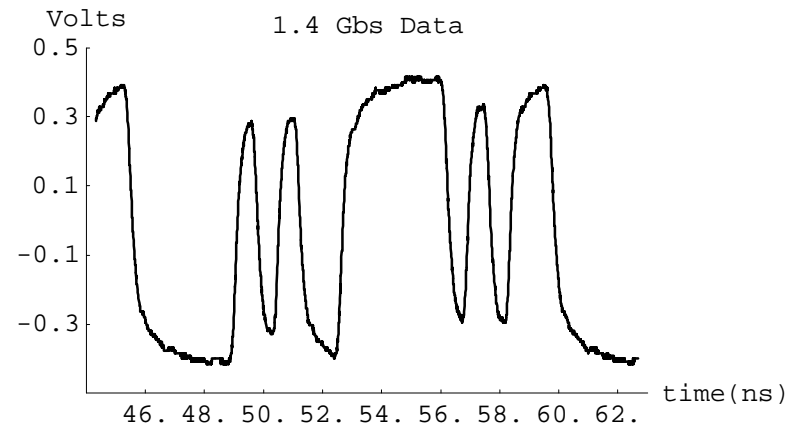
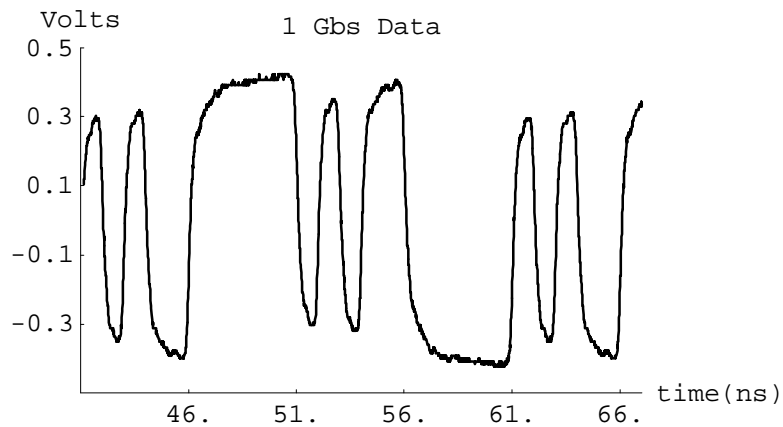
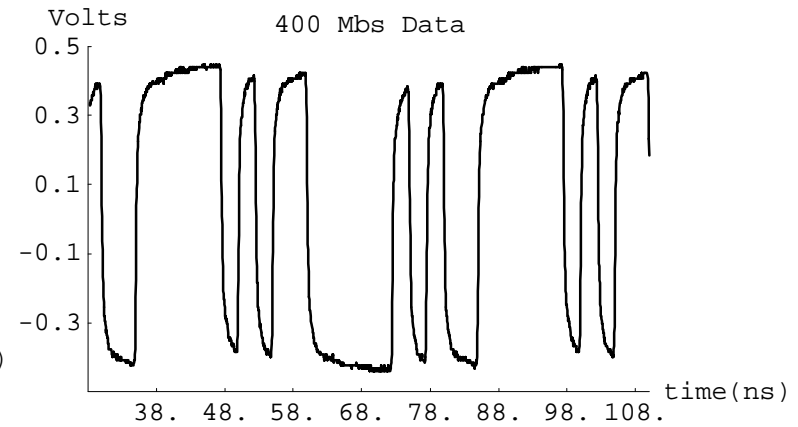
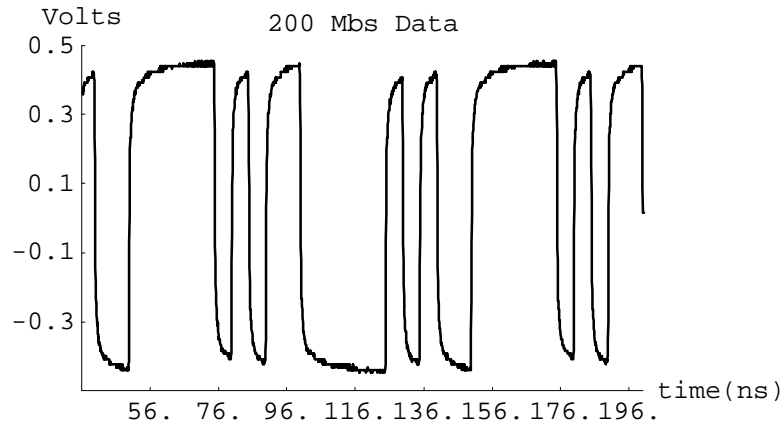


# 400 Mbs 4.5 Meter Simulation



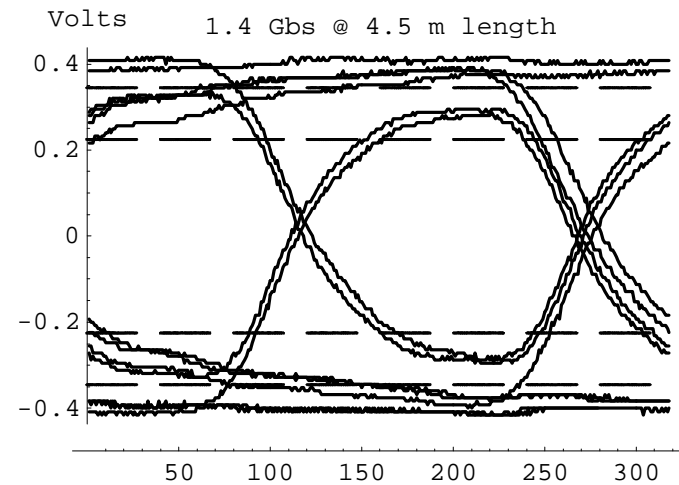
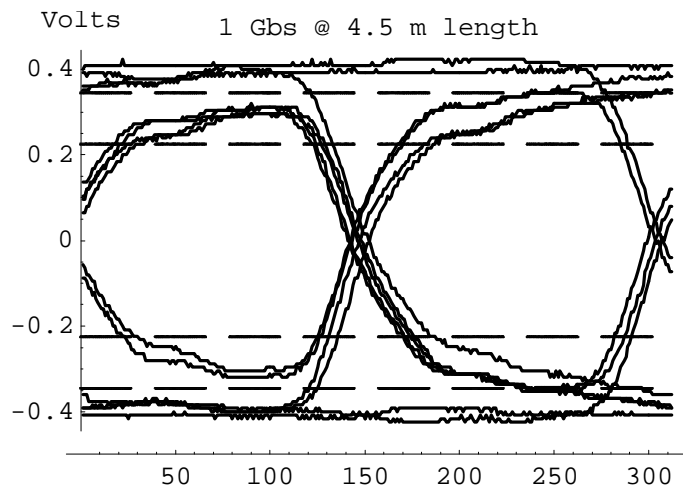
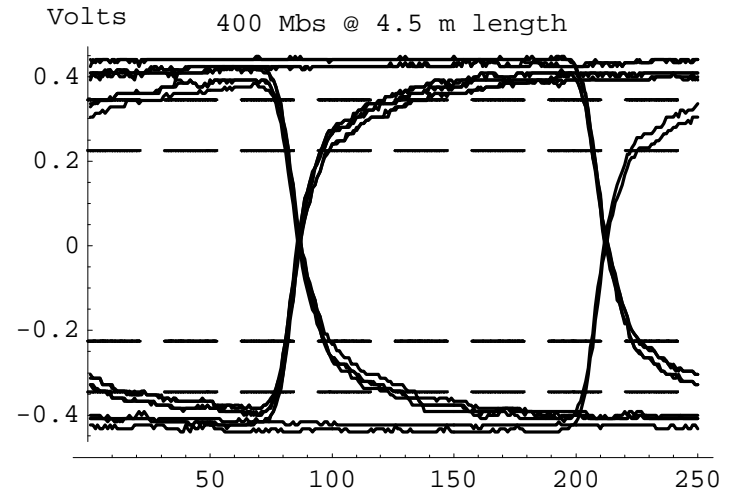
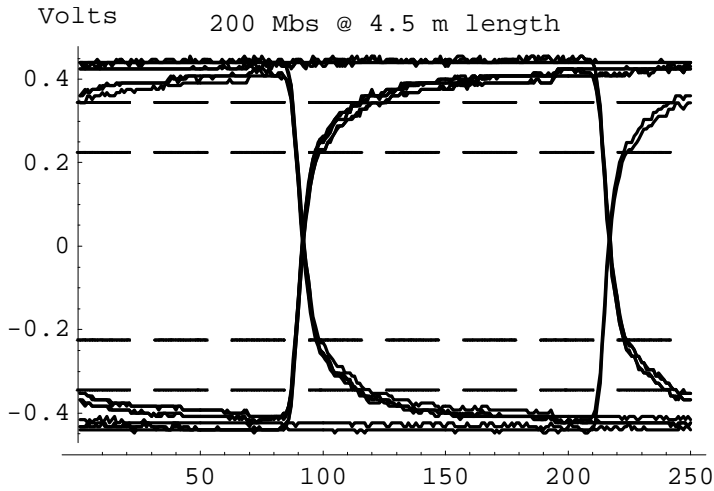


# Experimental Results





# Experimental Eyes





# Experimental Jitter Data

The margin for the S400 rate is defined:

$$(\text{Bit cell time} - (\text{Data jitter} + \text{Strobe jitter} + \text{Skew})) = \text{margin}$$

which equals  $(2.54 - (0.755 + 0.755 + 0.565)) = 0.48 \text{ ns}$ .

Bitrate	Measured Jitter	
	Jitter (ps)	
	68% Threshold	45% Threshold
200 Mbs	2300	554
400 Mbs	2400 (~ closed)	612
1 Gbs	closed	587
1.4 Gbs	closed	471

IEEE Jitter Budget, Table E-9, p. 298, IEEE 1394-1995

	Data Jitter HnsL	Strobe Jitter HnsL	Skew HnsL
Transmitter Skew			0.1
Transmitter Jitter	0.15	0.15	
Cable Reflections	0.035	0.035	
Cable intersymbol	0.13	0.13	
Cable Delay mismatch			0.4
Channel margin	0	0	
Jitter at receive pins	0.315	0.315	0.50
Receiver offset	0.14	0.14	0.05
Receiver intersymbol and power supply reject	0.01	0.01	
Flip flop setup and hold	0.2	0.2	
Total	0.755	0.755	0.55