CAT-5 UTP Analysis

-February 98 P1394b meeting-

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Model Assumptions

- Tune the system for 25 meter lengths
- Ignore transformer models, impedance matching issues for now
- Simulate to estimate maximum useful distance of operation
- Minimum transmitter launch voltage: 600 mV diff.
- Guaranteed receiver sensitivity: 200 mV diff.

CAT-5 UTP Loss Specification

	Attenuation [dB]			
Frequency [MHz]	LINK	100m UTP CAT 5	Three Connectors	
0.064	N/A	0.8	N/A	
0.256	N/A	1.1	N/A	
0.512	N/A	1.5	N/A	
0.772	N/A	1.8	N/A	
1	2.5	2.1	0.3	
4	4.8	4.3	0.3	
10	7.5	6.6	0.3	
16	9.4	8.2	0.6	
20	10.5	9.2	0.6	
31.25	13.1	11.8	0.6	
62.5	18.4	17.1	0.9	
100	23.2	22	1.2	

EIA/TIA 568 and DIS11801 standards specify the attenuation as a function of frequency for 100 meter CAT-5 UTP cable and connectors

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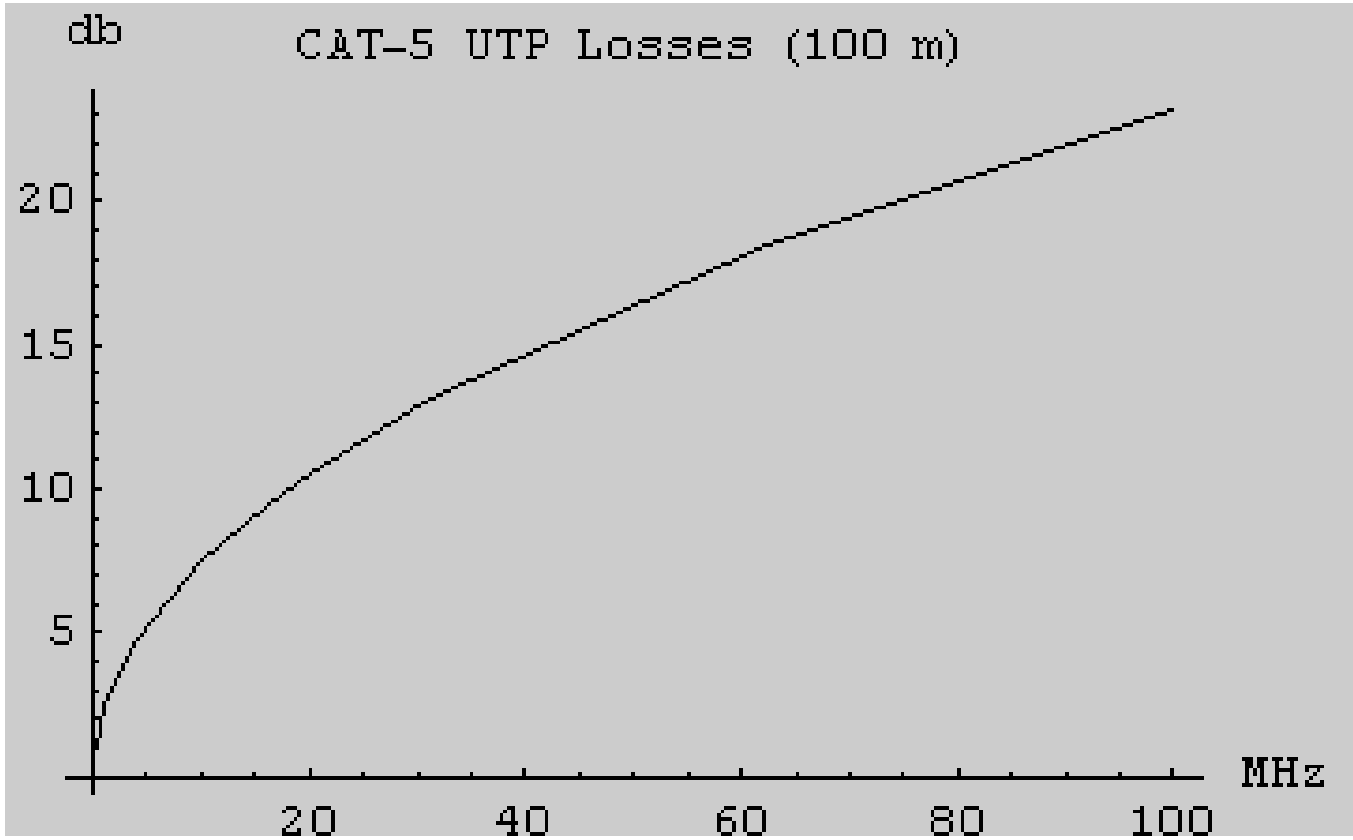
Loss Plot

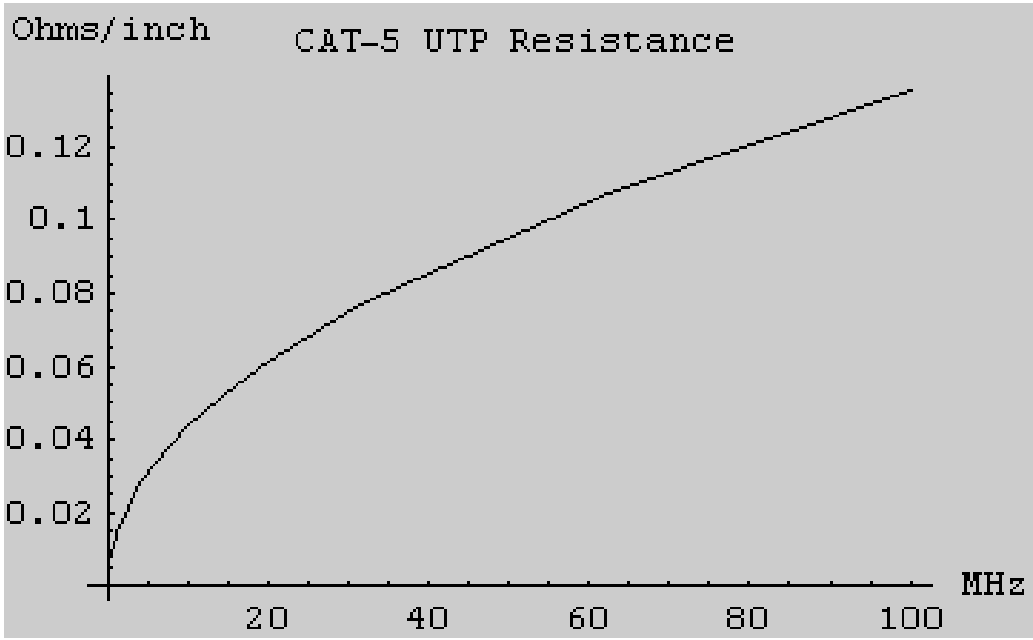


Cable Model

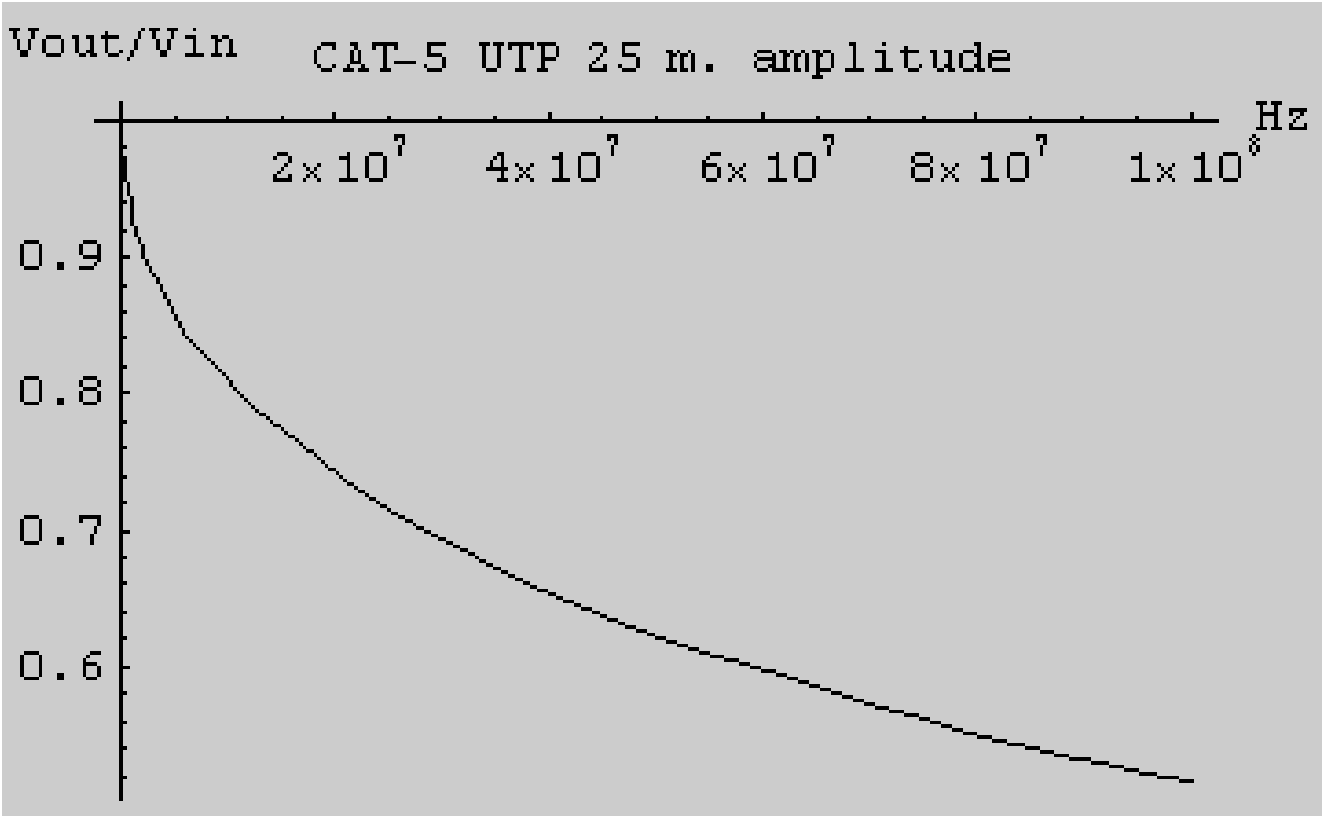
$$\partial_z v[z, t] == -r\, i[z, t] - l\, \partial_t i[z, t]$$

$$\partial_z i[z, t] == -g\, v[z, t] - c\, \partial_t v[z, t]$$

r is a function of frequency:

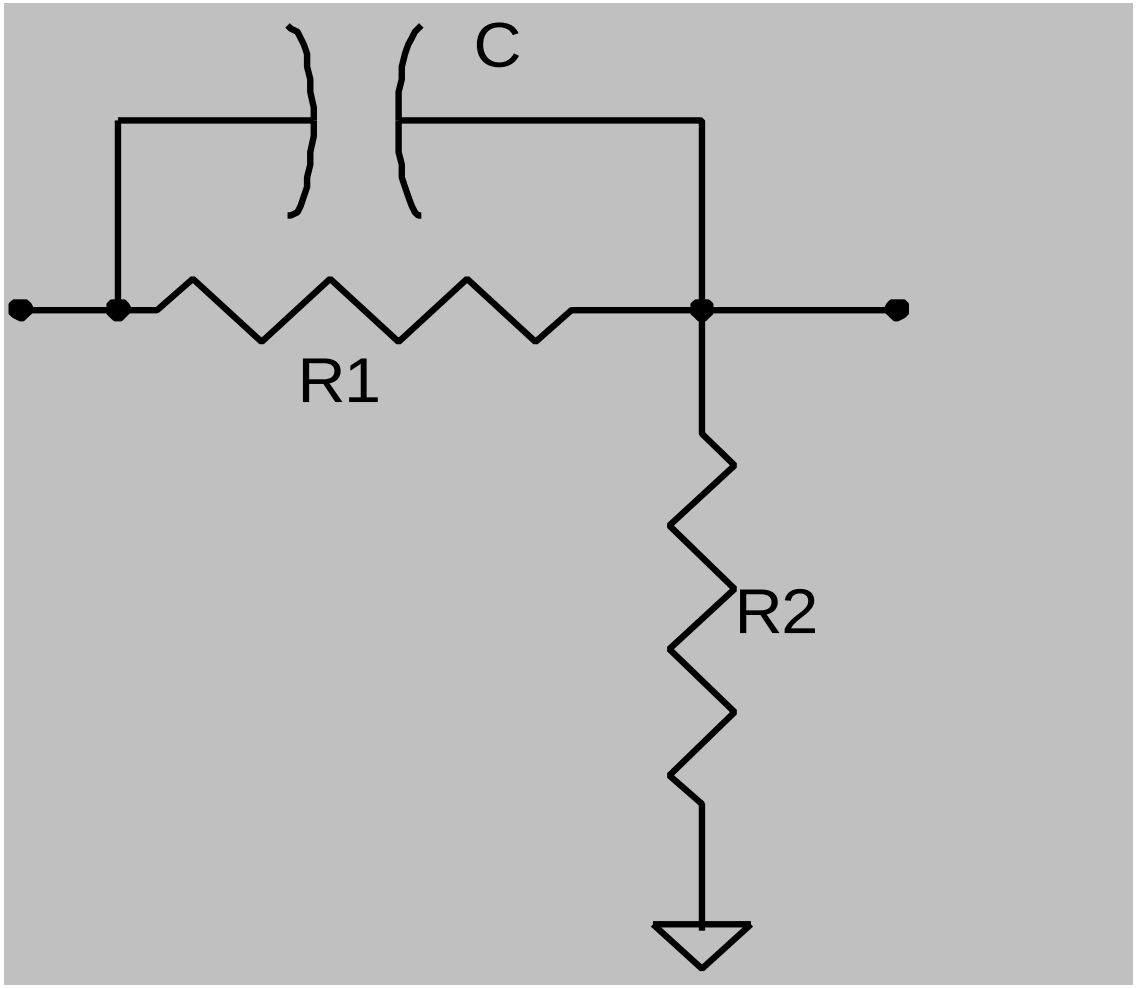


Cable Transfer Function



Equalization Network

R1 = R2 = 50 Ohms,
C = 127 pF



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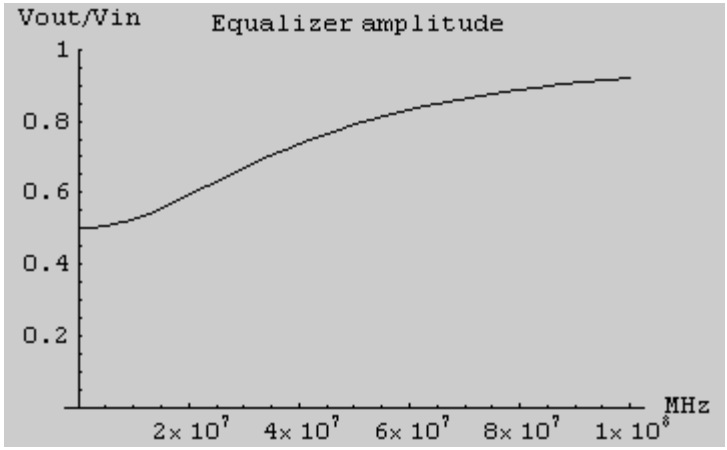
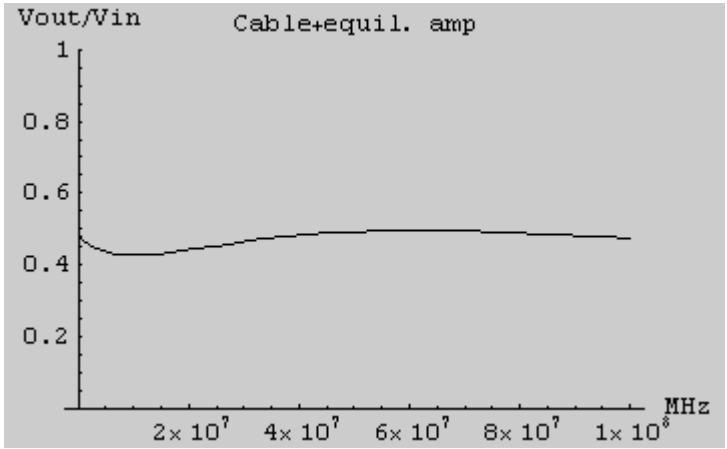
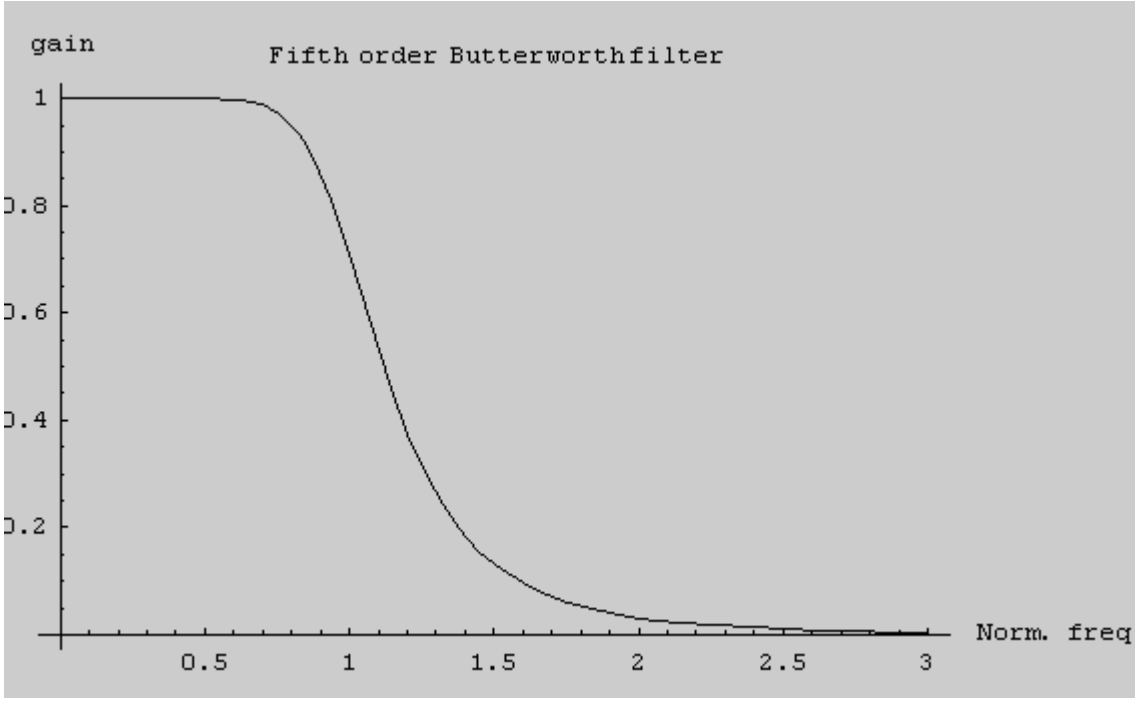
Result of adding equalization





EMI Suppression filter



$$\frac{1}{(1+s)\left(-E^{-\frac{3I\pi}{5}}+s\right)\left(-E^{\frac{3I\pi}{5}}+s\right)\left(-E^{-\frac{4I\pi}{5}}+s\right)\left(-E^{\frac{4I\pi}{5}}+s\right)}$$

s = i w

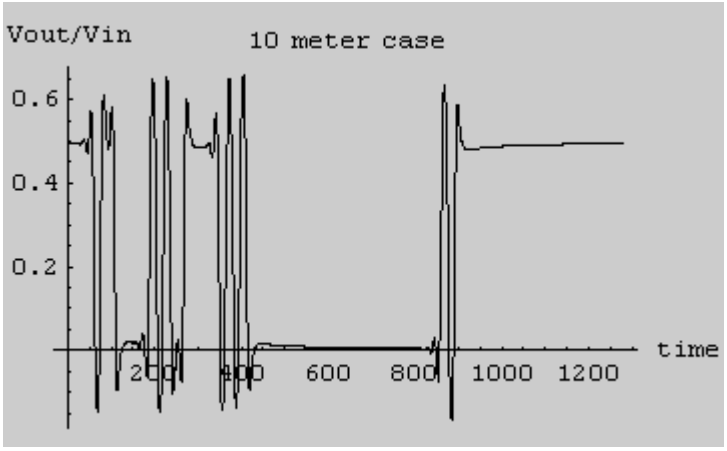
Test Pattern

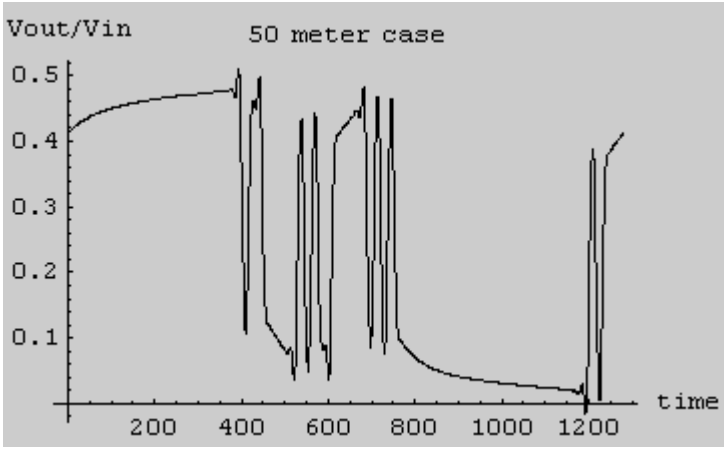
We use the following bit pattern to test the cable:

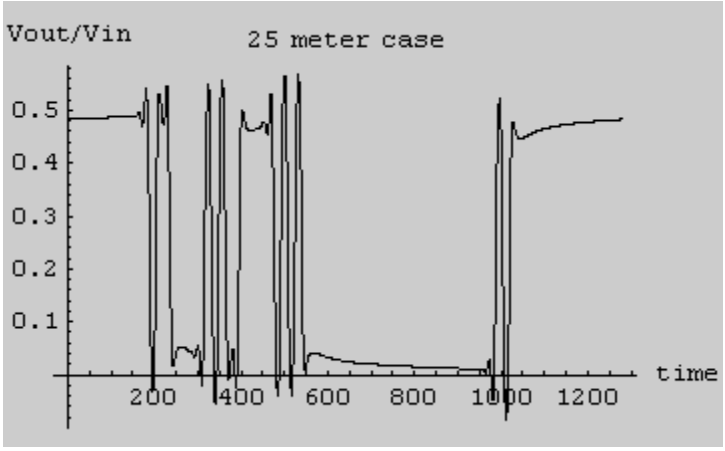
1100000101001111101010000000000000000000 ->

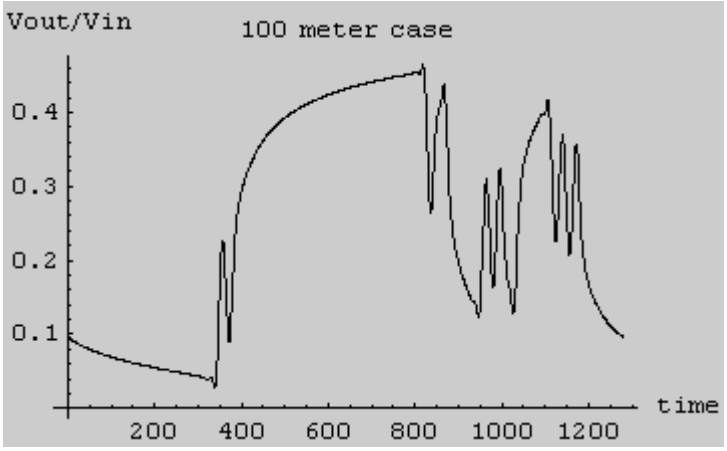
00000101111111111111111111111111110 … repeating

Output waveforms









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Simulated Eye diagrams