High-Frequency Effects on Transmission Media

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Outline

- Common transmission media
- Modeling uniform interconnects
- Interconnect parasitics and their physical significance
- EM-effects: skin effect, proximity effect, edge and Indy effects
- From lumped circuits to distributed circuits

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Proximity Effect

• Opposing high frequency (HF) currents in close proximity are drawn to each other















Loss Tangent of Typical Materials

Dielectric Material	Loss Tangent	Dielectric Constant
Ceramic (Alumina)	0.001	9.4
Glass-epoxy	0.03	4.0
Glass (Quartz)	0.00006	3.8
Polyimide	0.01	3.5
Silicon (100 Ω-cm)	0.51	11.8
Silicon (10 Ω-cm)	5.1	11.8
Teflon	0.00015	2.1
at 3GHz		

(A. Weisshaar, Tutorial on High-Speed Interconnects, IMS June 2004, Fort Worth, TX) Dr. J. E. Rayas-Sánchez

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