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High-Speed Design for non-EEs

Let MindShare Bring "High-Speed Design" to Life for You

The vast majority of digital designs today require disciplines of high-speed technology through all stages of the development process. Personnel responsible for the PCB layout, coordinating with bareboard manufacturer and overseeing the assembly processes need to be familiar with high-speed technology. The non-experts course provides insights into why high-speed boards require specific layer stacking, routing spaces and traces, keep away areas and power/ground layer requirements. For mechanical/thermal personnel, the requirements of heat transfer, PCB rigidity and component types become important issues. Parts procurement is also important today. Why are certain types of resistors, ICs and capacitors needed for high speed? Why can't we substitute and why are the lead times so long?

All of the above issues are discussed in a jargon-free, simple math environment. After attending this tutorial, students will have a clear understanding of the disciplines/risks associated with developing a high-speed product from CAE, CAD, bareboard manufacturing, assembly, test, prototyping, and integration with the customers.

You Will Learn:

This course provides the basics of electronic and digital design and then follows with high speed digital design fundamentals. The course will provide a background for non-EEs that fills the gap between the basic Electrical Engineer courses taken by Mechanical Engineers, Civil Engineers, Industrial Engineers, etc., and the courses taken from the Essentials of Electrical Engineer. From this understanding the topics that define the high-speed digital design disciplines are then covered.

Course Length: 3 Days

Who Should Attend?

Digital logic engineers, system architects, technicians, PCB layout professionals, IC designers, IC package designers, application engineers, anyone who works with high-speed digital logic, anyone who works with any logic implemented in the submicron processes that are becoming standard in the industry, engineering managers, and project managers.

Course Contents:

- Fundamentals of electricity and electronics
  - Science of electricity and electronics - matter, atoms, molecules, electrons, protons, neutrons, voltage, and current
  - Series circuits - Kirchhoff's voltage/current laws, voltage/current/ohms (resistance) in series circuits
  - Parallel circuits - Kirchhoff's voltage/current laws for parallel circuits, types of parallel circuits, voltage/current/power in parallel circuits
  - Inductance and RL circuits - transients, transformers, serial and parallel inductance, real and reactive power, power factor, balancing inductive loads
  - Capacitance - types, RC time constant, equivalent series and parallel capacitance, transient response, reactive power
- Fundamentals of Digital Design
  - Basic electronic devices, applications, digital circuits, and computers
  - Device construction - doping, diodes, transistors, FETS, LEDs, LCDs, flat panel displays
  - Integrated circuits (IC) - IC construction, common types of ICs: MOS devices, CMOS, NMOS, PMOS, PLDs, FPGAs
  - Amplifiers and linear ICs - NPN/PNP transistors, biasing, amplifier operation, voltage and current gain

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  - Digital circuits - binary numbering systems, bits and bytes, logic gates types (OR, NOR, AND, NAND, XOR), and flip-flops (D and JK) Computers - history, microprocessors and mini-computers, how a computers functions, memories (RAMs and PROMs), and storage technologies
  - Memory storage ICs - operation and programming of ROMs, PROMs, EPROMs, EEPROMs, and flash RAM
- High Speed Fundamentals
  - Frequency and Time
  - Time and Distance
  - Lumped Versus Distributed Systems
  - Four Kinds of Reactance
  - Ordinary Capacitance
  - Ordinary Inductance
- High-Speed Properties of Logic Gates
  - Speed
  - Ground Bounce and Lead Inductance
  - Electronic Packages: QFPs, PGAs, SOIC, PLCC, BGA, COB, TAB, FC, CSP and their relationship to Signal Integrity
  - Thermal Considerations
- Measurement Techniques
  - Rise Time and Bandwidth of Oscilloscope Probes
  - Self-inductance of a Probe Ground Loop
  - Viewing a Serial Data Transmission System
  - Transmission Lines and Terminations
  - Infinite Uniform Transmission Line
  - Effects of Source and Load Impedance
  - Line Impedance and Propagation Delay
  - End Terminators
  - Source Terminators
- Vias
  - Mechanical Properties of Vias
  - Capacitance of Vias
  - Inductance of Vias
  - Return Current and Its Relation to Vias
  - Through Hole, Blind, Buried, and Micro Vias
- Ground Planes and Layer Stacking
  - High-Speed Current Follows the Path of Least Inductance
  - Crosstalk in Solid Ground Planes
  - Guard Traces
  - How to Stack Printed Circuit Board Layers
- Power Systems
  - Providing a stable Voltage Reference
  - Distributing Uniform Voltage
  - Everyday Distribution Problems
  - Choosing a Bypass Capacitor
- Connectors and Cables
  - Mutual Inductance - How Connectors Create Crosstalk
  - Series Inductance-How Connectors Create EMI
  - Parasitic Capacitance-Using Connectors on a Multidrop Bus
  - Special Connectors for High-Speed Applications
  - Differential Signaling Through a Connector
  - Power Handling Features of Connectors
- Clock Distribution/Clock Oscillation
  - Clock Skew

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  - Using Low-Impedance Drivers
  - Using Low-Impedance Clock Distribution Lines
  - Source Termination of Multiple Clock Lines Controlling Crosstalk on Clock Lines
  - Delay Adjustments
  - Differential Distribution
  - Clock Signal Duty Cycle
- The PCB
  - Dielectric Constant and Dissipation Factor
  - FR4, Teflon (PTFE) and Substitution Materials
  - Layer Stackups, Power, Ground, and Signal Planes
  - Tradeoffs of R, C, L, and Manufacturing Concerns
  - Plating, Vias, CAM for Fast Turnaround
- High-Speed Development Tools
  - Signal Integrity Tools
  - Routing and Placement
  - Timing Analysis
- Board Design and Layout Guidelines for Manufacturability
  - Routing
  - PCB Density
  - Protective coatings
  - Solder Masks
  - Fiducials and Tooling Holes
- Issues of PCB Design and Layout for High-Density Pinout Configurations
  - PCB Layers
  - Vias
  - Standard Cells
  - Signal Quality

Recommended Prerequisites:

A fundamental understanding of electronics (i.e., how resistors, inductors, and capacitors function) and digital logic gates, flip-flops, counters, registers and memory devices.

Course Material:

Included in the course is the text "*High-Speed Digital Design: A Handbook of Black Magic*" by Howard Johnson, Ph.D. and Martin Graham, Ph.D. and a 284-page book of class notes.

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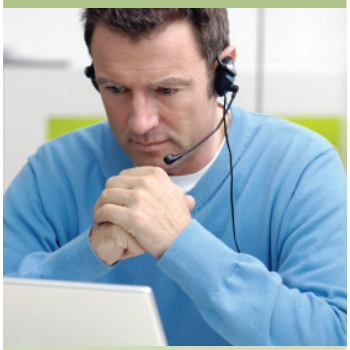
MindShare Virtual Classroom



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