High-Speed PCB Design

Training Programme
by
Dream Catcher Technologies Pte Ltd

02 - 04 Sep 19
Lingo Language School, Singapore

Dream Catcher Technologies Pte Ltd, Block 11 Kallang Place #07-01, Singapore 339155
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enquiry@dreamcatcher.asia
+65-62981892
+65-62968392
**Synopsis**

**SBL-Khas 1711**

In the past, those working in the digital field share little commonality in terms of theories, analysis, and design principles with their counterparts who work with RF/microwave frequencies. Today however, the line of separation is blurring due to the reduction in digital signal transition time or the consequent rise in bandwidth requirement.

The underlying knowledge for those working in these fields is RF/microwave theories or in their more basic forms, the Maxwell's Equations. EMI forms the subset of knowledge within the area of signal integrity. Hence this course imparts first the RF/microwave theories before going into discussion on signal integrity and EMI.

Whether a circuit is "high-speed" or not depends on the signal transition time. Hence this course is relevant not only for those working with high-speed clock but for almost all circuit design engineers who have seen their signal transition time reducing over time.

**What previous participants say about this course**

Answers to the question 'what did you like most about the course'

- "Examples with illustrations. Lots of fundamental theories that relate to real world design"
- "Going back to the basics of electrical and EM theory & how it affects the design of our circuits"
- "Good material, presentation. Slides have sufficient details and explanations that allow future reference to the material"
- "PCB stack up knowledge & transmission lines terminations"
- "It illustrates the link between theory and practical in a simple way"
- "The flow of the course with clear theory and explanation that is followed by simulation and actual demonstration"
- "Practical examples of designs and simulations with software on the spot. Good course material"
- "Demonstrations of the theory being taught. Having hands on activities to strengthen theory"

**What You Will Learn**

- Relevant concepts/tools for tackling high-speed digital design issues, such as transmission line theories, crosstalk, differential signalling, understand the mechanism of electromagnetic interference (EMI), useful calculator/software, and rules of thumb.
- Practical layout techniques for high-speed PCB in order to tackle signal integrity (SI) and electromagnetic interference (EMI) issues.

**Who Should Attend**

Technicians and engineers who work with digital circuits in the role of:

- product marketing
- application engineering
- design and development
- test development
• product engineering
• testing
• system architect
• PCB layout specialist
• EMC specialist

**Prerequisite**

Technical background or working experience with PCB layout for digital circuit.

**Course Methodology**

This course is presented classroom style, with case studies to illustrate the concepts taught. Usage of industry-leading electronic design automation software such as Agilent ADS or Agilent Genesys or LTSpice will be demonstrated.

**Course Duration**

3 day(s), 9am - 5pm

**Course Structure**

**Day 1**

**Review of PCB Interconnect Structures and Component Packaging**

- Brief review of multi-layer PCB technology and terminology (fabrication, material, cost)
- Integrated circuit packaging

**Introduction to Signal Integrity**

- Problem statement - PCB interconnection and electrical signal distortion
- Definition of SI, EMI and EMC
- What do we mean by "high-speed" and the related problems
- Time and frequency domain representation of signals
- Bandwidth estimation of digital signals

**Transmission Line and Signal Propagation**

- Lumped versus distributed circuit
- PCB traces as transmission line - planar transmission line configurations
- Digital signals and transmission line - characteristic impedance, delay, attenuation, reflection and dispersion
- Termination techniques for transmission line (Series, Parallel, RC, etc)
- Discontinuities in transmission line
- Transmission line design for PCB

**Signal Return Path and EMI**
- How does electrical current return to its source
- Perforation and splits in reference plane
- Common mode currents
- Basic grounding rules to minimize interference
- Layout techniques for minimizing EMI

Hands-on Session: Demonstrating SI issues via simulation/measurement

Day 2

**PCB Stack-up**

- What factors to consider when making a PCB stack-up
- How to control trace impedance (Zo) for microstrip, stripline, grounded co-planar line
- Criteria of a PCB stack-up configuration that promote good SI
- Steps in making a PCB stack-up

**Differential Signaling**

- Motivation for differential signaling
- Common-mode and differential-mode signal propagation
- EMI issues on differential signaling
- Termination techniques for differential signaling
- Tightly coupled and loosely coupled lines
- Controlling differential impedance on differential pair
- Differential transmission line design on PCB

Hands-on Session: Demonstrating SI issues via simulation/measurement

Day 3

**Crosstalk**

- Crosstalk and the effects on signal
- Near-end and far-end crosstalk
- Crosstalk on microstrip vs stripline
- What factors can be controlled for minimizing crosstalk
- Layout techniques for minimizing crosstalk

**Simultaneous Switching Noise (SSN) and Ground Bounce**

- What causes ground bounce
- Effect of ground bounce on driver/receivers voltage levels
- How to minimize ground bounce problem

**Decoupling Capacitors**

- Power Distribution Network and decoupling capacitors
- Effects of equivalent series inductance (ESL) on capacitors
- Package vs inductance
- Placement and layout techniques that minimize loop inductance
Quality high-speed PCB Design Procedure

- Steps in designing high-speed boards
- What analysis is required
- Useful rules for achieving good SI
- Timing skew adjustment
- Case study

Hands-on Session: Demonstrating SI issues via simulation/measurement

Course Instructor(s)

Mr Chai Ched Chang

Mr Chai Ched Chang received his B.Eng (Hons) from University of Malaya, Malaysia, and M.EngSc from Multimedia University, Malaysia. He was one of the pioneer researchers on signal integrity (SI) in Multimedia University. From 1998 to 2001, he had accomplished research projects in crosstalk, PCB modelling using 3-D full-wave Finite-Difference Time-Domain (FDTD) method, and lab measurement. His research outcome was published in reputable international conference and journal through Multimedia University.

Mr Chai then began his career as a signal integrity engineer in 2001 at Ultimate Technologies Asia Sdn Bhd, and specialized in designing high-speed PCB. He had delivered many consumer electronics PCB designs, where he is specifically experienced in resolving SI issues associated with high-speed memory (SDRAM, DDR, DDR2, DDR3, etc.), differential signaling (LVDS, HDMI, USB, PCI Express, Ethernet, etc.), and other digital interfaces (FPGA interface, FLASH memory, video bus, ADC & DAC, etc.). He also has vast experience in making PCB stack-up, and high-speed signal simulation and analysis.

In 2012, Mr Chai left Ultimate Technologies Asia as Chief Operating Officer and Chief Technical Officer, and started his company, iRtec Consulting Sdn Bhd. With over two decades of combined experience in both research and industry, he continues to strive to provide the best signal integrity consultation service with the vision to help his clients design products that meet their stringent quality requirements and shorten their product development cycle.
Administrative Details

Programme Logistics

**Duration:** 3 day(s), 9am - 5pm  
**Date:** 02 - 04 Sep 19  
**Venue:** Lingo Language School, Singapore

Morning break, lunch and tea break will be provided throughout the course duration. Course Manual and Certificate of Attendance will be provided.

Your Investment

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<td>10% discount for group registration of 5 pax and above. Registration must be made before 05-Aug-2019</td>
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<td>SGD100.09</td>
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3 Easy Steps to Register

- **Phone** +65-62981892  
- **Fax registration form** to +65-62968392  
- **Email registration form** to register@dreamcatcher.asia
Method of Payment

Cheque Payment:
Crossed cheque / bank draft made in favour of Dream Catcher Technologies Pte Ltd should be mailed to:
Block 11 Kallang Place #07-01
Singapore 339155

Telegraphic Transfer:
Oversea-Chinese Banking Corporation Ltd, Singapore, Jalan Besar Branch
Bank Code : 7339; Branch Code : 521; A/C No.: 521-851048-001; Swift Code : OCBCSGSG

Payment must be received no later than 10 working days before the course commences. An undertaking may be accepted in cases where payment is delayed. However all payments must be made before the course commences.

Refund and Cancellation

Fees will only be refunded in full for cancellation received in writing more than 10 working days prior to the commencement date. Substitute attendee(s) will be accepted at no extra charge.

Disclaimer

Dream Catcher Technologies Pte Ltd reserves the right to change the instructors, date and to vary/cancel the programme should unavoidable circumstances arise. All effort will be taken to inform participants of the changes. Upon sending the registration form, you are deemed to have read and accepted the terms.

Enquiries

Email us at enquiry@dreamcatcher.asia
## Registration Form

**Course Title**: High-Speed PCB Design  
**Course Date**: 02 - 04 Sep 19  
**Location**: Lingo Language School, Singapore

*(Emails are required to ensure notification of any changes reach the participant)*

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**Total Amount**

*(Emails are required to ensure notification of any changes reach the participant)*

Submitted by:

**Company Name**:  
**Company Address**:  
**Contact Person**:  
**Designation**:  
**Phone**:  
**Email**: 

*Please complete this form with an authorised signature below and fax to fax registration form to +65-62968392 or email to email registration form to register@dreamcatcher.asia. Call us at phone +65-62981892 for any enquiry*

**Authorised Signature**:  
*Please print full name (authorised signature) if you submit via email*

**Name**:  
**Designation**:  
**Date**:  

**This registration is invalid without a signature. Payment must be made no later than 10 working days before the course commences. An undertaking may be accepted in cases where payment is delayed, However all payment must be made before the course commences. Participants who registered but did not attend will be invoiced accordingly. Fees will only be refunded in full for cancellation received in writing more than 10 working days prior to the commencement date. Substitute attendee(s) will be accepted at no extra charge.*

**Please send payment with this form to**  
Dream Catcher Technologies Pte Ltd  
Block 11 Kallang Place #07-01,  
Singapore 339155

**Enclosed cheque/bank draft no ________________________ made in favour of DREAM CATCHER TECHNOLOGIES PTE LTD**