IPC PCB Design for Military, Aerospace and Other Extreme Environments
SYLLABUS

INSTRUCTOR INFORMATION

Instructor: Kristopher Moyer

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Best time to call: Usually available between 6pm – 9pm Pacific Time USA.
Leave message anytime.

PROGRAM DESCRIPTION

In the highly competitive electronics industry, the knowledge, and skills of staff directly responsible for the design and layout of the Printed Circuit Board (PCB) and Printed Board Assembly (PBA) can have a direct impact on the success or failure of the product design and impact time to market. The IPC PCB Design for Military, Aerospace and Other Extreme Environments is designed to provide the skills necessary to create PCB/PBA designs that require advanced or complex packaging, have reduced available board area, require non-orthogonal placement and routing, require non-standard board outline geometry, non-standard board mounting, require advanced board materials and comply with all necessary IPC standards. Taught by an IPC-certified industry expert with 25+ years of experience in the field, the eight-week program utilizes interactive webinars, on-demand recorded class sessions, job-specific exercises, and team projects to facilitate mastery of the key concepts required by circuit board designers.

This course is intended for those individuals that have completed or possess the equivalent skills experience of PCB Fundamentals parts 1 & 2 and who need further experience with design, manufacturing, packaging, and routing challenges involved with designs for military, aerospace, and outer space applications. These skills include:

- Schematic symbol creation in accordance with (IAW) IPC-2612-1
- Schematic Generation IAW IPC-2612
- Documentation and Dimensioning IAW IPC-2614, IPC-2615, & IPC-D-325
- Standard Rigid Printed Board Design IAW IPC-2221 & IPC-2222
- Printed Board manufacturing IAW IPC-6011 & IPC-6012
- Printed Board Assembly IAW IPC-J-STD-001
- Basics of Signal Integrity

LEARNING AND PERFORMANCE OBJECTIVES

This program is designed to provide circuit board designers with a balanced foundation of theoretical knowledge and practical skills in printed circuit board design. Upon completion, participants will be able to:

- Design boards for military, aerospace, and outer space applications.
- Understand the trade-offs in materials used in these applications.
- Define a board stackup that implements structures that will meet needs of these harsh environments.
- Understand and mitigate signal integrity issues for these environments.
- Understand and define effects of mechanical retention needs for these applications.
- Define and implement component packaging methodologies to mitigate effects of vibration, shock, and temperature on components used in these applications.
- Understand and mitigate effects of extended temperature range for operation in these applications.
- Introduction to radiation effects on these applications.

COURSE STRUCTURE

- Instructor and participants meet online twice per week from the comfort of their own home.
- Participants can view recorded online sessions to review course content and class discussions.
- Participants apply key concepts to create a real-world design from concept to completion.
- All required materials are included in the course. Participants may utilize a PCB design authoring software program of their choice. If participants do not have access to PCB design authoring software, IPC will provide complimentary access to a select choice of programs.
- Course materials are accessible 24/7 on the new IPC Edge Learning Management System.
- The course can be accessed on virtually any device with an Internet connection and major web browser, including Chrome, Firefox, Safari, Edge, and Internet Explorer.

SUPPLEMENTAL MATERIALS

- Printed Circuit Handbook – *Clyde F. Coombs* McGraw-Hill
- Right the First Time – Lee W. Ritchey Speeding Edge
- Signal Integrity Issues and Printed Circuit Boards – *Douglas Brooks* Prentice Hall

COURSE SCHEDULE

WEEK 1 – BASIC CIRCUIT DESIGN

Program overview outlining class schedule and options for accessing class material and assignments. Session will focus on basics of military / aerospace design.

Key concepts include:

- Stackup management
- CTE stresses
- Packaging challenges
- Test coverage / test access
- Mass
- Thermal control
- Isolation / power domains
- Power management / switch over

Resins and foils **ASSIGNMENT:**

- Design stackup for simple board
    - Complete by Week 2 Session 2

WEEK 2 – ADVANCED CIRCUIT DESIGN

Advanced military / aerospace design.

Key concepts include:

- Altitude effects
    - Pichon's curve
- Redundancy
- Acceleration
- Lightning
- Charge concentration
    - Point charge
    - Sharpe corners
- Radiation Effects
- IPC standards

INDIVIDUAL ASSIGNMENT:

- Design board for satellite application
- Define mounting features to mitigate stresses on PCB material
- Define stackup / stackup zones.
    - Complete by Week 3 Session 2

WEEK 3 – MATERIALS

Materials used in military / aerospace designs, physical properties, types of structures, and trade-offs.

Key concepts include:

- What materials are used in these designs
- How to define
- Physical and mechanical properties
- Trade-offs in different material types
- Vibration and shock
- Moisture
- Salt / sand effects
- Conformal coatings
- Potting compounds
- Staking compounds
- IPC standards

INDIVIDUAL ASSIGNMENT:

- Define different stackups for signal integrity, Navy, FAA, satellite.
    - Complete by Week 4, Session 2

WEEK 4 – MANUFACTURING PROCESS

Military / Aerospace manufacturing process. Effects on design.

Key concepts include:

- Understand the manufacturing process used in these designs
- Understand special fabrication allowances for space designs
- Understand assembly challenges and mitigation with these designs
- Extended qualifications
- Tailored test and certification
- Conformal coating

- Potting
- Class 3 / space addendum
- Staking

INDIVIDUAL ASSIGNMENT:

- Design board for a space application involving staking and potting.
    - Complete by Week 5, Session 2

WEEK 5 – DOCUMENTATION

Produce proper documentation in compliance with IPC standards for these designs

Key concepts include:

- IPC-2610 series.
- IPC-D-325.
- IPC-J-STD-001
    - Space addendum
- Documentation methodology
- Special feature call outs

INDIVIDUAL ASSIGNMENT:

- Create documentation package
- Define all special requirements described in course session
    - Submit by Week 6, Session 2

WEEK 6 – CONTENT REVIEW AND FINAL EXAM

Class session will focus on content review and final exam. Session 1 will be review. Session 2 will be final exam.

INDIVIDUAL ASSIGNMENTS:

- none

FINAL EXAM:

- Complete final exam during Session 2 or a defined exam time during the last week of the course.
- Completion of the program with a score of 70% or higher on the final exam and/or final project is required to earn a certificate of completion.
- Attempts allowed: 2. Grading method: Highest grade.