IPC PCB Design for Flex & Rigid-Flex Boards
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 Rigid-Flex Boards Course 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 six-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 flexible and rigid-flex designs.

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 flexible / rigid-flex board designs.
- Understand the trade-off of flexible PCB materials.
- Define a board stackup that implements flexible and rigid-flex structures.
- Import and / or define board outline geometry for complex flexible board shape.
- Understand and mitigate signal integrity issues with flexible circuits.
- Understand and define effects of mechanical retention on flexible substrates.
- Define and implement component packaging methodologies to mitigate effects of bending on component stresses.
- Understand and mitigate effects of bending stresses on conductive patterns in flexible circuits.

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

IPC STANDARDS COVERED (PROVIDED WITH COURSE

- IPC-2152 Standard for Determining Current Carrying Capacity in Printed Board Design
- IPC-2221 GENERIC STANDARD ON PRINTED BOARD DESIGN
- IPC-2223 SECTIONAL DESIGN STANDARD FOR FLEXIBLE/RIGID-FLEXIBLE PRINTED BOARDS
- IPC-2611 GENERIC REQUIREMENTS FOR ELECTRONIC PRODUCT DOCUMENTATION
- IPC-2612 SECTIONAL REQUIREMENTS FOR ELECTRONIC DIAGRAMMING DOCUMENTATION (SCHEMATIC AND LOGIC DESCRIPTIONS)
- IPC-2612-1 SECTIONAL REQUIREMENTS FOR ELECTRONIC DIAGRAMMING SYMBOL GENERATION METHODOLOGY
- IPC-2614 SECTIONAL REQUIREMENTS FOR BOARD FABRICATION DOCUMENTATION
- IPC-2615 PRINTED BOARD DIMENSIONS AND TOLERANCES
- IPC-4101 SPECIFICATION FOR BASE MATERIALS FOR RIGID AND MULTILAYER PRINTED BOARDS
- IPC-4202 FLEXIBLE BASE DIELECTRICS FOR USE IN FLEXIBLE PRINTED BOARDS
- IPC-4203 COVER AND BONDING MATERIAL FOR FLEXIBLE PRINTED CIRCUITRY
- IPC-4204 FLEXIBLE METAL-CLAD DIELECTRICS FOR USE IN FABRICATION OF FLEXIBLE PRINTED BOARDS
- IPC-D-325 DOCUMENTATION REQUIREMENTS FOR PRINTED BOARDS
- IPC-6011 GENERIC PERFORMANCE SPECIFICATION FOR PRINTED BOARDS
- IPC-6013 QUALIFICATION AND PERFORMANCE SPECIFICATION FOR FLEXIBLE/RIGID-FLEXIBLE PRINTED BOARDS
- IPC-7351 GENERIC REQUIREMENTS FOR SURFACE MOUNT DESIGN AND LAND PATTERN STANDARD
- IPC J-STD-001 REQUIREMENTS FOR SOLDERED ELECTRICAL AND ELECTRONIC ASSEMBLIES

COURSE SCHEDULE

WEEK 1 – BASIC FLEXIBLE CIRCUIT DESIGN

Program overview outlining class schedule and options for accessing class material and assignments. Session will focus on basics of flexible circuit design.

Key concepts include:

- Key differences between rigid design and flex / rigid flex design
- Single layer flexible circuit design

- IPC-2223 standard

Resins and foils **ASSIGNMENT:**

- Design simple single layer flex board
- Define bend location and radius
    - Complete by Week 2 Session 2

WEEK 2 – ADVANCED FLEXIBLE CIRCUIT DESIGN

Advanced flexible design, including multi-layer flex, component support, PTH in flex, stackup design, rigid-flex design, dynamic vs flex to install, and circuit layout / panel utilization

Key concepts include:

- Stackup design
- Component support / stiffeners
- PTH issues with flex
- Circuit layout / panel utilization
- Rigid-flex design
- IPC standards

INDIVIDUAL ASSIGNMENT:

- Design multi-layer rigid-flex design.
- Define bend locations and radius.
- Define stackup / stackup zones.
    - Complete by Week 3 Session 2

WEEK 3 – FLEXIBLE MATERIALS

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

Key concepts include:

- What materials are used in flex / rigid-flex
- How to define
- Physical and mechanical properties
- Trade-offs in different material types
- IPC standards

INDIVIDUAL ASSIGNMENT:

- Define different stackups for signal integrity, dynamic flex, flex to install, single fold.
    - Complete by Week 4, Session 2

WEEK 4 – MANUFACTURING PROCESS

Flex / rigid-flex manufacturing process. Effects on design. Limitations in IPC-6013

Key concepts include:

- Understand the manufacturing process used in flex / rigid-flex designs
- Understand fabrication allowances and impact on design
- Understand assembly challenges and mitigation with flexible materials

INDIVIDUAL ASSIGNMENT:

- Design an assembly array for a multi-segment rigid-flex design.
- Define rail attachment feature and removal method.
- Optimize for best panel utilization.
    - Complete by Week 5, Session 2

WEEK 5 – DOCUMENTATION

Produce proper documentation in compliance with IPC standards for flex / rigid-flex designs.

Key concepts include:

- IPC-2610 series.
- IPC-D-325.
- IPC-J-STD-001
- Datum and reference challenges with flex / rigid-flex designs
- 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.