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# Introduction to Printed Circuit Board Design and Fabrication

## Course No. 472

**FOR WHOM INTENDED** This course is intended for personnel involved in designing, testing and manufacturing printed circuit boards. Degreed engineers whose primary training is not in this field will benefit, as will technicians, quality assurance inspectors and manufacturing engineers. Course 472 will also benefit managers and supervisors in charge of these functions.

**BRIEF DESCRIPTION OF COURSE** The course follows a step-by-step approach to the development and manufacturing cycle of a printed circuit board. After an overview of standards and existing technology, the course discusses the various engineering functions involved in PCB design and manufacturing. Specific issues are addressed in the areas of manufacturing and assembly, before moving on to PCB testing and quality assurance. The course addresses the potential pollution and safety impacts of PCB manufacturing, as well as applicable standards.

**CERTIFICATE PROGRAMS** This course is a recommended elective for TTI's [Electronic Design Specialist \(EDS\)](#), and may be used as an elective for any other [TTI specialist certificate program](#).

**RELATED COURSES** TTI is developing a complete PCB design curriculum, including Course 473, on mechanical, structural and thermal considerations and layout, Course 474 on electrical considerations and layout, Course 475 on manufacturing, Course 476 on assembly and testing including quality assurance, and Course 477 on production including QA and screening.

**PREREQUISITES** Students should have completed TTI's Course No. 104-3, "[Electronics for Non-Electronic Engineers](#)" or the equivalent. This course is aimed toward individuals actively involved in related technical fields. An understanding of basic electrical theory is required.

**TEXT** Each participant will receive a [course workbook](#), containing most of the viewgraphs used during the presentation.

**COURSE HOURS, CERTIFICATE AND CEUS**  
Open courses meet seven hours per day. Upcoming presentation dates can be found on our current [open course schedule](#). Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

For [schedules](#), [general information](#) and [registration forms](#), see TTI's web site.

## Course Outline

### Introduction

General References & Standards • Technical Organizations

### Introduction to the PCB

Definition and Evolution of the Printed Circuit Board (PCB)  
Purposes of a PCB • Examples • Applications • Market Drivers  
Typical Development Flow for a PCB • PCB Problems and Root Causes

### Printed Circuit Technology

Basic Electronic Components: Resistors, Capacitors, Inductors, Diodes, Transistors, Relays, Connectors  
Integrated Circuits: How a silicon wafer becomes an IC  
Printed Circuit Board Characteristics  
PCB Materials: Fillers, resins, laminates, base material characteristics, dielectric, conductors

### Design and Analyses

Design & Environmental Requirements: Functional, Thermal, Vibration, Shock, EMI/EMC  
Electrical Engineering: Analog and digital signals, Signal integrity, Grounding concepts, Current carrying capacity, CAD, Schematics, Layout rules of thumb  
Mechanical Engineering: Panels, Standard board sizes, Packaging  
Thermal Design: Heat transfer basics, Convection, Conduction, PCB Thermal Design Features, Thermal modeling, cycling and fatigue  
Component Vibration Fatigue: Vibration Models and Terminology  
Combined Thermal and Structural Fatigue

### Contamination Control/Environmental Control

Contamination Control • Conformal Coatings  
Polluting Agents • Safety Controls • Pollution Controls  
Recycling • Standards

### Manufacturing

PCB Manufacturing Information  
PCB Layout and Artwork • Fabrication  
Machining Operations: Blanking, Cutting, Punching, Drilling  
Laminating Techniques • Plating, Etching, Surface Finishing  
Conformal Coatings • Inspection and Checkout  
Specifications and Standards

### Assembly

PCB Assembly Drawing Examples • Component considerations  
Component mounting and support • Mechanical Devices  
Soldering Technology • Nonsolder Connections  
Cleaning • Parts Staking • Conformal Coating removal  
Repair and Rework • Safety Considerations • ESD protection  
Specifications and Standards

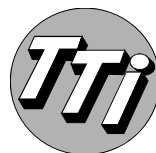
### Testing

Common PCB Production Faults • Bare Board Testing  
Electrical Performance Testing • Assembled PCB Testing

### Quality Assurance

Introduction • Quality Assurance in Design  
FMEA – Failure Mode and Effects Analysis • Software Tools  
Quality Assurance in Manufacturing and in Assembly  
Specifications and Standards

### Final Review • Certificates for Successful Completion



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