Training Course on Integrated Circuit Packaging and Reliability

Professional Development Training Course Outline

Category	Engineering	**Duration**	10 Days
Base Fee	$3,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Introduction

The rapidly evolving landscape of modern electronics demands increasingly sophisticated Integrated Circuit (IC) packaging solutions and robust reliability engineering. As devices shrink and performance expectations soar, the thermal, electrical, and mechanical challenges of housing and protecting ICs become paramount. Training Course on Integrated Circuit Packaging and Reliability provides a comprehensive deep dive into the cutting-edge technologies and advanced methodologies required to design, manufacture, and ensure the long-term reliability of IC packages for diverse applications, from AI accelerators to automotive electronics. Participants will gain critical insights into the latest heterogeneous integration, 3D packaging, and wafer-level packaging (WLP) techniques, empowering them to tackle complex design challenges and drive innovation in the semiconductor industry.

This program bridges the gap between theoretical understanding and practical application, focusing on real-world scenarios and failure analysis techniques. With a strong emphasis on materials science, thermal management, signal integrity, and advanced characterization, attendees will learn to mitigate critical reliability risks such as electromigration, thermal stress, and moisture ingress. Our expert-led sessions leverage case studies and industry best practices to equip professionals with the knowledge and skills necessary to optimize yields, enhance product longevity, and deliver high-performance, reliable electronic systems in today's competitive global market.

Programme Curriculum

Training Course on Integrated Circuit Packaging and Reliability

Introduction

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Course Objectives

1. Master Advanced Packaging Architectures.
2. Optimize Thermal Management Solutions.
3. Ensure Signal & Power Integrity.
4. Implement Robust Mechanical Reliability.
5. Apply Advanced Materials Science.
6. Conduct Comprehensive Failure Analysis.
7. Integrate AI/ML for Reliability Prediction.
8. Navigate Heterogeneous Integration Challenges.
9. Develop Cost-Effective Packaging Strategie.
10. Comply with Industry Reliability Standards.
11. Drive Sustainable Packaging Innovations.
12. Mitigate Cybersecurity Risks in Packaging.
13. Anticipate Future Packaging Trends.

Organizational Benefits

1. Reduced Product Development Cycle.
2. Enhanced Product Reliability & Longevity.
3. Cost Savings from Reduced Rework & Returns.
4. Improved Manufacturing Yields.
5. Competitive Advantage in High-Performance Markets.
6. Optimized Material Utilization.
7. Strategic Innovation Capability.
8. Effective Risk Management.

9. Compliance with Stringent Industry Standards.
10. Talent Retention & Skill Advancement.

Target Participants

- Packaging Engineers
- Semiconductor Process Engineers
- Product Engineers
- Reliability Engineers
- Quality Assurance Engineers
- Materials Scientists
- R&D Scientists
- Electrical Engineers
- Mechanical Engineers
- Manufacturing Engineers
- Technical Managers overseeing IC design and production.

Course Outline

Module 1: Fundamentals of IC Packaging & Evolution

- Introduction to IC Packaging: Definition, Function, and Importance in Modern Electronics.
- Historical Evolution of Packaging Technologies: From Through-Hole to Surface Mount.
- Key Packaging Parameters: Electrical, Thermal, Mechanical, and Environmental Considerations.
- Common Package Types: SOP, QFN, BGA, CSP, and their applications.
- **Case Study:** Evolution of Smartphone IC Packaging for Miniaturization and Performance.

Module 2: Advanced Packaging Architectures

- 2.5D Packaging: Interposers, Silicon and Organic, and their Role in High-Bandwidth Systems.
- 3D Stacking and Through-Silicon Vias (TSVs): Enabling Vertical Integration and Performance Density.
- Chiplet Technology: Disaggregated Designs and the Future of System-on-Package (SiP).
- Fan-Out Wafer-Level Packaging (FOWLP): Advantages in Form Factor and Performance.
- **Case Study:** Analyzing the Packaging Architectures of High-Performance Computing (HPC) Processors.

Module 3: Materials Science for IC Packaging

- Substrate Materials: Properties and Selection for Different Packaging Applications (e.g., Organic, Ceramic, Silicon).
- Encapsulation Materials: Mold Compounds, Underfills, and Dielectrics.
- Interconnect Materials: Solder, Copper Pillars, and Hybrid Bonding.
- Thermal Interface Materials (TIMs): Enhancing Heat Dissipation.
- **Case Study:** Material Selection Challenges in Automotive ICs for Extreme Environments.

Module 4: Thermal Management in IC Packages

- Heat Generation and Dissipation Mechanisms in ICs.
- Thermal Resistance and Thermal Modeling Techniques (CFD Simulation).
- Advanced Cooling Solutions: Liquid Cooling, Vapor Chambers, and Microfluidics.
- Thermal Characterization Techniques: IR Thermography and Thermal Cycling.
- **Case Study:** Designing a High-Efficiency Thermal Solution for an AI Accelerator Chip.

Module 5: Electrical Performance: Signal & Power Integrity

- Transmission Line Theory: Impedance Matching, Reflections, and Crosstalk.
- Power Delivery Network (PDN) Design: Decoupling, Voltage Droop, and Noise Reduction.
- High-Frequency Effects: Skin Effect, Proximity Effect, and Dielectric Loss.
- Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) in Packaging.
- **Case Study:** Optimizing Signal Integrity in a High-Speed Data Center Network Switch.

Module 6: Mechanical Reliability & Stress Analysis

- Sources of Mechanical Stress in IC Packages: CTE Mismatch, Warpage, and Assembly Processes.
- Stress Modeling and Simulation (FEA): Predicting Mechanical Failure.
- Fatigue and Creep in Solder Joints and Interconnects.
- Delamination and Cracking Mechanisms.
- **Case Study:** Mitigating Warpage Issues in Large-Area Fan-Out Packages.

Module 7: Reliability Physics of ICs & Packaging

- Key Failure Mechanisms: Electromigration, Stress Migration, and Time-Dependent Dielectric Breakdown (TDDB).
- Hot Carrier Injection (HCI) and Negative Bias Temperature Instability (NBTI).
- Moisture Ingress and Popcorning Phenomena.
- Electrostatic Discharge (ESD) and Latch-up.
- **Case Study:** Analyzing Electromigration Failures in Advanced Microprocessors.

Module 8: Advanced Characterization & Testing

- Non-Destructive Testing (NDT): X-ray, SAM (Scanning Acoustic Microscopy), and C-SAM.
- Destructive Physical Analysis (DPA): Cross-Sectioning, SEM, and TEM.
- Electrical Characterization: IV/CV Measurements, S-Parameters.
- Environmental Testing: Temperature Cycling, Humidity, and Mechanical Shock.
- **Case Study:** Using Advanced Imaging Techniques for Defect Detection in 3D Stacks.

Module 9: Failure Analysis Methodologies

- The Failure Analysis Process Flow: From Symptom to Root Cause.
- Decapsulation Techniques and Delayering.
- Microprobing and Fault Isolation Techniques.
- Data Interpretation and Reporting for Corrective Actions.
- **Case Study:** Performing a Comprehensive Failure Analysis on a Field-Returned Electronic Device.

Module 10: Reliability Qualification & Standards

- Industry Standards for Reliability Testing (e.g., JEDEC, MIL-STD).
- Accelerated Life Testing (ALT) and Highly Accelerated Life Testing (HALT).
- Reliability Modeling: Weibull Distribution and Bathtub Curve.

- Qualification Procedures for New Packaging Technologies.
- **Case Study:** Developing a Robust Qualification Plan for a New Automotive IC Package.

Module 11: Manufacturing Processes for Advanced Packaging

- Die Attach Technologies: Eutectic, Epoxy, and Sintering.
- Wire Bonding: Gold, Copper, and Silver Wire.
- Flip Chip Assembly: Underfill Dispensing and Reflow Soldering.
- Wafer Level Processing: RDL (Redistribution Layer) and Bumping.
- **Case Study:** Process Optimization for High-Volume Manufacturing of Advanced Packaging Solutions.

Module 12: Yield Enhancement & Quality Control

- Statistical Process Control (SPC) in Packaging Manufacturing.
- Design for Manufacturability (DFM) and Design for Reliability (DFR).
- In-Line Metrology and Inspection Techniques.
- Defect Classification and Yield Loss Analysis.
- **Case Study:** Implementing SPC to Improve Yields in a Complex Packaging Line.

Module 13: Emerging Trends in IC Packaging

- Co-packaged Optics (CPO) for High-Speed Data Communication.
- Heterogeneous Integration Roadmaps (HIR).
- Advanced Substrate Technologies and Glass Core Substrates.
- Sustainable and Eco-Friendly Packaging Solutions.
- **Case Study:** Future-Proofing Designs with Emerging Packaging Technologies for 6G and Beyond.

Module 14: AI and Machine Learning in IC Packaging & Reliability

- Predictive Maintenance and Anomaly Detection using AI.
- Machine Learning for Design Optimization and Material Selection.
- Automated Optical Inspection (AOI) with Deep Learning.
- Big Data Analytics for Yield and Reliability Improvement.
- **Case Study:** Implementing an AI-Driven System for Real-time Quality Monitoring in Packaging.

Module 15: Security & Supply Chain Considerations in Packaging

- Anti-Counterfeiting Measures in IC Packaging.
- Supply Chain Integrity and Traceability.
- Intellectual Property (IP) Protection in Disaggregated Designs (Chiplets).
- Hardware Security Modules (HSMs) and Secure Packaging.
- **Case Study:** Addressing Security Challenges in the Semiconductor Supply Chain.

Training Methodology

This course employs a participatory and hands-on approach to ensure practical learning, including:

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.

- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

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