TJ GREEN ASSOCIATES, LLC

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Microwave Packaging Technology

3 DAYS

Microwave Hybrids, MICs, RF MMIC modules all require a unique set of materials and processes necessary to achieve reliable operations in extreme military and commercial environments. This three day course examines all aspects of microwave packaging from a practical perspective. The instructor shares valuable lessons learned from years of experience. Design issues, material trade offs, process selection are all covered in detail with the goal of imparting useful information to the students so they can return to the work place better equipped to assemble and manufacture reliable microwave hybrids for military, space and other hi reliability commercial and medical device applications.

This course is intended as an introductory to intermediate level course for process engineers, designers, quality engineers, and managers responsible for design and manufacture of microwave hybrids.

Course Outline

Day 1

Introduction to Microwave Technology
- Terminology and product definitions
- Microwave hybrids, RF/MMIC modules
- Military, space, commercial and medical products

Military Requirements Flow Down and Design Guidelines
- MIL-PRF-38534 Hybrid Performance Specification
- MIL-STD-883 Test Methods

Manufacturing Assembly Process Overview
- Basic hybrid microwave manufacturing process flows
- Clean room requirements and industry protocols

Design for Manufacturability (DFM)
- Rationale and significance of DFM
- Typical problems encountered during hybrid manufacturing and
- How they can be prevented!

Wafer Fabrication Processes
- GaAs Gallium Arsenide wafer fabrication
- GaN Gallium Nitride on SIC wafer fab technology
- Device feature identification and significance
- Review of wafer fabrication defects at incoming inspection

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e.g., airbridge and channel damage, excessive probe marks

Packaging Design Considerations
- Thermal analysis, simulated stack up and junction temp calculations
- Stress analysis and basic material consideration and trade offs

Day 2

Substrate Technology
- Teflon PTFE (duroid) and other soft board material sets
- Alumina ceramic substrate fabrication

Thin Film Processes on Ceramic
- Sputtering vs. vapor deposition
- Photolithography, coat and etch
- Performance issues
- Plating processes and specifications

Laser Trimming of Precision Thin Film Resistors

Material and Process Fundamentals for Component Attach
- Silver epoxy attach of substrate and MMIC die
- Handling and assembly of bare die
- Solder and epoxy attach of discrete components

Eutectic Soldering Processes
- AuSn solder attach of GaAs chips
- Other eutectic solder process
- Issues with die voiding and how to detect

Die, substrate and package compatibility
- Coefficient of Thermal Expansion (CTE)
- Material selection and design trade offs

Thermal Impedance and Importance of Minimizing Junction Temperature
- Simple excel spreadsheet demonstrates importance of proper material selection for typical microwave hybrid material sets

Review of Defects from the Component Attach Processes

Overview of Common Cleaning Processes and Potential Problems
- Wet chemicals, oxygen/argon plasma, UV Ozone

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Day 3

Wirebonding and Interconnect Process Overview
- Ultrasonic/thermosonic bonding
- Thermocompression bonding
- Ribbon bonding
- Gap Welding
- Deep access bonding
- Fine wire (.7 mil) bonding gate pads on FETs

Factors that affect yield and reliability
- Lessons learned
- Review of defects from the wirebond process

Wirebond design and layout guidelines to facilitate ease of manufacture

Hermetic Packaging Process Overview
- Seam sealing, laser welding aluminum alloys, solder sealing
- Soldering in RF Feedthrus

Hermeticity Testing
- Traditional gross and fine helium leak testing per MIL-STD-883 TM 1014
- Hermeticity testing options; Optical Leak vs. CHLD vs. Kr -85 Radiflow
- Impact of a tighter hermeticity specification

Near Hermetic Packaging Options
- LCP and other packaging approaches

Course Summary
Student Examination Test and Review
Student Feedback and Course Critique