TJ GREEN ASSOCIATES, LLC

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Virtual Training Course Outline

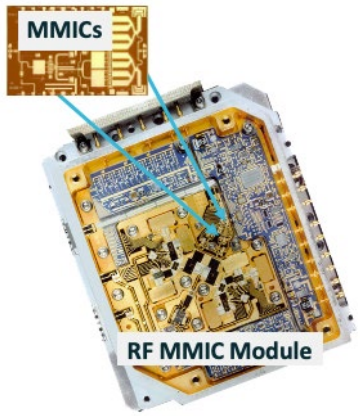
Microwave Packaging Technology

(3 Sessions)

This virtual training course is divided into three sessions, 2 hours each day with a 5 min break on the hour.

Instructor: Thomas Green, TJ Green Associates, LLC, tgreen@tjgreenllc.com

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, such as next generation 5G modules. 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 tradeoffs, 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

Session 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

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- Wafer Fabrication Processes
  - GaAs Gallium Arsenide wafer fabrication
  - GaN Gallium Nitride on SIC
  - MMIC device features identification
  - Review of wafer fabrication defects at incoming inspection (e.g., airbridge and channel damage, excessive probe marks)
- 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
  - 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
  - Solder and epoxy attach of discrete passive components
- Eutectic Soldering Processes
  - AuSn solder attach of GaAs chips
  - Issues with die voiding and how to detect

Session 2

- 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
- Packaging Design Considerations
  - Thermal analysis, simulated stack up and junction temp calculations
- Review of Defects from the Component Attach Processes
- Overview of Common Cleaning Processes and Potential Problems
  - Wet chemicals, oxygen/argon plasma, UV Ozone
- Wirebonding and Interconnect Process Overview
  - Ultrasonic/thermosonic bonding
  - Thermocompression bonding
  - Ribbon bonding
  - Deep access bonding
  - Fine wire (.7 mil) bonding gate pads on FETs
- Gap Welding
- Factors that affect yield and reliability

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- Lessons learned
- Review of defects from the wirebond process

Session 3

- Hermetic Packaging Process Overview
  - Seam sealing, laser welding aluminum alloys, solder sealing
- Hermeticity Testing
  - Traditional gross and fine helium leak testing per MIL-STD-883 TM 1014
- Near Hermetic Packaging Options
  - LCP and other packaging approaches
- Design for Manufacturability (DFM)
  - Rationale and significance of DFM
  - Typical problems encountered during hybrid manufacturing and how they can be prevented!
- Course Summary
- Student Feedback and Course Critique

INSTRUCTOR BIO

Thomas J. Green has more than 38 years combined experience in industry/academia and the Department of Defense, including years developing curriculum and teaching industry professionals about microelectronics assembly-related packaging and processes. Serving as a Research Scientist at the U.S. Air Force Rome Air Development Center, Tom worked as a reliability engineer analyzing component failures from fielded avionic equipment. As a Senior Process Engineer with Lockheed Martin Astronautics in Denver, Tom was responsible for materials and processes used to assemble hybrid microelectronic components for military and aerospace applications. While with Lockheed, he gained invaluable experience in wirebond, die attach, thick- and thin-film substrate fabrication, hermetic sealing, and leak test processes. For the last 15 years, Tom's expertise has helped position his company as a recognized industry leader in teaching and consulting services for high-reliability military, space, and medical device applications. Tom is a Fellow of IMAPS (International Microelectronics and Packaging Society).