Current Activities at SAE
SSTC G12 (Solid State Devices)
G24 (Pb-free Risk Mitigation)

Chair of SSTC G12 & G24

SSTC G12 Scope

- The SSTC G-12 Committee develops solutions to technical problems in the application, standardization, and reliability of solid state devices (discrete semiconductors, hybrids, and ICs) in government electronics.
  - Tends to represent USERS of electronic components
- This is implemented by evaluation and preparation of recommendations for specifications, standards, and other documents, both government and industry, to assure that solid state devices are suitable for their intended purposes.
- Partner with JEDEC JC-13 and JC-14 and with SAE SSTC G11, APMC, and G19
- Focus Areas:
  - Standardization
  - Manufacturability
  - Specifications and Standards Impacting Solid State Devices
  - Quality and Reliability
  - System Performance (End Use)
  - Diminishing Manufacturing Sources (DMS)
  - Market Consistency
  - Continued Improvement
  - Acquisition Reform
  - Best Commercial Practices
  - Commercial Part Insertion

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SSTC G12 Activity Overview

- Activities fall into 3 major categories
  - Maintaining Existing Mil Standards
    - Why? Continuous improvement, lessons learned
    - Ex. Update hermeticity testing for new test equipment
  - Preparing industry guides for new technologies and current practices
    - Why? Many programs using commercial parts but need to standardize best practices
    - Ex. Best practices for evaluating PEMS for space and military applications
  - Working to insert new technologies into the mil spec system
    - Why? Some programs swinging back to mil parts. Mil part system will die if not including current technologies
    - Ex. Class Y in MIL-PRF-38534 to allow mil grade non-hermetic parts in space applications

SSTC G12 Voting Members - 31

- Aerospace Corp
- Air Force
- Army
- BAE
- Boeing
- Corfin
- DLA
- DMEA
- DPACI
- EADS / TESAT / Airbus
- ESA
- GD
- HIREC
- Honeywell
- Integra
- JAXA
- L3
- Lockheed Martin
- Mitsubishi
- NASA
- Navy
- NEC
- Northrop Grumman
- Raytheon
- Rockwell Collins
- Scientic
- Six Sigma
- TCS
- Textron
- TNK

SSTC G12 Subcommittees

- Plastic Part Subcommittee
  - Use of plastic parts in mil, aero, and space
  - Discusses observed failures and best practices
- Space Subcommittee
  - Reports from space organizations on current challenges and accomplishments
  - Special topics
- Terrestrial and Avionics Subcommittee
  - Reports from the (non-space) services on current challenges and accomplishments
- Counterfeit Part Mitigation Subcommittee
  - Liaison with G19, more
  - Trusted electronics
- RHA Users Subcommittee
  - Best practices for radiation testing and evaluations

Current Technical Areas of Interest

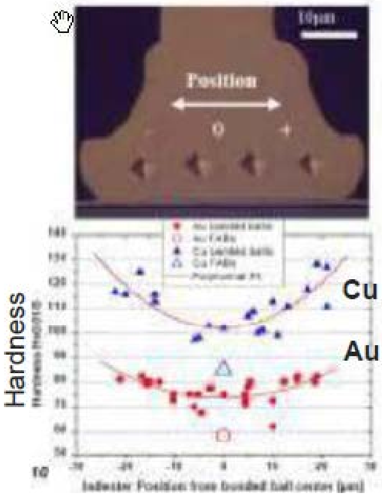
- Non-Hermetic Parts (plastic and ceramic)
  - Class Y in 38534
  - AS6294-1 (Space PEM Qual and Screening) Final comment resolution
  - AS6294-2 (PEM Qual and Screening for Military and Avionics) Balloting
- Long Term Storage of parts
  - GEA-STD-0003 REV A (Long Term Storage) -RELEASED 1/4/17
- Derating
  - GEIA-STD-0008 REV A in work; to work with SD-18 and others
- Updating DPA methods for new technologies and equipment
- New Technology Areas being worked in partnership with JEDEC
  - Use of automotive parts in mil / aero / space applications
  - Copper Wire Bonds
  - Silicon Carbide and Gallium Nitride devices for high power applications
  - Flip chip and necessary underfills
  - 3D Stacking / Packaging
  - Base Metal Electrode (BME) capacitors

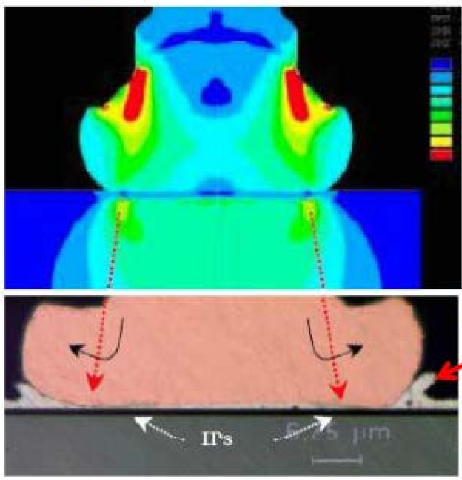
SAE Aerospace
An SAE International Group

Copper Wire Bonds

- Advantages
  - Much lower cost than gold
  - Better conductivity
  - Better high temp storage
- Disadvantages
  - Narrow process window
  - Harder so can damage bond pad
  - Req higher bonding force
  - More susceptible to chlorine corrosion
  - More oxidation
  - No agreed qual / test (even automotive revisiting standards)

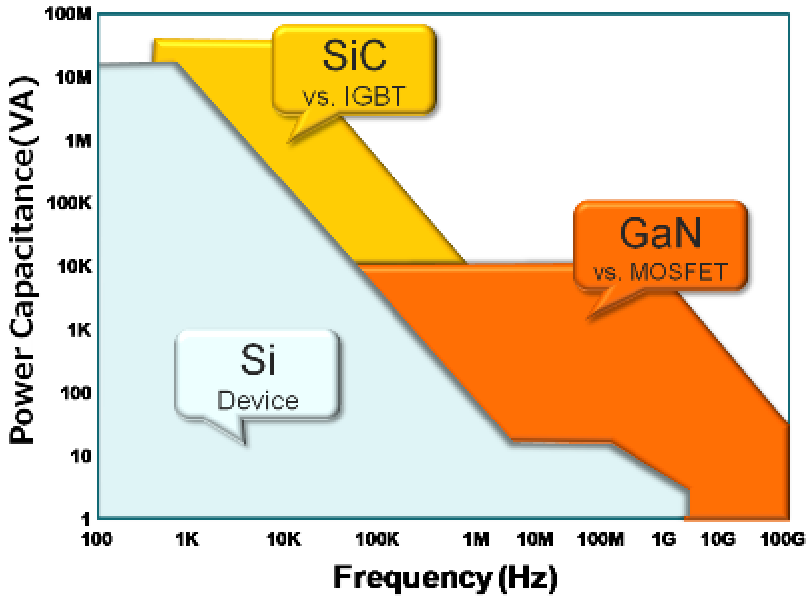
◦ Cu is harder and causes Al from pad to be forced outward – potentially reducing bond





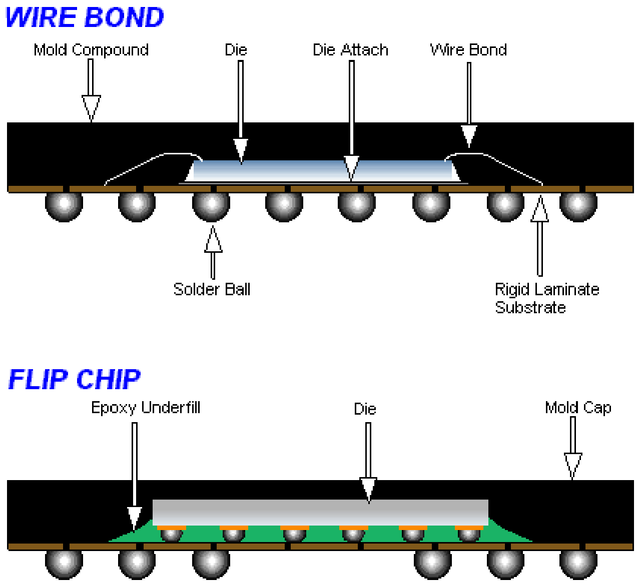
SiC and GaN

- Advantages: faster switching, lower conduction loss, reduced size
- Challenges: New materials with undefined testing protocols, limited work on radiation effects, etc.
- Commercial sector still working on standards, but already being considered for mil / aero / space insertion due to performance capability

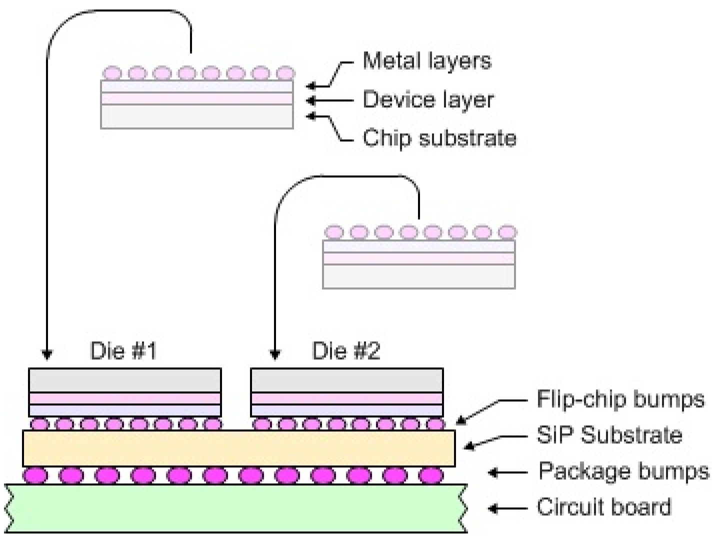


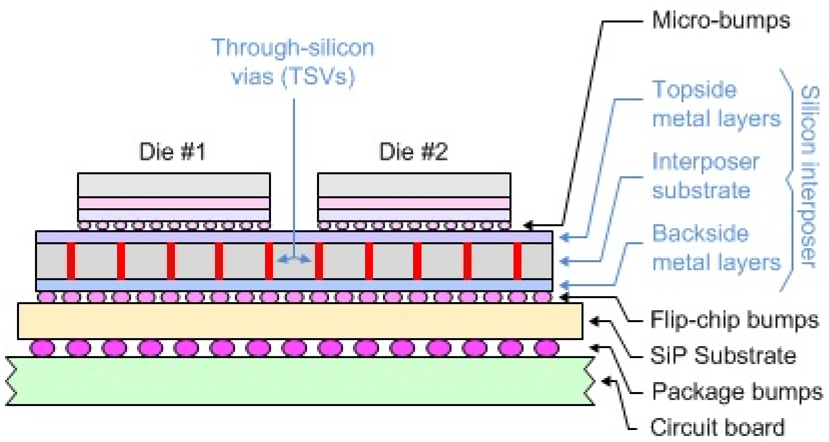
Flip Chip

- Flip Chip technology has been inserted into mil / aero / space applications for several years
- However, there has been little consensus on test methods, particular for new materials introduced by flip chip technology, such as underfills
  - What are the required material properties?
  - How do you determine if they will degrade with time?
  - Do we have to worry that the bumps are frequently Pb-free solders?



3D Stacking

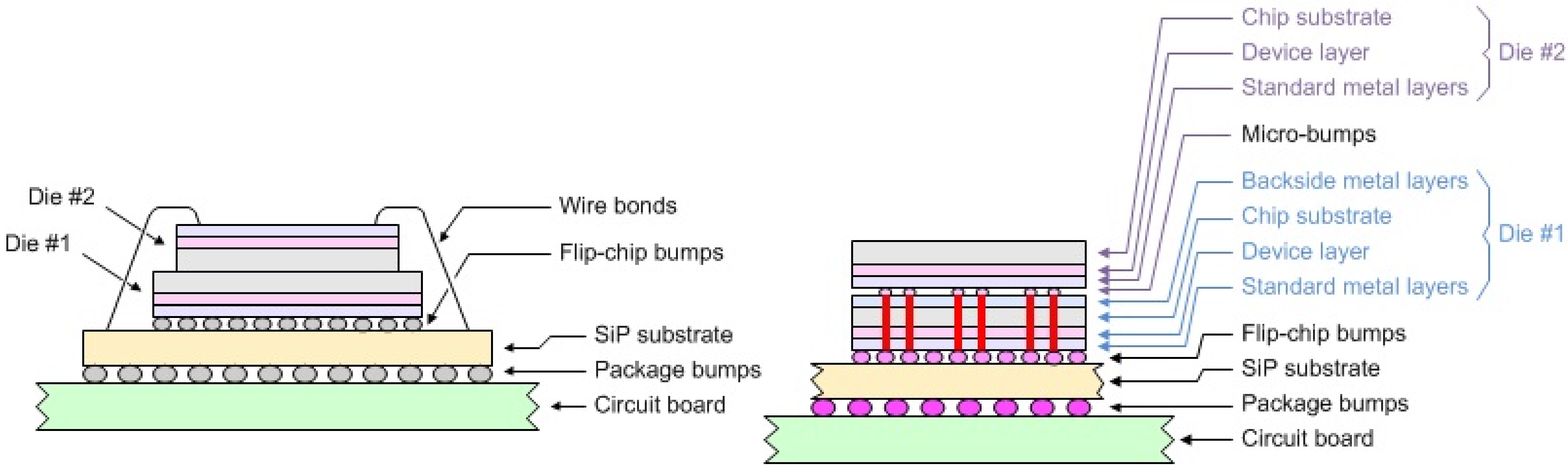




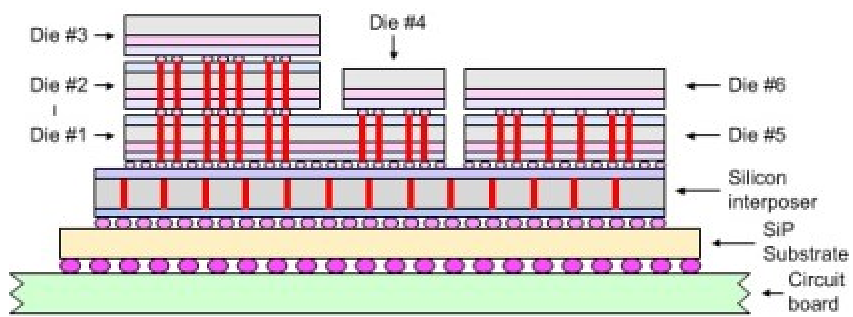
"2.5D" Stacking includes multiple die in package mounted in single plane

- Increased performance
- Increased quality due to smaller die?
- Challenges in test and material evaluation

3D Stacking (cont)



Simple “3D” packaging with stacked die



More complex “3D” packaging with mixed die

- Even better performance
- Even more testing challenges

BME Capacitors

- Why insert BMEs into military and space systems?
  - Some are already being used – sometimes difficult for users to easily identify BME vs. PME in catalogs
  - Business model for PME is on the wane
  - Higher functionality is only available in BME
  - The native reliability of *properly rated* BME is on par with PME
- Challenges of BME
  - Proven problems with BMEs in the 1990s led to an industry aversion
  - BME built using material systems and design rules unfamiliar to military and space users
  - Current approaches to capacitor qualification may not be applicable
- Goals
  - Provide detailed guidance on the Selection, Qualification and Screening of BME capacitors for military and space applications
  - Use this guidance to generate a military or industry spec or standard that is *practical and sustainable*
- Accomplishments: Worked with DLA to create new class to incorporate these capacitors and released first slash sheets.

G24 Scope

- Pb-free Risk Management for ADHP Committee develops standards and specifications for Pb-free electronics risk management for the aerospace, defense and high performance electronics industries. The committee also provides input to government and other industry standards related to Pb-free electronics risk management. It does not develop or revise workmanship and manufacturing standards.

- Objectives

- Develop and maintain standards, handbooks, and guidance documents for managing risk associated with Pb-free electronics;
- Provide recommendations to government and other industry activities regarding standards that include Pb-free risk management clauses;
- Coordinate activities with the IPC PERM Council, other SAE committees (including SSTC APMC, SSTC G-12, and SSTC G-11), and International Electrotechnical Commission (IEC) Technical Committee 107.

Current G24 Voting Members

- NASA
- Boeing (3)
- Six Sigma
- Northrop Grumman (2)
- SAIC
- Lockheed Martin
- Honeywell (3)
- Rockwell Collins
- Celestica
- Aerospace Corp
- BGA Test & Technology
- US Army
- BAE
- US Navy
- Airbus
- Raytheon (2)
- AVSI
- Forsite
- Embraer
- Wyle
- Corfin
- Consultant
- Zaccordix

29 voting members. >=15 participating for quorum.

Current WIP Status

GEIAHB0005_1A	Program Management/Systems Engineering Guidelines for Managing the Transition to Lead-Free Electronics	Feb 24, 2016	Revised
GEIAHB0005_2	Technical Guidelines for Aerospace and High Performance Electronic Systems Containing Lead-free Solder and Finishes	Jun 17, 2016	Reaffirmed
GEIAHB0005_3	Rework/Repair Handbook to Address the Implications of Lead-Free Electronics and Mixed Assemblies in Aerospace and High Performance Electronic Systems	Sep 17, 2015	Reaffirmed
GEIASTD0005_1A	Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder	Mar 01, 2012	Revised
GEIASTD0005_2A	Standard for Mitigating the Effects of Tin Whishers in Aerospace and High Performance Electronic Systems	May 01, 2012	Revised
GEIASTD0005_3A	Performance Testing for Aerospace and High Performance Electronic Interconnects Containing Pb-free Solder and Finishes	Dec 01, 2012	Revised
GEIASTD0006A	Requirements for Using Robotic Hot Solder Dip to Replace the Finish on Electronic Piece Parts	Feb 24, 2016	Revised

G-24 Pb-free Current Work

- GEIA-STD-0005-1 (Pb-free Control Plan Standard) will open for revision in 2017
  - Restructuring based on lessons learned in 5 year use
- GEIA-STD-0005-2 (Tin Whisker Mitigation) will open for revision in 2017
  - Update to include new findings about conformal coat, Pb self mitigation, and other lessons learned
- Work started on guideline for deciding between reballing and doing a mixed alloy installation (ARP6415)
- IEC Reballing document is in "pre-ballot" (Anduin is helping to gather comments that can be resolved either during or prior to the real ballot.)
- Formed a joint task group with JEDEC (and G12) to look at Pb-free solder bumps and other uses of part internal Pb-free solders