Agenda

- Introduction of Project Chair and iNEMI Project Staff
- iNEMI Project Development Process
- Project Briefing
  - Background & Objectives
  - Project Scope
    - Project Tasks
    - Project IS/IS Not
  - Timeline
- How to Join
- Q&A

Note: All phones will be on mute until the end of the presentation
Introduction of Project Chair & iNEMI Project Staff

Project Chair: Steve Brown,

MacDermid
PERFORMANCE SOLUTIONS

iNEMI Staff: Steve Payne
steve.payne@inemi.org
iNEMI Project Development Process - 5 Steps

0. INPUT
1. SELECTION
2. DEFINITION
3. PLANNING
4. EXECUTION / REVIEW
5. CLOSURE

"Initiative"
Open for Industry input

iNEMI Technical Committee (TC) Approval Required for Execution

"Project"
Limited to committed Members
Two governing documents for projects

- **SOW (Statement of Work):** sets out project scope, background, purpose, benefits, and outlines required resources, materials, processes, project schedule, etc.
- **Project Statement (PS):** signed by participating companies to secure commitment on resource and time contributions.

iNEMI Project requires iNEMI membership

- Signed membership agreement
- Commitment to follow iNEMI By-laws and IP policy
Project Briefing
Problem Statements

- There appears to be no coherent view of specifications for automotive electronics for high power, high density and high reliability. IPC class 3 (IPC-A-610 Class 3) is the highest IPC classification but not written specifically for under-the-hood applications and is therefore not always sufficient or appropriate.

- Initially a Tier 1 supplier may specify IPC class 3 whereas now they specify IPC class 3 + JIS + wide range of OEM specific standards, etc. There is a need to review OEM’s specifications and requirements (BMW, VW, HKMC, etc.) and undertake a cross comparison.

- Most standards mandate thermal cycling between -40C to +125C, with different ramp rates and dwell periods. This is overkill for some applications (particularly in-cabin electronics), yet not satisfactory for latest generation under-the-hood applications as many OEMs specify additional criteria such as high-temperature vibration testing. Operating temperatures in excess of +125C are now common (such as +140C); with many field failures caused by extreme conditions.

- There is also a trend to specify and procure material and components that do not meet any criteria more than is absolutely needed (good enough scenario). Typical Tier 1’s will be serving multiple OEMs requiring multiple validation cycles while trying to simplify the choice or common suite of materials. This is a challenge for both the material suppliers and the users.
The purpose of this project is to:

- Identify common failure mechanisms in automotive electronics and determine how standards can relate to each.

- Define a suite of test procedures for Tier 1 and material manufacturers that will give a high degree of confidence in meeting OEM’s requirements.

- Correlate the various standards and proprietary specifications for automotive PCB and PCBA materials for a range of harsh environments to enable a consensus for standardized procurement categories.
Scope of Work
Phase 1

Task 1: Define product categories and terminology for high power / high density (level of miniaturization)

- Through industry discussion and referral, determine a set of categories for materials used within a range of products at various degrees of power density and environmental conditions.

Task 2: Define the main attributes of each material that would place it in a specific category

- Investigate a broad range of materials encompassing bare PCB and PCB assembly materials.
  - Catalogue data against corresponding performance criteria for a range a pre-defined harsh environment conditions.
- PCB materials will include laminates, flexible circuit materials and solderable pad finish including solder mask. The miniaturization or density of PCB design features including pads, via holes and track dimensions will also be considered.
- Standards with relation to specific component types should be included; e.g., voiding standards with respect to critical components.
- PCBA materials will include solder alloys, flux systems and may also consider conformal coatings, underfills, etc.
Scope of Work continued

Task 3: Review existing standards for PCB and PCBA

- Tabulate & summarize existing standards for bare PCBs and PCBA
- Tabulate & summarize existing OEMs (& T1) existing requirements.
- Review, compare and contrast existing standards and tests for various and defined criteria such as thermal, sheer tests, etc.
- Determine commonality of material attributes with the objective of rationalization of range of standards.

Task 4: Identify the suite of tests that can meet a consensus of requirements from Tier 1 and OEMs

- Identify failure mechanisms in various applications experiencing harsh environments; cross-reference to testing regimes to meet compliance to reliability requirements.
- Investigate the range of tests that may be considered for all harsh environment categories. Determine which tests are most compatible with particular failure mechanisms; obtain a consensus for which tests most closely resemble actual ‘in-life’ experiences. Propose a suite of tests for each environmental category.
Task 5: Publish best practice guide

- Dissemination of deliverables through publication of technical paper(s) including associated presentations on the recommendations to adopt a set of standard categories for materials used in PCB & PCBA products for a range of automotive applications that experience harsh environments.

- Determine need for Phase 2: Propose possible experimental methodology for a Phase 2.

The project will consider all vehicle locations which may experience a range of predefined harsh environments.

- All vehicles with Internal combustion engine
- Hybrid vehicles
- All electric vehicles
# IS / IS NOT Analysis

<table>
<thead>
<tr>
<th>This Project IS:</th>
<th>This Project IS NOT:</th>
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<tbody>
<tr>
<td><strong>PCB/PCBA Material Characterization for Automotive Harsh Environments Project</strong></td>
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<tr>
<td>A PCB, flex circuit &amp; PCBA study for harsh environment automotive applications; harsh condition with &gt;100°C continuous operating temperature</td>
<td>Not revising existing or creating new global standards</td>
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<tr>
<td>To collect information from OEMs and Tier 1 auto electronics industries to identify key differences in their requirements and expectations</td>
<td>Not developing new reliability test standards/test methods and not developing Failure Analysis requirements/procedures</td>
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<td>To define several categories and terminology for high power and high density PCBs used in harsh environment automotive applications</td>
<td>Not developing the root cause analysis of common failure mechanisms under harsh conditions in automotive PCB/PBCA</td>
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<td>To identify and define common failure mechanisms and performance limitations of PCB/PCBA used in harsh environment automotive applications</td>
<td>Not defining the acceptance criteria of failure modes</td>
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<td>Will review current PCB and PCBA global standards and automobile OEM requirements and test standards for automotive electronic applications</td>
<td>Not intended for In-Cabin applications (Infotainment/Instrumentation/Comfort Convenience)</td>
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<td>Will identify and review Best Known Methods/Best Known Practices used in reliability assessments for automotive PCBA by OEMs</td>
<td>Not intended for non-automotive electronic applications</td>
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<td>Will identify the key attributes and identify measurement methods of PCB/interconnect materials and PCBA processes</td>
<td>Not biased to any supplier</td>
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<td>Will recommend test methods for PCB/PCBA most relevant to harsh automotive applications and decide whether the output will culminate in a guideline</td>
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<td>Will be PCB materials (laminate, surface finish) and assembly materials-centric</td>
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<td>Will define and measure key material properties to meet the application requirements</td>
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<td>Will determine if a Phase 2 project is required to obtain empirical evidence from reliability tests by the recommended test methods proposed</td>
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Outcome of Project

- Produce a Catalogue of PCBA products for various automotive harsh environments.
- Produce a Compendium of PCB & PCBA material attributes used in automotive applications.
- Publish a Directory of related PCB and PCBA standards and tests.
- Propose a common material qualification and quality reliability scheme for use by the global automotive supply chain to include the previously described, catalogues, compendium and directory to define suites of existing tests that meet a consensus of supply chain requirements.
## Project Plan

### Schedule with Milestones

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<th>Phase 1</th>
<th>Q1</th>
<th>Q2</th>
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<td>Task 1: Define product categories</td>
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How to Join

INEMI
Advancing manufacturing technology
iNEMI membership is required to join the project

Download SOW and PS from iNEMI website:

- http://community.inemi.org/content.asp?contentid=496

For iNEMI Existing Members

- Sign the Project Statement (PS)
- Signature of representative of participants
- Signature for Management Approval
- Send scanned PS to steve.payne@inemi.org
- iNEMI VP of Operations will sign and approve your participation and send you back the completed PS with acceptance

For Non-members interested in Project

- Consider iNEMI membership; contact Steve Payne
  steve.payne@inemi.org
Questions?