

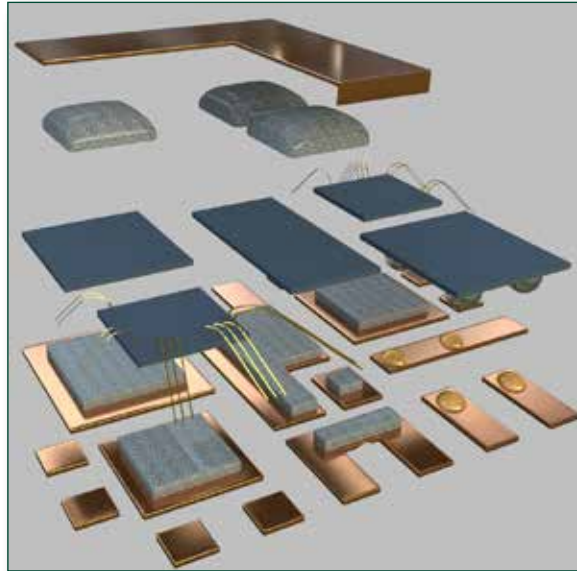
“Power-Safe” NC-SMQ®75 Die-Attach Solder Paste

Introduction

Indium Corporation’s “Power-Safe” NC-SMQ®75 is the world’s first and only solder paste suitable for use in non-cleaned clip bond applications in power semiconductor die-attach. The ultra-low flux residue, combined with a benign, low reactivity flux chemistry, enables power semiconductor assemblers to eliminate the costs of cleaning completely in clipbond applications.

Features

- Ultra-low post-reflow residue <0.5%w/w of solder paste
- “Power-Safe” residue compatible with overmolding compounds without delamination
 - e.g., Hitachi 9420, Sumitomo G770
- Halogen-free
 - No halogens used in formulation
- Consistent dispensing deposit size without clogging
 - Powder types 3, 4, 5, 6
- Airlessly syringe-packed (bubble-free)
- Wide range of alloy compatibility
- Reflow up to 400 °C
 - Low oxygen or forming gas needed (<100ppmO2)
- Low voiding for smaller die
 - < 6mm x 6mm
 - Meets <5% single, <10% total industry voiding standard
- Good wetting with common metal finishes
 - Leadframe: Cu, Cu spot-plate silver
 - Die: NiAg, NiAu, NiPdAu



BELLCORE AND J-STD TESTS & RESULTS

Test	Result
J-STD-004 (IPC-TM-650)	
• Flux Type Classification	ORLO
• Presence of Halide Fluoride Spot Test	Pass
• Elemental Analysis	Halogen-free
• Post Reflow Flux Residue (ICA Test)	0.4% of solder paste
• Corrosion	Pass
• SIR (Post Clean)	Pass
• Acid Value (Typical)	31.5

Test	Result
J-STD-005 (IPC-TM-650)	
• Typical Solder Paste Viscosity (Pb92.5/Sn5/Ag2.5, Type 3, 88%)	
Brookfield (TF 5 rpm)	230 kcps
Brookfield (R7 10 rpm)	170 kcps
• Slump Test	Pass
• Solder Ball Test	Pass
• Wetting Test	Pass
• Standard Metal Load	88%

All information is for reference only.
Not to be used as incoming product specifications.

Example Product Specifications

Alloy	Metal Content	Mesh Size	Particle Size	Recommended Needle Size ¹
Sn10/Pb88/Ag2 Sn5/Pb92.5/Ag2.5 Sn5/Pb95 Sn5/Pb85/Sb10	88%	Type 3	25 to 45 microns (Type 3)	20 gauge*

Form No. 99168 (A4) R0

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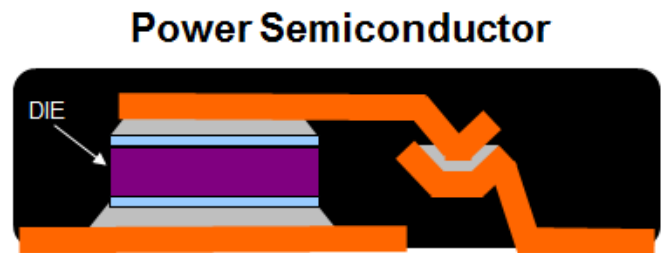
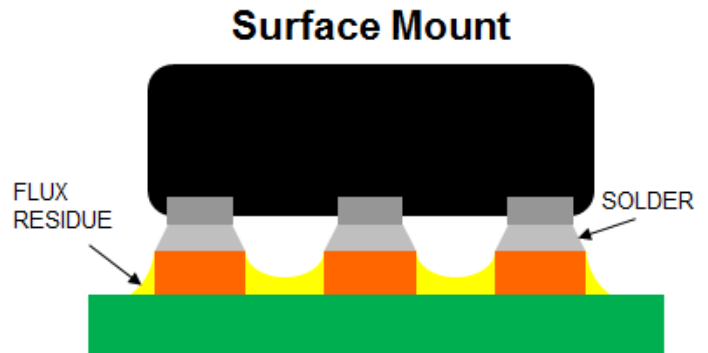
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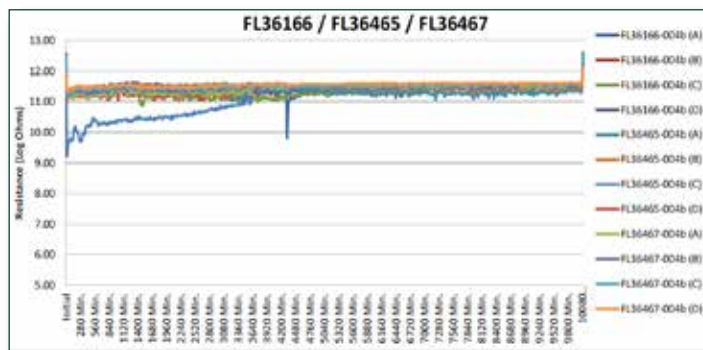
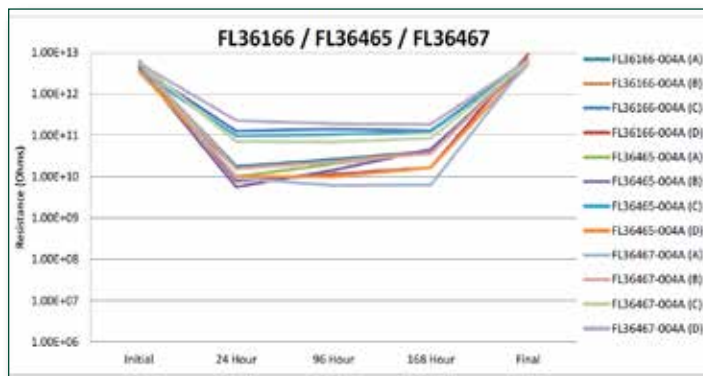
Why "power-safe" and not no-clean?

- **Possible concerns with flux residues**
 - Electrical "short" between adjacent conductors
 - Current leakage
 - Breakover voltage degradation
 - Contamination of wirebond pads
 - Interference with overmolding compound (OMC) adhesion
 - Delamination during MSL testing (JEDEC/IPC J-STD-020)
- **"Power-Safe" versus "No-Clean" terminology**
 - "No-clean"
 - Only for PCB assembly failure modes
 - Only standards are ANSI/IPC - PCB/SMT standards
 - No formal standard for semiconductor "no-clean"
 - "Power-Safe" term for customer-proven materials reliability
- **Device applicability**
 - "Power-safe" for selective non-wire bond applications, especially clip-bonding
 - Cleaning still dominant for wire bonded die



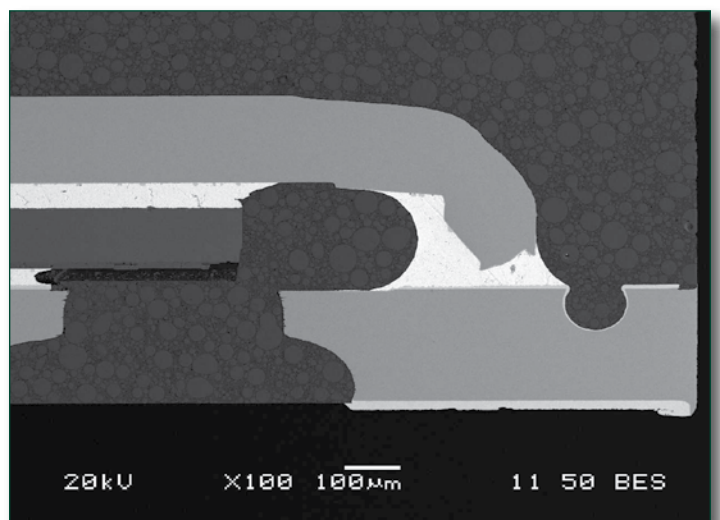
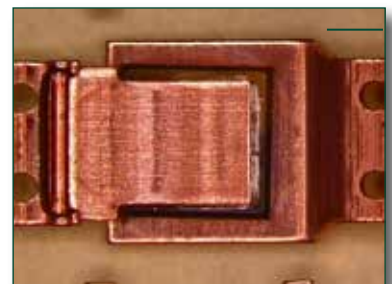
SIR Results

Surface insulation resistance (SIR) test is for SMT failure modes, but may be indicative of utility in "Power-Safe" applications.



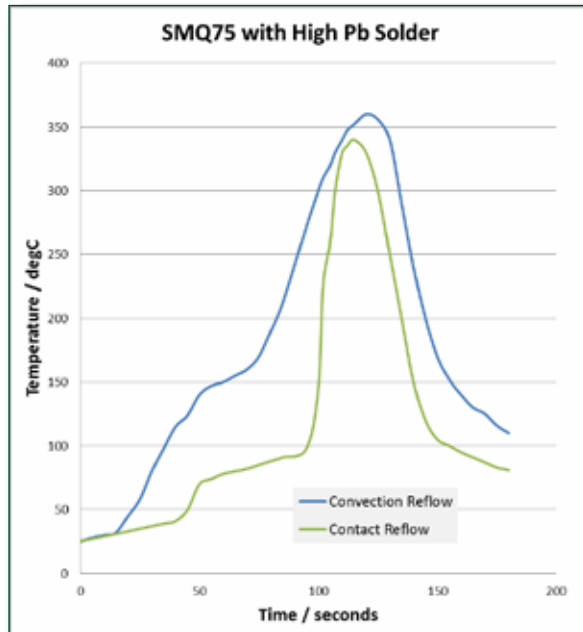
Compatibility with OMC NC-SMQ[®] 75

- Clip-bonded package
- 1000 hours thermal cycle (-55 to +150°C)
- SEM of cross-section:
 - No evidence of flux residues
 - No delam



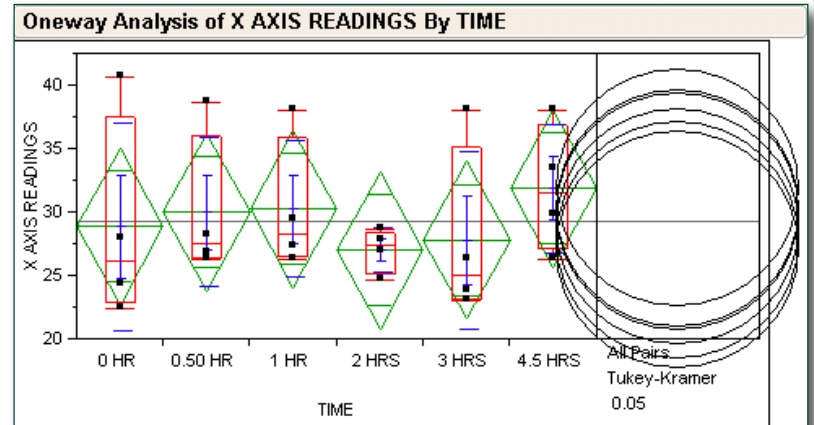
High-Pb Solder Reflow

- Must be <100ppmO₂ in N₂ or H₂/N₂
- Spike: 320-390°C
- Higher temperature → lower voiding
- Minimum 15 seconds TAL
- Preheat plateau eliminates volatiles from flux



NC-SMQ[®]75 Dispense Consistency

Statistically-based dispense trials showed no variation in deposit size, even after multiple start/stop cycles, including dispense after a 90-minute pause.



Standard Die-Attach Solder Paste Alloys

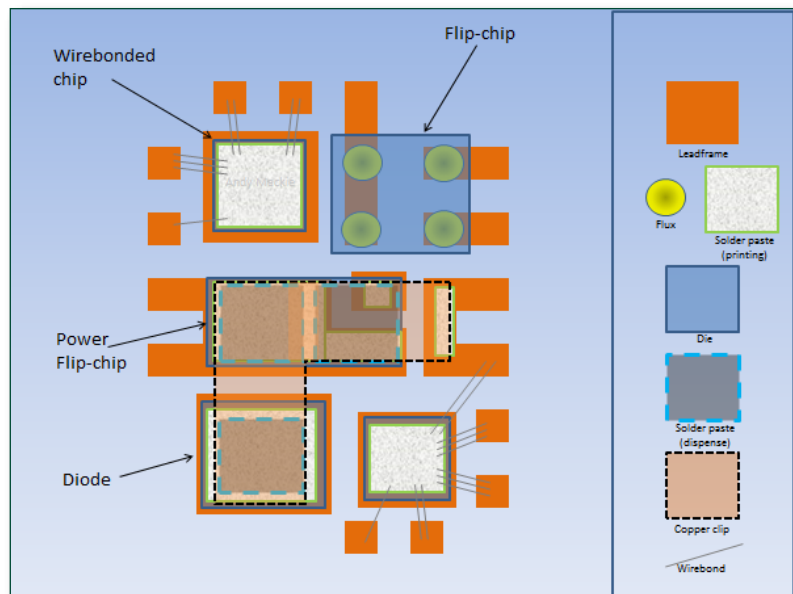
Commonly used alloy

	Die-Attach Application	Comments	Elemental %w/w					degC	
			Sn	Ag	Sb	Au	Bi	Solidus	Liquidus
Pb-free	IGBT and modules	Low Tj IGBT usage	96.5	3.5				221	Eutectic
	Through-hole components	High reliability	65	25	10			233	340
		Lowest Sb level alloy	95		5			237	240
		Most common Sb-based alloy	90		10			243	257
	High tensile strength; high cost	20			80		280	Eutectic	

	Die-Attach Application	Comments	Elemental %w/w					degC	
			Sn	Ag	Sb	Pb	In	Solidus	Liquidus
Pb-containing	SMT components	Step-soldering usage	5		10	85		240	256
		Good tilt control		2.5		92.5	5	300	310
		Poor thermal cycling	10	2		88		268	290
	Automotive usage		5			95		308	312
			10			90		275	302
			5	2.5		92.5		287	296
			2	2.5		95.5		299	304

"Power-Safe" NC-SMQ®75 Die-Attach Solder Paste

Assembly Materials for PQFN Packages



• Die-attach

- High temperature Pb-free solder paste

- BiAgX®

• Flip-chip on leadframe

- Fluxes

- No-clean and water-wash

- Solder pastes

- Fine and ultra-fine pitch
 - Types 4, 5, 5.5, 6, 6-SG, 7

Other Materials

- Solder pastes
- Fluxes
- Thermal interface materials
- Preforms



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