High Brightness LED Thermal Attach with NanoBond®

APPLICATION NOTE

Features

- **Superior thermal performance**
- **Millisecond soldering**
- **Lead-free**
- **RoHS compliant**

Introduction

NanoBond®, a joining process using **NanoFoil®**, is used to bond the thermal pad on many of today's packaged LEDs to their heat-sinking substrates. **NanoBond®** eliminates the need for conventionally reflowing LEDs, resulting in improved brightness, color, and lifetime. When combined with conventional assembly techniques, **NanoBond®** produces superior thermal performances as compared to thermal epoxies. Typical surface finishes suitable for **NanoBond®** include immersion tin plating, ENIG plating, and immersion silver plating.

Material Description

NanoFoil® is a self-contained, localized heat source that can be used to solder bond electronic packages to substrate materials. The foil is a RoHS compliant material consisting of hundreds of alternating nanoscale layers of aluminum and nickel. Once activated, inter-mixing between the alternating metal layers generates heat within the foil. This heat can be used to melt adjacent solder layers and join components together with minimal thermal exposure of the components.

Typical Component Properties for NanoBond®

Board Material	Metal Core PCB
Board Surface Finish	Tin-Plated (matte 1-2µm)
Component Material	Tin-Plated (matte 6-10µm)
Heat Spreader Material	Copper Over Aluminum
NanoFoil®	NF40, NF40-S10
Typical Bonding Pressure	1-8MPa (145 - 1160 psi)
Activation Source	Controlled Electronic Pulse (<2V)

NanoBond® Advantages

Features	Benefits
6-10x Lower Thermal Resistance than Adhesives	• LEDs run cooler, which increases lifetime, reduces spectral drift, and allows higher powers to be used
Flux-free, Metallic Bond	• High strength, low thermal resistance, low electrical resistance • No corrosion from flux residue
Uniform Bond Line Thickness	• Consistent performance characteristics • Consistent package height • Improved package mounting planarity
Limited Thermal Exposure	• Spectral stability maintained • Solder bonds temperature-sensitive packages including those with lenses • Prevents discoloration of packaging • No curing or reflow ovens necessary
Ease of Bonding	• NanoBond® can be used after reflow of passive components is completed • Lead-free, RoHS compliant • Suitable for automated assembly

OVER→

Form No. 98783 R0

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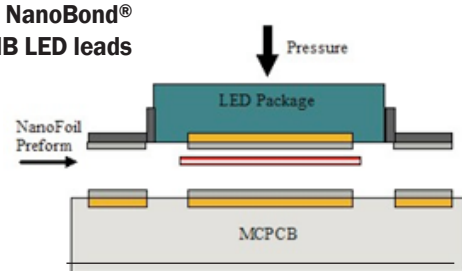
The NanoBond® Process

1. **Screen print solder paste**
2. **Pick & place passives**
3. **Reflow**
4. **Clean**
5. **Pick & place NanoFoil® preform**
6. **Pick & place HB LED**
7. **Activate NanoBond®**
8. **Solder HB LED leads**
9. **Clean**



Typical NanoBond® Properties

Physical Property	Typical Value
Thermal Conductivity	30 W/mK
Electrical Resistivity	44 Ω cm
Bond Line Thickness	40µm (0.0016")
Shear Strength	> 30 MPa (4351 psi)
Void Content	< 5%

Additional **NanoFoil®** properties can be found in NanoFoil® NF40 datasheet.

Reliability Testing

Test	Conditions	Standard	Result (Bond Quality)
Temperature Cycling	-40°C to +125°C, $t_{extreme}$ = 15 min, 1000 cycles	JESD22-A104-C	Passed
Temperature Humidity Bias	T_A = 60°C, R.H. = 90%, I_f = 1A	JESD22-A108-B	Passed
Mechanical Shock	500g, >4 ms, 6 directions, 3 times	IEC 60068-2-27	Passed
Random Vibration	20g, 10-2000Hz, 3 axes, 90 min. per axis, 20 cycles per axis	IEC 60068-2-6	Passed
High Temperature Storage	T_A = 125°C, 1000 hours	JESD22-A103-C	Passed

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