Protec Laser assisted Bonder
PLA-100 Introduction

SH LEE
Why Laser Assisted Bonder?
Introduction

Absorption Laser energy
Transited the vibrational energy
The vibrational energy
Become heating source
The means Heating source is
Welding point
**Thermocouple temperature Test**

**Rapid ramp up test**

- **Measurement tools**
  Thermo-couple: ST-50
  NR-500 Wave Logger

- **Parameter**
  Input Power: 80W
  Die peak temperature: 260°C

- **Test Device**
  Die Size about 10x10mm
  Die Thickness 150um
  CSP Type

- **Test result**
  Ramp up time to peak temp(260°C): 300ms

![Graph showing test results with a 300ms ramp up time to 260°C peak temperature]
Laser Assisted bonding (LAB) Applications

- LAB experience (tested by customer)
  1. Chip Size: 5x5mm ~ 35x35mm
  2. Chip Thickness: 50um ~ 780um
  3. Substrate Type: Strip & Single type substrate / Ceramic substrate / 200mm, 300mm wafer
  4. Product: Single & MCM FC bonding, chip & SMD(SiP) POP, Chip on wafer (CW) 2.5D
  5. Process: Single Bonding, Global (Multiple) Bonding
PLA-100A Machine Overview

- IR Camera
- Optic Head
- Trolley system
- Laser Source
- 3 Stage Indexer
- XY Gantry System
- 3 Stage Unloader system
- XY Gantry System
- Trolley system
# PLA-100A Specification

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UPH</td>
<td>30,000ea (Global shot  Dependent on chip size &amp; number, emission time 700msec )  * Process dependent</td>
</tr>
<tr>
<td>2</td>
<td>Gantry Resolution</td>
<td>0.5µm</td>
</tr>
<tr>
<td>3</td>
<td>Flatness of Stage Bond Stage</td>
<td>Bond Stage ≤ 25um</td>
</tr>
<tr>
<td>4</td>
<td>Stage Temp</td>
<td>Max 150°C(±5°C)</td>
</tr>
<tr>
<td>5</td>
<td>Laser Power</td>
<td>2KW (100W ~ 5Kw Optional)</td>
</tr>
<tr>
<td>6</td>
<td>Beam Size</td>
<td>4~60mm ( choose Optic for fix size)</td>
</tr>
<tr>
<td>7</td>
<td>Boat size (substrate) Wafer</td>
<td>L : 100<del>330mm / W : 62</del>330mm / T : 0.3~4.5mm Up to 12 inch wafer</td>
</tr>
<tr>
<td>8</td>
<td>Monitoring system</td>
<td>Laser power / Real time IR Camera</td>
</tr>
<tr>
<td>9</td>
<td>Vision system</td>
<td>5.3um Resolution, 14.4x10.8mm FOV, coaxial &amp; ring light</td>
</tr>
</tbody>
</table>
**PLA-100 Machine main module**

**Optic System (Homogenizer)**
- Variable beam size: 4mm ~ 60mm (choice optic)
- Motorized X, Y Axis, beam size control by software
- Active water cooling system
- Protect lens contamination (air curtain)

**Head Unit**
- Theta ±5°, Resolution 0.00000455°/pulse
- Z Stroke 50mm, Resolution 0.015um/pulse
- Tilt adjustable
PLA-100 Machine main module

Laser system

- Power 2KW (optional 100W ~5Kw)
- Cooling method : Water
- Wavelength : NIR
- Mode of operation : CW

Vision System

- Camera Resolution : 1280x1024 pixel
- Pixel pitch : 5.3um
- Frame rate : 60Hz
- Telocentric lens : 14.4x10.8mm FOV
- Lighting : Red
**PLA-100 Machine main module**

Heated work stage & Conveyor

- Z Stroke 10mm, Up & down
- Z Position Programmable
- Tilt Adjustable
- Motorized Width Adjust
- Conveyor speed control (Step-Motor)
- Max Stage Temp : 150 °C (±5 °C)
**PLA-100 Machine main module**

**IR Camera**

- Camera Resolution: 384x288 pixel
- Pixel Pitch: 25um
- Measurement Range: -20~650 °C
- Real Time bonding temperature profile by IR camera
- Reading Frequency: 50msec
PLA-100 Machine main module

Trolley System

• Using Trolley Easy setup
• 1 Trolley Cover 10 MC
• Z Height Adjustable
PLA-100 Machine Strong Point via Mass reflow system

Machine size

1,600mm
2,000mm
2,000mm
4~5m

1,600mm
PLA-100 Machine Strong Point via Mass reflow system

Easy of Use

- User Friendly interface
- Data Storage : SSD/HDD
- SECS/GEM
- SMEMA interface
Appendix Laser Density Test

Optic Density

- Plan to develop auto size checking & homogeneity check
Appendix Laser Density Test

Optic Density

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<tbody>
<tr>
<td></td>
<td></td>
<td>25.821 mm</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.433</td>
<td>0.000</td>
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<tbody>
<tr>
<td></td>
<td></td>
<td>31.285 mm</td>
<td>0.087</td>
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<tr>
<td></td>
<td></td>
<td>30.828</td>
<td>0.000</td>
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<tbody>
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<td></td>
<td></td>
<td>35.807 mm</td>
<td>0.147</td>
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<tr>
<td></td>
<td></td>
<td>35.066</td>
<td>-0.193</td>
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Appendix

- Quoted by AMKOR 2015 Taiwan Semicon show DongSu Ryu

PCB warpage

- 60mm BD & 400um Core
  - 40~50um PCB warpage on Die area @ 225°C HT

*Typical Max Warpage at 225 deg C*
Appendix

- Quoted by AMKOR 2015 Taiwan Semicon show DongSu Ryu

Die warpage

- 12x12mm size / 100um thickness
  - 50um die warpage (Smile type) @ 217°C HT
## Appendix

*Quoted by AMKOR 2015 Taiwan Semicon show DongSu Ryu*

### MR vs. LAB – FCBGA Coreless sub

- **Coreless FCBGA W/ LAB**
  - 52.5mm BD, 19.7x19.2mm Die, Eutectic, 160um pitch, Coreless 12+1 PCB
  - LAB : Good interconnection & stable joint height

<table>
<thead>
<tr>
<th>Position</th>
<th>Left</th>
<th>Center</th>
<th>Right</th>
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<tbody>
<tr>
<td><strong>LAB</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Top</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
</tr>
<tr>
<td>Core</td>
<td><img src="image4" alt="Image" /></td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
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<tr>
<td>Bottom</td>
<td><img src="image7" alt="Image" /></td>
<td><img src="image8" alt="Image" /></td>
<td><img src="image9" alt="Image" /></td>
</tr>
<tr>
<td><strong>Mass Reflow</strong></td>
<td><img src="image10" alt="Image" /></td>
<td><img src="image11" alt="Image" /></td>
<td><img src="image12" alt="Image" /></td>
</tr>
</tbody>
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- Quoted by AMKOR 2015 Taiwan Semicon show DongSu Ryu

- Low thermal stress
  - Limited die / PCB extension as applying optimized energy for interconnection
Appendix

- Quoted by AMKOR 2015 Taiwan Semicon show DongSu Ryu

• Purpose
  - To confirm Electrical performance & Reliability test after LAB

• Information & Result

<table>
<thead>
<tr>
<th>PKG</th>
<th>BD size</th>
<th>Die size</th>
<th>Pitch</th>
<th>Si Node</th>
<th>Electrical test test</th>
<th>Reliability test test</th>
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<tbody>
<tr>
<td>fcCSP</td>
<td>15x15mm m</td>
<td>12x12mm m</td>
<td>55/110um m</td>
<td>28nm</td>
<td>182/182 (100%)</td>
<td>MRT(L3) TCBx1500 HTS1500hrs</td>
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<tr>
<td>fcCSP</td>
<td>15x15mm m</td>
<td>10x10mm m</td>
<td>130um</td>
<td>16nm</td>
<td>40/40 (100%)</td>
<td>MRT(L3) TCBx1000 HTS1000hrs</td>
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</table>
Appendix Video
Thank you very much