Industry trends are boosting Jet Printing

Nico Coenen – Global Sales Director Jet Printing
Agenda

- What is Jet Printing
- Market Overview
- Industry Trends
- Typical Applications
What is Jet Printing
What is Jet Printing?

- Jet Printing at high frequency while moving over the board at high speed

- Solder paste and SMA (Surface Mount Adhesive)

- Dot volumes 5-20 nl

- Unique in the industry
Jet Printing solder paste
Jet printing
3 basic elements

Print head

Software control

MY600 Jet printer
The print head in details
The MY600 Cassette

Cassette has ID chip and barcode on the cartridge
- The right paste for the right job
- Paste/glue within due date
- Low paste level warning

Temperature control
- Maintains local paste temperature at 30°C

Closed system
- Low solder paste waste
- Environmentally friendly
The print head
Market overview
## The electronics industry segments

<table>
<thead>
<tr>
<th>Segment</th>
<th>CAGR 2013-2018</th>
<th>Total: 1,678 BUSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>2.7%</td>
<td>490 BUSD</td>
</tr>
<tr>
<td>Communications</td>
<td>3.1%</td>
<td>482 BUSD</td>
</tr>
<tr>
<td>Consumer</td>
<td>3.5%</td>
<td>147 BUSD</td>
</tr>
<tr>
<td>Automotive</td>
<td>6.5%</td>
<td>178 BUSD</td>
</tr>
<tr>
<td>Industrial/Medical</td>
<td>5.8%</td>
<td>253 BUSD</td>
</tr>
<tr>
<td>Military/Aerospace</td>
<td>2.8%</td>
<td>128 BUSD</td>
</tr>
</tbody>
</table>

### Geographic distribution

- **Asia/ROW**: 71%
  - Americas: 17%
  - Europe: 7%
  - Japan: 5%

- **Americas**: 66%
  - Americas: 14%
  - Europe: 16%
  - Japan: 4%

- **Europe**: 57%
  - Americas: 16%
  - Europe: 19%
  - Japan: 9%

- **Japan**: 34%
  - Americas: 18%
  - Europe: 29%
  - Japan: 20%

- **Asia/ROW**: 17%
  - Americas: 17%
  - Europe: 50%
  - Japan: 5%

- **Military/Aerospace**: 67%
  - Americas: 11%
  - Europe: 19%
  - Japan: 3%

Source and copyright: Prismark April 2014
PCB assembly market

Total: 86 BUSD
-of which equipment: 5 BUSD

<table>
<thead>
<tr>
<th>Region</th>
<th>CAGR 2012-2017</th>
<th>Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td>4.2%</td>
<td>Industrial/Medical, Military/Aerospace, Infrastructure</td>
</tr>
<tr>
<td>Europe</td>
<td>5.4%</td>
<td>Industrial/Medical, Automotive, Infrastructure</td>
</tr>
<tr>
<td>Japan</td>
<td>5.4%</td>
<td>Automotive, Consumer</td>
</tr>
<tr>
<td>Asia/ROW</td>
<td>6.5%</td>
<td>Mobile, Consumer, Automotive</td>
</tr>
<tr>
<td>China</td>
<td>5.4%</td>
<td>Computer, Mobile, Consumer, Automotive</td>
</tr>
</tbody>
</table>

Source and copyright: Prismark April 2014
Market dynamics and trends
Electronics products and effect on PCB assembly

Decreasing cost for electronics
- Cost per placement
- Higher speed lines
- Higher utilization, quality & yield (DPMO, reject rates, etc.)

Build to order
- Higher mix and shorter batches
- NPI turn around time
- Logistics and material handling

Functionality increases and miniaturization
- More complex boards → ‘broad band’ PCBs
- Semicon assembly – new packaging needs
- Higher accuracy

Increasing safety and reliability requirements
- Higher quality & yield (DPMO, reject rates, etc.)
- Higher accuracy
Electronics Components
To be mounted in PCB assembly

<table>
<thead>
<tr>
<th>2013-2018 CAGR</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passives</td>
<td>+5.0%</td>
<td>+7.5%</td>
</tr>
<tr>
<td>Discretes</td>
<td>+3.8%</td>
<td>+5.9%</td>
</tr>
<tr>
<td>ICs</td>
<td>+5.2%</td>
<td>+5.9%</td>
</tr>
</tbody>
</table>

Source and copyright: Prismark April 2014
Array package pitch trends
Excludes Small Die DCA, Display Driver and RF Modules

Note: Sub 0.5mm was 2% of overall volume in 2008. By 2018 this will increase to 28% or 19Bn units

Source and copyright: Prismark April 2014
Passive component size reduction

Market Share

Source and copyright: Prismark April 2014
PCBA & SCA slowly merging

Accuracy / Quality

- SCA
  - <1 µm: Die packaging
  - 5µm: System packaging
  - 15µm: High-end SMT
  - 35µm: Traditional SMT

- PCBA
  - 5000 cph

Speed

5000 cph

Electronic Equipment: 1,678 USD
Assembly Service: 1,250 USD
Electronics Components: 681 USD
Electronics Materials: 134 USD
Technology Trends
Strong technology trends
drive need for new capabilities on equipment

Technology drivers
- miniaturization
- mixing large and small components
- higher density boards
- 3D electronics and boards
- new semiconductor packaging
- new LED technology
- hybrid packaging/devices
- flexible boards

Stencil printers
- difficult to do everything on the board

Dispensers
- very slow, not cost effective
- accuracy is challenging
Opportunity for jet printing
replacing both stencil printers and dispensers

Examples

1. high-end electronics
   low to mid volume
   
2. high volume SMT
   smart phone board
   
3. semiconductor
   LED technology
Which stencil to use?

Do I need to compromise?

COMMON ISSUES WITH SCREEN PRINTING

THICK STENCIL
Optimized for large components.

1

2

3

GOOD JOINT  DRY JOINT

THIN STENCIL
Optimized for small components.

1

2

3

LEAN JOINT  GOOD JOINT

STEPPED STENCIL
Require a larger board area.

1

2

3

LARGER DISTANCE

SOLVED WITH JET PRINTING

Each component get the right amount of solder paste.

1

2

ALWAYS PERFECT JOINTS
**IPC 7525 stencil guidelines**

As a general design guide K1 should be 0.9mm [35.4mil] for every 0.025mm [0.98mil] of step-down thickness.

<table>
<thead>
<tr>
<th>Step in mm</th>
<th>K1 is distance from the step edge to the nearest aperture in step-down area</th>
</tr>
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<tbody>
<tr>
<td>0.010 [0.397mil]</td>
<td>0.36mm [14.1mil]</td>
</tr>
<tr>
<td>0.020 [0.787mil]</td>
<td>0.72mm [28.3mil]</td>
</tr>
<tr>
<td>0.025 [0.984mil]</td>
<td>0.90mm [35.4mil]</td>
</tr>
<tr>
<td>0.030 [1.181mil]</td>
<td>1.08mm [42.5mil]</td>
</tr>
<tr>
<td>0.050 [1.969mil]</td>
<td>1.80mm [70.9mil]</td>
</tr>
<tr>
<td>0.080 [3.14 mil]</td>
<td>2.88mm [113.4mil]</td>
</tr>
<tr>
<td>0.100 [3.937mil]</td>
<td>3.60mm [141.7mil]</td>
</tr>
</tbody>
</table>
perfect volume control

mix small and large parts
3D print examples

Each solder joint can be optimized for: solder paste volume, position, height, shape, pad coverage
Flexible & thin boards - Panels

Board stretch and alignment
- Boards are aligned and any stretch is compensated for by using board fiducials

Board warpage
- Laser height sensor maps board surface
- Control software ensures the print head travels with constant jet height over the board
Jet printing challenging boards

With jet printing, you can easily handle multi-level PCB’s
Pin-in-paste

- Enough solder to cover the pins
Jet print on mounted boards

Typical applications shielding and repair.

Excellent position accuracy even at larger jet printing heights. Result depends on dot size and distance to board.
MY500 in high volume production (add-on)

Use the jet printer after the screen printer to add volume or add solder paste to challenging board designs. No need for stepped stencils, special coating, preforms etc.

Step 1. Screen print full board
Step 2. Add volume with MY500

Step 1. Screen print all pads except cavities.
Step 2. Jet print in the board cavities
Alpha confirms solder joint quality with add-on

**ALPHA® Laboratory Report**


JP-500 jetted before and after Re-flow.
Industry trends

Industry 4.0

Lights out factory

4th the Industrial Revolution
Definition Industry 4.0

1st Industrial revolution through introduction of mechanical production facilities with the help of water and steam power

First mechanical weaving loom 1784

End of 18th century

2nd Industrial revolution through introduction of mass production with the help of electrical energy

First assembly line 1870

Beg. Of 20th century

3rd Industrial revolution through application of electronics and IT to further automate production

First programmable logic control system 1969

Beginning of 1970

4th Industrial revolution On the basis of cyber-physical production systems (CPPS), merging of real and virtual worlds

Today

Industry 1.0

Industry 2.0

Industry 3.0

Industry 4.0
Smart Factory – Cyber Physical Production Systems (CPPS)

Internet of:

- Things
- People
- Service
- Data
How does Jet printing serve Industry 4.0
Electronics products and effect on PCB assembly

- **Automation**
  - Automatic changeover possible without human intervention for lot size 1

- **Software driven**
  - Easy to communicate with other devices, programs received from engineers desk

- **Closed Loop**
  - Integrated 2D inspection and repair
Conclusions

- Exciting times with 4the industrial revolution
- Industry trends pushes PCBA further
- Jet Printing will be part of this
Thank You

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