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Automatic Probe Assembly Machine
1\textsuperscript{st} Section: Conventional Methods of Assembly

- Introduction CPC
- Conventional Manufacturing Process

2\textsuperscript{nd} Section: Innovative Methods of Assembly

- Introduction Automatic Probe Assembly Machine
- Productivity Effects / Quality Effects

3\textsuperscript{rd} Section: Conclusion

- Summary
- Future Action Items
1st Section. Conventional Methods of Assembly

**CPC (Compact Probe Card)**

- High Pin Count: up to 23,000 Pins (depend on ATE resource)
- Large Probing Area: 12”
- Applied to both Hot & Cold Temperature: (-30 ~ 100 ℃, Pad Size 75umX75um)
- Stable along with thermal deformation

1T/D 12” NAND Flash CPC
1st Section. Conventional Methods of Assembly

CPC Structure (Sectional View)
1st Section. Conventional Methods of Assembly

**Conventional Manufacturing Process.**

1. **Probe Bending**
   - Labor & Time Required
   - Less Reliable for Partial Inspection
   - Technicians Demanded

2. **Positioning**

3. **Aligning**

**Disadvantages**

1. Labor & Time Required
2. Less Reliable for Partial Inspection
3. Technicians Demanded
2nd Section. Innovative Methods of Assembly

Automatic Probe Assembly Machine (IM-800)

1. Objectives
   - Full Probe Inspection
   - Productivity Improvement
   - Quality Consistency

2. Features
   - High Resolution Image Processing
   - Highly Accurate & Repeatable Positioning
2nd Section. Innovative Methods of Assembly

IM-800 Process Steps

1. Loading a Pin from Cassette
2. Probe Inspection before Bending
3. Bending
4. Probe Inspection after Bending
5. Probe Tilt Inspection
6. Probe Positioning

<Bloc Diagram>
2nd Section. Innovative Methods of Assembly

**Advantages**

1. Full Inspection & Data Logging
   - Inspect Tip Length, Bending Angle, Probe Tilt
   - Record Inspection Data

2. High Precision Repeatability
   - Increased the Uniformity of Tip Length
   - Increased the Uniformity of Probe Bending Angle
2nd Section. Innovative Methods of Assembly

Full Inspection

- Hole Position Check
- Real-time check
- Tilt Check
- Damage & Bending Angle
2nd Section. Innovative Methods of Assembly

High resolution Image processing

◆ Probe Bending Angle / Tip Length / Tilt Check

<table>
<thead>
<tr>
<th>Specifications</th>
<th></th>
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<tbody>
<tr>
<td>FOV (Field of View)</td>
<td>1.6mm * 1.2mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 2µm</td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 2µm</td>
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2nd Section. Innovative Methods of Assembly

**Repeatability**

- **Tip Length Tolerance**
- **Probe Bending Angle Tolerance**
2nd Section. Innovative Methods of Assembly

Repeatability

- Comparative data of Tip Length Tolerance

<table>
<thead>
<tr>
<th>Pins</th>
<th>Manual</th>
<th>IM-800</th>
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<tbody>
<tr>
<td>1</td>
<td>±380</td>
<td>±380</td>
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<tr>
<td>12</td>
<td>±380</td>
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<tr>
<td>23</td>
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<td>78</td>
<td>±380</td>
<td>±380</td>
</tr>
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<td>89</td>
<td>±380</td>
<td>±380</td>
</tr>
<tr>
<td>100</td>
<td>±380</td>
<td>±380</td>
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</tbody>
</table>

Manual: ±380 ± 10μm
IM-800: ±380 ± 4μm
2nd Section. Innovative Methods of Assembly

Repeatability

◆ Comparative data of Probe Bending Angle Tolerance

(Bending Angle)

<table>
<thead>
<tr>
<th>Manual</th>
<th>IM-800</th>
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<tbody>
<tr>
<td>103.8</td>
<td>103</td>
</tr>
<tr>
<td>103.6</td>
<td>± 0.6°</td>
</tr>
<tr>
<td>103.4</td>
<td>± 0.3°</td>
</tr>
<tr>
<td>103.2</td>
<td>± 0.6°</td>
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</table>

103 ± 0.6° (Manual)
103 ± 0.3° (IM-800)
2nd Section. Innovative Methods of Assembly

**Effects**

1. Productivity
   - Enhanced Throughput
   - Reduced Products Delivery

2. Quality
   - Increased the Accuracy of the Tip Dia. By Precise Bending Angle of the Probe
   - Enhanced Scrub Marks by Full Probe Inspection
2nd Section. Innovative Methods of Assembly

Productivity Effects

1. Shorten Delivery Time by Automatic Process
   - CPC™ New Product : 5 → 4 weeks
   - CPC™ Repeat Order : 4 → 3 weeks

2. Compare

Skillful Engineer (More than 3 years)  VS  IM-800
### 2nd Section. Innovative Methods of Assembly

## Productivity Effects

<table>
<thead>
<tr>
<th></th>
<th>IM-800</th>
<th>Technician (With 3 Years Experience)</th>
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<tbody>
<tr>
<td>Time for 1pin</td>
<td>15 sec</td>
<td>30 sec</td>
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<tr>
<td>Working time</td>
<td>20 hours</td>
<td>* 83%</td>
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<tr>
<td>Total Pins in a day</td>
<td>4800</td>
<td>960</td>
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<tr>
<td>Comparison</td>
<td>5X</td>
<td>X</td>
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</table>
2nd Section. Innovative Methods of Assembly

Productivity Effects

IM-800 = 5 Technicians

June 8 to 11, 2008
IEEE SW Test Workshop
2nd Section. Innovative Methods of Assembly

Quality Effects

- Measuring Equipments

1. WaferWoRx

2. ProbeWoRx
Quality Effects

- Reducing Tip Length Gap by Probe Insert Depth Uniformity
2nd Section. Innovative Methods

Quality Effects

- Reducing Tip Dia. Dispersion by Probe Insert Depth Uniformity

![Graph showing the comparison between manual and IM-800 methods for reducing tip diameter dispersion.](image)
2nd Innovative Methods of Assembly

Quality Effects

- Enhanced Scrub Marks by Full Probe Inspection

a) Before

Max. Size
X : 29.0µm
Y : 13.6µm

Min. Size
X : 18.8µm
Y : 12.7µm

GAP
X : 10.2µm
Y : 0.9µm

b) After

Max. Size
X : 22.2µm
Y : 12.0µm

Min. Size
X : 17.9µm
Y : 11.3µm

GAP
X : 4.3µm
Y : 0.7µm

June 8 to 11, 2008
IEEE SW Test Workshop
3rd Section. Conclusion

Summary

• Got Rid of the Manual Drawbacks by Automation

• Improved the Reliability & Accuracy by Q.C & Q.A
  - Automatic Full Inspection
  - Reduce Tolerance of Tip Length and Bending Angle
  - Enhance Scrub Marks Quality

• Shorten the Delivery
  - One Week Faster
3rd Section. Conclusion

Future Action Items

• Reduce TAT (Total Acting Time)
  - 15sec → 12sec

• Enhance the Uniformity
  - Tip Length & Probe Bending Angle
  - Tip Diameter & Scrub Mark

• Increase Automation
Thank You for Kind Attention!

Question?