Semiconductor Industry

Entering a New Era as the World Finds Ways to Extract More Value from Chips

John West
Lin Fu
For Probe Card Market Research, We Can help ...

... provide intelligence to make better decisions faster
Over 40 Customers for Probe Card Reports
Overview

1. New Era of End Demand
2. Global IC Market
3. Asian IC Market
4. Global Probe Card Market
5. Summary
Virtuous Cycles of Demand

1990’s
- Broadband
- Internet
- Laptop
- Digital Cellular

2000’s
- High Speed Modem

2010’s
- Smartphone
- Social Media
- Multicore APU
- Search
- Touch Screen

2020’s
- Cloud
- Neuromorphic IC
- IOT

2030’s
- AI
- Blockchain
New Era of Data

Data Collection
- IOT

Data Transfer
- 5G

Data Analysis
- CPU + GPU

Data Storage
- Data Center
Technology Roadmap

Manufacture

Nanometer process: 90 nm, 65 nm, 45 nm, 32 nm, 22 nm, 14 nm, 10 nm, 7 nm, 5 nm, 3 nm, ...

Wafer Size: 200 mm, 300 mm, 450 mm
Technology Roadmap

Package

Area Array Package:

- BGA, uBGA, QFN, CSP...

Stacked Package:

- POP, PIP, SIP, TSV 2.5D IC, TSV 3.0D IC...

Packing Component

Packing System
Continuous improvement of performance for supporting the test:

- smaller size,
- higher pin count,
- finer pitch,
- higher frequency or testing speed,
- larger temperature range
Overview of IC Market 2018

Key Revenue Drivers

- Memory: 15% (E) ↑
- DRAM: 28% (E) ↑
- NAND:
- IC: 15% (E) ↑
- Semi: 15% (E) ↑

Estimated IC Sales > $400Bn
Estimated Semi Sales > $480Bn
IC Sales Growth: Weekly Moving Averages

- Peak called: Mar 18
- Upturn maturing: Apr 18
- Cooling & Cloudy: Aug 18
- Scattered Showers: Sep 18
- Bubbly: Jul 17
- Hot: Mar 17
- Hot: Nov 16
- Sunny: Aug 16
- In Upturn: Jul 16
- Bottoming: Apr 16
Outlook of Memory Market

- Memory market growth in 2017 was price driven
- Weakening NAND and DRAM prices will slow down revenue growth in 2018 and may result in negative revenue growth in 2019 even if unit shipments steadily increase
Outlook of Non-Memory Market

Revenue Growth of Non-Memory Market

- Graphics processor sales strong due to AI and Blockchain
- Applications processor sales weaken as smartphone and tablet sales mature
<table>
<thead>
<tr>
<th>Region</th>
<th>Consumption</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>$160B</td>
<td>$20B</td>
</tr>
<tr>
<td>Japan</td>
<td>$30B</td>
<td>$25B</td>
</tr>
<tr>
<td>South Korea</td>
<td>$25B</td>
<td>$90B</td>
</tr>
<tr>
<td>Taiwan</td>
<td>$50B</td>
<td>$50B</td>
</tr>
</tbody>
</table>
Japanese Market

- **Advanced Image Sensor Technology**
  - will be widely used in AI, IOT, driverless vehicles

- **Mature Automotive Electronics Market**
  - strong demand on power chips

- **Devaluation of Japanese Yen**
  - helpful to exports and increases international competitiveness
Korean Market

• Korean test consumables’ suppliers concentrate on the local market, more than 90% of probe cards and 80% of burn-in sockets are consumed locally

• Strongly dependent on two chip designers: Samsung and SK Hynix. (Main growth drivers for elastomer socket business)

• Samsung started to reduce the cost of test in 2018, which had a negative effect on Korean suppliers
Taiwanese Market

- Major Foundries and OSATs are located in Taiwan, but no powerful local IDM or fabless companies except MediaTek
- Most decisions still heavily influenced by companies outside Taiwan, especially the North American chip designers
- Chinese chip designers also prefer to use Taiwanese foundries
China-Sourced IC Sales

- $17.4B in 2017
  - 28% of sales domestic
- $42.8B in 2022 at CAGR ~ 20%
  - 34% of sales domestic
- Domestic 2017-22 CAGR ~ 25%
- Multinational 2017-22 CAGR ~17%
China-Sourced ICs: Memory & Non-Memory

- Most of China sourced IC sales by domestic vendors are for non-memory applications
- Domestic memory Capex will increase significantly over the next five years
Probe Card Market Overview

• 2018: IC market is still hot, with relatively low growth rate compared with 2017. However, sales of probe cards in H1 were not as good as we expected.

• 2019: A correction year

• 2020: A recovery year, 5G era coming
Probe Card Spend % of Total Semi Revenue

Less Volatile
• Very high end probe card price growth greater than average price growth
Revenue and Unit Distribution

Revenue Distribution, 2017
- MEMS 60%
- Epoxy/Cantilever 19%
- Vertical 19%
- Other Advanced 6%
- Blade/Tungsten 1%

Unit Distribution, 2017
- Epoxy/Cantilever 58%
- Vertical 8%
- MEMS 8%
- Blade/Tungsten 20%
- Other Advanced 6%
### Supply and Consumption Distribution

**Supply Distribution, 2017**
- North America: 36%
- Europe: 16%
- China: 2%
- Japan: 22%
- Rest of World: 1%
- Korea: 15%
- Taiwan: 8%

**Consumption Distribution, 2017**
- North America: 20%
- Europe: 8%
- Singapore: 6%
- China: 10%
- Japan: 12%
- Korea: 26%
- Taiwan: 16%
Top Probe Card Suppliers

<table>
<thead>
<tr>
<th>Top 5 Suppliers of Probe Cards</th>
<th>Market Share: 2017</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 FormFactor</td>
<td>29.2%</td>
<td>20.8%</td>
</tr>
<tr>
<td>2 MJC</td>
<td>13.0%</td>
<td>17.1%</td>
</tr>
<tr>
<td>3 Technoprobe</td>
<td>11.6%</td>
<td>8.2%</td>
</tr>
<tr>
<td>4 JEM</td>
<td>7.7%</td>
<td>7.4%</td>
</tr>
<tr>
<td>5 MPI</td>
<td>5.0%</td>
<td>6.4%</td>
</tr>
</tbody>
</table>
Summary

• 2018 is still expected to be another great year even if the sales growth slows down.

• 2019 is likely to be a correction year. As new memory capacity comes on line, rapidly falling memory prices may result in an overall semiconductor sales decline.

• From 2020, new end demand will gradually mature and become major market drivers, which will make the semiconductor industry enter a new era.