MARCH 2016

OUTLOOK FOR SEMICONDUCTORS & POWER DISCRETES & MODULES

Forecast Outlook

Dale Ford, Vice President
Electronic systems market – Growth drops below 2% in 2016

- Five year CAGR = 2.6%
- Industrial Electronics leads growth followed by Automotive & Consumer Electronics & Wired
- Industrial Electronics passed Data Processing as largest market in 2012; Wireless followed in 2013

Global Electronic Systems Revenue
2014 WW Revenue = $2.02 T

Year-on-Year Growth

-10%  -5%  0%  5%  10%  15%
Electronics growth weighed down by Wireless & Data Processing

Source – IHS Application Market Forecast Q4 2015
Annual semiconductor outlook

- Semiconductor market growth outlook – Next four years challenging
  - September 2012 began a new cycle that peaked in Q4 2014 – 2015/16 contracts
  - Long-term outlook sees five-year CAGR of only 1.9%

Global Semiconductor Revenue
2015 Revenue = $351.5B

Source – IHS Application Market Forecast Q4 2015
Historic alignment between economy and electronics

*Semiconductor growth profile continues to predict accurately*

Source – IHS Global Insight and IHS Technology
Quarterly semiconductor forecast

Q1 2015 slumps below -8.0%; Rest of year disappoints and drops 2015/16 negative

Quarter-to-Quarter Growth

Source – IHS  Application Market Forecast Q4 2015
2016 Growth – Weak and Negative

Quarter-over-Quarter Revenue Growth

Total Semiconductor | DRAM + Data Flash | Rest of Semiconductor

Source – IHS Application Market Forecast Q4 2015
3/12 and 12/12 moving averages

Source – IHS Application Market Forecast Q4 2015
New semiconductor growth drivers for next 5 years

Source – IHS Application Market Forecast Q4 2015
Power discrete revenues by market

2015 Revenue = $12.4B

- Automotive & Transportation: 27.4%
- Industrial: 21.0%
- Computer & Office Equipment: 18.2%
- Consumer: 15.5%
- Cellular Handsets & Infrastructure: 6.8%
- Lighting: 4.6%
- Renewable Energy: 1.9%
- Medical: 1.1%
- Other Communications: 3.3%

2019 Revenue = $14.6B

- Automotive & Transportation: 29.4%
- Industrial: 21.7%
- Computer & Office Equipment: 16.2%
- Consumer: 14.8%
- Cellular Handsets & Infrastructure: 6.8%
- Lighting: 4.2%
- Renewable Energy: 2.2%
- Medical: 1.3%
- Other Communications: 3.5%

Power discrete module revenues by market

2015 Revenue = $4.6B

- Industrial Motor Drives: 38.0%
- Consumer: 14.9%
- Traction: 11.6%
- Car & Light Trucks: 10.3%
- Wind & Other Renewable Energy: 5.7%
- Solar Energy: 4.8%
- Power Supplies: 4.2%
- Other Applications: 10.5%

2019 Revenue = $6.3B

- Industrial Motor Drives: 35.4%
- Consumer: 16.6%
- Traction: 11.5%
- Car & Light Trucks: 13.5%
- Wind & Other Renewable Energy: 4.9%
- Solar Energy: 4.8%
- Power Supplies: 3.7%
- Other Applications: 9.7%

Power discretes & modules growth drivers for next 5 years

Source – IHS Application Market Forecast Q4 2015
Power discrete revenues by device type

2015 Revenue = $12.4B

- MOSFETs: 48.5%
- Rectifiers: 27.5%
- Bipolar Power Transistors: 7.1%
- Discrete IGBTs: 8.0%
- Thyristors: 5.0%
- Pressure Contact IGBTs: 0.6%
- GTOs, IGCTs & GCTs: 0.5%
- Protected MOSFETs: 2.9%

2019 Revenue = $14.6B

- MOSFETs: 49.2%
- Rectifiers: 26.5%
- Bipolar Power Transistors: 6.2%
- Discrete IGBTs: 9.0%
- Thyristors: 4.7%
- Pressure Contact IGBTs: 0.6%
- GTOs, IGCTs & GCTs: 0.5%
- Protected MOSFETs: 3.3%

Power discretes growth opportunities

Source – IHS Application Market Forecast Q4 2015
Power discrete module revenues by module type

2015 Revenue = $4.6B

- Standard (Non-Integrated) IGBT Modules: 46.5%
- Intelligent Power Modules (IPM): 29.9%
- Thyristor/Diode Modules (& Rectifier Bridges): 10.9%
- Power Integrated Modules (PIM)/CIB: 7.8%
- MOSFET Modules: 5.0%
- MOSFET Modules: 4.4%

2019 Revenue = $6.3B

- Standard (Non-Integrated) IGBT Modules: 48.2%
- Intelligent Power Modules (IPM): 30.7%
- Thyristor/Diode Modules (& Rectifier Bridges): 9.4%
- Power Integrated Modules (PIM)/CIB: 7.4%
- MOSFET Modules: 4.4%

# Preliminary 2015 semiconductor market share for top 20 suppliers

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rank</th>
<th>COMPANY NAME</th>
<th>2014 Revenue</th>
<th>2015E Revenue</th>
<th>Percent Change</th>
<th>Percent of Total</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Intel**</td>
<td>49,964</td>
<td>49,319</td>
<td>-1.3%</td>
<td>14.0%</td>
<td>14.0%</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Samsung Electronics</td>
<td>38,064</td>
<td>40,722</td>
<td>7.0%</td>
<td>11.6%</td>
<td>25.6%</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>SK Hynix</td>
<td>16,113</td>
<td>16,944</td>
<td>5.2%</td>
<td>4.8%</td>
<td>30.4%</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Qualcomm*</td>
<td>19,291</td>
<td>16,205</td>
<td>-16.0%</td>
<td>4.6%</td>
<td>35.0%</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Micron Technology</td>
<td>16,110</td>
<td>14,759</td>
<td>-8.4%</td>
<td>4.2%</td>
<td>39.2%</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Texas Instruments</td>
<td>12,246</td>
<td>12,285</td>
<td>0.3%</td>
<td>3.5%</td>
<td>42.7%</td>
</tr>
<tr>
<td>15</td>
<td>7</td>
<td>NXP*</td>
<td>5,483</td>
<td>10,104</td>
<td>84.3%</td>
<td>2.9%</td>
<td>45.6%</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>Toshiba</td>
<td>10,234</td>
<td>9,203</td>
<td>-10.1%</td>
<td>2.6%</td>
<td>48.2%</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>Broadcom**</td>
<td>8,398</td>
<td>8,414</td>
<td>0.2%</td>
<td>2.4%</td>
<td>50.6%</td>
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<tr>
<td>14</td>
<td>10</td>
<td>Avago Technologies**</td>
<td>5,644</td>
<td>6,951</td>
<td>23.2%</td>
<td>2.0%</td>
<td>52.6%</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
<td>STMicroelectronics</td>
<td>7,404</td>
<td>6,887</td>
<td>-7.0%</td>
<td>2.0%</td>
<td>54.6%</td>
</tr>
<tr>
<td>13</td>
<td>12</td>
<td>Infineon Technologies*</td>
<td>5,937</td>
<td>6,870</td>
<td>15.7%</td>
<td>2.0%</td>
<td>56.5%</td>
</tr>
<tr>
<td>23</td>
<td>13</td>
<td>Apple</td>
<td>2,985</td>
<td>6,664</td>
<td>123.2%</td>
<td>1.9%</td>
<td>58.4%</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
<td>MediaTek</td>
<td>7,016</td>
<td>6,571</td>
<td>-6.3%</td>
<td>1.9%</td>
<td>60.3%</td>
</tr>
<tr>
<td>11</td>
<td>15</td>
<td>Renesas Electronics Corporation</td>
<td>6,815</td>
<td>5,731</td>
<td>-15.9%</td>
<td>1.6%</td>
<td>61.9%</td>
</tr>
<tr>
<td>17</td>
<td>16</td>
<td>Sony</td>
<td>5,053</td>
<td>5,250</td>
<td>3.9%</td>
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<td>16</td>
<td>19</td>
<td>Advanced Micro Devices (AMD)</td>
<td>5,388</td>
<td>3,914</td>
<td>-27.4%</td>
<td>1.1%</td>
<td>67.1%</td>
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<tr>
<td>21</td>
<td>20</td>
<td>ON Semiconductor**</td>
<td>3,516</td>
<td>3,528</td>
<td>0.3%</td>
<td>1.0%</td>
<td>68.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other Semiconductor Companies</td>
<td>119,178</td>
<td>112,102</td>
<td>-5.9%</td>
<td>31.9%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

** Total Semiconductor ** | 355,212 | 351,515 | -1.0% | 100.0% **

* Includes 2015 Acquisitions; ** Does not include announced acquisitions for 2016

Source – IHS Competitive Landscaping Tool Q4 2015
Preliminary 2015 semiconductor market share for top 20 suppliers
Plus results from major announced acquisitions expected to close in H1 2016

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</tr>
<tr>
<td>22</td>
<td>20</td>
<td>Analog Devices</td>
<td>3,094</td>
<td>3,358</td>
<td>8.5%</td>
<td>1.0%</td>
<td>69.9%</td>
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<tr>
<td></td>
<td></td>
<td>Other Semiconductor Companies</td>
<td>124,482</td>
<td>105,745</td>
<td>-15.1%</td>
<td>30.1%</td>
<td>100.0%</td>
</tr>
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Total Semiconductor: 355,212 | 351,515 | -1.0% | 100.0%

* Includes 2015 Acquisitions AND announced acquisitions for 2016

Source – IHS Competitive Landscaping Tool Q4 2015
Combined market shares of top semiconductor suppliers

Cumulative Market Share

Source – IHS Competitive Landscaping Tool Q4 2015
Combined market shares of top power discrete & module suppliers

Source – IHS Competitive Landscaping Tool Q4 2015
Average annual semiconductor revenue by ranking group

Millions of Dollars

- 10,000
- 5,000
- 0

Top 10
Top 11-25
Top 26-50
Top 51-100
Top 101-200
Top 201 plus
OVERALL AVERAGE

2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015E

Source – IHS Competitive Landscaping Tool Q4 2015
Average annual power discrete / module revenue by ranking group

Millions of Dollars

- 1,400
- 1,200
- 1,000
- 800
- 600
- 400
- 200
- 0

Top 5 
Top 6 to 10
Top 11+
OVERALL AVERAGE

Source – IHS Competitive Landscaping Tool Q4 2015
Combined market shares of top five semiconductor suppliers in each market segment

Source – IHS Competitive Landscaping Tool Q4 2015
Combined market shares of top five semiconductor suppliers in each market segment

Cumulative Market Share

- Infineon
- Mitsubishi
- Toshiba
- Fairchild
- STMicroelectronics

Source – IHS Competitive Landscaping Tool Q4 2015
Combined margins of 100 companies with semiconductor revenues over 70% of total company revenue

Representing over 63% of semiconductor revenue in 2014

Source – IHS Competitive Landscaping Tool Q4 2015
## Comparison of Top 10 power discrete & module suppliers
### 2001 to 2015

<table>
<thead>
<tr>
<th>Rank</th>
<th>2006</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STMicroelectronics</td>
<td>Infineon Technologies</td>
</tr>
<tr>
<td>2</td>
<td>Fairchild Semiconductor</td>
<td>Mitsubishi</td>
</tr>
<tr>
<td>3</td>
<td>International Rectifier</td>
<td>Toshiba</td>
</tr>
<tr>
<td>4</td>
<td>Toshiba</td>
<td>Fairchild Semiconductor</td>
</tr>
<tr>
<td>5</td>
<td>Infineon Technologies</td>
<td>STMicroelectronics</td>
</tr>
<tr>
<td>6</td>
<td>Mitsubishi</td>
<td>Vishay Intertechnology</td>
</tr>
<tr>
<td>7</td>
<td>Vishay Intertechnology</td>
<td>Fuji Electric</td>
</tr>
<tr>
<td>8</td>
<td>Fuji Electric</td>
<td>ON Semiconductor</td>
</tr>
<tr>
<td>9</td>
<td>ON Semiconductor</td>
<td>Renesas Electronics Corporation</td>
</tr>
<tr>
<td>10</td>
<td>Sanken Electric Company</td>
<td>ROHM Semiconductor</td>
</tr>
</tbody>
</table>

Top Ten Transformational Technologies . . . And More

CURRENT IHS TECHNOLOGY RESEARCH COVERAGE

1) Internet of Things
2) Cloud Computing / Big Data
3) 3D Printing
4) Energy Storage / Advanced Battery Technology
5) Graphene
6) Advanced User Interfaces
7) Sensors of all Types
8) Flexible Displays
9) Biometrics for Security / Health
10) Artificial Intelligence

• Encryption & Security
• Carrier Aggregation
• Wireless Charging
• Virtual Reality
• Biomedical Technology
• HEVC
• High Resolution Displays
• LTE Direct
• “Smart” Extensions
• Quantum Computing
• Visible Light Communications
The developing technology triumvirate

IoT

Perfect Storm

2020 / 2022

Cloud

Waves of Amplified Growth

5G
For More Information -

  [https://technology.ihs.com/Services/426851/power-semiconductor-intelligence-service](https://technology.ihs.com/Services/426851/power-semiconductor-intelligence-service)

- Semiconductor Application Forecast AMFT Intelligence Service

- Semiconductor Competitive Landscaping CLT Intelligence Service
MARCH 2016

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Forecast Outlook

Dale Ford, Vice President