CMOS Image Sensors in Automotive Industry

ADAS & AUTONOMOUS

Are Taking Off

Dec. 2018
Safe Harbor Notice

KINGPAK’s statements of its current expectations are forward-looking statements subject to significant risks and uncertainties and actual results may differ materially from those expressed or implied in these forward-looking statements for a variety of reasons, including but not limited to, among other things: the cyclical nature of our industry; our dependence on introducing new products on a timely basis; our dependence on growth in the demand for our products; our ability to compete effectively; our ability to successfully expand our capacity; our dependence on key personnel; general economic and political conditions, including those related to the electronic device industries; possible disruptions in commercial activities caused by natural and human-induced disasters, including terrorist activity and armed conflict; and fluctuations in foreign currency exchange rates.

Except as required by law, we undertake no obligation to update any forward-looking statement, whether as a result of new information, future events, or otherwise.
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Ⅱ Automotive CIS Market Outlook
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Ⅳ Kingpak Major Customers & Landscape
Ⅴ Kingpak’s Growth Potential & Driver
Ⅵ Overview of Kingpak
Ⅶ Technology Competition & Analysis
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IC Insights believes that the compound annual growth rate of automotive IC will reach 12.5% from 2017 to 2021, of which the market growth rate is estimated to be 18.5% (about $32.3 billion) in 2018 alone. The sales amount in 2021 will be expected to reach at $43.6 billion. The emergence of driverless car from 2020 to 2021, coupled with the other types of electric vehicles, will propel the market growth of automotive IC to a higher level.
### 1. Overall CIS CAGR in Revenue (Y2017-2023) ~9.4%

### 2. Automotive CAGR in Revenue (Y2017-2023) ~16%

### 3. Security CAGR in Revenue (Y2017-2023) ~15%

#### 3. CMOS Image Sensor Market (in $M, %)

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th>YoY (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
<td>8,068</td>
<td>9,360</td>
<td>16%</td>
</tr>
<tr>
<td>Consumer</td>
<td>1,097</td>
<td>1,104</td>
<td>1%</td>
</tr>
<tr>
<td>Computing</td>
<td>1,394</td>
<td>1,298</td>
<td>-7%</td>
</tr>
<tr>
<td><strong>Automotive</strong></td>
<td>582</td>
<td>734</td>
<td>26%</td>
</tr>
<tr>
<td>Medical</td>
<td>60</td>
<td>69</td>
<td>15%</td>
</tr>
<tr>
<td>Security</td>
<td>624</td>
<td>786</td>
<td>26%</td>
</tr>
<tr>
<td>Industrial/Space/Defense</td>
<td>462</td>
<td>555</td>
<td>20%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><em>11,598</em></td>
<td><em>13,906</em></td>
<td>19.9%</td>
</tr>
</tbody>
</table>

*Adjusted by reducing $689 based on Yole’s report*

![2017 CIS revenue breakdown by market](image)

- Mobile: 5.7%
- Automotive: 5.3%
- Security: 7.9%
- Medical, Computing, Consumer, Industrial/Space/Defense: 4%

**TOTAL 2017: $13,906M**

**2017 CIS revenue breakdown by market:**

- Mobile: 67.3%
- Automotive: 5.7%
- Security: 5.7%
- Medical, Computing, Consumer, Industrial/Space/Defense: 4%

Status of the CIS Industry | www.yole.fr | ©2018
4. CMOS Image Sensor Market (in unit)

Market TAM:
1. 5.2B units market in 2017 & should reach 8.2B units by 2023
2. CAGR(2017~2023) in Unit: 7.7%
3. ‘18 vs ‘19 YoY in Unit for Automotive(26%) & Security(21%)
5. CMOS Image Sensor Market (in $M)

- **Automotive** will become 2nd largest segment by Y2020
- '17~'23 CAGR in Revenue for Automotive(16%) & Security(15%)
- '18~'19 YoY in Revenue for Automotive(23%) & Security(18%)

---

<table>
<thead>
<tr>
<th>Year</th>
<th>Industrial/Space/Defense</th>
<th>Security</th>
<th>Medical</th>
<th>Automotive</th>
<th>Computing</th>
<th>Consumer</th>
<th>Mobile</th>
<th>TOTAL</th>
<th>YoY Growth</th>
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<tbody>
<tr>
<td>2011</td>
<td>220</td>
<td>63</td>
<td>30.3</td>
<td>24</td>
<td>1 045</td>
<td>1 200</td>
<td>3 551</td>
<td>5 793</td>
<td>13%</td>
</tr>
<tr>
<td>2012</td>
<td>257</td>
<td>85</td>
<td>33.9</td>
<td>62</td>
<td>1 740</td>
<td>1 517</td>
<td>4 220</td>
<td>8 010</td>
<td>19%</td>
</tr>
<tr>
<td>2013</td>
<td>293</td>
<td>120</td>
<td>38.3</td>
<td>140</td>
<td>1 791</td>
<td>1 491</td>
<td>4 897</td>
<td>8 010</td>
<td>16%</td>
</tr>
<tr>
<td>2014</td>
<td>332</td>
<td>207</td>
<td>43.7</td>
<td>279</td>
<td>1 771</td>
<td>1 529</td>
<td>5 909</td>
<td>9 362</td>
<td>17%</td>
</tr>
<tr>
<td>2015</td>
<td>398</td>
<td>427</td>
<td>50.1</td>
<td>540</td>
<td>1 755</td>
<td>1 566</td>
<td>6 803</td>
<td>10 248</td>
<td>19%</td>
</tr>
<tr>
<td>2016</td>
<td>462</td>
<td>624</td>
<td>59.9</td>
<td>582</td>
<td>1 794</td>
<td>1 664</td>
<td>8 068</td>
<td>11 598</td>
<td>20%</td>
</tr>
<tr>
<td>2017</td>
<td>555</td>
<td>786</td>
<td>68.8</td>
<td>734</td>
<td>1 823</td>
<td>1 707</td>
<td>9 360</td>
<td>13 006</td>
<td>15%</td>
</tr>
<tr>
<td>2018e</td>
<td>651</td>
<td>947</td>
<td>82.8</td>
<td>934</td>
<td>1 882</td>
<td>1 783</td>
<td>10 620</td>
<td>15 580</td>
<td>15%</td>
</tr>
<tr>
<td>2019e</td>
<td>722</td>
<td>1 113</td>
<td>96.9</td>
<td>1 524</td>
<td>1 950</td>
<td>1 858</td>
<td>11 769</td>
<td>17 161</td>
<td>10%</td>
</tr>
<tr>
<td>2020e</td>
<td>810</td>
<td>1 286</td>
<td>108.6</td>
<td>1 317</td>
<td>1 800</td>
<td>1 813</td>
<td>12 896</td>
<td>18 699</td>
<td>10%</td>
</tr>
<tr>
<td>2021e</td>
<td>894</td>
<td>1 470</td>
<td>121.8</td>
<td>1 477</td>
<td>1 773</td>
<td>1 795</td>
<td>14 166</td>
<td>20 430</td>
<td>8%</td>
</tr>
<tr>
<td>2022e</td>
<td>996</td>
<td>1 671</td>
<td>121.8</td>
<td>1 633</td>
<td>1 773</td>
<td>1 795</td>
<td>14 166</td>
<td>20 430</td>
<td>8%</td>
</tr>
<tr>
<td>2023e</td>
<td>1 089</td>
<td>1 858</td>
<td>148.9</td>
<td>1 807</td>
<td>1 773</td>
<td>1 795</td>
<td>14 166</td>
<td>20 430</td>
<td>8%</td>
</tr>
</tbody>
</table>

**CAGR 9.4%**
### 6-1. Who Are Major Players & Ranking (by Revenue)

<table>
<thead>
<tr>
<th>Rank (Previous)</th>
<th>Company</th>
<th>2016 (in $M)</th>
<th>2017 (in $M)</th>
<th>YoY(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sony</td>
<td>$4,848</td>
<td>$5,890</td>
<td>21%</td>
</tr>
<tr>
<td>2</td>
<td>Samsung</td>
<td>$2,126</td>
<td>$2,727</td>
<td>28%</td>
</tr>
<tr>
<td>3</td>
<td>Omnvision</td>
<td>$1,437</td>
<td>$1,480</td>
<td>3%</td>
</tr>
<tr>
<td>4</td>
<td>On Semi</td>
<td>$717</td>
<td>$768</td>
<td>7%</td>
</tr>
<tr>
<td>5</td>
<td>STMicro</td>
<td>$290</td>
<td>$669</td>
<td>131%</td>
</tr>
<tr>
<td>6</td>
<td>Panasonic</td>
<td>$387</td>
<td>$433</td>
<td>12%</td>
</tr>
<tr>
<td>7</td>
<td>Canon</td>
<td>$360</td>
<td>$382</td>
<td>6%</td>
</tr>
<tr>
<td>8</td>
<td>SK Hynix</td>
<td>$310</td>
<td>$319</td>
<td>3%</td>
</tr>
<tr>
<td>9</td>
<td>Galaxycore</td>
<td>$286</td>
<td>$252</td>
<td>-12%</td>
</tr>
<tr>
<td>10</td>
<td>Hamamatsu</td>
<td>$132</td>
<td>$152</td>
<td>15%</td>
</tr>
<tr>
<td>11</td>
<td>Smartsens</td>
<td>$52</td>
<td>$129</td>
<td>148%</td>
</tr>
<tr>
<td>12</td>
<td>ams</td>
<td>$80</td>
<td>$88</td>
<td>10%</td>
</tr>
<tr>
<td>13</td>
<td>Other</td>
<td>$573</td>
<td>$617</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$11,598</td>
<td>$13,906</td>
<td>19.9%</td>
</tr>
</tbody>
</table>

**SONY**  
#1 in CCD Image sensor; leading BSI technology for Apple

**SAMSUNG**  
#1 Smartphone market share, plus leading Semiconductor Technology

**OVT**  
Working with TSMC, 1st BSI release for Apple, leading in low-end market

**ON SEMI**  
Merged Aptina in 2014, with a focus on Automobile & Security areas
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V Kingpak’s Growth Potential & Driver
VI Overview of Kingpak
VII Technology Competition & Analysis
VIII Kingpak Performance Updated
1. From 2017~2023 growth should be back to a ~19% CAGR in volume
2. Some cars will require +10 cameras.
2. CMOS Automotive Top 10

Remark:
1. On semi is No1 in automotive with 49% share, furthermore, 55+% On OEM sector.
2. Sony, as No1 share in CIS, will be our 2nd largest customer in auto 2018.
3. Omnipvision will be very promising customer in 2019.
1. The average timeline for camera module house to certify the system is ~ 1 to 2 years.
2. These Tier1 & Tier2 module/system makers have qualified Kingpak System/Products.
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CMOS sensor sales for security systems and surveillance applications are expected to grow by a CAGR in Unit ~+19% (2017-2023).

CMOS sensors for security cameras have seen a recent boost due to the replacement of previous CCD camera technology.
Remark:
1. Kingpak continues to support high tier customer in security and surveillance customers.
2. Continues to support and focus on high-end products sector.
3. Security CAGR in Revenue(Y2017-2023)~15%
### Security / Surveillance Supply Chain

#### Security Camera Map

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Package</th>
<th>Optics</th>
<th>Major</th>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON Semiconductor</td>
<td>Xintec</td>
<td>LARGAN</td>
<td>AXIS Communications</td>
<td>B/ASL/ER</td>
</tr>
<tr>
<td>SONY</td>
<td>Aptina</td>
<td>SHARP</td>
<td>BOSCH</td>
<td>PHILIPS</td>
</tr>
<tr>
<td>Samsung</td>
<td>SONY</td>
<td>FUJINON</td>
<td>PELCO</td>
<td>AREVA</td>
</tr>
<tr>
<td>Pixim</td>
<td>KYOCERA</td>
<td>VIVOTEK</td>
<td>THALES</td>
<td>Dallmeier</td>
</tr>
<tr>
<td>Clairpixel</td>
<td>KINGPAK</td>
<td>MOBOTIX</td>
<td>G&amp;P</td>
<td>ZAVIO</td>
</tr>
<tr>
<td>PurePixel</td>
<td>ChipMOS</td>
<td>SONY</td>
<td>Chip500</td>
<td>VIO</td>
</tr>
<tr>
<td>Viimagic</td>
<td></td>
<td>Sunex</td>
<td>ACTi</td>
<td>COHU</td>
</tr>
</tbody>
</table>

*Research Report: Kingpak Management*
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1. On Semi: the leader of CMOS in Auto field.
2. Others: Sony, Panasonic, Pixelplus, STM, etc.
3. Promising new customers: Omnivision
1. Kingpak continues to support high-tier customer in security and surveillance customers.
2. Continues to support and focus on high-end products sector.
3. Security CAGR in Revenue(Y2017-2023)~15%
1. The average timeline for camera module house to certify the system is ~ 1 to 2 years.
2. These Tier1 & Tier2 module/system makers have qualified Kingpak System/Products.
c. Supply Chain Landscape - CAR maker name plate
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1. Tapping the 19% CAGR growth in automotive camera market driven by ADAS and autonomous vehicle.
2. Leveraging Kingpak’s 55-65% global share in assembly/testing of automotive camera sensors. The global share is over 70% in OEM market.
2. CIS Migration from 0.3MP to 1.0/2.0/3.0MP

Moving forward to 2.0M and 3.0M or even higher resolution

Remark:
Automotive camera sensor resolution migration (Upgrading from 0.3M to 1.3/2.0/3.0MP)

Source: Toshiba
3. CIS Anticipating More Applications & Sensor Fusion

Longer term, more automotive image sensor for 3D cameras, short to long distance, Infra-red

Source: Yole
ADAS to Autonomous vehicle – Increasing number of camera sensors per vehicle
Automotive Market Trend

THE END OF DRIVING

By 2035, 50% of all vehicles will have some level of autonomous capability (>Level 2)

By 2035, more than 50% of all vehicles sold will have some level of autonomous capability
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1. Kingpak is an OSAT focusing on CIS (CMOS Image Sensor) for Auto.
2. Kingpak has 55-65% of global market share in auto camera sensors outsourced Packaging & Testing
3. Kingpak is also strong in security camera sensors.
Product & Service (Package Solutions)

Security

Automotive

Sport Camera

Mobile

13M

8M

5M

1.3M  2M  HD  FHD

VGA

iLCC

imBGA

imLCC

DIC  miniPLCC

CLCC

DIC

mPLCC

iPLCC (Main Cam)

Second Cam
b-2 Kingpak Dedicated Reconstructed Assembly

1. Class 10 clean room for CMOS Image Sensors
2. Auto/Visual Inspection
3. Polish Grinding
4. Laser Grooving
5. Auto/Visual Inspection
b-3  Kingpak Final Test

1. Industrial Standard System

2. In-house Developed System
5-1 Kingpak IPs

Technology Field Distribution (%)

~705 patent applications filed

More IPs under Filing

Technology Field Distribution (Application Count)

Remark

1. World#1 CSP Package Mass Production for DRAM
2. Y2000 started Micro SD PIP Package, Y2005 World#1 MP
3. Most CMOS Image Sensor Package IP Company
d. Automotive Supply Chain Certification

Remark:
The average timeline for tier 1 or 2 automotive integrator to certify is 1.5 to 2 years. Plus CIS package qualification=> The total timeline takes 3 ~4 years.
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3. Entry Barriers for Package

Stage 1: IP Patent
- Over 700 Patents, and 77% focus on CMOS

Stage 2: Quality System
- System certify: TS16949; ISO14001
- 0 dppm target: 6 sigma implement
- Passed Tier 1 customer audit

Stage 3: Process Control
- High Level Clean room setup: Class 10
- Good experience & Know-How at Particle control

Stage 4: Technical Supporting
- Fully Turn-Key Solution
- Small Pixel size Handling experience
- Package development Know-How & Profile

Stage 5: Management Team
- Over 15 years CMOS experience Elite
- Long term Relationship w/ Suppliers
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KINGPAK Q3 2018 Consolidated Statement of Financial Information (QoQ)

<table>
<thead>
<tr>
<th>Unit: NTD K</th>
<th>Q1-2017</th>
<th>%</th>
<th>Q2-2017</th>
<th>%</th>
<th>Q3-2017</th>
<th>%</th>
<th>Q4-2017</th>
<th>%</th>
<th>Q1-2018</th>
<th>%</th>
<th>Q2-2018</th>
<th>%</th>
<th>Q3-2018</th>
<th>%</th>
<th>Q2 o Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>500,908</td>
<td></td>
<td>536,585</td>
<td></td>
<td>530,791</td>
<td></td>
<td>584,113</td>
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<td>572,498</td>
<td></td>
<td>594,884</td>
<td></td>
<td>572,786</td>
<td></td>
<td>-3.7%</td>
</tr>
<tr>
<td>Gross profit</td>
<td>171,971</td>
<td>34.33</td>
<td>178,302</td>
<td>33.23</td>
<td>167,968</td>
<td>31.64</td>
<td>209,417</td>
<td>35.85</td>
<td>199,576</td>
<td>34.86</td>
<td>193,557</td>
<td>32.54</td>
<td>191,347</td>
<td>33.41</td>
<td>-1.1%</td>
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<tr>
<td>Operating income</td>
<td>109,266</td>
<td>21.81</td>
<td>102,669</td>
<td>19.13</td>
<td>106,298</td>
<td>20.03</td>
<td>160,957</td>
<td>27.56</td>
<td>147,080</td>
<td>25.69</td>
<td>125,464</td>
<td>21.09</td>
<td>127,672</td>
<td>22.29</td>
<td>1.8%</td>
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<td>EPS</td>
<td>2.06</td>
<td></td>
<td>2.12</td>
<td></td>
<td>2.14</td>
<td></td>
<td>2.43</td>
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<td></td>
<td>3.16</td>
<td></td>
<td>2.10</td>
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<tr>
<td>ROA</td>
<td>20.37%</td>
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<td>18.91%</td>
<td></td>
<td>17.99%</td>
<td></td>
<td>17.03%</td>
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<td>12.39%</td>
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<td>18.65%</td>
<td></td>
<td>17.94%</td>
<td></td>
<td>-0.71%</td>
</tr>
<tr>
<td>ROE</td>
<td>29.85%</td>
<td></td>
<td>32.34%</td>
<td></td>
<td>30.94%</td>
<td></td>
<td>30.83%</td>
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<td>25.47%</td>
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<td>38.31%</td>
<td></td>
<td>31.81%</td>
<td></td>
<td>-6.50%</td>
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<tr>
<td>Debt/Assets</td>
<td>34.94%</td>
<td></td>
<td>51.23%</td>
<td></td>
<td>50.99%</td>
<td></td>
<td>54.39%</td>
<td></td>
<td>51.40%</td>
<td></td>
<td>49.05%</td>
<td></td>
<td>28.71%</td>
<td></td>
<td>-20.33%</td>
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<tr>
<td>Current ratio</td>
<td>158.07%</td>
<td></td>
<td>121.77%</td>
<td></td>
<td>137.62%</td>
<td></td>
<td>152.02%</td>
<td></td>
<td>156.14%</td>
<td></td>
<td>128.22%</td>
<td></td>
<td>173.48%</td>
<td></td>
<td>45.27%</td>
</tr>
<tr>
<td>Quick ratio</td>
<td>140.54%</td>
<td></td>
<td>112.34%</td>
<td></td>
<td>129.35%</td>
<td></td>
<td>144.42%</td>
<td></td>
<td>147.93%</td>
<td></td>
<td>115.53%</td>
<td></td>
<td>151.10%</td>
<td></td>
<td>35.57%</td>
</tr>
</tbody>
</table>

a. Better product portfolio by more auto engagement in 2018
b. Auto product migrate to 1.3 and 2M
KINGPAK Q3 2018 Consolidated Statement of Financial Information

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>500,908</td>
<td>536,585</td>
<td>530,791</td>
<td>584,113</td>
<td>572,498</td>
<td>594,884</td>
<td>572,786</td>
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<tr>
<td>Gross profit</td>
<td>171,971</td>
<td>178,302</td>
<td>167,968</td>
<td>209,417</td>
<td>199,576</td>
<td>193,557</td>
<td>191,347</td>
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<tr>
<td>EPS</td>
<td>2.06</td>
<td>2.12</td>
<td>2.14</td>
<td>2.43</td>
<td>2.01</td>
<td>3.16</td>
<td>2.10</td>
</tr>
<tr>
<td>GM %</td>
<td>34.33%</td>
<td>33.23%</td>
<td>31.64%</td>
<td>35.85%</td>
<td>34.86%</td>
<td>32.54%</td>
<td>33.41%</td>
</tr>
</tbody>
</table>

- a. revenue pick up again by 1.3M launch
- b. Record high EPS in Q2, 2018
KINGPAK Q3 2018 Business Segment (In Revenue)

Unit: NTD in Million

1-3Q 2018 YoY +9.5%
For Automotive in
Automotive sector is going to dominate our business and keep growing
Thank you