Camera Module Industry

2015 report

From Technologies to Market

Report Sample
CAMERA MODULE INDUSTRY

- Global camera module industry has reached $20.1B in 2014 and should reach $51B in 2020.

- Size and quality are driving the mobile camera module industry, the technology of computational imaging could capsize the market in the next few years.

- Front and rear camera for mobile account for 73% of the market, new additional sensors could bring new momentum to wafer level approaches.

- Photography has been disrupted by mobile, there is a high probability that another disruption occurs with embedded 3D vision. Device interactivity could add a second layer of innovation.

- Sensing itself should bring new usages in the consumer and automotive space.

- Automotive has a long way to go, the technologies are just good enough to enter the current market as they reach consumer expectation. The technology will quickly evolve and serve the autonomous vehicle trend.
The industry has several revenue overlap.

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Total CCM manufacturers
- CCM assembly
- AF&OIS suppliers
- Lens suppliers
- CIS suppliers

**2014**
- $1,850M
- $7,700M
- $7,250M
- $3,300M
- $20,100M

**2020**
- $5,500M (CAGR +21%)
- $22,500M (CAGR +20%)
- $15,500M (CAGR +13%)
- $7,500M (CAGR +14%)

$7,700M
$22,500M
$51,000M
(CAGR +16.8%)

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ECOSYSTEM OF THE CAMERA MODULE INDUSTRY
2014-2020 Camera module industry

**2014**
- Total CCM manufacturers
  - CCM assembly
  - AF&OIS suppliers
  - Lens suppliers
  - CIS suppliers

**2020**
- Total CCM manufacturers
  - CCM assembly
  - AF&OIS suppliers
  - Lens suppliers
  - CIS suppliers

CAGR:
- $22,500M: +20%
- $15,500M: +13%
- $7,500M: +14%

The industry has several revenue overlap.
CCM REVENUE FORECAST 2012-2020

by market (in $M)

CCM revenue growth will keep its exceptional momentum due to improving ASP in Mobile doubled by increasing volumes.

In the coming years, Automotive will become the second market for CCM overtaking Computing (Tablets included).

Consumer will remain a few $100M market despite the Wearable entry.

Revenue has reached $20.1B in 2014.

Growth is expected at 16.8% CAGR.

2012-2020 CCM Revenue Forecast (in $M)
by Market

- Mobile
- Consumer
- Computing
- Automotive
- Medical
- Security
- Industrial

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Combined revenues in the CCM business has reached $20.1B in 2014 and should reach $51B in 2020.

Double digit growth for all components of the CCM business.

AF&OIS is the fastest growing sub-segment.

The industry should double in the next 5 years.
MOBILE MARKET TREND

Improving CCM specifications kept the market growing

most of the business is for 10x10x5mm³ modules

Camera phones: Innovation from Sharp in June 2000
Smartphones: the size of main camera stops shrinking and a front facing camera is added
Selfies: the size of front facing camera is increasing
WL-CCM: Need for additional sensors (3D, depth, motion, IR) should renew interest for low to mid resolution

$10B Market
$5B Market

Rear smartphone camera module
Front smartphone camera module
Wafer level camera module


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Automotive Technology Trend

Technology roadmap for (front) ADAS cameras

Module size & cost

- 1-3 Cameras per car
  - Global cost: ~$30 to $100
  - Module size: 30x30mm², $30

- 4-8 Cameras per car
  - Global cost: ~$100 to $200
  - Module size: 20x20mm², $20

- 10+ Cameras per car
  - Global cost: ~$200
  - Module size: 10x10mm², $10

For Display and Assist camera roadmap
Price depreciation will be compensated by volume

Forward cameras for ADAS technology drive will keep the price high

Probably two different markets

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Main players market share analysis
MOBILE TECHNOLOGY TREND

Packaging: CCM have become marvels of micro technology

Apple 6 Plus Rear (Main) camera module

Courtesy of System Plus

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MOBILE TECHNOLOGY TREND

Packaging: structure of high end modules with AF & OIS

High end module manufacturer develop maximum effort to reduce height

Gold stud bump Flip Chip on a ceramic substrate

Rear camera
Apple

Rear camera
Samsung
LG

Wire bond on a cut-out Flex-rigid substrate
Volvo equip all of its cars with the City Safety triple camera system. It has announced that its future system will implement a stereo and central camera.

Subaru Eyesight (from Fuji Heavy Industry) is a stereo camera system that equips most vehicles of the brand sold in Japan.
## Automotive Camera Technology Trend

Other optical sensor technologies for automotive  
(Source: Yole Développement, 2015)

<table>
<thead>
<tr>
<th>Players</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Near Infrared</strong></td>
<td>RGB-NIR is an interesting approach for day / night conditions</td>
</tr>
<tr>
<td>OmniVision, SONY, ON Semiconductor</td>
<td></td>
</tr>
<tr>
<td><strong>Time of Flight</strong></td>
<td>TOF will probably be used as 3D / Gesture sensor inside the car</td>
</tr>
<tr>
<td>HEPTAGON, PMD Technologies, SoftKinetic</td>
<td></td>
</tr>
<tr>
<td><strong>Stereo cameras</strong></td>
<td>Stereo camera are probably the best 3D sensing tech for forward cameras</td>
</tr>
<tr>
<td>BOSCH, LG</td>
<td></td>
</tr>
<tr>
<td><strong>Time Gated Sensors</strong></td>
<td>Time gating may solve the issue of imaging in poor climatic conditions</td>
</tr>
<tr>
<td>BrightWayVision, e2V</td>
<td></td>
</tr>
<tr>
<td><strong>Far Infrared</strong></td>
<td>Probably the best security add-on for pedestrian detection</td>
</tr>
<tr>
<td>FLIR, BOSCH</td>
<td></td>
</tr>
<tr>
<td><strong>Single Photon TOF</strong></td>
<td>Possibly the future of low light and 3D sensing</td>
</tr>
<tr>
<td>STMicroelectronics, Fasttree 3D Imagers, Politecnico Di Milano</td>
<td></td>
</tr>
<tr>
<td><strong>Hyperspectral Sensors</strong></td>
<td>Used in precision agriculture, could improve image recognition</td>
</tr>
<tr>
<td>imec, VTT</td>
<td></td>
</tr>
</tbody>
</table>
ABOUT THE AUTORS OF THIS REPORT

Biography & contact

**Pierre Cambou**
From 1999, Pierre Cambou has been part of the imaging industry. He has earned an Engineering degree from Université de Technologie de Compiègne and a Master of Science from Virginia Tech. More recently he graduated from Grenoble Ecole de Management’s MBA. Pierre took several positions at Thomson TCS which became Atmel Grenoble in 2001 and e2v Semiconductors in 2006. In 2012 he founded a start-up called Vence Innovation (now Irlynx) in order to bring to market a disruptive Man to Machine interaction technology. He joined Yole Développement as Imaging Activity Leader in 2014.

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**Jean-Luc Jaffard**
From 1966 Jean-Luc Jaffard paved the way of imaging activity at STMicroelectronics being at the forefront of the emergence and growth of this business. At STMicroelectronics Imaging Division he was successively appointed Research Development and Innovation Director managing a large multidisciplinary and multicultural team and later on promoted Deputy General Manager and Advanced Technology Director in charge of identifying and developing breakthrough Imaging Technologies and to transform them into innovative and profitable products. In 2010 he was appointed STMicroelectronics Intellectual Property Business Unit Director. In January 2014 he created the Technology and Innovation branch of Red Belt Conseil.
Yole Développement

From Technologies to Market
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- We are working across multiple industries to understand the impact of More-than-Moore technologies from device to system.

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- Advanced packaging
- Power electronics
- Compound semiconductors
- OLED, LED & Laser diode
- Semiconductor Manufacturing
- Photovoltaics
- Batteries

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- In-depth analysis of applications and market drivers: challenges, inflection points, etc.
- Market data ($, units, wafer starts, etc.)

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MARKET & TECHNOLOGY REPORTS by Yole Développement

**MEMS & SENSORS**
- Sensors and Data Management for Autonomous Vehicles
- AlN Thin Film Markets And Applications
- Sensors for Wearable Electronics And Mobile Healthcare
- Status of the MEMS Industry
- Uncooled IR Imagers
- IR Detectors
- High End Gyro, Accelerometers and IMU
- Non-Volatile Memory

**IMAGING & OPTOELECTRONICS**
- Camera Module Packaging (Vol 1 : Market & Technology Trends / Vol 2 Teardowns & Reverse Engineering)
- Uncooled IR Imagers
- Wafer Level Optics
- Status of the CMOS Image Sensors
- Machine Vision

**MEDTECH**
- Microfluidic for Sample Preparation
- Microfluidic Applications
- Sensors for Wearable Electronics And Mobile Healthcare

**COMPOUND SEMICONDUCTORS**
- High Purity Alumina (HPA)
- Sapphire
- Wide Bandgap Materials For Power Electronics: SiC, GaN (and also Ga2O3, AlN, Diamond, Graphene… as a trend)

**LED**
- LED Module
- OLED for Lighting
- UV LED
- LED Phosphors Market

**POWER ELECTRONICS**
- Power Packaging
- Thermal Management for LED and Power
- Power Electronics for Renewable Energy
- Energy Management For Smart Grid And Smart Cities
- Status of Chinese Power Electronics Industry
- New Technologies For Data Center
- Inverter Market Trends For 2013 – 2020 And Major Technology Changes*
- IGBT Markets And Application Trends
- Power Electronics for HEVEV*
- Status of Power Electronics Industry

**ADVANCED PACKAGING**
- Advanced Packaging in Emerging Markets in China
- Status of the Advanced Packaging Industry
- Supply Chain Readiness for Panel Manufacturing in Packaging
- WLCSP*
- Flip Chip Business Update
- 2.5D & 3DIC Business Update
- Fan-Out and Embedded Business Update

**MANUFACTURING**
- Lithography for MEMS, Advanced Packaging and LED
- Thinning & Dicing Equipment for Advanced Packaging, MEMS, Photovoltaics, LED, CMOS Image Sensors
- Non-Volatile Memory

* Reports to be decided within 2015
OUR 2015 REPORTS PLANNING

PATENT ANALYSIS by Knowmade
- Patent Infringement (crossed analysis based on Knowmade and System Plus Analysis expertise)
  - MEMS Microphone Applications
  - Infrared Imaging
- Patent Investigation (crossed analysis based on Knowmade & Yole Développement expertise)
  - Power GaN
  - MEMS Gyroscope
  - 6-axis & 9-axis Inertial MEMS IMUs
  - Microbatteries
  - Embedded Active & Passive Packages
  - Interposer
  - Phosphors for LED

TEARDOWN & REVERSE COSTING by System Plus Consulting
More than 30 teardowns and reverse costing analysis and cost simulation tools to be published in 2015.

* Reports to be decided within 2015.
Our 2014 Published Reports List

Market & Technology Reports by Yole Développement

- MEMS & Sensors
  - Technologies & Sensors for the Internet of Things: Businesses & Market Trends 2014-2024
  - MEMS Microphone: Market, Applications and Business Trends 2014
  - Status of the MEMS industry
  - MEMS & Sensors for Mobile Phones and Tablets
  - High End Gyroscopes and Accelerometer Applications
  - Inertial MEMS Manufacturing Technical Trends
  - New Detection Principles & Technical Evolution for MEMS & NEMS
  - 6/9 DOF Applications in Consumer Electronics
  - MEMS for RF filters and Antenna Switches - BAW / SAW

- Imaging & Optoelectronics
  - Status of the CMOS Image Sensor Industry
  - Uncooled Infrared Imaging Technology & Market Trends
  - Silicon Photonics

- MedTech
  - Point of Care Testing: Applications for Microfluidic Technologies
  - Solid State Medical Imaging: X-ray and Endoscopy

- Compound Semiconductors
  - RF GaN Technology & Market Analysis: Applications, Players, Devices & Substrates 2010-2020
  - SiC Modules, Devices and Substrates for Power Electronics Market
  - GaN-on-Si Substrate Technology and Market for LED and Power Electronics
  - Power GaN Market
  - Graphene Materials for Opto & Electronic Applications
  - Sapphire Applications and Market: from LED to Consumer Electronics

- LED
  - LED Packaging
  - LED Front-End Manufacturing Trends
  - LED Front-End Equipment Market

- Power Electronics
  - Power Electronics for HEV/EV
  - Inverters
  - Gate Driver Unit Market for Power Transistors

- Photovoltaics
  - Emerging and Innovative Technology Approaches in the Solar Industry

- Advanced Packaging
  - 3DIC Equipment and Materials
  - 3DIC & 2.5D TSV Interconnect for Advanced Packaging - 2014 Business Update

- Manufacturing
  - Market & Technology Trends in Materials & Equipment for Printed & Flexible Electronics
  - Permanent Wafer Bonding for Semiconductor: Application Trends & Technology

Patent Analysis by Knowmade

- LED Based on Nano-wires Patent Investigation
- GaN on Si Patent Investigation (LED, Power devices and RF Devices)
- New MEMS Devices Patent Investigation
- Non Volatile Memory Patent Investigation

Teardown & Reverse Costing by System Plus Consulting

More than 30 teardowns and reverse costing analysis and cost simulation tools to be published in 2014.
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