Camera Module 2017
Physical Analyses Overview
Imaging report by Audrey LAHRACH
November 2017
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Executive Summary

This comparative review was conducted to provide insights into the structure and technology of 19 CMOS camera modules (CCM) released in flagship smartphones from the major brands. In this report, rear and front-facing compact camera modules (including standard (mono), dual, iris scanners, and 3D camera modules) are analyzed and compared in terms of structural overview, module integration, lens number and dimensions, CIS resolution, and pixel size. Indeed, OIS and dual-cameras are the big new trends for mobile camera modules.

Since our last report in 2015, the automotive camera module has changed completely. Manufacturers have rationalized their components in terms of size and number of boards and connectors, expressing their desire to get closer to the mobile camera module’s structure in order to reduce their manufacturing cost. Also, an analysis of five automotive camera modules (three forwards and two surrounds) was realized to highlight the main differences.

Mobile is the main driver for technology, asking for more performance in a constrained footprint. Sensor technology has been transformed by stacked BSI technologies.

This report explains the main players’ technology choices and provides a comparison between competitors.
The reverse costing analysis is conducted in 2 phases:

**Component choice**
- Teardown of the smartphone in order to have access to the Consumer Camera Module.
- Automotive Camera Module are studied.

**Physical analysis**
- Package is analyzed and measured
  - Module are opened and dies are extracted to get data on dimensions, marking
  - Cross-section is made to have access to module structure
## Mobile CCM Analyzed – Rear Facing - Standard

<table>
<thead>
<tr>
<th>Phone</th>
<th>Position</th>
<th>OIS</th>
<th>AF</th>
<th>pixel H</th>
<th>pixel W</th>
<th>Resul. (Mp)</th>
<th>Ffactor</th>
<th>pixel</th>
<th>area H</th>
<th>area W</th>
<th>Diagonal</th>
<th># of lens</th>
<th>Assy</th>
<th>Connector</th>
<th>Size H</th>
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<th>Sensor</th>
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## Mobile CCM Analyzed – Rear Facing – Dual/3D

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<th>Position</th>
<th>OIS</th>
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<th>pixel H</th>
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</table>
Samsung Galaxy S7

Rear-Facing

- Standard
  - Samsung Galaxy S7
  - Samsung Galaxy S8
  - Sony Xperia XZs
- Dual
  - iPhone 7 Plus
  - Huawei P9
  - Huawei P10
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  - LG G6
- 3D
  - Lenovo Phab 2 Pro

Front-Facing

For more details, complete report is available!
Samsung Galaxy S7_specs (from DeviceSpecifications)

Primary camera
The primary camera of the mobile device is usually placed at its back and is used for taking photos and recording videos.

| Sensor model | Sony IMX260 Exmor RS |
| Sensor type | CMOS (complementary metal-oxide semiconductor) |
| Aperture | f/1.7 |
| Focal length | 4.2 mm (millimeters) |
| Flash type | LED |
| Image resolution | 4032 x 3024 pixels, 12.19 MP (megapixels) |

Video resolution
Information about the maximum resolution available for recording a video with the device.

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Video FPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3840 x 2160 pixels</td>
<td>30 fps (frames per second)</td>
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</tbody>
</table>

Features
Information about additional software and hardware features of the primary camera, which improve its overall performance.

- Auto-focus
- Continuous shooting
- Digital zoom
- Digital image stabilization
- Optical image stabilization
- Geotagging
- Panorama
- HDR
- Touch focus
- Face detection
- White balance settings
- ISO settings
- Exposure compensation
- Self-timer
- Scene modes
- Macro mode
- RAW

Front-facing

- Lenovo Phab 2 Pro

About System Plus

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Camera Module with Flex

Overview / Introduction / Market

Physical Analysis

Consumers

Rear-Facing
- Standard
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Front-Facing

Automotive

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Camera Module with Flex

Physical Analysis
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Front-Facing

Automotive

About System Plus
Camera Module Dimensions

- Dimensions without Flex: xxmm x xxmm x xxmm
Camera Module Teardown

Physical Analysis

Consumer

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Front-Facing

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About System Plus
Camera Module Teardown

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About System Plus
Camera Module Teardown

Samsung Galaxy S7
Rear-Facing

Physical Analysis
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Front-Facing

Automotive

About System Plus

Camera Module Disassembly: CMOS Image Sensor

Microlenses – SEM View
CIS View and Dimensions

Die Area: $xx \text{ mm}^2$
(xx x xx mm)

Nb of PGDW per 12-inch wafer: $xxx$

Pad number: $xxx$

Pixel array: $xxx \text{ mm}^2$
(xx x xx mm)

CIS resolution: 4032x3024 (12.2Mp)

- Pixel area: $xx \mu\text{m}^2$
- Pixel size: $xx \mu\text{m}$
Camera Module Cross-Section - Overview

Cross-Section Planes

1

2

1

2

Physical Analysis

Consumer

Rear-Facing

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About System Plus

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Camera Module Cross-Section

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Front-Facing

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Camera Module Cross-Section – Optical View
Camera Module Cross-Section

• All lenses are in xxxx.
Related Reports

**REVERSE COSTING ANALYSES - SYSTEM PLUS CONSULTING**

- Iris Scanner Samsung Galaxy S8
- Sony IMX400 Tri-stacked Image Sensor
- Lenovo Phab2Pro 3D Time of Flight Camera
- Samsung Galaxy S7 Rear-Facing
- Apple iPhone 7 Plus Rear-Facing Dual Camera Module
- Huawei P9 Rear Facing Dual Camera Module
- Fujitsu Iris Authentication IR Camera Module & IR LED
- Camera Module Industry 2015 – Mobile CCM Technology Review

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**MEMS & SENSORS**

- Status of the CMOS Image Sensor Industry 2017
- 3D Imaging and Sensing 2017
Business Models Fields of Expertise

- Custom Analyses
  (>130 analyses per year)

- Reports
  (>40 reports per year)

- Costing Tools

- Trainings

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