Sony’s 3D Time-of-Flight System

Sony IMX316 and Flood Illuminator in the Oppo RX 17 Pro

IMAGING report by Stéphane ELISABETH
March 2019 – Version 1
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Executive Summary

This full reverse costing study has been conducted to provide insight on technology data, manufacturing cost and selling price of the Sony IMX316 and the Flood Illuminator found in the Oppo RX 17 Pro.

- The rear optical hub packaged in one metal enclosure features several cameras and a flood illuminator. The complete system features a Telephoto and a Wide-angle Camera Module and a 3D Time of Flight Camera. The specify of the 3D Depth sensing camera is the addition of a NIR flood illuminator.

- This report will be focused on the analysis of the 3D depth sensing system. All components are standard that can be found on the market. That includes a BSI Time of Flight image sensor featuring 10 µm size pixels and resolution of 46 kilopixel developed by Sony Depth Sensing Solution and one vertical cavity surface emitting laser (VCSEL) for the flood illuminator coming from a major supplier. This the first Time of Flight imager found on the market featuring Backside Illumination technology commonly used by Sony coupled with Current Assisted Photonic Demodulation (CPAD) developed by Sony Depth Solution (formerly SoftKinetic).

- Along with the complete 3D depth sensing system, this report goes with cost analysis and price estimation for the system. It also includes a physical and technical comparison with another 3D sensing system from Lenovo in the Phab2Pro using first generation of the pmd/Infineon ToF Imager. The comparison looks at system integration, the NIR camera module and the Flood Illuminator architecture.
Summary of the Physical Analysis

NIR Camera Module Assembly:

- NIR Camera Module:
  - Dimensions:
  - BSI sensor die:
  - Optical features:

NIR ToF Sensor Die:

- Process:
  - Electrical connections:

Flood Illuminator Module Assembly:

- VCSEL Die:
  - Process:
  - Electrical connections:
  - Placement in the package:
Overview / Introduction

Company Profile & Supply Chain

Market Analysis

Physical Analysis

- 3D ToF Module
  - Overview
  - Cross-Section
  - NIR Camera Module
    - Overview
    - Cross-Section
  - NIR ToF Sensor Die
    - Views & Dimensions
    - Delaying & Process
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  - Flood Illuminator Module
    - Overview
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    - Views & Dimensions
    - Die Process
    - Die Cross-section

Physical Comparison

Manufacturing Process Flow

Cost Analysis

Related Reports

About System Plus
3D Depth Sensing Module – Sensor Die Overview & Dimensions

- Die area:

- Nb of PGDW per 8-inch wafer:

- Pad number:
  - Connected:

- Pixel array:

- NIR ToF sensor resolution:
  - Pixel area:
  - Pixel size:
Sensor Die – Die Delayering – Pixels

Die Delayering – Optical View
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Sensor Die – Pixels Deprocessing – SEM View
©2019 by System Plus Consulting
Sensor Die – Die Cross-Section – Substrate

- Sensor die thickness: \( XX \, \mu m \)
VCSEL Die Overview & Dimensions

- Die area:
- Pad number:
  - Wire bonding:
  - Material:
  - Diameter:
- Emitting array:
- Emitter number:
  - Cavity area:
  - Cavity diameter:

Physical Analysis
- 3D ToF Module
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  - Cross-Section
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Physical Comparison
Manufacturing Process Flow
Cost Analysis
Related Reports
About System Plus
### Oppo vs. Lenovo – NIR Camera Module

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<th>Oppo RX 17 Pro (NIR Camera Module)</th>
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## NIR Camera Module – Pixel Array Front-End Cost

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### Pixel Array Front-End Cost

The **front-end cost** for the Pixel array ranges from [ ] to [ ] according to yield variations.

The largest portion of the manufacturing cost is due to the [ ].
The component cost ranges from [ ] according to yield variations.

- The **sensor die** represents [ ] of the component cost.
- The **module assembly** represents [ ] of the component cost.
- The **lens module** represents [ ] of the component cost.
- The **filter, housing and metal parts** represents [ ] of the component cost.
- The **other part** represents [ ] of the component cost.
Complete System Price

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**3D System Cost**
- Main Camera Cost
- Wide Angle Cost

**Tri-Cam System Price**

Oppo RX17 Pro 3D Depth Sensing System Cost
According to Yield Variation

We estimate that Sunny Optical realizes a gross margin of [redacted] on the 3D ToF Module. The gross margin results in a final component price ranging from [redacted] for the 3D ToF Module, which results in a Tri-Cam cost ranging from [redacted] to [redacted].

This corresponds to the selling price for large volume to OEMs.
Related Reports

REVERSE COSTING ANALYSES - SYSTEM PLUS CONSULTING

IMAGING
- Huawei Mate 20 Pro’s 3D Depth-Sensing System
- Mantis Vision’s 3D Depth Sensing System in the Xiaomi Mi8 Explorer Edition
- Orbbec’s Front 3D Depth Sensing System in the Oppo Find X
- STMicroelectronics’ Near Infrared Camera Sensor in the Apple iPhone X
- Apple iPhone X – Infrared Dot Projector
- Lenovo Phab2Pro 3D ToF Camera

MARKET AND TECHNOLOGY REPORTS - YOLE DÉVELOPPEMENT

IMAGING
- Status of the Camera Module Industry 2019 – Focus on Wafer Level Optics
- Status of the CMOS Image Sensor Industry 2018
- 3D Imaging & Sensing 2019
- VCSELs - Technology, Industry and Market Trends
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