Sony’s 3D Time-of-Flight System

Sony IMX316 and Flood Illuminator in the Oppo RX 17 Pro

IMAGING report by Stéphane ELISABETH
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## Feedbacks  

## SystemPlus Consulting services
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:
3D Depth Sensing Module Cross-Section
3D Depth Sensing Module – Sensor Die Overview & Dimensions

Die area:

Nb of PGDW per inch wafer:

Pad number:

Connected:

Pixel array:

Pixel area:

Pixel size:

NIR ToF sensor resolution:
Sensor Die – Die Cross-Section – Substrate

- Sensor die thickness: XX µm
VCSEL Die Overview & Dimensions
# Oppo vs. Lenovo – NIR Camera Module

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Pixel Array & DSP Circuit Process Flow

Si Wafer

Gradient Implant(s)

Manufacturing Process Flow
- Global Overview
- NIR Sensor Die Front-End Process
- NIR Sensor Process Flow
- NIR Sensor Fabrication Unit
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- NIR VCSEL Fabrication Unit

Cost Analysis

Related Reports

About System Plus
# NIR Camera Module – Pixel Array Front-End Cost

## Overview

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### Pixel Array Front-End Cost

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

The largest portion of the manufacturing cost is due to the **[cost factor]**.
The component cost ranges from $\text{low yield}$ to $\text{high yield}$ according to yield variations.

- The sensor die represents $\text{X}$ of the component cost.
- The module assembly represents $\text{Y}$ of the component cost.
- The lens module represents $\text{Z}$ of the component cost.
- The filter, housing and metal parts represents $\text{A}$ of the component cost.
- The other part represents $\text{B}$ of the component cost.
We estimate that Sunny Optical realizes a gross margin of [ ] on the 3D ToF Module. The gross margin results in a final component price ranging from [ ] for the 3D ToF Module, which results in a Tri-Cam cost ranging from [ ] to [ ].

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

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- 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
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- Lenovo Phab2Pro 3D ToF Camera

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Following its first introduction of a 3D structured light camera on the front of the Find X, last year, Oppo is now pioneering the use of 3D Time-of-Flight (ToF) in its Rx17 Pro. Lenovo did a similar integration on the rear of one of its products a few years ago, integrating a pmd/Infineon solution in a high-end phone. In doing this, Asus and Lenovo added an additional Near Infra-Red (NIR) Global Shutter (GS) camera, but Oppo doesn’t have such a dedicated NIR GS Camera. Instead, Oppo uses the latest generation of ToF camera technology from Sony Depthsensing Solutions, formerly known as SoftKinetic.

The rear optical hub is packaged in one metal enclosure and features several cameras and a flood illuminator. The complete system features a telephoto and wide-angle camera module and a 3D ToF camera. The distinguishing characteristic of the 3D depth sensing camera is the addition of a NIR flood illuminator.

This report focuses its analysis on the 3D depth sensing system. All components are standard and can be found on the market. That includes a BackSide Illumination (BSI) ToF image sensor featuring 10 µm x 10 µm size pixels and resolution of 46 kilopixel, developed by Sony Depthsensing Solutions. It also has one vertical cavity surface emitting laser (VCSEL) for the flood illuminator, coming from a major supplier. This is the first ToF imager found on the market featuring BSI technology, which is commonly used by Sony, coupled with Current Assisted Photonic Demodulation (CPAD) developed by Sony Depthsensing Solutions.

Along with the complete 3D depth sensing system, this report analyses the system’s cost and estimates its price. It also includes a physical and technical comparison with another 3D sensing system from Lenovo in the Phab2Pro, using the first generation pmd/Infineon ToF Imager. The comparison looks at system integration, the NIR camera module and the flood illuminator architecture.
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### Physical Comparison: Lenovo Phab2Pro

- System Integration
- NIR Camera Module and ToF Sensor
- Flood Illuminator and VCSEL

### AUTHORS

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