Apple iPad Pro LiDAR Module

The first 3D direct ToF CIS sensor from Sony with dedicated Lumentum’s VCSEL

SP20557 - Imaging report by Sylvain HALLEREAU & Taha AYARI
Laboratory analysis by Nicolas RADUFE
June 2020 – Sample
Table of Contents

Overview / Introduction 4
  o Executive Summary
  o Reverse Costing Methodology

Company Profile 8

Market Analysis 19

Physical Analysis 23
  o Summary of the Physical Analysis
  o Lidar Module Assembly
    ✓ Module Views
    ✓ Module Opening
    ✓ Module Cross-Section
    ✓ NIR CIS lenses
    ✓ NIR VCSEL lenses
  o NIR CIS die
    ✓ Die Overview & Dimensions
    ✓ Die Process
    ✓ Die Cross-Section
    ✓ Die Process Characteristic
  o NIR VCSEL die
    ✓ Die View & Dimensions
    ✓ Die Cross-Section
    ✓ Die Process Characteristic
  o DOE
    ✓ DOE Dimensions
    ✓ DOE Disassembly & Main Blocks Identification
    ✓ DOE Cross Section
    ✓ Process Characteristics
  o VCSEL driver die
    ✓ View & Dimensions
    ✓ Delayering & main Blocs
    ✓ Dies Process

Manufacturing Process 111
  o Global overview
  o NIR Sensor Die Front-End Process & Fabrication Unit
  o NIR VCSEL Process Flow & Fabrication Unit
  o DOE Wafer Process Flow & Fabrication Unit
  o VCSEL driver die Front-End Process & Fabrication Unit

Cost Analysis 128
  o Summary of the cost analysis
  o Yields Explanation & Hypotheses
  o NIR sensor
    ✓ Logic, Pixel Array, BSI & Optical Front-End Cost
    ✓ NIR Sensor Wafer & Die Cost
    ✓ CIS lens module
  o NIR VCSEL
    ✓ NIR VCSEL Front-End Cost
    ✓ NIR VCSEL Probe Test, Thinning & Dicing
    ✓ NIR VCSEL Die Wafer Cost
    ✓ NIR VCSEL lens module
  o DOE
  o IC Die
    ✓ Front-End Cost
    ✓ Probe Test, Thinning & Dicing
    ✓ Dies Cost
  o Lidar Module
    ✓ Complete Module Cost
    ✓ Complete Module Price

Technical and cost comparison 161
  o iPad 11 pro vs. LG G8 vs. vivo nex dual display

Feedbacks 166

SystemPlus Consulting services 168
Module cross section ©2020 by System Plus Consulting
Lidar module – 3D xRay

Physical Analysis
- Summary of the Physical Analysis
- Lidar Module Assembly
  - NIR CIS die
  - NIR VCSEL die
  - DOE
  - VCSEL driver die

Manufacturing Process Flow

Cost Analysis

Technical & Cost Comparison

Feedbacks

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Lidar module – 3D xRay

Physical Analysis
- Summary of the Physical Analysis
- Lidar Module Assembly
  - NIR CIS die
  - NIR VCSEL die
  - DOE
  - VCSEL driver die
Overview & Dimensions

- Die area:
- Nb of PGDW per 12-inch wafer:
- Pad number: 80
  - Connected: 74
- Pixel array:
- NIR sensor resolution:
  - Pixel area: 100 μm²
  - Pixel size: 10 μm
Image Sensor Die – Cross-Section

- Manufacturing Process Flow
- Cost Analysis
- Technical & Cost Comparison
- Feedbacks
- Related Reports
- About System Plus

- Overview / Introduction
- Company Profile & Supply Chain
- Market Analysis

Physical Analysis
- Summary of the Physical Analysis
- Lidar Module Assembly
  - NIR CIS die
  - NIR VCSEL die
  - DOE
  - VCSEL driver die

- Image Sensor Die – Cross-Section
Logic Die – Cross-Section – Substrate

Sensor Die – Cross-Section Plan
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• Sensor die thickness:

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VCSEL Die Overview & Dimensions

- VCSEL die:
- VCSEL die area:
- Pad number:
  - Wire bonding:
  - Material:
  - Diameter:
- Emitter number:
  - Cavity area:
  - Cavity diameter:

Overview / Introduction
Company Profile & Supply Chain
Market Analysis
Physical Analysis
  - Summary of the Physical Analysis
  - Lidar Module Assembly
  - NIR CIS die
  - NIR VCSEL die
  - DOE
  - VCSEL driver die
Manufacturing Process Flow
Cost Analysis
Technical & Cost Comparison
Feedbacks
Related Reports
About System Plus

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VCSEL Die Cross-Section

Summary of the Physical Analysis
- Lidar Module Assembly
- NIR CIS die
- NIR VCSEL die
- DOE
- VCSEL driver die

Manufacturing Process Flow

Cost Analysis

Technical & Cost Comparison

Feedbacks

Related Reports

About System Plus
Diffractive Optical Element

- DOE die:
- VCSEL die area:
- Pad number:
VCSEL Driver Die - Logic Circuit

- Transistor gate length on the logic circuit
- Corresponds to technology node
VCSEL Driver Die - Cross-Section

Packaging: fan-in WL CSP
5-side molded
Himax– Diffractive Optical Element

- Substrate bonding
By adding the probe test cost and the dicing, according to yield variations.

The number of good dies per wafer is estimated to ranges from 3600 to 12044, according to yield variations, which results in a die cost ranging from

We estimate a gross margin for the Image Sensor from Sony, which results in a die price ranging from

<table>
<thead>
<tr>
<th>NIR CIS – Image Sensor Wafer &amp; Die Cost</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Low Yield</th>
<th>Medium Yield</th>
<th>High Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
</tr>
<tr>
<td>Front-End Cost</td>
<td>BE : Probe Test Cost</td>
<td>BE : Dicing Cost</td>
</tr>
<tr>
<td>Total Wafer Cost</td>
<td>Nb of potential dies per wafer</td>
<td>Nb of good dies per wafer</td>
</tr>
<tr>
<td>Die Cost</td>
<td>Sony Gross Margin</td>
<td>Die Price</td>
</tr>
</tbody>
</table>

Die Cost Breakdown (Medium Yield)
# Apple vs. LG vs. Vivo – ToF System

## Pictures at scale

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3D Sensing technology</strong></td>
<td>Direct ToF, SPAD CIS</td>
<td>Indirect TOF, NIR CIS</td>
<td>Indirect TOF, NIR CIS</td>
</tr>
<tr>
<td>Lenses Number</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Spacer Number</td>
<td></td>
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<tr>
<td>FOV (*)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module Height (mm)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Filter thickness (µm)</td>
<td></td>
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</tr>
<tr>
<td>Substrate</td>
<td></td>
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<tr>
<td>Image Sensor Assembly</td>
<td></td>
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<td></td>
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<tr>
<td>3D ToF System Price</td>
<td></td>
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<td></td>
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</tbody>
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Apple vs. LG vs. Vivo – NIR ToF Image Sensor

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<th></th>
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</thead>
<tbody>
<tr>
<td>Die Area (mm²) (mm x mm)</td>
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</tr>
<tr>
<td>Pixel Array (mm²) (mm x mm)</td>
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<td></td>
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<tr>
<td>Pixel Array Fill Factor (%)</td>
<td></td>
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</tr>
<tr>
<td>Image Sensor Resolution (H x V) (pixels)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pixel Area (µm²)</td>
<td>Pixel Size (µm)</td>
<td>Substrate</td>
<td>CMOS Price</td>
</tr>
<tr>
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### Apple vs. LG vs. Vivo – NIR VCSEL

#### Pictures at scale

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<td>Die Area (mm²)</td>
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<td>Cavity Array (mm²)</td>
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<td>Cavity Number</td>
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</tr>
<tr>
<td>Cavity Area (µm²)</td>
<td></td>
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</tr>
<tr>
<td>Cavity Diameter (µm)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Substrate (Thickness)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCSEL Assembly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCSEL Die Price</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Related Reports

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IMAGING
- Samsung Galaxy Note 10+ 3D Time of Flight Depth Sensing Camera Module
- Sony’s 3D Time-of-Flight Depth Sensing Camera Module
- Huawei’s 3D Depth Sensing System, 3D Camera, Flood Illuminator and DOT projector in the Mate 20 Pro
- STMicroelectronics’ Near Infrared Camera Sensor in the Apple iPhone X
- Apple iPhone X – Infrared Dot Projector
- Orbbec’s Front 3D Depth Sensing System in the Oppo Find X

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- 3D Imaging & Sensing 2020
- Status of the CMOS Image Sensor Industry 2019
- VCSELs - Technology, Industry and Market Trends 2019