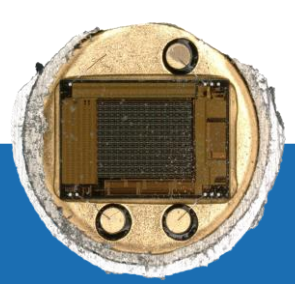

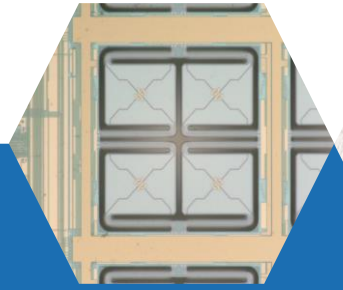

Melexis FIR Sensor MLX906

Thermopile

SP19429 - IMAGING report by Sylvain HALLEREAU
PHYSICAL ANALYSIS done by Yvon LE GOFF

June 2019 – version 1

SAMPLE

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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 Melexis Far InfraRed sensor MLX90640.

Far infrared thermal sensors are finding increased uses in myriad applications, from consumer to industrial. The ideal for this component type is to miniaturize it, because it is more cost-competitive compared to microbolometers and it is adapted to smart home/smart building applications (presence and movement detection, high-precision non-contact temperature measurements, visual infrared thermometers, etc.) which represent a growing market. The consumer market means more quantity and the most integration in order to improve the component's dimensions and minimize cost. For example, integrating the lenses directly onto the die would allow switching to wafer-level packaging.

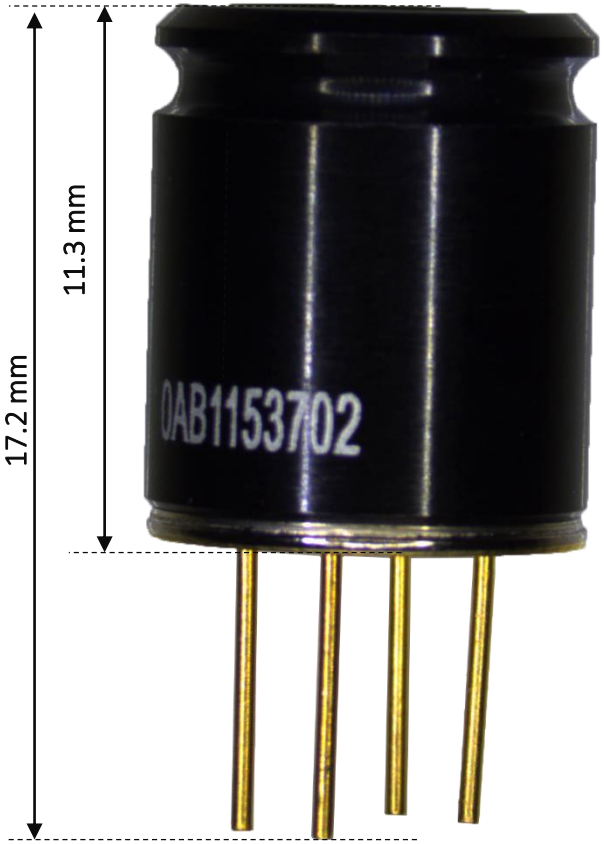
Based on a low-definition, thermopile/far infrared thermal sensor, the Melexis Sensor MLX90640 32 x 24 is dedicated to these markets. Cheaper than a microbolometer and easier to integrate, the thermopile offers very good performance for applications that do not require high-resolution images or a high frame rate.

The thermopile array sensor consists of only a 1cm3 camera (with lens). The system is made very compact and easy for integrators with a digital I²C interface, and it includes a silicon lens for low-cost applications. The 32 x 24 array sensor uses a 100µm pixel based on a thermopile technology for a very compact design.

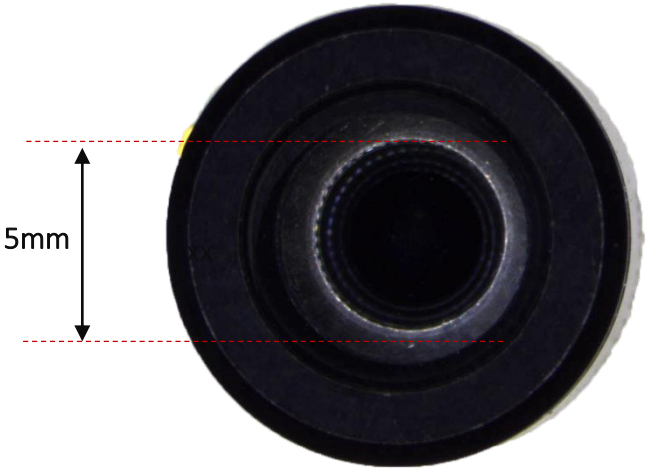
This report provides a detailed teardown and cost analysis of the thermopile die where the memory is directly integrated, along with the silicon lens and the packaging. Also included is a comparison between the characteristics of both versions of the thermopile sensors from the Melexis MLX90640 Sensor, as well as a comparison with the Heiman sensor HTPA 32 x 32d. The latter comparison highlights the differences in technical choices made by each company.

Package Views & Dimensions

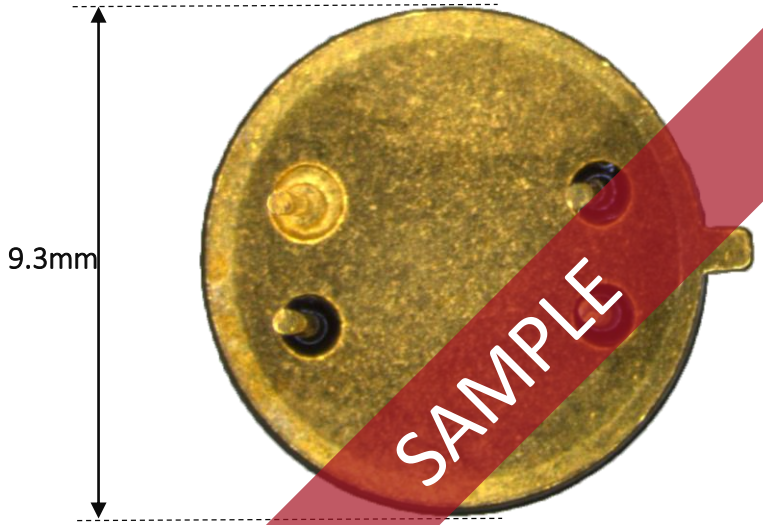
- Package: TO39 4-pin
- Dimensions: 11.3 x 9.3 x 9.3 mm
- Pin Pitch: 2.54mm
- Marking: 0AB1153702



Lateral View

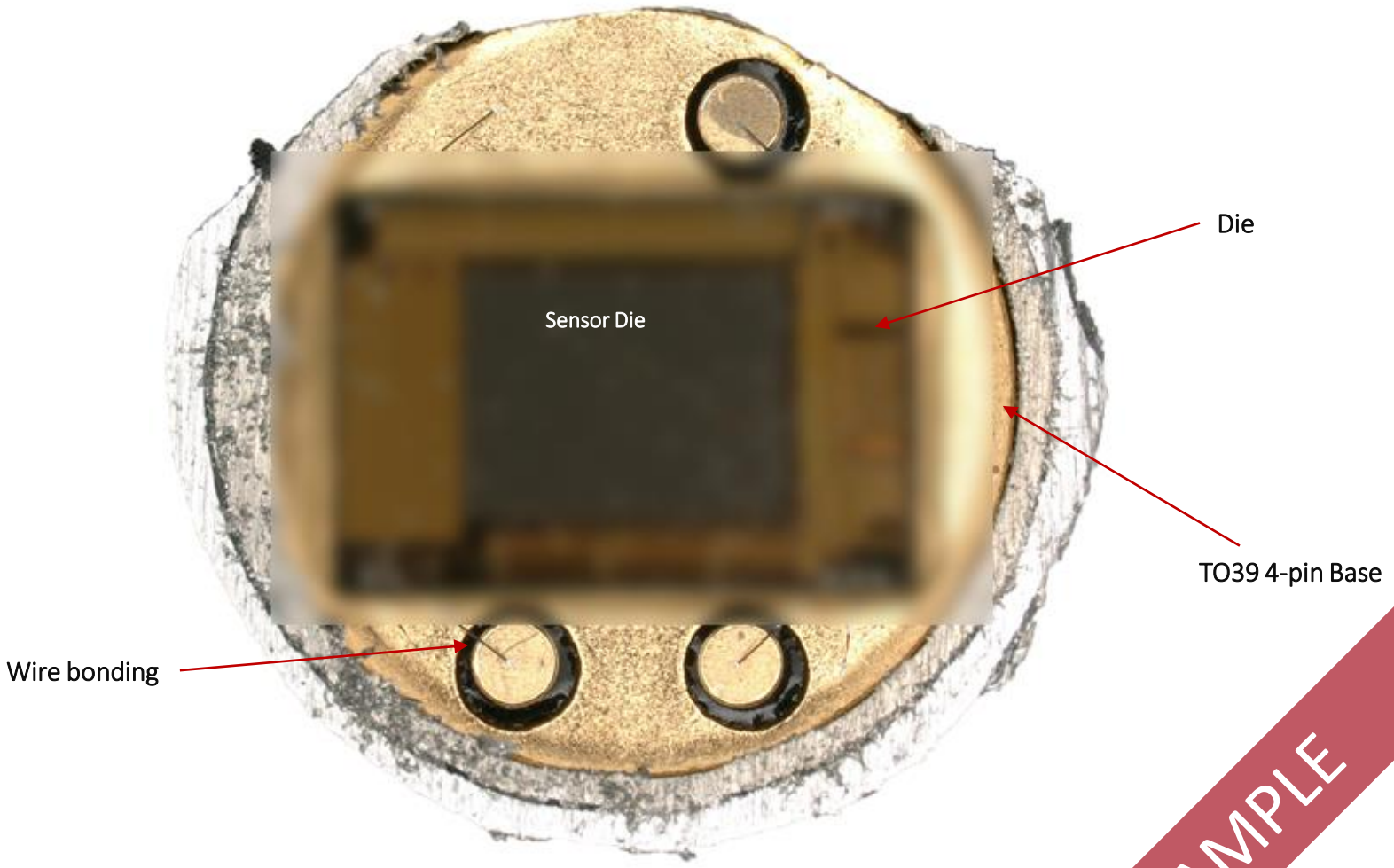


Top View



Back View

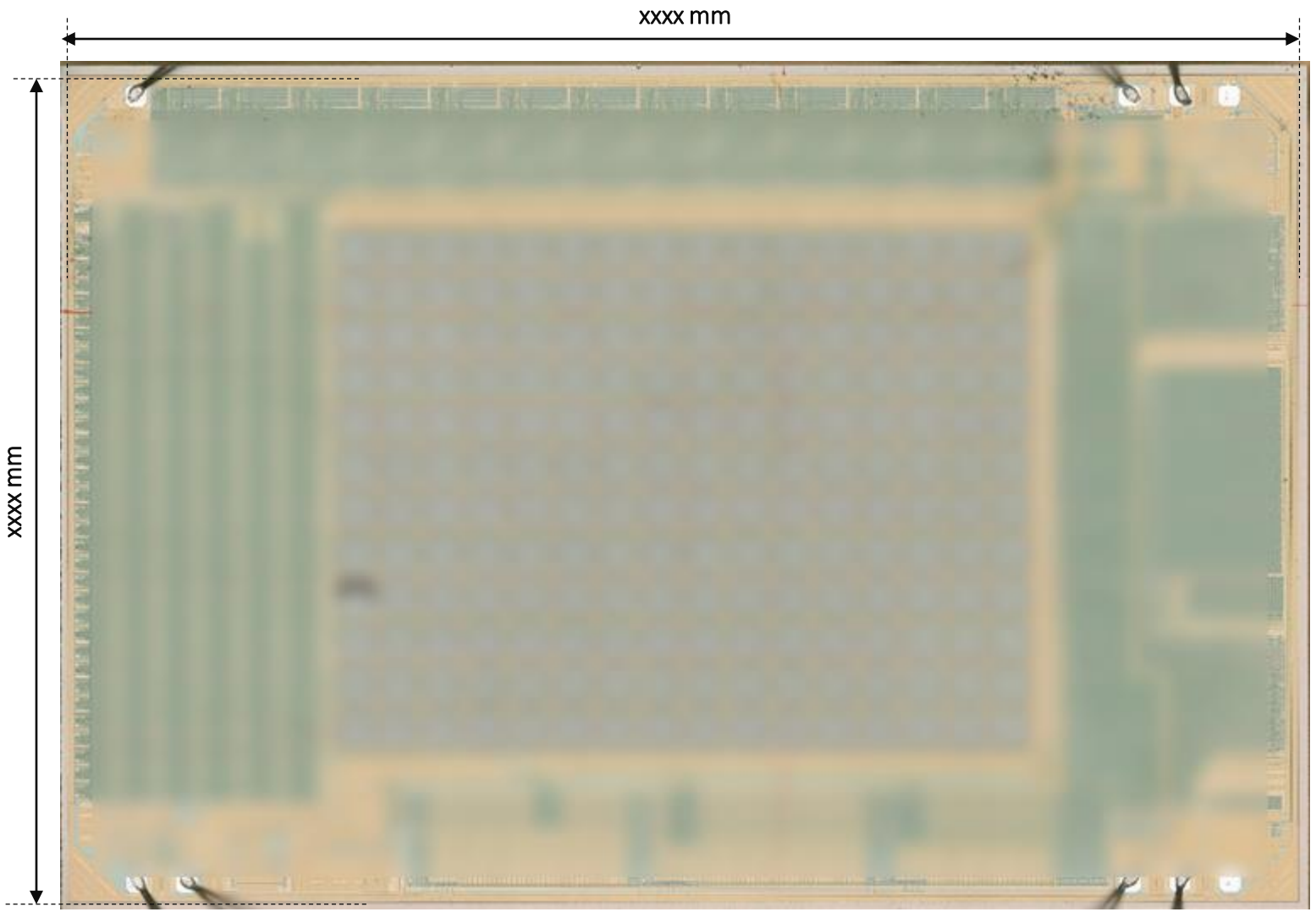
Package Opening



Wire bonding:
Number: x
Length: xx mm
Diameter: xx µm
Material: xxxxxxxx

Package Opening – Front View

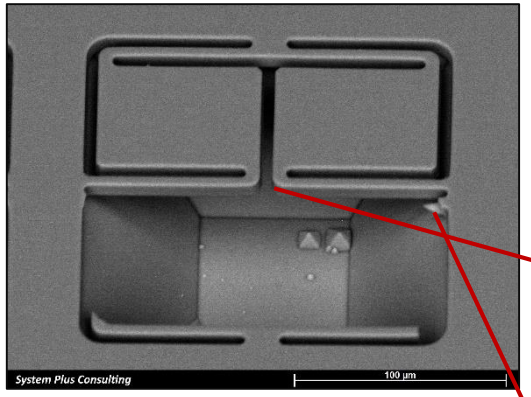
Die Overview & Dimensions



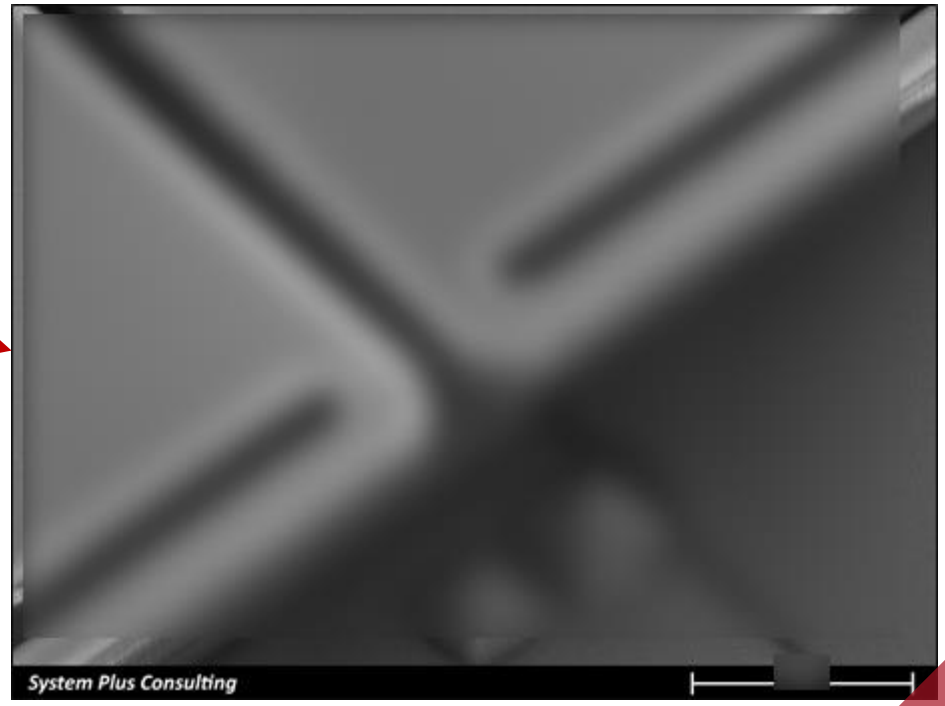
Die Sensor - Overview

- Die Area: xxx mm² (xxx x xxxmm)
- Nb of PGDW per 8-inch wafer: xxx
- Pad number: x
  - Connected: x

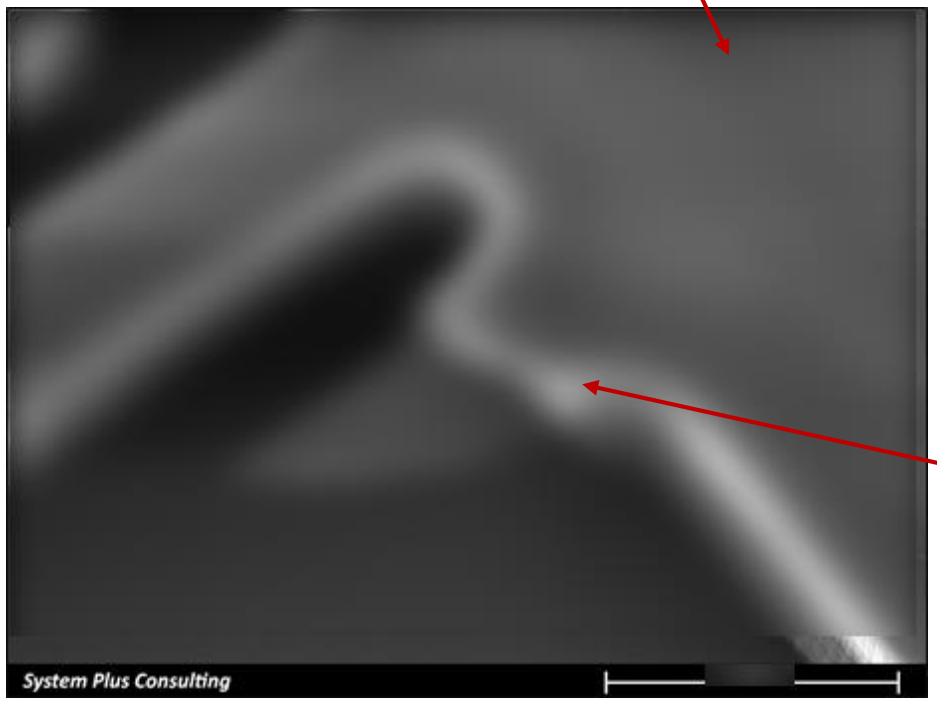
Die Overview – Pixels Details



Overview of a broken pixel – SEM View



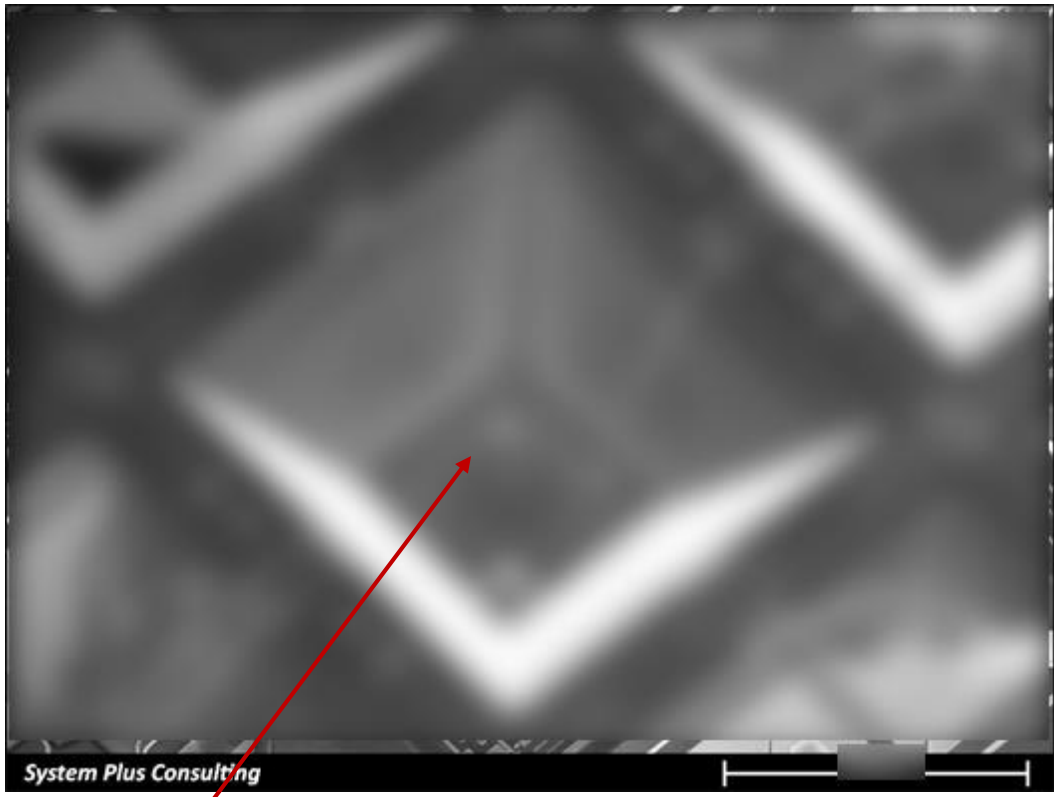
Pixels View - SEM View



Overview of a broken pixel – SEM View

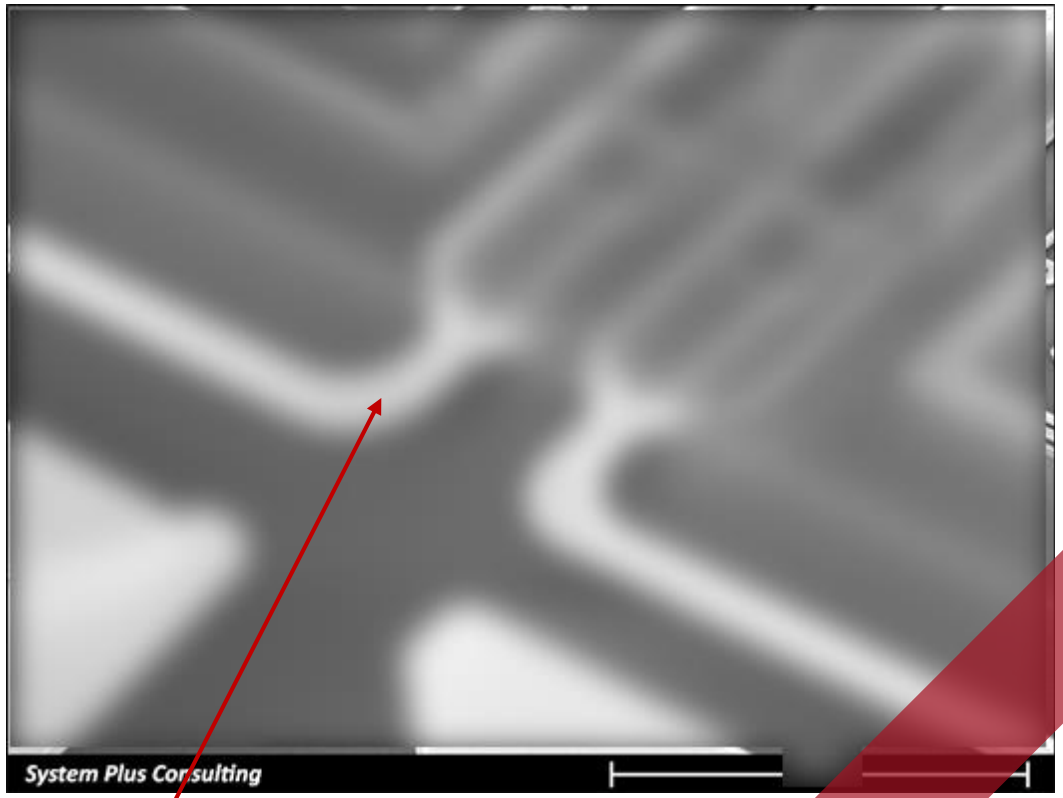
The pixel are manufactured in the xxx layer of the xxx process.

Die Overview – Pixels Details



Cavity - SEM View

Cavity etched by an xxxxx etching, characteristic shape.



2 cool end detail - SEM View

arm

Sensor Front-End Cost

MEMS Front-End	Low Yield		Medium Yield		High Yield	
	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
wafer Cost						
Clean Room Cost						
Equipment Cost						
Consumable Cost						
Labor Cost						
Yield losses Cost						
Wafer Front-End Cost						
Gross Marging						
Wafer Front-End Price						

The front-end cost for the ROIC and the cavity is estimated at $xxx.

The largest portion of the manufacturing cost is due to the ROIC part at xx%.

The process is assumed to be realized by xxxx in xxxxxxx and xxxxxx.

We estimate a gross margin of xx% for xxxx, which results in a front-end price ranging from $xxx to $xxx. This corresponds to the selling price to Melexis.

MEMS Front-End Cost Breakdown (200 Wafers)

MLX90640 Component Cost

	Low Yield		Medium Yield		High Yield	
	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
Silicon Lens cost						
Thermopile Die cost						
Packaging cost						
Final test & Calibration cost						
Yield losses cost						
Component Cost						

Component Cost Breakdown (Medium Yield)

The FIR Sensor component cost is estimated between $xxx and $xxx according to yield variations.

The Thermopile die cost accounts for x% of the cost (for medium yield).

The Silicon Lens represents xx% of the cost.

Packaging represents xx% of the total component cost (for medium yield).

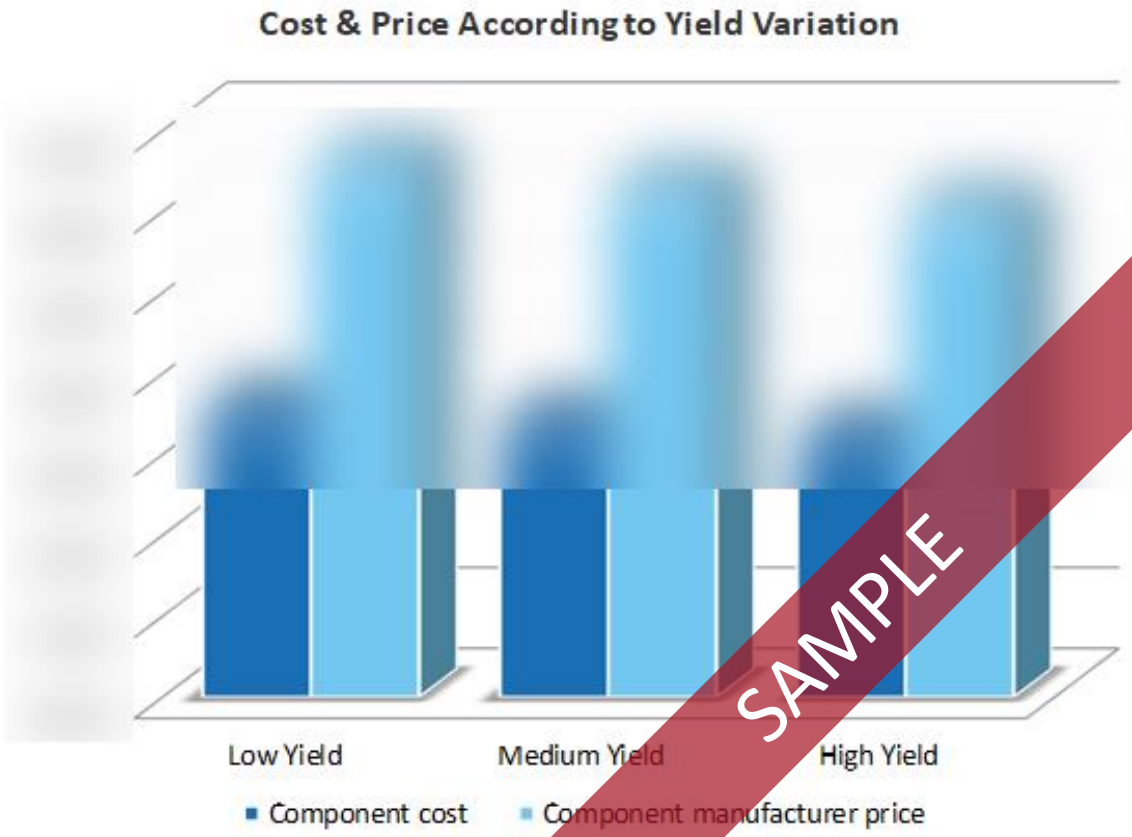
Final Test and yield losses represent xx% of the total component cost (for medium yield).

Complete System Price

	Low Yield		Medium Yield		High Yield	
	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
Component cost						
Gross Profit						
Component manufacturer price						

We estimate that Melexis realizes a gross margin of xx% on the system, which results in a final component price ranging from $xxx to $xxx.

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



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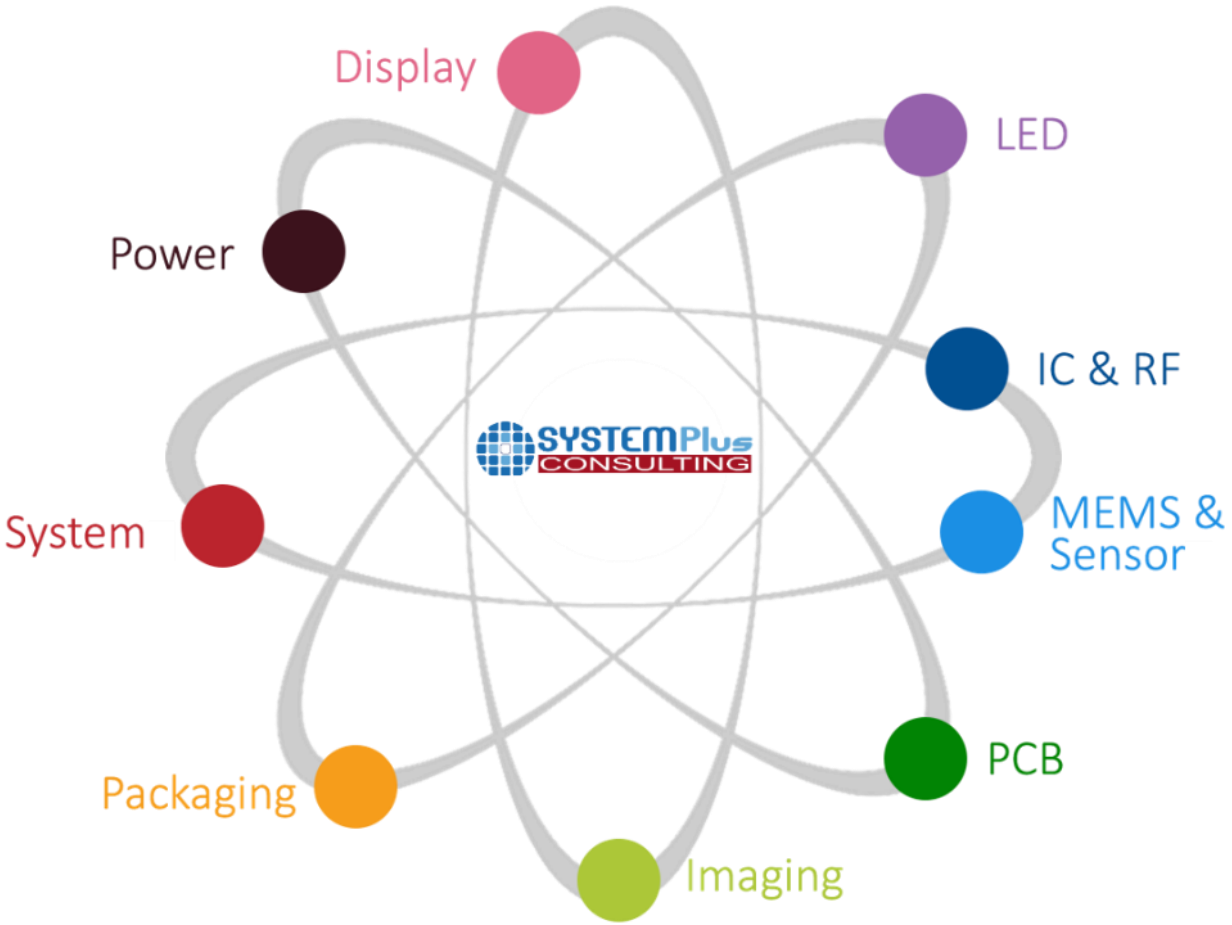

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