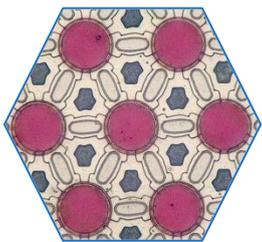




Apple iPhone 13 Face ID Module

Apple's 2nd generation Face ID solution in the iPhone 13 with comparison to the previous system.



The Face ID system introduced in the iPhone X was the first structured light-based system in a smartphone and is considered by some to be Apple's biggest innovation in recent years. Front-facing 3D smartphone sensing modules are now present in 14.6% of smartphones and consumer 3D imaging modules represent a \$3.1B industry. The iPhone X was also an early pioneer of the notch, which allows top-to-bottom displays by using a cut-out for the front-facing camera. The iPhone 11 and 12 largely retained the front camera configuration from the iPhone X, but the iPhone 13 launched with a more compact system that allowed for a ~33% smaller notch.

This full reverse costing study has been conducted to provide insights into technology data, the manufacturing cost and selling price of the Face ID module in the iPhone 13. We divide the system into eight parts: the module assembly, NIR CMOS image sensor, diffractive optical element, dot projector VCSEL, flood illuminator VCSEL, VCSEL driver, and two lens modules. Each part undergoes detailed physical analysis such as optical and electron microscopy, deprocessing, cross-sectional analysis, and energy-dispersive x-ray spectroscopy to determine the technologies and manufacturing processes involved. We then calculate the cost of each manufacturing step and present itemized fabrication and bill-of-material costs. This data is then used to calculate the total cost and estimate the selling price of the Face ID module.

In line with Apple's usual strategy, the new system keeps many things the same while incrementally advancing some

things and totally rethinking others. On the NIR detection side, Apple has retained the global shutter CIS from STMicroelectronics. The two VCSELs from Lumentum are significantly smaller than their predecessors, suggesting either that the previous generation's VCSELs were over-spec'd or that the newly designed diffractive optical element is more efficient. The two VCSELs now share the same driver and the same optics, reducing both cost and space needs in the phone. The new single-module system has a 6 mm baseline distance between the emission and detection axes, which makes the notch reduction possible. All together, the new design results in a Face ID system that is significantly less costly to Apple.

We will present a technical and cost comparison with the previous generation Face ID system in the iPhone 12.

COMPLETE TEARDOWN WITH:

- Analysis of Face ID Module structure
- Detailed optical, X-ray and SEM images
- Precise measurements
- Materials analysis
- Manufacturing process flow
- Supply chain evaluation
- Manufacturing cost analysis
- Estimated selling price
- Technology & cost comparison with previous system in the iPhone 12

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TABLE OF CONTENTS

Overview / Introduction

Company Profile & Supply Chain

Market Analysis

Physical Analysis

- Face ID Module Assembly
 - ✓ Module overview
 - ✓ Module teardown
 - ✓ Module cross-section
 - ✓ 3D CT scan
 - ✓ Component connections
 - ✓ Lens modules & optical filter
- Diffractive Optical Element
 - ✓ DOE overview & dimensions
 - ✓ DOE ITO resistor structure
 - ✓ DOE diffractive patterns & optical layers
 - ✓ Process characteristics
- NIR CIS Die
 - ✓ Die overview & dimensions
 - ✓ Die deprocessing, technology & main blocs
 - ✓ Die cross-section
 - ✓ Die process characteristic
- Dot Projector VCSEL
 - ✓ Die view & dimensions
 - ✓ Die deprocessing & cross-section
 - ✓ Die process characteristic
- Flood Illuminator VCSEL
 - ✓ Die view & dimensions
 - ✓ Die deprocessing & cross-section
 - ✓ Die process characteristic
- VCSEL Driver die
 - ✓ View & dimensions
 - ✓ Delayering & main blocs

✓ Dies process

Manufacturing Process Flow

- ✓ NIR CIS die front-end process & fabrication unit
- ✓ NIR VCSEL process flow & fabrication unit
- ✓ DOE wafer process flow & fabrication unit
- ✓ VCSEL driver die front-end process & fabrication unit

Cost Analysis

- Yields Explanation & Hypotheses
- Diffractive Optical Element
- NIR CMOS Image Sensor
 - ✓ CIS circuit front-end cost
 - ✓ Optical layers front-end cost
 - ✓ NIR CIS die cost
- Dot Projector VCSEL
 - ✓ Front-end cost
 - ✓ Front-end step costs
 - ✓ Dot projector VCSEL die cost
- Flood Illuminator VCSEL
 - ✓ Front-end cost
 - ✓ Front-end step costs
 - ✓ Flood illuminator VCSEL die cost
- VCSEL Driver
 - ✓ Front-end cost
 - ✓ Die cost
- Face ID Module
 - ✓ Lens module costs
 - ✓ Bom & assembly costs
 - ✓ Complete module cost
 - ✓ Complete module selling price

Comparison of Face ID Systems in iPhone 12 and 13

- Technical & Cost Comparison

AUTHORS



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RELATED ANALYSES



Smartphone 3D Sensing Modules Comparison 2020

Technical & cost comparison of 3D sensing modules in flagship smartphones (Apple, Huawei, Samsung, Xiaomi and Oppo).
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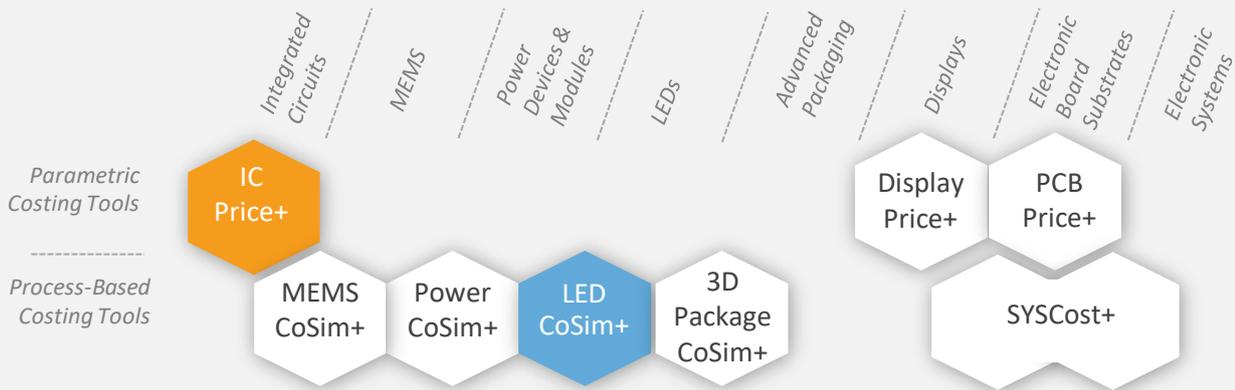
New time-of-flight and illumination device from the Apple iPhone 12.
June 2021



3D Imaging and Sensing – Technology and Market Trends 2021

Can Apple's use of direct Time-of-Flight (dToF) sensors in the iPhone 12 Pro accelerate and consolidate the use of ToF 3D sensing technology?
June 2021

COSTING TOOLS



Our analysis is performed with our costing tools LED CoSim+ and IC Price+.

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IC Price+

The tool performs the necessary cost simulation of any Integrated Circuit: ASICs, microcontrollers, DSP, memories, smartpower...

ABOUT SYSTEM PLUS CONSULTING

WHAT IS A REVERSE COSTING®?

Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.



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System Plus Consulting is specialized in the cost analysis of electronics from semiconductor devices to electronic systems.

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- **TEARDOWNS**
- **CUSTOM ANALYSES**
- **COSTING SERVICES**
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System Plus Consulting delivered services are to be paid within 30 days end of month by bank transfer except in the case of a particular written agreement.

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