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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 STMicroelectronics L2G2IS Gyroscope.

The L2G2IS is a 2-axis gyroscope optimized for optical image stabilization in smartphones and digital still cameras.

With dimensions of 2.3 x 2.3 x 0.65 mm, it can be integrated in compact camera modules. It offers a 50% smaller footprint compared to the previous generation and a 60% smaller volume.

The device is manufactured using the same THELMA process than all STMicroelectronics inertial devices. This THELMA platform requires a two dies approach which became to be very challenging for very thin package integration.

Key technical features of the device include ±100dps / ±200dps full-scale range, 3- and 4-wire SPI interface, and integrated low- and high-pass filters with selectable bandwidth. The L2G2IS operates with a supply voltage range of 1.7V to 3.6V.
The reverse costing analysis is conducted in 3 phases:

**Teardown analysis**
- Package is analyzed and measured
- The dies are extracted in order to get overall data: dimensions, main blocks, pad number and pin out, die marking
- Setup of the manufacturing process.

**Costing analysis**
- Setup of the manufacturing environment
- Cost simulation of the process steps

**Selling price analysis**
- Supply chain analysis
- Analysis of the selling price
Synthesis of the Physical Analysis

Package:
- Number of Pins: 16-pin
- Dimensions: 2.3x2.3x0.7mm
- Type: LGA
- Substrate: FR4 PCB

ASIC:
- Process:
- Electrical Connection:
- Placement in the package:

MEMS:
- Sensing Axis: two axes (Pitch, Roll)
- Process:
  - Cap:
  - Sensor:
- Electrical Connection:
- Placement in the package:
Package View & Dimensions

- **Package:** LGA 16-pin
- **Dimensions:** 2.3 x 2.3 x 0.70mm
- **Pin Pitch:** 0.4mm
- **Marking:** 525 2NWT

---

*Package Top View*

*Package Bottom View*

*Package Side View*
The die marking includes the logo of STMicroelectronics and:

VA09B
2014
MEMS Marking

The die marking includes the logo of STMicroelectronics and:

CGK19A
2013
MEMS – Sensor Process Flow

- Sensor Wafer Process:
  - Global Overview
  - ASIC Front-End Process
  - MEMS Front-End Process
  - Packaging Process

- Cost Analysis
- Selling Price Analysis
- About System Plus
MEMS – Sensor Process Flow 1/2

- Si wafer
- Si wafer
- Si wafer
- Si wafer
## ASIC Front-End Cost

<table>
<thead>
<tr>
<th></th>
<th>Low Yield</th>
<th></th>
<th>Medium Yield</th>
<th></th>
<th>High Yield</th>
<th></th>
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<tbody>
<tr>
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<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
<td>Breakdown</td>
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<tr>
<td>Raw wafer Cost (Si)</td>
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<tr>
<td>Clean Room Cost</td>
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<td>Equipment Cost</td>
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<td>Consumable Cost</td>
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<td>Labor Cost</td>
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<tr>
<td>Yield losses Cost</td>
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</tbody>
</table>

### ASIC Front-End Cost Breakdown (Medium Yield)

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

The largest portion of the manufacturing cost is due to the [ ]
MEMS Wafer & Die Cost

MEMS Die Cost Breakdown (Medium Yield)

<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>
</tbody>
</table>

Front-End Cost
BE 0: Probe Test Cost
BE 0: Dicing Cost

MEMS Wafer Cost

Nb of potential dies per wafer
Nb of good dies per wafer

Front-End Cost
BE 0: Probe Test
BE 0: Dicing Cost
BE 0: Yield losses

MEMS Die Cost

By adding the probe test cost and the dicing, the **MEMS wafer cost** ranges from $\text{[value]}$ according to yield variations.

The number of **good dies per wafer** is estimated to range from $\text{[value]}$ according to yield variations, which results in a **die cost** ranging from $\text{[value]}$. 
Component Cost

The component cost ranges from [minimum] to [maximum] according to yield variations.

- The **ASIC die** represents [percentage] of the component cost.
- The **MEMS die** represents [percentage] of the component cost.
- The **package assembly** represents [percentage] of the component cost.
- **Final test and yield losses** account for [percentage] of the component cost.
Business Models a Fields of Expertise

- Custom Analyses
  (>130 analyses per year)

- Reports
  (>40 reports per year)

- Costing Tools

- Training