Reverse Costing analysis

Nemotek Wafer-Level Camera
Shellcase® MVP Wafer-Level Package
OptiML™ Wafer-Level Optics

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   - CIS WLP : Material Cost per Family
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   - WL-Optics Cost
   - WL-Optics Cost per Process Steps
   - WL-Optics : Equipment Cost per Family
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Physical Analysis Methodology

- Package is analyzed and measured.
  - X-ray pictures are used to identify the package construction and the redistribution.
- Package is opened in order to identify the elements constituting it.
- Cross-section are realized to get overall package data: dimensions, main characteristics.
- An analysis of the technologies and of the materials used is performed.

![Diagram of package components]

- Foam
- Lens #1
- IR filter
- AP layer
- Lens #2
- Housing
- Adhesive
- Spacer Adhesive
- Imaging Area with micro-lenses
- Cavity
- Bumps
- Glass wafer #2
- FR-4 Spacer
- Glass Wafer #2 (carrier wafer)
- TSV
Camera Module Views & Dimensions

- **Package:** 21-pin WLCSP
- **Dimensions:** 3.7x3.3x2.4mm
- **Min ball pitch:** 0.5mm
- **Ball diameter:** 250µm
Camera Module Cross-Section

Camera module cross-section – SEM view
Wafer-Level Packaging Cross-Section

TSV cross-section – SEM view

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Nemotek wafer-Level Camera – WLP + WL-Optics
The lenses wafer is manufactured with a replication technology. A plastic tool (likely PDMS silicone), molded into a master (likely in steel or glass), is used to imprint the polymer lenses. Each masters can be used to make a large number of PDMS tools and each PDMS tools can be used to imprint a large number of lenses.

Blank Glass wafer 200mm Borosilicate type glass → IR filter layers evaporation coating → Chrome layers sputtering deposition

Specific Mastering preparation

Master Mold

Working Mold replicas

IR filter layers evaporation coating

Chrome layers patterning (litho + etch)

1st Polymer UV replication

Polymer « Drop deposition »

Polymer drop + 2nd UV replication + mask alignment

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• We perform the economic analysis of the CIS WLP and the WL-Optics with the MEMS CoSim+ software.
## WL-Optics Die Cost

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<th>Low Yield</th>
<th>Medium Yield</th>
<th>High Yield</th>
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<tr>
<td></td>
<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
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<td>FE : WLO Manufacturing Cost</td>
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<td>BE 0 : WLO Test Cost</td>
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<tr>
<td>BE 0 : WLO Dicing Cost</td>
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<tr>
<td><strong>WL-Optics Wafer Cost</strong></td>
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| Nb of potential dies per wafer | | | |
| Nb of good dies per wafer     | | | |

| FE : WLO Manufacturing Cost | | | |
| BE 0 : WLO Test & Dicing Cost | | | |
| BE 0 : Yield losses Cost     | | | |
| **WL-Optics Die Cost**       | | | |

| BE 0 : WLO Test yield | | | |
| BE 0 : WLO Dicing yield | | | |

- The WLO die cost ranges from [fill in] according to yield variations.
### Camera Module Assembly Cost (WLP+WLO+Test)

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<td>CIS WLP Royalties</td>
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<td>WL-Optics cost</td>
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<tr>
<td>WL-Optics Royalties</td>
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<tr>
<td>CIS/WLO Assembly &amp; Housing Cost</td>
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<tr>
<td>Final test cost</td>
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<td>Final yield losses</td>
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**Water-Level Camera Cost (without CIS)**

- **BE 1**: Assembly & Housing yield
- **BE 1**: Final test yield

### Camera Module Cost Breakdown (Medium Yields)

- The camera module cost (without the CIS) ranges from [ ] according to yield variations.
- The wafer-level packaging (Shellcase® MVP process) represents [ ] of the module cost.
- The WL-Optics represents [ ] of the module cost.
- The royalties paid to Tessera represents [ ] of the module cost.