Reverse Costing analysis

Sample Report

Qualcomm MEMS Mirasol Interferometric Modulator Display

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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 a Qualcomm Mirasol display, a MEMS display using the Interferometric Modulator (IMOD) technology.

- The Display was extracted from a Kyobo eReader. It is a special version designed for the South Korea's Kyobo Book Centre.

- The Mirasol Display integrates an interferometric modulator display, 8 drivers and 4 flex circuits.

- The economic analysis is done according to 2 parameters:
  - the number of displays produced monthly
  - the manufacturing yield.

  The aim is to show changes in the cost of manufacturing from the introduction phase with low volumes and low yields to the production phase at full capacity.
The reverse costing analysis is conducted in 3 phases:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>System is analyzed and measured.</td>
<td>Teardown analysis</td>
</tr>
<tr>
<td>The display is extracted in order to get overall data: dimensions,</td>
<td></td>
</tr>
<tr>
<td>main blocks, pad number and pin out, marking</td>
<td></td>
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<tr>
<td>Set up of the manufacturing process</td>
<td></td>
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<tr>
<td>Setup of the manufacturing environment</td>
<td>Costing analysis</td>
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<td>Cost simulation of the process steps with different scenarios</td>
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<tr>
<td>Supply Chain Analysis</td>
<td>Selling price analysis</td>
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<tr>
<td>Analysis of the selling price</td>
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</tbody>
</table>
Kyobo display Characteristics

- 5.7 inches
- XGA (1024 x 768 pixels)
- Power consumption lower than for standard LCD
- 30 frames per second.
Mirasol Display - Electrode

Cross-section of the 5 glass layers – optic view

Tracks connect the driver to the pixels and the flex to the drivers

Cross-section of tracks on the Display Glass – optic view

Sample Report
The mirrors are built on the display glass.

The color is defined by the thickness of the gap.

1 column = 1 color.
Mirasol Display - Pixels

Thickness of the mirrors is function of the pixel color:
- Thick
- Thin

Mirror – tilted SEM view
Mirasol Display – Cavity Thicknesses

Cavity thickness:
- Thin mirror:
- Medium mirror:
- Thick mirror:
Display : Process Flow 3/5

Sacrificial Etch

Anti-Stiction coating

Cap

Red - xxnm

Green - xxnm

Blue - xxnm

Drawing not to Scale
**Consumables Cost**

- The Main consumables are:
  - The Mother glasses for the display and the cap.
  - The molybdenum for the sacrificial layer
  - The XeF2 (expensive material used to etch the sacrificial layer)
  - Other = SiO2 and SiON layers, MoCr thin layers, Aluminium layers, etc.

- The consumable cost is

- The consumable part is between and of the display cost according to the number of displays manufactured by month.

- The final cost of the display is between and according to the number of displays manufactured by month.
Estimated Manufacturer Price

<table>
<thead>
<tr>
<th>Yield</th>
<th>Final component cost</th>
<th>Floor price</th>
<th>Manufacturer price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Yield</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Middle Yield</td>
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<tr>
<td>High Yield</td>
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</tbody>
</table>

Cost and Price according to Yield Variation

- The component manufacturing cost ranges from according to yield variations and the number of displays manufactured by month.
- The selling price by Qualcomm should be between