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Reverse Costing analysis

Epson Toyocom X3500W
1-Axis QMEMS Gyroscope

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   – QMEMS Front-End : Material Cost per Family
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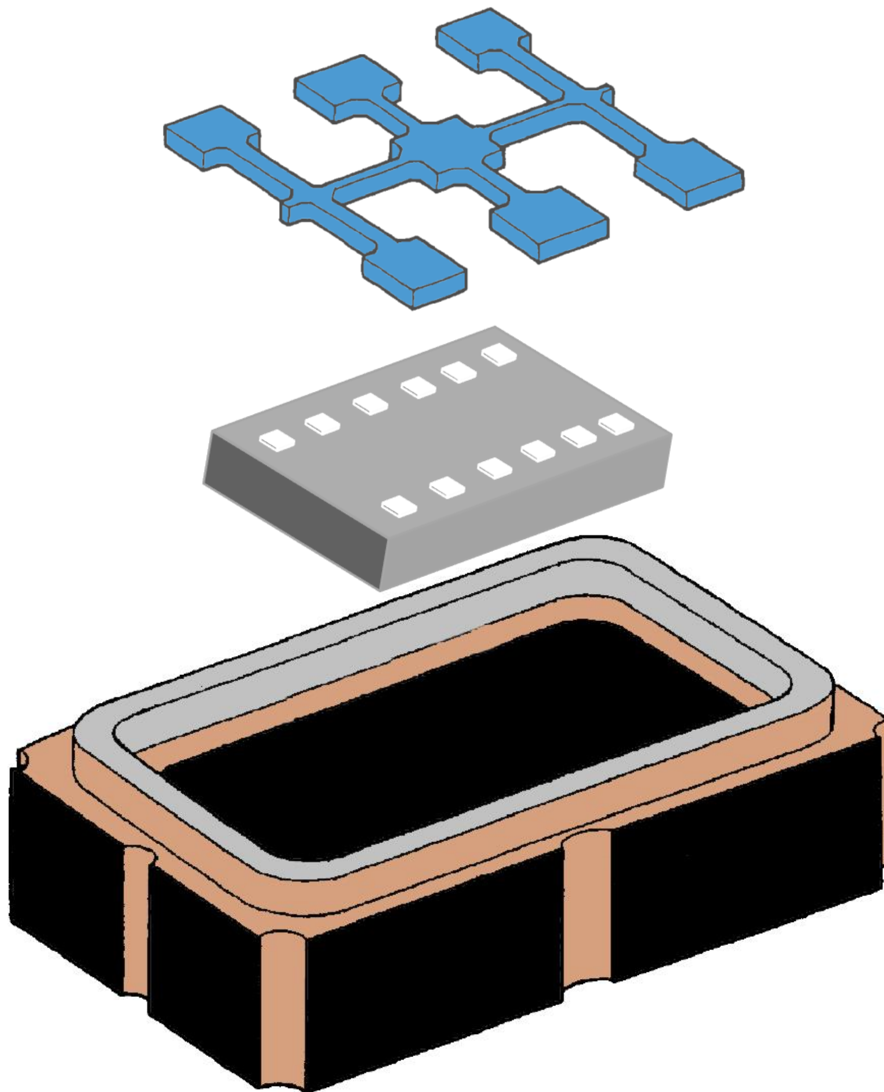
Executive Summary

- **2 dies assembled in a CLCC package are used to build the X3500W component**



QMEMS

- ✓ Quartz Substrate
- ✓ Bulk Micro-Machining
- ✓ Lithography steps

ASIC

- ✓ Silicon Substrate
- ✓ process
- ✓
- ✓ Lithography steps

Package

- ✓ CLCC-8
- ✓ Multi-Chip
- ✓ Hermetic Encapsulation

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Reverse Costing Methodology

The reverse costing analysis is conducted in 3 phases:

- **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**
- **Set up of the manufacturing process.**

Teardown analysis

- **Setup of the manufacturing environment**
- **Cost simulation of the process steps with different year scenarios**

Costing analysis

- **Supply Chain Analysis**
- **Analysis of the selling price**

Selling price analysis

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Epson Toyocom Profile

- **Epson Toyocom Gyro Sensor product line :**

Model	Package	Dimensions	Operating voltage	Bias	Rate Range	Scale Factor
XV-8100CB	Ceramic LCC-8	5.0mm x 3.2mm x 1.3mm	3.0V	1350mV	+/- 100 deg/s	2.5 mV/(°.s^{-1})
XV-8000LK	Plastic LCC-8	6.0mm x 4.8mm x 3.3mm	5.0V	50% Vdd	+/- 60 deg/s	25 mV/(°.s^{-1})
XV-8000CB	Ceramic LCC-8	5.0mm x 3.2mm x 1.3mm	5.0V	50% Vdd	+/- 60 deg/s	25 mV/(°.s^{-1})
XV-3500CB	Ceramic LCC-8	5.0mm x 3.2mm x 1.3mm	3.0V	1350mV	+/- 100 deg/s	0.67 mV/(°.s^{-1})

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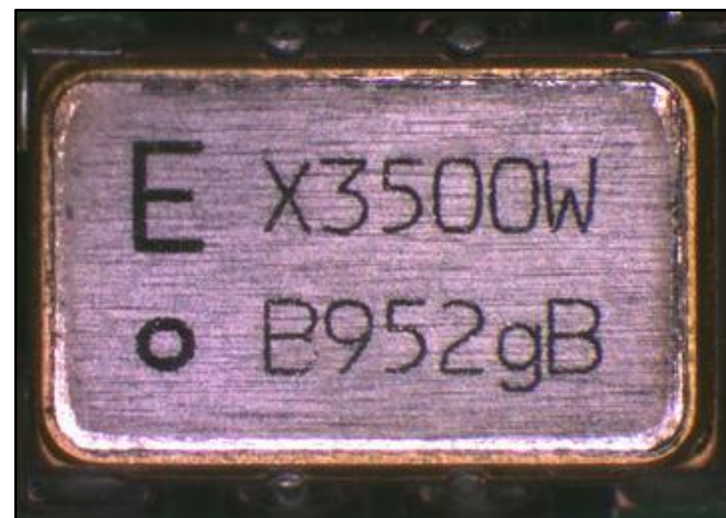
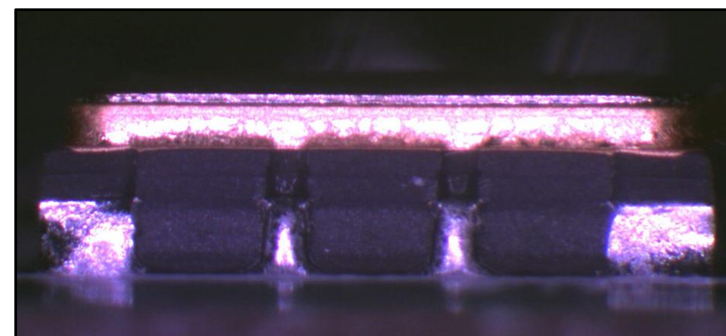
Package Characteristics & Markings

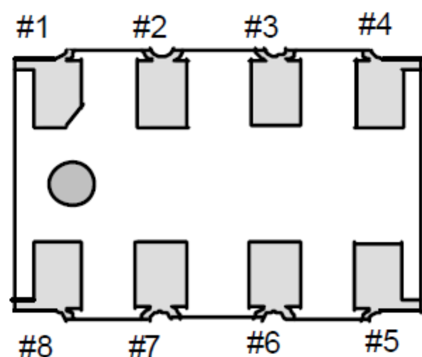
- **Package type:** Ceramic LCC 8-pin SMD hermetically sealed
- **Dimensions:** 5.00mm x 3.20mm x 1.3mm
- **Pin pitch:** 1.27mm
- **Marking :** E X3500W
  o B952gB



Package Top view



Package Side view



Pin	Connection
1	N.C.
2	N.C.
3	N.C.
4	GND
5	V_{OUT}
6	V_{REF}
7	Sleep
8	V_{DD}

Supposed Pin Map (according to XV-3500CB Datasheet)

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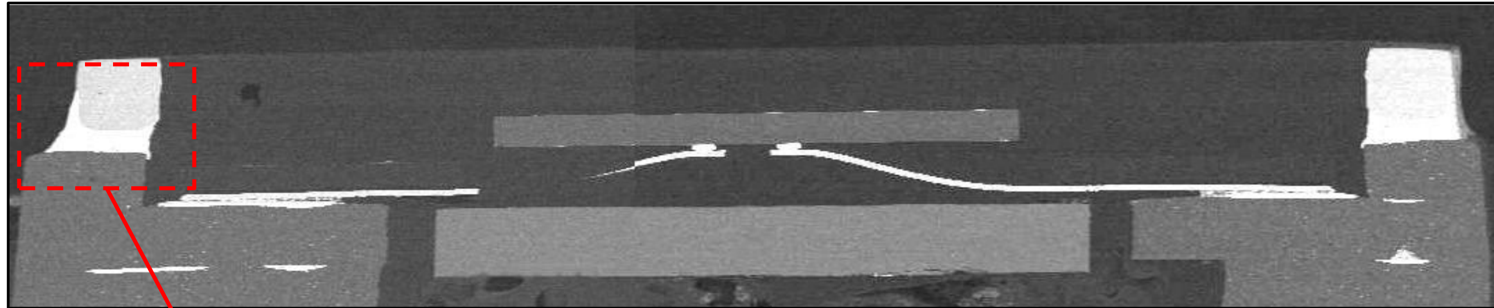
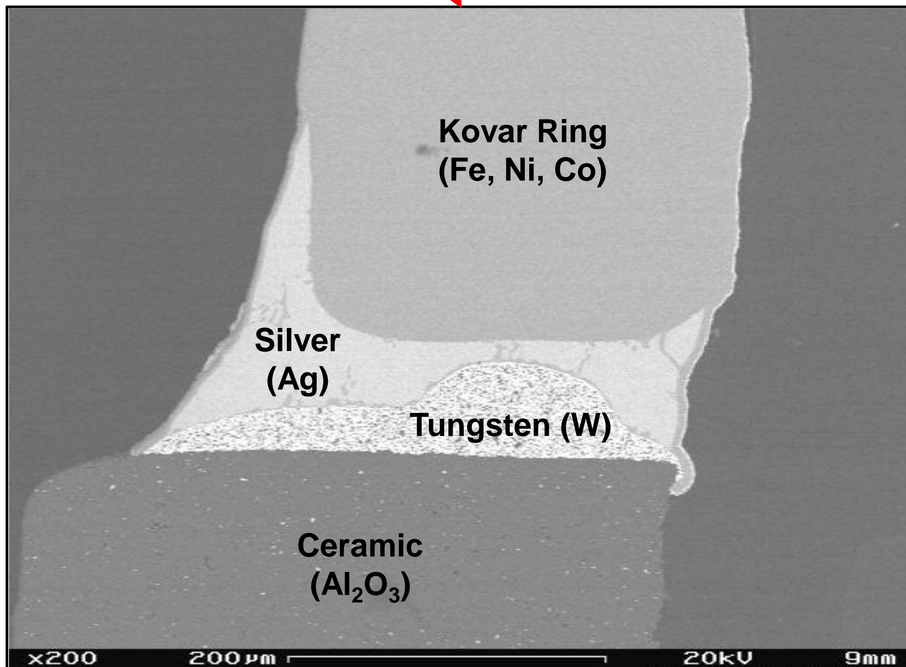
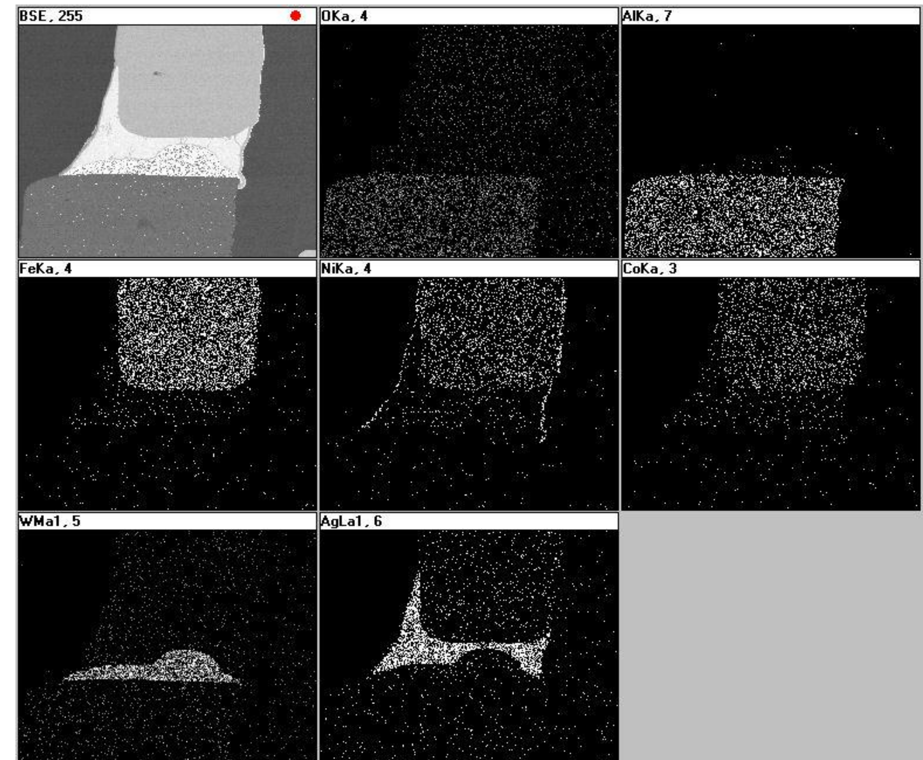
Component Cross-Section





Component Cross-Section



SEM-EDX

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QMEMS Process Flow 1/2

- **Double-T Structure Formation:**
  - ✓ **Substrate:**
  - ✓ **Process type:**
  - ✓ **Metal layers:**
  - ✓ **Lithography steps:**

Double-T Structure Formation

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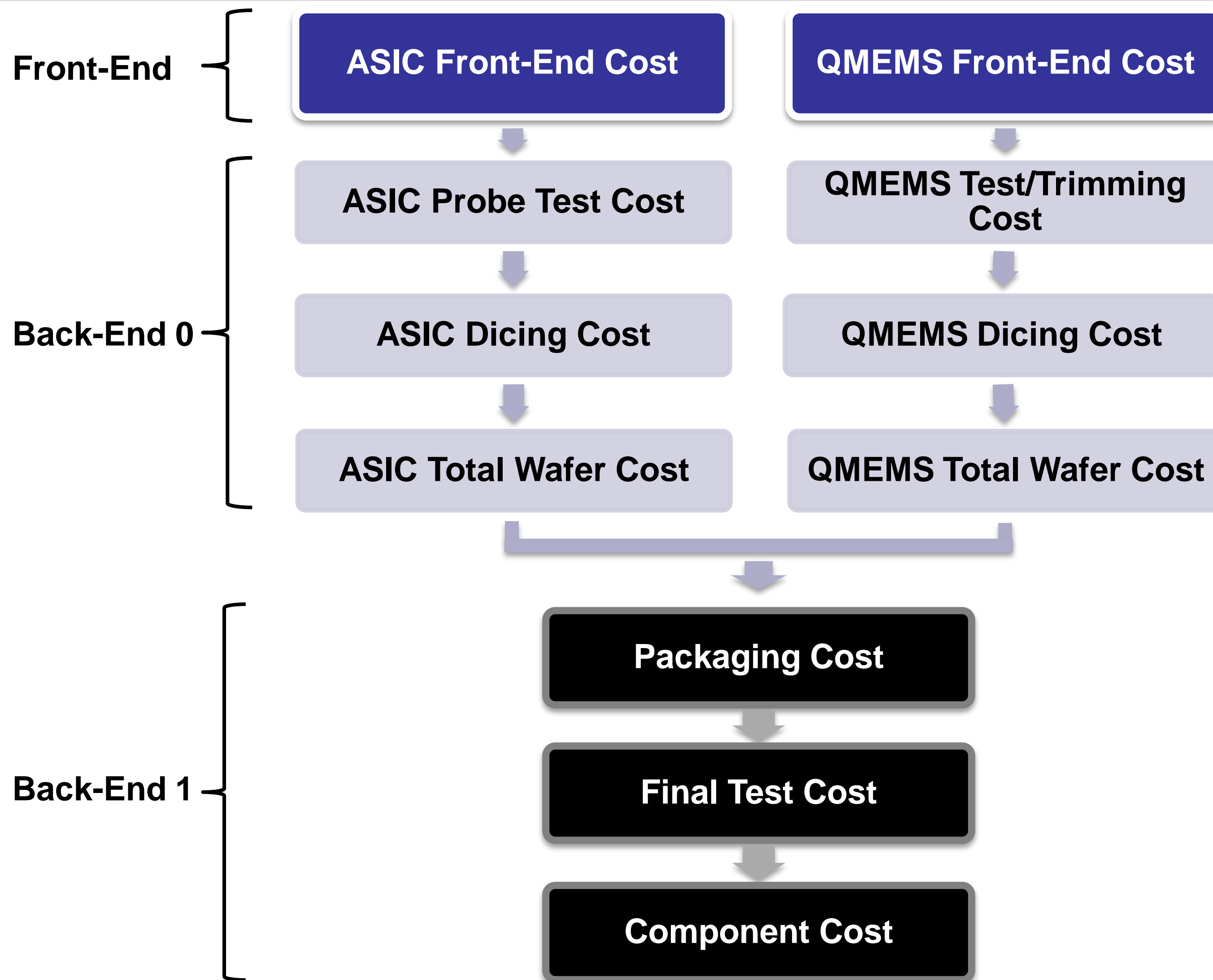
Main steps of economic analysis



- **We perform the economic analysis of the ASIC with the IC Purchaser software.**
- **We perform the economic analysis of the MEMS and the packaging with the MEMS CoSim+ software.**

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QMEMS Front-End Cost

QMEMS Manufacturing	Low Yield		Medium Yield		High Yield	
	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
Raw wafer (Quartz)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Clean Room	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Equipment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Consumable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Salary	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Yield losses	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
QMEMS Manufacturing Cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

QMEMS Manufacturing Cost Breakdown (Middle Yield)

- **The QMEMS Front-End manufacturing cost range from $xx to $xx according to yield variations.**
- **The main part of the manufacturing cost is due to the xxx with xx%.**
- **The manufacturing yield ranges from xx% to xx%.**

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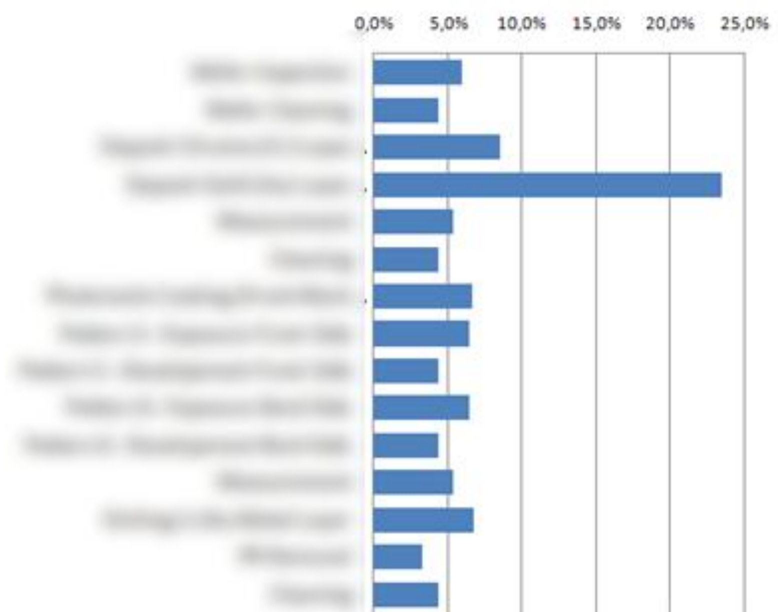
Electrodes Formation	Cost	Breakdown
[illegible]	[illegible]	6,0%
[illegible]	[illegible]	4,4%
[illegible]	[illegible]	8,5%
[illegible]	[illegible]	23,5%
[illegible]	[illegible]	5,3%
[illegible]	[illegible]	4,4%
[illegible]	[illegible]	6,7%
[illegible]	[illegible]	6,5%
[illegible]	[illegible]	4,4%
[illegible]	[illegible]	6,5%
[illegible]	[illegible]	4,4%
[illegible]	[illegible]	5,3%
[illegible]	[illegible]	6,7%
[illegible]	[illegible]	3,2%
[illegible]	[illegible]	4,4%
[illegible]	[illegible]	

Electrodes Formation Step Cost Breakdown



Electrodes Formation Steps Cost
(Simulated with MEMS CoSim+ Cost Simulation Tool)

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X3500W Packaging Cost

Packaging Step	Cost	Breakdown
[illegible]	[illegible]	37,7%
[illegible]	[illegible]	1,0%
[illegible]	[illegible]	0,4%
[illegible]	[illegible]	10,8%
[illegible]	[illegible]	21,8%
[illegible]	[illegible]	1,5%
[illegible]	[illegible]	0,4%
[illegible]	[illegible]	17,7%
[illegible]	[illegible]	0,4%
[illegible]	[illegible]	6,7%
[illegible]	[illegible]	0,9%
[illegible]	[illegible]	0,7%
[illegible]	[illegible]	**100%**

Packaging Steps Cost
(Simulated with MEMS CoSim+ Cost Simulation Tool)