Reverse Costing Analysis

Infineon RRN7745P & RTN7735P
77GHz Radar Receiver & Transmitter
SiGe:C HBT & eWLB Package

October 2015 – Version 1 – Written by Sylvain HALLEREAU

DISCLAIMER: System Plus Consulting provides cost studies based on its knowledge of the manufacturing and selling prices of electronic components and systems. The given values are realistic estimates which do not bind System Plus Consulting nor the manufacturers quoted in the report. System Plus Consulting is in no case responsible for the consequences related to the use which is made of the contents of this report. The quoted trademarks are property of their owners.
Infineon RRN7745P & RTN7735P – SiGe:C RASIC dies and eWLB package

Table of contents

Glossary
1. Overview / Introduction 4
   – Executive Summary
   – Reverse Costing Methodology

2. Company Profile 8
   – Infineon

3. Physical Analysis 14
   – Synthesis of the Physical Analysis
   – Physical Analysis Methodology
   – Bosch MRR1Plus Radar 16
     – Module Views, Dimensions & Pin Out
     – Module Opening
     – RF PCB Board
   – Fan-Out Wafer Level Package 22
     – RRN7745P Package
     – RTN7735P Package
     – Die Bond
     – eWLB Cross-Section
     – Redistribution Layer
     – Comparison eWLB
   – RRN7745P Die 43
     – View, Dimensions & Marking
     – Area Overview
     – Contact
     – Details
   – RTN7735P Die 51
   – Die Cross-Section 59
     – Bipolar Cross-Section
     – SiGe:C HBT Cross-Section
     – Metal layer Cross-Section

4. Manufacturing Process Flow 72
   – Global Overview
   – SiGe die Process Flows
   – SiGe die Wafer Fabrication Unit
   – eWLB Process Flows
   – eWLB Wafer Fabrication Unit

5. Cost Analysis 83
   – Main steps of economic analysis
   – Yields Hypotheses
   – SiGe Wafer Front-End Cost
   – SiGe die Front-End Cost
   – eWLB Wafer Front-End Cost
   – Component Cost

6. Estimated Price Analysis 98
   – Manufacturer Financial Ratios
   – RRN7745P Estimated Selling Price

Contact 104
This full reverse costing study has been conducted to provide insight on technology data, manufacturing cost and selling price of the Infineon RRN7745P and RTN7735P high frequency in SiGe HBT.

The RRN7745P and RTN7735P has been found in the Bosch MRR1Plus automotive 77GHz radar.

The RRN7745P is a 4 channels receiver 77GHz from Infineon for automotive radar applications. The RRN7745P is featuring a 9mm² die. The transistor technology in the RRN7745P is a SiGe:C HBT.

The RTN7735P is a 3 channels transmitter 77GHz from Infineon for automotive radar applications. The RTN7735P is featuring a 9mm² die. The transistor technology in the RTN7735P is a SiGe:C HBT.

Based on complete physical analysis of the RRN7745P and RTN7735P component, this report provides the manufacturing cost of the RF component.

The analysis of the Bosch MRR1 radar is performed in a second report.
Total Weight: 200g

The RRN7745P and RTN7735P dies have been found in the MRR1Plus radar from Bosch.
The Radar receiver die is packaged in an eWLB (embedded Wafer Level Ball) package, the Fan-Out technology of Infineon.

- The package is a **122-pin eWLB**, 6mm x 6mm x 0.6mm
- Pin pitch: 0.50mm
- The package marking includes the logo of Infineon and:

  ```
  RRN7745P
  3A232190
  638 02
  H1221
  ```

The die has been de-soldered of the PCB. The solder balls are defomed and partially removed.
**Package cross-section**

重要因素包括：

- **Fan-Out epoxy with glass balls filler**
- **Redistribution layer and the solder bumps**
- **Die: XXµm**
- **Protective layer on the backside: 24µm**

此页内容详细展示了eWLB跨截面的微结构。
The RRN7745P die has been cut to observe on the cross-section the bipolar transistor. Few pictures of the top have been performed.

- **Die Area:** 9mm²
  (3x3mm)

- **Nb of PGDW per 8-inch wafer:** 3048
  - Assuming scribe line of 100µm

- **Pad number:** 101
  - Connected: 71
  - Test only: 13
  - Thermal dissipation: 16

*4-channel Receiver 77GHz eWLB Radar Die Overview*
### SiGe Wafer Front-End Cost

<table>
<thead>
<tr>
<th>SiGe HBT Manufacturing 200mm</th>
<th>Low Yield</th>
<th>Medium Yield</th>
<th>High Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
</tr>
<tr>
<td>Raw Substrates (Si)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean Room</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield losses</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The **front-end cost** for the two SiGe Dies range from according to yield variations.

The largest portion of the manufacturing cost is due to the **SiGe HBT Wafer Manufacturing Cost**.
The eWLB manufacturing cost ranges from [blank] according to yield variations.

Without the second probe test, the eWLB manufacturing cost ranges from [blank] according to yield variations.

The largest portion of the manufacturing cost is due to the [blank].
## SiGe HBT Component Cost

<table>
<thead>
<tr>
<th>Die Cost</th>
<th>Low Yield</th>
<th>Medium Yield</th>
<th>High Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost</td>
<td>Breakdown</td>
<td>Cost</td>
</tr>
<tr>
<td>Die Cost per eWLB Wafer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eWLB Manufacturing Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEMS Wafer Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb of potential dies per wafer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb of good dies per wafer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SiGe Die Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eWLB Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Test Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE 0 : Yield losses</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- By adding the final test cost, the **RRN7745P and RTN7735P component costs** range from according to yield variations.
Reverse costing analysis represents the best cost/price evaluation given the publically available data, and estimates completed by industry experts.

Given the hypothesis presented in this analysis, the major sources of correction would lead to a +/- 10% correction on the manufacturing cost (if all parameters are cumulated).

These results are open for discussion. We can reevaluate this circuit with your information. Please contact us: