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# **Reverse Costing Analysis**



#### April 2016 – Version 1 – Written by Stéphane ELISABETH

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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 Qualcomm WCD9335 Fan-Out WLP Audio Codec.
- The Audio codec from Qualcomm should be found in all smartphone using Snapdragon 820 chipset. The packaging use fan-out technology. Actually more than 100 models all around the world featured the entire chipset, among them the Samsung Galaxy S7 and S7 Edge in their US version.
- The WCD9335 is an audio codec from Qualcomm for smartphone. The WCD9335 is featuring a die packaged in a fan-out technology.
- The analysis is focused on the fan-out packaging.
- The package corresponds to wafer-level package licensed by Intel/Infineon called eWLB (embedded Wafer Level Ball Grid Array).
- Based on a complete physical analysis of the WCD9335 component, this report provides the manufacturing cost of the component. It will be compared to other Fan-out package from Infineon and NXP.

3



# **Samsung Galaxy S7 Teardown**



Samsung S7 US Version Main Board view

Audio area



Samsung S7 US Version Main Board (Bottom view)

4

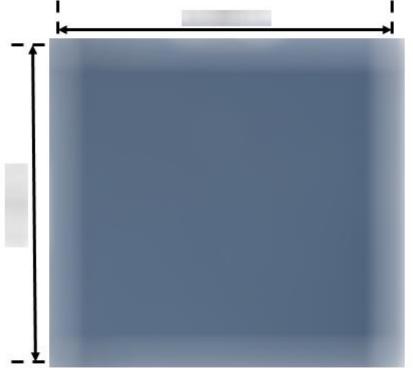
The Audio Codec chip is located on the main board.

94V-0 DAP6021023



# **Package Views & Dimensions**

- Package:
- Dimensions:
- Pin Pitch:



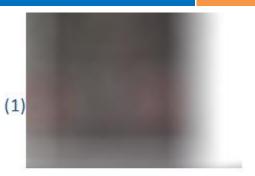




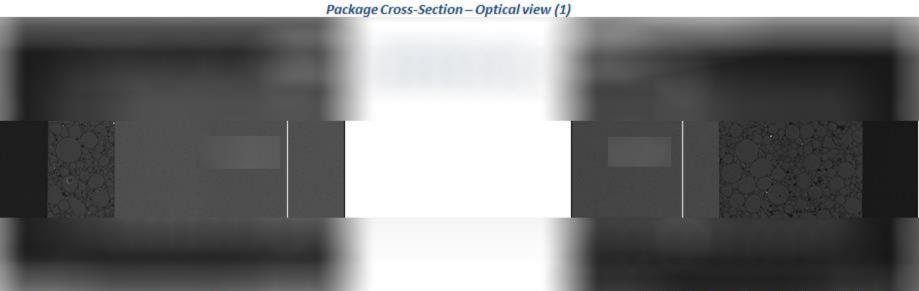
Package Side View











Details Package Cross-Section – SEM view

Details Package Cross-Section - SEM view



# eWLB - Reconstitution Flow (1/2)

 Metal Carrier • Tape Deposition



## **eWLB Wafer Front-End Cost**

Dies Cost	Low Yield		Medium Yield		High Yield	
Dies Cost -	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
Die Cost		- A		- 0		***************************************
Dies per eWLB Wafer						
Dies Cost per eWLB Wafer						

eWLB Manufacturing	Low Yield		Medium Yield		High Yield	
300mm	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
Clean Room Cost						
Equipment Cost						
Consumable Cost						
Labor Cost						
Yield losses						
eWLB Manufacturing Cost						
eWLB Manufacturing Price						

- The eWLB manufacturing cost ranges from according to yield and function variations.
- The largest portion of the manufacturing cost is due to the
- We estimate a gross margin of 25 % for the package manufacturer which results in a packaging price ranging from corresponds to the selling price to Qualcomm.

eWLB Wafer Manufacturing Cost Breakdown (Middle Yield)



# **Fan-In WLP Package Cost**

Dio Cost	Low Yield		Medium Yield		High Yield	
Die Cost	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
Die Cost						
Dies per WLP Wafer						
Dies Cost per WLP Wafer						

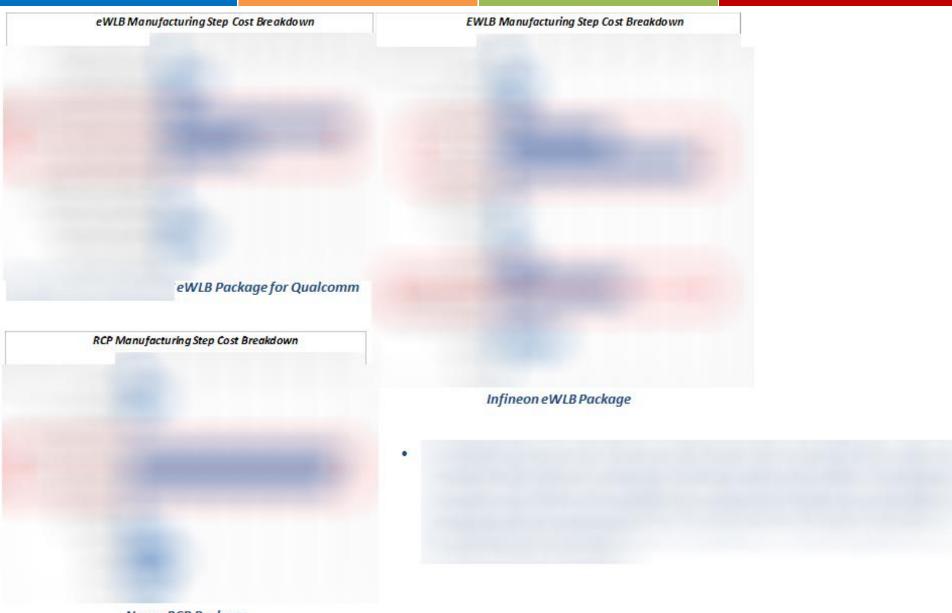
eWLB Manufacturing	Low Yield		Medium Yield		High Yield	
300m m	Cost	Breakdown	Cost	Breakdown	Cost	Breakdown
Clean Room Cost						
Equipment Cost						
Consumable Cost						
Labor Cost						
Yield losses						
WLP Manufacturing Cost						
WLP Manufacturing Price						

- The WLP packaging manufacturing cost ranges from according to yield and function variations.
- The largest portion of the manufacturing cost is due to the
- We estimate a gross margin of 25 % for the package manufacturer which results in a Package price ranging from

WLP Wafer Manufacturing Cost Breakdown
(Middle Yield)



# **Packaging Process Comparison**







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:

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LED

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# Qualcomm WCD9335 Fan-Out WLP Audio Codec

Qualcomm's Fan-Out Wafer-Level Package Chip
Audio Codec in eWLB Package inside Samsung Galaxy S7 and S7 Edge



Qualcomm, a world leader in mobile technologies, offers the new Snapdragon 820, a complete chipset currently powering or in-development with more than 100 smartphones worldwide. The U.S. versions of Samsung's latest flagship phones, the Galaxy S7 and Galaxy S7 Edge, integrate the

Snapdragon 820 chipset. In this chipset, we discovered for the first time a Qualcomm component featuring Fan-Out Wafer-Level Packaging (FOWLP): the Qualcomm Audio Codec WCD9335.

Located on the smartphone's main board, the audio codec chip's presence in the Samsung Galaxy S7 and S7 Edge depends on the smartphone version. The international version, featuring an Exynos chipset, integrates the audio codec chip from Cirrus Logic. The U.S. version, featuring the Snapdragon 820 chipset, integrates the audio codec from Qualcomm.

The Qualcomm WDC9335 is wafer-level packaged with fan-out technology. This is still relatively rare in the smartphone market but is expected to spread quickly. The FOWLP technology used is the eWLB, licensed by Intel/Infineon to several OSATs including ASE Group, Nanium, and STATS ChipPAC.

Thanks to this FOWLP process, Qualcomm is able to propose a very small die independent of the area required by the I/O pads. The result is a very cost-effective component that can compete with a standard fan-in WLP technology.

This report includes a comparison with the audio codec solution from Cirrus Logic for the international version, which uses a standard fan-in WLP technology. It also features comparisons with FOWLP technologies like RCP from NXP/nepes, and eWLB 1<sup>st</sup>-generation from Infineon.





**Title**: Qualcomm WCD9335 Fan-Out WLP Audio Codec

**Pages**: 93

Date: April 2016

Format: PDF & Excel file

Price: Full report: EUR 3,290

#### **COMPLETE TEARDOWN WITH:**

- · Detailed photos
- Precise measurements
- Material analysis
- Manufacturing process flow
- Supply-chain evaluation
- Manufacturing cost analysis
- Estimated sales price
- Comparison with Cirrus
   Fan-In WLP Audio Codec in
   Samsung S7 European
   Version
- Comparison with Intel/Infineon's eWLB & NXP/nepes RCP



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Technology and Cost Comparison with Infineon's eWLB and NXP's RCP



**Author:** Stéphane Elisabeth

Dr Stéphane Elisabeth has joined our team this year. He has a deep knowledge of Materials characterizations and Electronics systems. He holds an Engineering Degree in Electronics and Numerical Technology, and a PhD in Materials for Microelectronics.



Author (Lab): Yvon Le Goff

Yvon Le Goff has joined System Plus Consulting in 2011, in order set up the laboratory System Plus Consulting. He previously worked during 25 vears in Atmel **Nantes** Technological Analysis Laboratory as fab support in physical analysis, and 3 years at Hirex Engineering in Toulouse, in a DPA lab.

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The new 77 GHz Radar Chipset for ADAS from NXP/Freescale - SiGe:C xHBT technology & Fan-Out RCP Wafer-Level Packaging.

Pages: 129 Date: March 2016 Full report: EUR 3,290\*

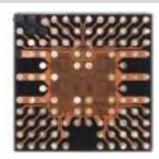
# Infineon RRN7745P & RTN7735P

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Termination

- 7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.
- 7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of thirty (30) days without solving the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

  8. Miscellaneous
- All the provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer. Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

  The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due
- Governing law and jurisdiction
- 9.1 Any dispute arising out or linked to these Terms and Conditions or to any contract (orders) entered into in application of these Terms and Conditions shall be settled by the French Commercial Courts of Lyon, which shall have exclusive jurisdiction upon such issues.
- 9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.



