

# Bosch BMA180

## 3-axial Accelerometer

Reverse Costing Analysis – July 2010

### Physical Analysis of the Device

#### Step by Step Reconstruction of the Process Flow

#### Cost of Manufacturing and Estimation of Selling Price

Yole Développement is pleased to publish a reverse costing report on the BMA180 digital triaxial acceleration sensor supplied by Bosch Sensortec and targeting low-power consumer market applications.

Based on a complete teardown process the report will provide an estimation of the production cost as well as the selling price of the chip.

This report provides a reverse costing of the MEMS Accelerometer with:

- Detailed photos
- Material analysis
- Schematic assembly description
- Manufacturing Process Flow
- In-depth economical analysis
- Manufacturing cost breakdown
- Selling price estimation



## TABLE OF CONTENTS

### Glossary

#### Overview/Introduction

- Executive Summary
- Reverse Costing Methodology

#### Bosch Sensortec Company Profile

- Bosch Sensortec
- BMA180 Specifications & Block Diagram

#### Physical analysis

- Synthesis of the Physical Analysis
- Physical Analysis Methodology
- Package Characteristics & Markings
- Package Opening & Bonding Number
- ASIC Markings
- ASIC Dimensions
- ASIC Minimal Dimension and Metal Layers
- ASIC Process Characteristics
- MEMS Markings
- MEMS Dimensions
- MEMS Details
- MEMS Cross-Sections
- MEMS process characteristics
- Thickness Comparisons with Previous Generation

#### Manufacturing Process Flow

- Overview
- ASIC Process Flow
- MEMS Process Flow
- Description of the Wafer Fabrication Units

### Cost Analysis

- Synthesis of the Cost Analysis
- Main Steps of Economic Analysis
- Yields Explanation
- ASIC Wafer Cost Hypothesis
- ASIC Wafer Cost
- ASIC Probe & Dicing cost
- ASIC Die Cost
- MEMS Wafer Cost Hypothesis
- MEMS Wafer Cost
- MEMS Wafer Cost Breakdown per Steps
- MEMS Wafer : Equipment Cost per Family
- MEMS Wafer : Material Cost per Family
- MEMS Back end 0 : Probe & Dicing Cost
- MEMS Die cost
- Back-End 1 : Packaging, Final test, calibration
- BMA180 Component Cost (FE + BE 0 + BE 1)
- Yields Synthesis

### Estimated Manufacturer Price Analysis

- Supply Chain Analysis
- Manufacturers ratios
- Estimated manufacturer Price

### Conclusion

# ORDER FORM

Please enter my order for "Bosch BMA180 Teardown and Reverse Costing Analysis":

- Single user license price: EURO 2,490\*
- Site license price: EURO 2,890\*
- Corporate license price: EURO 3,690\*

\*For price in dollars please use the day's exchange rate

\*All reports are delivered electronically in pdf format

\*For French customer, add 19,6 % for VAT

## SHIP TO

Name (Mr/Ms/Dr/Pr):  
.....  
Job Title:  
.....  
Company:  
.....  
Address:  
.....  
City: State:  
.....  
Postcode/Zip:  
.....  
Country\*:  
.....  
\*VAT ID Number for EU members:  
.....  
Tel:  
.....  
Email:  
.....  
Date:  
.....  
Signature :  
.....

## PAYMENT

On line on Yole website:

Credit Card:

- Visa
- Mastercard
- Amex

Name of the Card Holder:  
Credit Card Number:  
Card Verification Value (3 last digits except AMEX: 4 last digits) :  
Expiration date:

By bank transfer:

BANK INFO: HSBC, 1 place de la Bourse, F-69002 Lyon, France,  
Bank code : 30056, Branch code : 00170  
Account No : 0170 200 1565 87,  
SWIFT or BIC code : CCFRFRPP,  
IBAN : FR76 3005 6001 7001 7020 0156 587

Return order by:

- FAX: +33 (0)472 83 01 83
- MAIL: YOLE DEVELOPPEMENT,  
45 rue Sainte Geneviève, F - 69006 Lyon

Contact:

David Jourdan, [jourdan@yole.fr](mailto:jourdan@yole.fr), Tel: +33 (0)472 83 01 90

The present document is valid till 1<sup>st</sup> December 2010.

## BILLING CONTACT

First Name: ..... Last Name: .....  
Email: ..... Phone: .....

## ABOUT YOLE DEVELOPPEMENT

Our commitment is to facilitate market access for innovative technology, devices, equipment and materials in the disruptive semiconductor businesses. Founded in 1998, Yole Développement is involved in the following fields, with strong leadership worldwide:

- MEMS Devices and Equipment & Materials for MEMS manufacturing
- Compound Semiconductors
- Nanomaterials
- Photovoltaic
- Microfluidics
- 3 D IC/ TSV & Advanced Packaging

Our services and publications:

• Market research	• Market reports & databases
• Technology analysis	• Magazine Publication Micronews (print version and on line services)
• Strategy consulting	• Exclusive newsletters in MEMS, 3D IC, photovoltaic, compound semiconductors and microfluidics
• M&A support and due diligence	

Yole Développement is the world leader in the analysis of disruptive semiconductor applications and markets. Each day, Yole Développement's team of 20 consultants is in contact with industrial companies, R&D institutes and investors worldwide in order to help them understand the market and technology trends. In its analysis, Yole Développement takes into account the complete value chain including materials, equipment suppliers, device & system manufacturers and end users.

# TERMS AND CONDITIONS OF SALE

Definitions: "Acceptance": Action by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by ticking the box "I accept the conditions".

"Buyer": Any business user (i.e. any person acting in the course of its business activities, for its business needs) entering into the following general conditions to the exclusion of consumers acting in their personal interests.

"Contracting Parties" or "Parties": The Seller on the one hand and the Buyer on the other hand.

"Intellectual Property Rights" ("IPR") means any rights held by the Seller in its Products, including any patents, trademarks, registered models, designs, copyrights, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights or similar in any part of the world, notwithstanding the fact that they have been registered or not and including any pending registration of one of the above mentioned rights.

"License": For the reports and databases, 3 different licenses are proposed. The buyer has to choose one license: 1. Single user license: the purchaser is the sole authorized user of the report 2. Multi-user, single site license: the report can be used by various users provided that the report is only use within the same company at same post address 3. Multi-user, multi-site license: the report can be used by various users within the same company or group and its subsidiaries (more than 50% share) at a global scale.

"Products": Depending on the purchase order, reports or database on MEMS, CSC, Optics/MOEMS, Nano, bio... to be bought either on a unit basis or as an annual subscription. (i.e. subscription for a period of 12 calendar months). The annual subscription to a package (i.e. a global discount based on the number of reports that the Buyer orders or accesses via the service, a global search service on line on I-micronews and a consulting approach), is defined in the order. Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

"Seller": Based in Lyon (France headquarters), Yole Développement is a market research and business development consultancy company, facilitating market access for advanced technology industrial projects. With more than 18 consultants, Yole works worldwide with the key industrial companies, R&D institutes and investors to help them understand the markets and technology trends.

## 1. Scope

1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. ANY ADDITIONAL, DIFFERENT, OR CONFLICTING TERMS AND CONDITIONS IN ANY OTHER DOCUMENTS ISSUED BY THE BUYER AT ANY TIME ARE HEREBY OBJECTED TO BY THE SELLER, SHALL BE WHOLLY INAPPLICABLE TO ANY SALE MADE HEREUNDER AND SHALL NOT BE BINDING IN ANY WAY ON THE SELLER.

1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorised person representing the Buyer. For these purposes, the Buyer accepts these conditions of sales when ticking the box "I accept the conditions". This results in acceptance by the Buyer.

1.3 Orders are deemed to be accepted only upon written acceptance and confirmation by the Seller, within [7 days] from the date of order, to be sent either by email or to the Buyer's address. In the absence of any confirmation in writing, orders shall be deemed to have been accepted.

## 2. Mailing of the Products

2.1 Products are sent by email to the Buyer:

- within [1] month from the order for Products already released; or

- within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 Some weeks prior to the release date the Seller can propose a pre-release discount to the Buyer

The Seller shall by no means be responsible for any delay in respect of article 2.2 above, and including incases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.

2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 The mailing is operated through electronic meanseither by email via the sales department or automatically online via an email/password. If the Product's electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

2.4 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects. .

2.5 No return of Products shall be accepted without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information to the Seller as required under article 2.5 shall remain at the Buyer's risk.

## 3. Price, invoicing and payment

3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are expressed to be inclusive of all taxes. The prices may be reevaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.

3.2 Yole may offer a pre release discount for the companies willing to acquire in the future the specific report and agreeing on the fact that the report may be release later than the anticipated release date. In exchange to this uncertainty, the company will get a discount that can vary from 15% to 10%.

3.3 Payments due by the Buyer shall be sent by cheque payable to Yole Développement, credit card or by electronic transfer to the following account:

HSBC, 1 place de la Bourse 69002 Lyon France Bank code: 30056 Branch code: 200 1565 87BIC or SWIFT c00170 Account n°: 0170 ode: CCFRFRPP IBAN: FR76 3005 6001 7001 7020 0156 587

To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code.

3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

## 4. Liabilities

4.1The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.

4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

4.3 In no event shall the Seller be liable for:

a) damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller's website or the Products, or any information provided on the website, or in the Products;

b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.

4.7 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the orders, except for non acceptable delays exceeding [4] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of saleability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

## 5. Force majeure

The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

## 6. Protection of the Seller's IPR

6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.

6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company. The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

- Information storage and retrieval systems; - Recordings and re-transmittals over any network (including any local area network); - Use in any timesharing, service bureau, bulletin board or similar arrangement or public display; - Posting any Product to any other online service (including bulletin boards or the Internet);- Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

6.5 In the context of annual subscriptions, the person of contact shall decide who within the Buyer, shall be entitled to access on line the reports on I-micronews.com. In this respect, the Seller will give the Buyer a maximum of 10 password, unless the multiple sites organisation of the Buyer requires more passwords. The Seller reserves the right to check from time to time the correct use of this password.

6.6 In the case of a multisite, multilicence, only the employee of the buyer can access the report or the employee of the companies in which the buyer have 100% shares. As a matter of fact the investor of a company, the joint venture done with a third party etc... can not access the report and should pay a full licence price.

## 7. 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 time.

## 9. 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.