BCD Technology and Cost Comparison 2021

In-depth comparative study of 40 BCD technologies from the major 17 manufacturers (Infineon, STMicroelectronics, NXP, Renesas, etc.)

This report presents an in-depth analysis of the latest innovations in Bipolar-CMOS-DMOS devices. It shows the differences between 40 selected devices from Infineon, STMicroelectronics, Elmos, Bosch, NXP, Littlefuse, Texas Instruments, Analog Devices, Tower Semiconductor, Denso, Renesas, Toyota, Toshiba, Mitsubishi, Rohm, and TSMC. The report covers all the major players in the market and their new technologies.

In this 2021 version, you will find:
• More details on galvanic isolation.
• Four new manufacturers: Xfab, Mitsubishi, Rohm, TSMC.
• Nine new technologies, 90nm, high voltage.
• An update of the wafer cost calculation for the 31 technologies linked to the effects of COVID-19 and the worldwide material shortage.

BCD (Bipolar-CMOS-DMOS) has been developed to simplify the control of power devices by proposing a monolithic IC solution to integrate different functions such as the gate driving circuit and current/temperature measurements to protect the power component in the same silicon IC.

The 2021 version adds nine new technologies from seven manufacturers and four new manufacturers (X-Fab, Mitsubishi, Rohm, and TSMC), who have adopted very different solutions analyzed in this report. Additionally, 13 SOI technologies are studied in this report, with technology nodes ranging from 3µm to 90nm. The components range from monolithic piloted power transistors to microcontrollers with high-voltage analog inputs and outputs.

For each analyzed device, this report details the manufacturing process and materials used, the component design, and the technical choices. The cost report provides an estimation of the cost structure of the wafers using the various technologies, highlighting the influence of the technological innovations.

This report also offers a unique opportunity to understand the technology evolutions and the manufacturing cost of the major BCD manufacturers and furnishes the basics for an optimal choice of components during design and integration.

In this report, System Plus Consulting analyzes and compares products from the 17 main manufacturers, with a focus on technology evolution and a description of the cost impact of these innovations. Technical and cost comparisons of the main parameters, transistors, metal layers, isolation, and passives are all performed.

COMPLETE TEARDOWN WITH
• Synthesis of the technology evolution (substrate, transistor, metallisation, and passives)
• Detailed photos
• SEM analysis of transistor structure, metal layer
• Exhaustive technology comparison
• In-depth economic analysis
• Manufacturing cost breakdown
TABLE OF CONTENTS

Overview / Introduction

Technologies Evolution

- Transistors: Summary, Gate Oxides, LDMOS and VDMOS
- Isolation: Summary, LOCOS and STI, Deep Trench Isolation, Substrate SOI, Galvanic Isolation
- Metal Layer Process: Summary, Aluminum and Tungsten Plug, Copper Metal Layer, Thick Metal Layer
- Passives: Summary, Capacitor in Polysilicon, Resistor in Polysilicon, Metal Insulator Metal Capacitor, Thin Film Resistors, Inductors, Shrink, High Voltage

Foundry Technologies

- Infineon: Roadmap, SPT9 Process, BCD 90nm, SMART6 Process, Infineon’s Thin-Film SOI-Technology
- STMicroelectronics: BCD6s, SOI-BCD6s, BCD6s-offline, BCD8, SOI-BCD8, BCD9, VIPower M0-3, VIPower M0-5, VIPower M0-7
- Elmos: BCD 0.8µm
- Bosch: BCD6, BCD8
- Melexis-X-Fab: BCD 0.35µm
- NXP: A-BCD3, A-BCD9, SMARTMOS8, SMARTMOS10
- Littelfuse: BCDMOS on SOI High Voltage
- Texas Instruments: LBC5, LBC5-SOI, LBC8, LBC9
- Analog Devices: BCD 0.5µm, BCD 0.18µm, BCD 0.7µm
- Tower Semiconductor: BCD 0.4µm, SOI-BCD 0.18µm, BCD 0.18µm
- Denso: SOI-BCD 0.8µm, SOI-BCD 0.5µm
- Renesas: BCD 0.15µm
- Toyota: SOI-BCD 0.5µm
- Toshiba: SOI High Voltage
- Mitsubishi: BCD 3µm
- Rohm: BCD 0.5µm
- TSMC: BCD 0.35µm
- Synthesis Comparison
- Synthesis Comparison

Company Services

AUTHORS

Sylvain Hallereau has been Project Manager at System Plus Consulting since 2000. He is in charge of costing analyses for Integrated Circuits, Power semiconductors and LEDs. He has significant experience in the modeling of manufacturing costs for electronics components, Sylvain holds a Master degree in Microelectronics from the University of Nantes, France.

Tom Herve has joined System Plus Consulting as a Microelectronic Laboratory Technician in order to strengthen the laboratory team. In 2020, Tom was graduated from the University of Blois where he obtained a Technical degree (DUT) in Physical Measurements. He previously worked on different subject among which precipitation of zinc oxide.

RELATED ANALYSES

Smartphones PMIC Comparison 2021
Technology and cost comparison of 20 power management integrated circuits (PMIC) in recent smartphones.
August 2021

Automotive Low-Voltage Si MOSFET Comparison 2021
Exhaustive technology and cost comparisons of 11 AEC-Q101 Si MOSFETs from Infineon, ON Semiconductor, STMicroelectronics, Toshiba, Nexperia, Rohm, Diodes Incorporated, and Taiwan Semiconductor.
July 2021

Power Management IC: Technology, Industry and Trends 2019
China, 300mm, societal impacts, and important strategic decisions are shuffling the cards in the power IC industry.
November 2019
WHAT IS A REVERSE COSTING®?

Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.

Our analysis is performed with our costing tool IC Price+.

System Plus Consulting offers powerful costing tools to evaluate the production cost and selling price from single chip to complex structures.

IC Price+

The tool performs the necessary cost simulation of any Integrated Circuit: ASICs, microcontrollers, DSP, memories, smartpower...

COSTING TOOLS

Parametric Costing Tools

Process-Based Costing Tools

Integrated Circuits | MEMS | Power | Devices & Modules | LEDs | Advanced Packaging | Displays | Electronic Board Substrates | Electronic Systems

IC Price+
MEMS CoSim+
Power CoSim+
LED CoSim+
3D Package CoSim+
Display Price+
PCB Price+
SYSCost+

System Plus Consulting is specialized in the cost analysis of electronics from semiconductor devices to electronic systems.

A complete range of services and costing tools to provide in-depth production cost studies and to estimate the objective selling price of a product is available.

Our services:
- STRUCTURE & PROCESS ANALYSES
- TEARDOWNS
- CUSTOM ANALYSES
- COSTING SERVICES
- COSTING TOOLS
- TRAININGS

www.systemplus.fr
sales@systemplus.fr

CONTACTS

Headquarters
22, bd Benoni Goullin
Nantes Biotech
44200 Nantes
France
+33 2 40 18 09 16
sales@systemplus.fr

Europe Sales Office
Lizzie LEVENEZ
Frankfurt am Main
Germany
+49 151 23 54 41 82
llevenez@systemplus.fr

America Sales Office
Steven LAFERRIERE
Western USA & Canada
+1 310-600-8267
laferriere@yole.fr
Chris YOUMAN
Eastern USA & Canada
+1 919-607-9839
chris.youman@yole.fr

Asia Sales Office
Takashi ONOZAWA
Japan & Rest of Asia
+81 80 4371 4887
onozawa@yole.fr
Mavis WANG
Greater China
TW +886 979 336 809
CN +8613661566824
wang@yole.fr
Peter OK
Korea
+82 10 4089 0233
peter.ok@yole.fr
TERMS AND CONDITIONS OF SALES

Definitions: "Acceptance": Action by which the Buyer accepts the terms and conditions of sale in its entirety. It is done by signing the purchase order which mentions "I hereby accept Yole Development's Terms and Conditions of Sale".

"Buyer": Any person or company (for the sake of its business activities, for its business needs) entering into the following general conditions to the exclusion of any other particular interests.

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

"Intelectual Property Rights" ("IPR") means any rights held by the Seller in its Products, including but not limited to copyrights, patents, trademarks, trade secrets, proprietary technical and commercial know-how, registered or unregistered trademarks, any similar right in any part of the world, notwithstanding the fact that they have been registered or not, and any goodwill associated with them.

"Purchase order": Any order received by the Seller, which shall be deemed accepted only if it is written and signed by a duly authorized person representing the Buyer.

"Product": Any item or Product as defined in the Product brochures.

3. PRICE, INVOICING AND PAYMENT

3.1 The effective price is deemed to be the one applicable at the time of the order.

3.2 Any disputes arising out or linked to these Terms and Conditions or to any document issued by the Seller are exclusively subject to the jurisdiction of the courts of Paris, France.

3.3 Any notices under these Terms and Conditions shall be given in writing. They shall be also for its licensors, employees and agents. Each of them is entitled to assert and enforce the rights conferred by these Terms and Conditions to the Buyer.

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 as well as under all other applicable laws, rules and regulations. Nothing herein is intended to prevent the Yole Group of Companies from offering to sell a report to an employee who shall place an order with Yole Group of Companies for such purpose.

6.2 The Buyer shall be solely responsible for any delay in the delivery of the Product or for non-delivery of the Product to the Buyer. The Seller shall be wholly inapplicable to any sale made hereunder and shall not be "Banned in ANY WAY on the SELLER".

6.4 The Buyer shall be entitled to ask for a reimbursement of its first down payment to the extremity of the Product for purposes such as:

- Any information or data transmitted over any network (including any local area network);
- Use in any timesharing service, bureau, bulletin board service 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.

7. MISCELLANEOUS

7.4 If the Buyer would like to use data coming from the Products for presentations, press announcements or any other purposes, the Buyer must obtain written permission from the Seller. The Seller reserves the right to charge for such use of the data.

7.8 Any return of Products shall be accepted only if it is written and signed by a duly authorized person representing the Buyer.

9. GOVERNING LAW AND JURISDICTION

9.1 The Buyer and the Seller agree that the terms and conditions of this agreement, as well as any dispute arising out of or in connection with this agreement, shall be subject to French law.

9.2 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 as well as under all other applicable laws, rules and regulations. Nothing herein is intended to prevent the Yole Group of Companies from offering to sell a report to an employee who shall place an order with Yole Group of Companies for such purpose.

9.3 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Products, or any part of it to any other party other than employees of its company (user license: The report can be shared by the identified user of the Company and any internal email address). However these rights are limited to the country of the identified user. Subscribers and joint-ventures are excluded.

9.8 If the Buyer would like to use data coming from the Products for presentations, press announcements or any other purposes, the Buyer must obtain written permission from the Seller. The Seller reserves the right to charge for such use of the data.

9.9 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 as well as under all other applicable laws, rules and regulations. Nothing herein is intended to prevent the Yole Group of Companies from offering to sell a report to an employee who shall place an order with the Yole Group of Companies for such purpose. A licence to distribute the Products shall be granted to the Buyer on the condition that the Buyer only uses the Product for its own internal information purposes. In particular, the Buyer shall therefore not use the Product or any part of it to any other party other than employees of its company (only in its business needs) entering into the following general conditions to the exclusion of any other particular interests.

10. INVOICE AND PAYMENT

10.1 The Buyer shall be entitled to ask for a reimbursement of its first down payment to the extremity of the Product for purposes such as:

- Any information or data transmitted over any network (including any local area network);
- Use in any timesharing service, bureau, bulletin board service 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.

11. TERMINATION

11.1 If the buyer cancels the order in whole or in part or postpones the date of delivery, the Seller shall be entitled to charge the Buyer for any costs or expenses incurred by the Seller in connection with the order.

11.2 The Buyer shall be entitled to ask for a reimbursement of its first down payment to the extremity of the Product for purposes such as:

- Any information or data transmitted over any network (including any local area network);
- Use in any timesharing service, bureau, bulletin board service 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.

11.3 If the Buyer would like to use data coming from the Products for presentations, press announcements or any other purposes, the Buyer must obtain written permission from the Seller. The Seller reserves the right to charge for such use of the data.

11.4 If the 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 of the Products. In the event that the Buyer transfers the IPR attached to the Products or arising from a material breach of this agreement

11.5 If no event the Seller shall be liable for any direct or indirect consequences, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of information) for the Buyer caused by the use of the Products or any information provided on the website, or in the Products; or

- Any claim attributable to errors, omissions or other inaccuracies in the Product or information thereof.

11.6 All the IPR 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, or any part thereof.

11.7 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time, be subject to or withdrawn from any Product. 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.

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

6.5 If the Buyer would like to use data coming from the Products for presentations, press announcements or any other purposes, the Buyer must obtain written permission from the Seller. The Seller reserves the right to charge for such use of the data.

6.6 The Buyer shall be entitled to ask for a reimbursement of its first down payment to the extremity of the Product for purposes such as:

- Any information or data transmitted over any network (including any local area network);
- Use in any timesharing service, bureau, bulletin board service 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.

6.7 If the Buyer would like to use data coming from the Products for presentations, press announcements or any other purposes, the Buyer must obtain written permission from the Seller. The Seller reserves the right to charge for such use of the data.

6.8 If the Buyer would like to use data coming from the Products for presentations, press announcements or any other purposes, the Buyer must obtain written permission from the Seller. The Seller reserves the right to charge for such use of the data.