Bonding and Lithography Equipment Market for More than Moore devices - Sample 2018
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COMPANIES CITED IN THE REPORT

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AGC, AML, AustriaMicrosystems (AMS), Amkor, ASE Group, ASML, ASM Pacific, AST, Ayumi industry, Applied Materials, Broadcom/Avago, BondTech, Canon, Corning, Delphi Laser, ERS, EVG, EO Technics, Infineon, Georgia Tech, ITRI, LAM Research, KLA Tencor/Orbotech, Kulicke & Soffa, JCET/Statschippac, Micron, Mitsubishi Heavy Industries, Murata, Nepes, Nikon, Qorvo, Qualcomm, On Semiconductor, ORC, PlanOptik, PowerTech Technology (PTI), Screen, Samsung, Shin Etsu, SK Hynix, Skyworks, SOITEC, SPIL, ST Microelectronics, SUSS MicroTec, Shanghai Micro Electronics Equipment Co (SMEE), SUMCO, SunEdison, Kingyoup Optronics, Rudolph, Tazmo, Okmetic, TOK, Tokyo Electron Limited (TEL), TSMC, Ushio, Veeco, Via Mechanics…
OBJECTIVES OF THE REPORT

• This report a research update for the bonding technologies as well as lithography equipment markets in the More than Moore (MtM) area including Advanced Packaging, MEMS & Sensors, RF, LED, CIS and Power applications

• This report’s objectives include
  • Detailed information regarding bonding as well as lithography equipment for the following MtM applications: Advanced Packaging, MEMS & Sensors, RF, LED, CIS and Power applications
  • Identify manufacturing challenges regarding both bonding and lithography processes for each MtM device covered
  • Furnish an overview of bonding’s & lithography’s technological trends
  • Better understanding of the equipment industries for bonding and lithography processes steps involved in the fabrication of each MTM device
  • Offer 2017-2023 market metrics at equipment levels for bonding & lithography technologies for the MtM applications addressed
    • Evaluate market developments in terms of market size (units, value)
  • Collect and update all necessary information needed to benchmark and compare the different alternatives offered by current bonding and lithography equipment toolbox
  • Discuss technology process, specification, and value chain
  • Describe the competitive landscape and identify key players in technology development and manufacturing
    • Review the key bonding and lithography equipment suppliers and position them by application, technology, and process step

• The report does not cover the following applications
  • DOE µoptics applications, AR/VR
  • OLEDs, Flat Panel Display (FPD)
  • PV applications
REPORT METHODOLOGY

Market forecast methodology

Forecast of system market volume (unit)

Definition of functions using devices, technical requirements at device level and device penetration rate and competitiveness with alternative technologies

Forecast of device market volume (unit)

Definition of ASP per application

Forecast of device market size ($)

Definition of manufacturing flows for front-end and packaging at module and device level

Forecast of device manufacturing equipment and material markets (unit and $)

Understanding and definition of market share

Definition of device die surface (mm²) and substrate die surface (mm²) and epiwafer volume (unit)

Forecast of device substrate markets (unit, wafers and $)

Market segmentation methodology

USES

Variant

Quasi segments

Fonction and technological application matrices

APPLICATIONS

SEGMENTS

CLIENTS

Commercial key success factors behaviour and competitor behaviour matrices

BEHAVIOUR
Technology analysis methodology

1. Define the key parameters
2. Understand the requested specifications per parameter and application
3. Define the competing technologies and the potential evolutions of the technologies
4. Define the roadblocks and challenges to be overcome
5. Establish the technology roadmaps and maps
6. Experts discussions

Information collection

- Material makers
- Equipment makers
- Device makers
- System designers
- OSAT
- Analysts’ processing to answer your needs and questionnings on market size, positioning, technical challenges...
- Trade shows: attendance and participation
- Literature, web, scientific publications, white papers...
Yole’s market forecast methodology is based on both top bottom and a bottom up approach with more than dozens of interviews of companies across the entire value chain.
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SCOPE OF THE REPORT

Applications and package type covered

**Advanced Packaging**
- 3D TSV ICs
- FO WLP
- Fan-In WLCSP
- 2.5D interposer

**MEMS/sensors**
- Accelero
- Gyro
- RF duplexer
- µphone
- µmirror

**CMOS Image sensors**
- CIS – pixel array
- CIS – logic array

**Power devices**
- 3D WLP

**RF devices**
- IGBT
- MOSFET
- Bipolar

**SOI Substrate**
- Silicon (SiO2) ~ 0.15µm
- Si0.8(SiN) ~ 0.5-1.8µm
- High linearity > 100µm

**LED devices**
- Bonding & Lithography Equipment Market for More than Moore Devices | Sample | www.yole.fr | ©2018
# SCOPE OF THE REPORT - EQUIPMENT TYPE COVERED

Equipment focus for More Than Moore devices

## Bonding equipment

<table>
<thead>
<tr>
<th>Focus</th>
<th>Equipment Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent bonding</td>
<td>W2W bonder</td>
</tr>
<tr>
<td>Temporary bonding</td>
<td>D2W/D2D bonder</td>
</tr>
<tr>
<td></td>
<td>Temporary bonding</td>
</tr>
<tr>
<td></td>
<td>Debonder system</td>
</tr>
</tbody>
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## Lithography equipment

<table>
<thead>
<tr>
<th>Focus</th>
<th>Equipment Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask aligner</td>
<td>Laser ablation</td>
</tr>
<tr>
<td>Stepper</td>
<td>Laser direct imaging</td>
</tr>
<tr>
<td>Full field scanner</td>
<td></td>
</tr>
<tr>
<td>NanolImprint (NIL)</td>
<td></td>
</tr>
<tr>
<td>Spin coater + Developer track</td>
<td></td>
</tr>
</tbody>
</table>
**Applications overview**

**PROCESS STEP**
- Bonding process
  - Permanent bonding W2W
  - Temporary bonding & debonding

**EXPERIMENT TECHNOLOGY**
- Direct bonding
  - Fusion bonding
  - Hybrid bonding
  - Anodic bonding
- Intermediate bonding
  - Insulating bonding
  - Metal bonding
- Lift-off process
  - Mechanical debonding
  - Laser debonding
  - Slide-off
- Slide-off process
  - Mask aligner
  - Stepper
  - Laser direct imaging
  - Laser ablation

**APPLICATIONS**
- Advanced Packaging: 3D stacked memories
- MEMS & Sensors
- 3D stacked memories
- MEMS & Sensors
- Advanced Packaging
  - FO WLP
  - 3D TSV
- MEMS & Sensors
- Advanced Packaging
  - Power devices
  - Power devices
  - RF
  - CIS
  - LED

**Scope of the report in terms of equipment and applications investigated**
KEY EQUIPMENT TECHNOLOGY ADOPTION - ROADMAP

Permanent bonding

Hybrid bonding

Fusion bonding

CMOS Image Sensors (CIS)

Smartphones

Smartphones

Smart automotive infotainment

Mainstream devices

Data center

Bonding & Lithography Equipment Market for More than Moore Devices | Sample | www.yole.fr | ©2018
Equipment technology roadmap

Understand the W2W permanent bonding and temporary bonding & debonding technology trends

And which equipment technology is going to ramp-up in the future
Equipment technology roadmap

Understand the lithography technology trends

And which lithography technology will be the suitable solution
2017-2023 W2W PERMANENT BONDING, TEMPORARY BONDING & DEBONDING EQUIPMENT MARKET FOR MORE THAN MOORE DEVICES

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Total Lithography, W2W permanent bonding, temporary bonding & debonding equipment market *
- Permanent bonding
- Lithography
- Temporary bonding & debonding

**2017**
- ~518M
  - >$120M
  - ~$340M
  - <$60M

**2023**
- ~>200M CAGR +10%
- ~$600M CAGR +10%
- ~$90M CAGR +8%
- >$900M CAGR +10%

*New Brand Equipment
**CAGR: Compound Annual Growth Rate
2017 MARKET SHARE OVERVIEW

By Equipment type and MtM device

Permanent bonding equipment market forecasts by equipment technology, MtM market applications

As well as more in-depth analysis for each MtM device
Positioning of the equipment suppliers by process step

**More than moore Equipment**

- **Lithography**
  - Vecco
  - Ultratech
  - SUSS MicroTec
  - SMEE
  - Ushio
  - Canon
  - Nikon
  - EVG
  - Rudolph
  - SPTS
  - ORC
  - SCREEN

- **CVD**
  - SPTS
  - Orbotech
  - TEL
  - Lam Research
  - Applied Materials
  - Vecco
  - Canon
  - Nexx
  - Tango
  - Veeco

- **PVD**
  - SPTS
  - Orbotech
  - TEL
  - Canon
  - Evatec
  - ULVAC
  - Applied Materials
  - ALD
  - Nanosolutions

- **ALD**
  - ASM Pacific Technology
  - Beneq
  - ALD Nanosolutions
  - Encapsulix
  - Nano-Master, Inc.

- **DRIE**
  - SPTS
  - Applied Materials
  - Lam Research
  - AMEC
  - Samco
  - Vecco
  - TEL

- **Etching**
  - Applied Materials
  - Lam Research
  - SAMCO
  - AMEC
  - Vecco
  - TEL

- **Temporary bonding & debonding**
  - EVG
  - TEL
  - ERS
  - tok
  - AZMO
  - Kinggoop Optoelectrics

- **Permanent bonding**
  - EVG
  - TEL
  - ERS
  - tok
  - TAZMO
  - bondtech
  - SOSS MicroTec
  - MITSUBISHI HEAVY INDUSTRIES, LTD.
There are barriers to entry for both front-end and back-end lithography vendors.
2017 Market share of the equipment vendors in the More than Moore area (W2W permanent bonding, lithography, temporary bonding & debonding)

- Canon
- Veeco
- SMEE
- TEL
- EVG
- SUSS MicroTec
- Tok
- Rudolph Technologies
- Others

>$400M
Permanent bonding, Lithography and temporary bonding equipment market shares by MtM segment application
**BONDING AND LITHOGRAPHY EQUIPMENT MARKET FOR MORE THAN MOORE DEVICES**

*Market & Technology report - October 2018*

*More than Moore devices fueled by megatrend applications will strongly drive the growth of the lithography, permanent bonding, and temporary bonding and debonding equipment market.*

**KEY FEATURES**
- Wafer-to-Wafer (W2W) permanent bonding, lithography, temporary bonding and debonding tools for More than Moore (MtM) markets (advanced packaging, MEMS & sensors, CMOS Image Sensors (CIS), RF, LED and power applications) volume and value metrics forecasted for 2017–2023
- by MtM device
- by technology type
- Key technical insights into each equipment type covered, including trends, requirements and challenges
- Competitive landscape and 2017 market shares for each bonding and lithography equipment manufacturer by MtM device
- Technology roadmap for W2W permanent bonding, temporary bonding and debonding and lithography for each MtM device

**WHAT’S NEW**
- Update of our 2017-2023 equipment market forecast with unit and market value: split by More than Moore (MtM) device and by equipment type
- Updated technology trends analysis across MtM devices and technology roadmap
- New analysis based on competitive landscape for each equipment and technology roadmap
- Comparison between new brand and refurbished equipment by MtM device

**DRIVEN BY MEGATREND APPLICATIONS, MORE THAN MOORE (MTM) DEVICES COULD DISRUPT MAINSTREAM BONDING AND LITHOGRAPHY TECHNOLOGY ADOPTION**

Megatrend applications like 5G wireless technologies, electric vehicles, and advanced mobile devices demand miniaturization and extra functionality. Therefore, fabricating the next MtM device generation requires tools with new technical specifications. These are very different to the "More Moore" mainstream semiconductor industry with respect to resolution, overlay, depth of focus (DOF), wafer bow and backside alignment.

MEMS, sensors and power devices have more relaxed specifications, so that mask aligner tools are sufficient at lower cost. However, megatrend applications are pushing devices with more stringent requirements, with lithographic features below 1µm. This would pave the way towards greater adoption of stepper tools.

Wafer-to-Wafer (W2W) bonding is fueled by MtM devices. It’s currently supported by CMOS Image Sensors (CIS) based on fusion bonding, which enables Phase Difference Auto Focus (PDAF) as well as faster shooting. Nevertheless, W2W process growth will be led mainly by potentially integrating hybrid bonding with no Through-Silicon Vias (TSVs). Such processes could be used in new consumer CIS approaches such as global shutter and Time-of-Flight (ToF) technology and also the automotive industry in advanced driver-assistance systems (ADAS). Looking ahead, emerging mainstream products such as 3D NAND memory and 3D Systems on Chips (SoCs) are expected to reshuffle the W2W business in the next few years. They will replace die-to-wafer (D2W) and wire bonding, in order to maximize the number of memory cells and yield and solve stacking layer limitations.

We had expected W2W production to pick up earlier for 3D DRAM stacked memories. However in reality, cost and technical aspects today firmly limit adoption of W2W to replace D2W assembly methods.

This report presents a comprehensive overview of the status of the three equipment types used for MtM devices, along with a more in-depth analysis of technology trends and impacts made by the megatrend applications.

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**Key equipment technology adoption - roadmap**

<table>
<thead>
<tr>
<th>Year</th>
<th>MtM Devices</th>
<th>Megatrend Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td></td>
<td></td>
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<tr>
<td>2018</td>
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<td>&gt;2023</td>
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(Yole Développement, October 2018)
## More than Moore Industry Manufacturing Complexity Brings New Business Opportunities in Bonding and Lithography Equipment Markets

The overall semiconductor equipment market is worth several billion dollars. By contrast, the permanent bonding, temporary bonding and debonding and lithography equipment market for the MtM industry is a small niche representing millions of dollars.

However, megatrend markets push MtM devices to new levels of complexity, resulting in big investments. Consequently, the total equipment market for these processes generated revenue of more than $500M in 2017. It is expected to peak at ~$900M by 2023, with a 10% compound annual growth rate (CAGR) over this period. This is mostly driven by lithography, followed by W2W permanent bonding.

The new lithography equipment market for MtM devices is mostly driven by advanced packaging. This sector accounts today for almost 60% of the overall MtM lithography tools market and will continue dominating this industry with stepper technology.

Meanwhile, a high percentage of lithography equipment revenue for MEMS and sensors, CIS and power devices comes generated by retrofitted tools coming from the legacy semiconductor industry. Nevertheless, new lithography systems will be shipped to meet smaller alignment and feature sizes, where older tools will face limitations.

The W2W bonding market is mostly driven by CIS imaging and is expected to be fueled by emerging CIS products. However, new mainstream semiconductor applications such as 3D NAND and 3D SoC will also strongly push W2W bonding market growth over the next five years.

Temporary bonding and debonding still represents a rather small niche reaching more than $55M revenue in 2017. Yet it’s been already applied in numerous MtM areas such as 3D TSV platforms, fan-out wafer level packaging (FO WLP), MEMS and sensors, power devices and photonics applications.

From a technology point of view, laser debonding represents the dominant technology widely used today for FO WLP and 2.5D interposer packaging. It is expected to remain the leading process, mainly supported by the major memory manufacturers such as Samsung, SK Hynix and Micron. These companies are expecting to transition from mechanical debonding/slide-off debonding to laser debonding for the next generation of HBM2 memory due to yield issues and to support the future high volume production forecasted by end of 2019.

This report offers a detailed analysis of the MtM equipment market forecast by volume and value, for the 2017-2023 timeframe, broken down by MtM segment application and by technology.

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### More than More Devices Lead to a Much Broader Bonding and Lithography Landscape

When looking at the competitive landscape, the MtM equipment market is diversified, with groups of equipment vendors coming from different angles.

As such, the bonding equipment market is highly concentrated under the control of specialist equipment suppliers, like EVG and SUSS MicroTec. These companies have developed expertise in very specific equipment lines where legacy equipment suppliers do not have the capabilities to support such processes. The exception is Tokyo Electron Limited (TEL), which is very active in the permanent bonding equipment.

In contrast, the lithography equipment landscape for MtM devices is fragmented in different ways since it is served by two main company types:

- Specialist equipment vendors like Veeco, EVG, SUSS MicroTec, SMEE, who offer brand new lithography tools specifically for the MtM industry
- Top-tier semiconductor equipment suppliers like ASML, Canon, Nikon, mostly supporting refurbished equipment

However, the equipment landscape is currently evolving towards greater diversification in both bonding and lithography.

For instance, Asian equipment vendors have recently created strong price pressure and could reshuffle the MtM equipment market. New Chinese local players benefit from strong subsidies from local governments. They have entered the market and started competing with the top players. SMEE today is the dominant Chinese company, holding around 70% market share of the domestic LED market in terms of volume, providing low-cost bonding and lithography.

Some other Asian equipment suppliers include Korean company EO Technics, and Taiwanese company Kinyoup Optronics, offering laser debonding processes mostly dedicated to FO WLP.

Meanwhile, in the quest to acquire market share in the MtM industry, large semiconductor Front-End or Back-End equipment suppliers have adopted different strategies. They are expanding their lithography activities through acquisitions of other companies to diversify and complete their product portfolio. For example, ASML spin-off Liteq was acquired by Kulicke & Soffa, Veeco bought Ultratech and KLA Tencor purchased Orbotech.

Finally, Canon, a key front-end lithography equipment supplier, is challenging MtM suppliers by developing...
brand new tools at a reasonable cost. In addition, they recently skipped a step in the bonding business by leveraging their physical vapor deposition (PVD) capabilities to launch a permanent bonding tool based on metal interfaces. This report quantifies and details the competitive landscape and major bonding and lithography equipment supplier markets by MtM devices.

2017 Market share of the equipment vendors in the More than Moore area
(Wafer-to-Wafer permanent bonding, lithography, temporary bonding & debonding)

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COMPANIES CITED IN THE REPORT (non exhaustive list)
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OBJECTIVES OF THE REPORT
• This report is a research update for bonding and lithography equipment markets in the Moore Than Moore (MtM) area (including advanced packaging, MEMS & sensors, CMOS Image Sensors (CIS), RF, LED and power applications)

This report’s objectives include:
• Furnish an overview of bonding and lithography technological trends and identify manufacturing challenges
• Benchmark the equipment toolbox used for MtM devices
• Offer 2017-2023 market metrics in volume and value at equipment levels for bonding and lithography technologies for MtM applications
• Discuss technology processes, specifications, and value chains
• Describe the competitive landscape and identify key players in technology development and manufacturing

MARKET & TECHNOLOGY REPORT

AUTHOR
Amandine Pizzagalli is a Technology & Market Analyst in Equipment & Materials - Semiconductor Manufacturing, at Yole Développement (Yole). Amandine is part of the development of the Semiconductor & Software division of Yole with the production of reports and custom consulting projects. She is in charge of comprehensive analyses focused on semiconductor equipment, materials and manufacturing processes.

Previously, Amandine worked as Process engineer on CVD and ALD processes for semiconductor applications at Air Liquide. Amandine was based in Japan during one year to manage these projects. Amandine graduated from CPE Lyon (France), with a technical expertise in Semiconductor & Nano-Electronics and has a master focused on Semiconductor Manufacturing Technology, from KTH Royal Institute of Technology (Sweden). She has spoken in numerous international conferences and has co-authored more than 10 papers.

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SALES CONTACTS

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Our Terms and Conditions of Sale are available at www.yole.fr/Terms_and_Conditions_of_Sale.aspx
The present document is valid 24 months after its publishing date: October 4, 2018

PRODUCT ORDER - Ref YD18038

Please enter my order for above named report:
☐ One user license*: Euro 5,990
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- The report will be ready for delivery from November 5, 2018
- For price in dollars, please use the day’s exchange rate. All reports are delivered electronically at payment reception. For French customers, add 20% for VAT

I hereby accept Yole Développement's Terms and Conditions of Sale(*)
Signature:

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SHIPPING CONTACT

First Name: 
Email: 
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ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and image sensors, Compound Semiconductors, RF Electronics, Solid-state lighting, Displays, Software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

CONSULTING AND ANALYSIS
• Market data & research, marketing analysis
• Technology analysis
• Strategy consulting
• Reverse engineering & costing
• Patent analysis
• Design and characterization of innovative optical systems
• Financial services (due diligence, M&A with our partner)
More information on www.yole.fr

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• Patent investigation and patent infringement risk analysis
• Tear downs & reverse costing analysis
• Cost simulation tool
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CONTACTS
For more information about :
• Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)
• Reports: David Jourdan (jourdan@yole.fr) Yole Group of Companies
• Press Relations & Corporate Communication: Sandrine Leroy (leroy@yole.fr)
1. SCOPE

1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller:

1.2 "Products": the subject of the contract, including: reports, databases, tools, 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.

1.3 Orders are deemed to have been accepted only upon written acceptance and confirmation by the Seller, within 7 days from the receipt of the request or inquiry by 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 shall be mailed by the Seller: within 15 months 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 For various technical reasons, the Seller may propose a pre-release discount to the Buyer.

The Seller shall by no means be responsible for any delay in respect of article 2.1 above, and including inaccuracies where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the latest results in order to enable the Seller to deliver a high quality Product.

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

2.4 The mailing is operated through electronic means either by email, fax or online service (including but not limited to bulletin boards or the Internet).

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 format within 90 days from the date of the original download or receipt of the Product.

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 exclusive of taxes and all other duties or levies.

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

3.2 Yole may offer a pre-release discount for the companies willing to acquire the Product. In this case, the fact that the report may be release later than the anticipated release date. In exchange to this uncerainty, 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: 30556
Branch code: 0011
Account n°: 0170 2015 1565 87
BIC or SWIFT code: CCFRFRPP
IBAN: FR76 3005 6001 7001 0254 387
To ensure payment, the Buyer shall be entitled to request the right to download payments from the Buyer. In this case, the need of download payments will be mentioned on the order.

4. LIABILITY

4.1 The Seller shall only be liable for: (i) direct and (ii) foreseeable pecuniary losses sustained by the Products or arising from a material breach of this agreement.

4.2 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 data); or for inability to use the Seller's website or the Products, or any information provided on the website, or in the Products; or

any act or inactivity or other inaccuracies in the Product or interpretations thereof.

4.3 All 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.

4.4 All the Products are the Seller's property and are protected under French and international copyright law and conventions. The Products are not disseminated out of the company. In the context of annual subscriptions, the person of contact shall be the one who will inform the Buyer that the Products are not disseminated out of the company. The Buyer cancels the order in whole or in part or postpones the date of mailing, the Seller shall be entitled to access the report on line the reports on I-micronews.com. In this respect, the Seller will give the Buyer a maximum of 10 passwords, unless the multiple sites organization of the Buyer requires more passwords. The Seller reserves the rights to check from time to time the correct use of this password.

6. TERMINATION

6.1 In the event of a major event such as the non-payment of the price for the Products, the Buyer may be deemed to have accepted the latest information to the Seller, in accordance with these Terms and Conditions.

6.2 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, etc. 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 above.

6.3 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guarantees. The Seller 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, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

6.4 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 shall take all necessary precautions to avoid any damage of viruses, worms, Trojan horses or other codes containing contagious or destructive properties before mailing the Products, the Seller cannot guarantee that any Product will be free from infection.

5. FORCE MAJEURE

5.1 The Seller shall not be liable for any delay in performance directly or indirectly caused by 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 the Seller shall not be liable for any use of the information to the Seller as required under article 2.5 shall be deemed to have been accepted.

7. MISCELLANEOUS

7.1 Any dispute arising out or linked to these Terms and Conditions or to their interpretation, shall be settled by the French Commercial Courts of Lyon, which shall have exclusive jurisdiction upon such issues.

7.2 The Buyer cancels the order in whole or in part or postpones the date of mailing, the Seller shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

8. GOVERNING LAW AND JURISDICTION

8.1 Any dispute arising out or linked to these Terms and Conditions or to their interpretation, shall be settled by the French Commercial Courts of Lyon, which shall have exclusive jurisdiction upon such issues.
Yole Développement

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- Photonics
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- MEMS & Sensors
- RF Devices & Techno.
- MedTech
- Manufacturing
- Advanced Packaging
- Advanced Substrates
- Memory
- Batteries & Energy Management
- Power Electronics
- Displays
- Compound Semi.
- Solid State Lighting (LED, OLED, …)
- Software
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- **Consulting and Analysis**
  - Market data & research, marketing analysis
  - Technology analysis
  - Strategy consulting
  - Reverse engineering & costing
  - Patent analysis
  - Design and characterization of innovative optical systems
  - Financial services (due diligence, M&A with our partner)

- **Syndicated reports**
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  - Teardowns & reverse costing analysis
  - Cost simulation tool

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6 COMPANIES TO SERVE YOUR BUSINESS

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Cost simulation tools
www.systemplus.fr

IP analysis
Patent assessment
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30% of our business

30% of our business
SERVING THE ENTIRE SUPPLY CHAIN

Our analysts provide market analysis, technology evaluation, and business plans along the entire supply chain.

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We work across multiples industries to understand the impact of More-than-Moore technologies from device to system.
Yole Développement, System Plus Consulting, KnowMade and PISEO, all part of Yole Group of Companies, keep on increasing their collaboration to offer, in 2018, a collection of 150+ reports. Combining respective expertise and methodologies from the 4 companies, the reports aim to provide market & technology analysis, patent investigation and patent infringement risk analysis, teardowns & reverse costing analysis. They cover:

- MEMS & Sensors
- RF devices & technologies
- Imaging
- Medical technologies (MedTech)
- Photonics
- Advanced packaging
- Manufacturing
- Advanced substrates
- Power electronics
- Batteries and energy management
- Compound semiconductors
- Solid state lighting
- Displays
- Software
- Memory

You are looking for:
- An analysis of your product market
- A review of your competitors evolution
- An understanding of your manufacturing and production costs
- An understanding of your industry technology roadmap and related IPs
- A clear view on the evolution of the supply chain…

Our reports are for you!

The combined team of 60+ experts (PhDs, MBAs, industry veterans…) from Yole Développement, System Plus Consulting, KnowMade and PISEO, collect information, identify the trends, the challenges, the emerging markets, the competitive environments and turn it into results to give you a complete picture of your industry landscape.

In the past 20 years, we worked on more than 1 700 projects, interacting with technology professionals and high level opinion makers from the main players of the industry.

In 2018, Yole Group of Companies plan to publish +150 reports. Gain full benefit from our Bundled Offer and receive at least a 36% discount.
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  - Silicon Photonics 2018 – Update
  - Consumer Biometrics: Hardware & Software 2018 – Update
  - Inkjet Functional and Additive Manufacturing for Electronics 2018
  - Fingerprint Sensor Applications and Technologies – Consumer Market Focus 2017
  - Sensors and Sensing Modules for Smart Homes and Buildings 2017
  - Acoustic MEMS and Audio Solutions 2017
  - MEMS & Sensors for Automotive Market & Technology Trends 2017
  - High End Inertial Sensors 2017
  - Magnetic Sensor 2017

- **REVERSE COSTING® – STRUCTURE, PROCESS & COST REPORT** – by System Plus Consulting
  - Piezo MEMS 2018 *

- **PATENT ANALYSES** – by KnowMade
  - MEMS Microphone – Patent Landscape Analysis
  - Knowles MEMS Microphones in Apple iPhone 7 Plus – Patent-to-Product Mapping 2017

- **LINKED REPORTS** – by Yole Développement, System Plus Consulting and KnowMade
  - MEMS Pressure Sensor 2018 – Market & Technology Report
  - Air Quality Sensors 2018 – Market & Technology Report
  - LiDARs for Automotive and Industrial Applications 2018 – Market & Technology Report
  - LiDAR for Automotive 2018 – Patent Landscape Analysis
  - MEMS Packaging 2017 – Market & Technology Report

RF DEVICES AND TECHNOLOGIES
- **MARKET AND TECHNOLOGY REPORT** – by Yole Développement
  - Wireless technologies (Radar, V2X) for Automotive 2018
  - RF Standards and Technologies for Connected Objects 2018
  - RF & Photonic Components & Technologies for 5G Infrastructure 2018

- **REVERSE COSTING® – STRUCTURE, PROCESS & COST REPORT** – by System Plus Consulting
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- **PATENT ANALYSES** – by KnowMade
  - RF Acoustic Wave Filters 2017 – Patent Landscape Analysis

- **LINKED REPORTS** – by Yole Développement, System Plus Consulting and KnowMade
  - 5G impact on RF Front End Modules and Connectivity for Cellphones 2018 – Market & Technology Report – Update
  - RF Front End Modules for Cellphones 2018 – Patent Landscape Analysis
  - Advanced RF System-in-Package for Cellphones 2018 – Market & Technology Report – Update*
  - RF GaN 2018 – Patent Landscape Analysis

SOFTWARE
- **MARKET AND TECHNOLOGY REPORT** – by Yole Développement
  - Consumer Biometrics: Sensors & Software 2018 – Update
  - Processing Hardware and Software for AI 2018 - Vol. 1 & 2
  - Embedded Software in Vision Systems 2017

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IMAGING & OPTOELECTRONICS

- **MARKET AND TECHNOLOGY REPORT** – by Yole Développement
  - Status of the Compact Camera Module and Wafer Level Optics
  - Industry 2018 – Update
  - 3D Imaging and Sensing 2018 – Update
  - Sensors for Robotic Vehicles 2018
  - Machine Vision for Industry and Automation 2018
  - Imagers and Detectors for Security and Smart Buildings 2018
  - Uncooled Infrared Imagers 2017

- **PATENT ANALYSES** – by KnowMade
  - iPhone X Dot Projector – Patent-to-Product Mapping

- **LINKED REPORTS** – by Yole Développement, System Plus Consulting and KnowMade
  - Status of the CMOS Image Sensor Industry 2018 – Market & Technology Report - Update
  - CMOS Image Sensors Monitor 2018 – Quarterly Update
  - Camera Module 2017 – Market & Technology Report
  - LiDARs for Automotive and Industrial Applications 2018 – Market & Technology Report
  - LiDAR for Automotive 2018 – Patent Landscape Analysis

ADVANCED PACKAGING

- **MARKET AND TECHNOLOGY REPORT** – by Yole Développement
  - Status of Advanced Packaging Industry 2018 – Update
  - Status of Advanced Substrates 2018: Embedded Die and Interconnects, Substrate Like PCB Trends
  - 3D TSV and Monolithic Business Update 2018 – Update
  - Power Modules Packaging 2018 – Update
  - Discrete Power Packaging 2018 – Update
  - Status of Panel Level Packaging 2018
  - Trends in Automotive Packaging 2018
  - Hardware and Software for AI 2018 - Vol. 1 & 2
  - Integrated Passive Devices (IPD) 2018
  - Thin-Film Integrated Passive Devices 2018
  - Memory Packaging Market and Technology Report 2018 – Update

- **PATENT ANALYSES** – by KnowMade
  - Hybrid Bonding for 3D Stack – Patent Landscape Analysis

- **LINKED REPORTS** – by Yole Développement and System Plus Consulting
  - Advanced RF System-in-Package for Cellphones 2018 – Market & Technology Report - Update
  - Fan-Out Packaging 2018 – Market & Technology Report – Update

MANUFACTURING

- **MARKET AND TECHNOLOGY REPORT** – by Yole Développement
  - Wafer Starts for More Than Moore Applications 2018
  - Equipment for More than Moore: Technology & Market Trends for Lithography & Bonding/Debonding 2018
  - Polymeric Materials for wafer-level Advanced Packaging 2018
  - Laser Technologies for Semiconductor Manufacturing 2017
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- MARKET AND TECHNOLOGY REPORT – by Yole Développement
  - Emerging Non Volatile Memory 2018 – Update
  - Memory Packaging Market and Technology Report 2018 – Update
- QUARTERLY UPDATE – by Yole Développement**
  - Memory Market Monitor 2018 (NAND & DRAM)
- MONTHLY UPDATE – by Yole Développement**
  - Memory Pricing Monitor 2018 (NAND & DRAM)
- REVERSE ENGINEERING & COSTING REVIEW – by System Plus Consulting
  - DRAM Technology & Cost Review 2018
  - NAND Memory Technology & Cost Review 2018
- PATENT ANALYSES – by KnowMade
  - 3D Non-Volatile Memories – Patent Landscape

COMPOUND SEMICONDUCTORS
- MARKET AND TECHNOLOGY REPORT – by Yole Développement
  - Status of Compound Semiconductor Industry 2018*
  - GaAs Materials, Devices and Applications 2018
  - InP Materials, Devices and Applications 2018
  - Bulk GaN Substrate Market 2017
- LINKED REPORTS – by Yole Développement, System Plus Consulting and KnowMade
  - SiC Transistor Comparison 2018 – Structure, Process & Cost Report
  - Power SiC 2018 – Patent Landscape Analysis
  - GaN-on-Silicon Transistor Comparison 2018 – Structure, Process & Cost Report

POWER ELECTRONICS
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  - Power Modules Packaging 2018 – Market & Technology Report – Update
  - Power ICs Market Monitor 2018 – Quarterly Update**

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  - Solid State Electrolyte Battery 2018 – Market & Technology Report
  - Solid-State Batteries 2018 – Patent Landscape Analysis

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SOLID STATE LIGHTING

- **MARKET AND TECHNOLOGY REPORT** – by Yole Développement
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  - LED Lighting Module Technology, Industry and Market Trends 2017
  - CSP LED Lighting Modules
  - Phosphors & Quantum Dots 2017 - LED Downconverters for Lighting & Displays
  - Horticultural Lighting 2017
- **LINKED REPORTS** – by Yole Développement and System Plus Consulting
  - VCSELs Comparison 2018 – Structure, Process & Cost Report

DISPLAYS

- **MARKET AND TECHNOLOGY REPORT** – by Yole Développement
  - Quantum Dots and Wide Color Gamut Display Technologies 2018 – Update
  - Displays and Optical Vision Systems for VR/AR/MR 2018
- **PATENT ANALYSES** – by KnowMade
  - MicroLED Display – Patent Landscape Analysis

MEDTECH

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- Microfluidic Technologies for Diagnostic Applications – Patent Landscape 2017
- FLUIDIGM – Patent Portfolio Analysis 2017
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- Circulating Tumor Cell Isolation – Patent Landscape
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- RF Acoustic Wave Filters Patent Landscape Analysis
- NMC Lithium-Ion Batteries Patent Landscape Analysis
- Pumps for Microfluidic Devices Patent Landscape
- III-N Patent Watch
- FLUIDIGM Patent Portfolio Analysis
- Knowles MEMS Microphones in Apple iPhone 7 Plus Patent-to-Product Mapping 2017
- Consumer Physics SCiO Molecular Sensor Patent-to-Product Mapping
- Patent Licensing Companies in the Semiconductor Market - Patent Litigation Risk and Potential Targets
- Microfluidic Technologies for Diagnostic Applications Patent Landscape

TEARDOWN & REVERSE COSTING – by System Plus Consulting
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Contact: Camille Veyrier (veyrier@yole.fr), Marketing & Communication Project Manager
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- **Ivan Donaldson**, VP of Financial Market Development
  Email: ivan.donaldson@yole.fr - +1 208 850 3914

GENERAL

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- Email: info@yole.fr - +33 4 72 83 01 80