

## INDUSTRY OVERVIEW

*Certain information and statistics set out in this section and elsewhere in this document are derived from various official government and other publicly available sources, and from the market research report prepared by Frost & Sullivan, an independent industry consultant which was commissioned by us (the “Frost & Sullivan Report”). No independent verification has been carried out on the information from official government sources by us, the Sole Sponsor, the [REDACTED], the [REDACTED], the [REDACTED], the [REDACTED], the [REDACTED], the [REDACTED] or any other parties (other than Frost & Sullivan) involved in the [REDACTED] or their respective directors, officers, employees, advisers, or agents, and no representation is given as to the accuracy. Unless and except for otherwise specified, the market and industry information and data presented in this “Industry Overview” section is derived from the Frost & Sullivan Report. The information and statistics contained in this section may not be consistent with other information and statistics compiled within or outside of China. As a result, you are advised not to place undue reliance on such information.*

## SOURCES OF INFORMATION

We have commissioned Frost & Sullivan, an independent market research and consulting company, to conduct an analysis of, and to prepare a report on China’s IC industry. The report prepared by Frost & Sullivan for us is referred to in the document as the Frost & Sullivan Report. We have agreed to pay a total fee of RMB580,000 to Frost & Sullivan for the preparation of the Frost & Sullivan Report, which we believe reflects market rates for reports of this type. Frost & Sullivan is a global consulting company founded in 1961 in New York and has over 40 global offices with more than 3,000 industry consultants, market research analysts, technology analysts and economists.

During the preparation of the market research report, Frost & Sullivan performed both (i) primary research, which involved in-depth interviews with leading industry participants and industry experts; and (ii) secondary research, which involved review of company reports, independent research reports and data based on Frost & Sullivan’s own research database. Projected data was obtained from historical data analysis plotted against macroeconomic data with reference to specific industry-related factors. Unless otherwise noted, all of the data and forecasts contained in this section are derived from the Frost & Sullivan Report, various official government publications and other publications.

In compiling and preparing the Frost & Sullivan Report, Frost & Sullivan has adopted the following assumptions (i) the social, economic, and political environment in China is expected to remain stable in the forecast period; (ii) industry key drivers are likely to drive China’s IC industry in the forecast period; and (iii) there is no extreme force majeure or unforeseen industry regulations in which the industry may be affected in either a dramatic or fundamental way.

Our Directors have confirmed that there has been no adverse change in the market situation since the date of the Frost & Sullivan Report which may qualify, contradict, or have impact on the information of this section.

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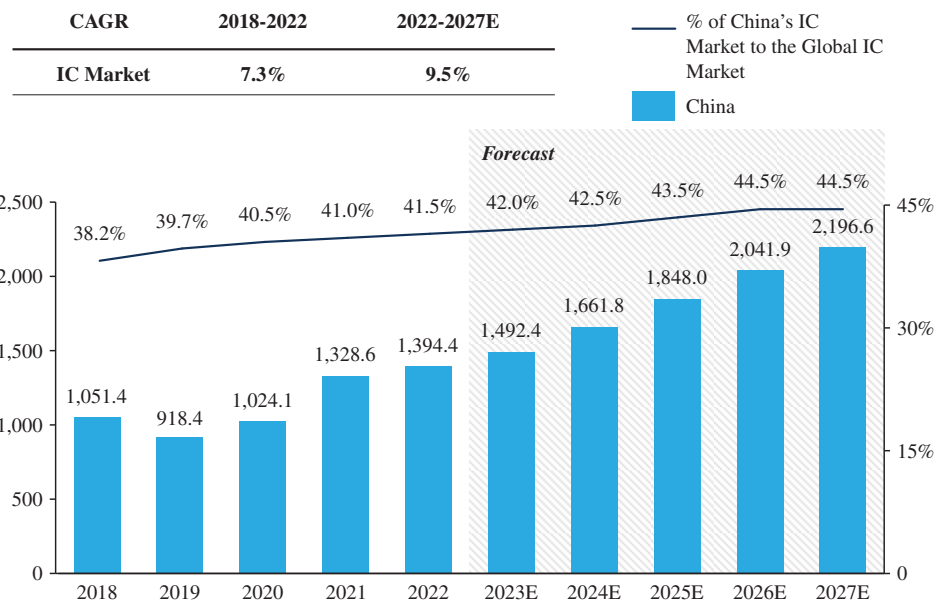
### THE IC MARKET IN CHINA

#### Overview

The integrated circuit, or IC, is a miniature electronic device or component that serves as the fundamental building block and central component of the global information technology industry. According to Frost & Sullivan, it is expected that in the next few years, along with the promotion of new technologies represented by 5G, Internet of Things and cloud computing, the market size of the IC market in China is projected to reach RMB2,196.6 billion by 2027, growing at a CAGR of 9.5% from 2022 to 2027. With the shift of the global IC market to China and the strong support of Chinese national policies and funding, the market share of China’s IC industry has accounted for a substantial portion of the global IC market, increasing from 38.2% in 2018 to 41.5% in 2022 and expected to reach 44.5% in 2027.

The following chart demonstrates the IC market size in China in terms of revenue, and the percentage of China’s IC market share to the global IC market:

**Market Size of the IC Industry in China, by Revenue**  
RMB in Billions, 2018-2027E



Source: Frost & Sullivan Report

Note:

- (1) The market size is measured by aggregating the total revenue generated from various IC products.

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### Value Chain of the IC Industry

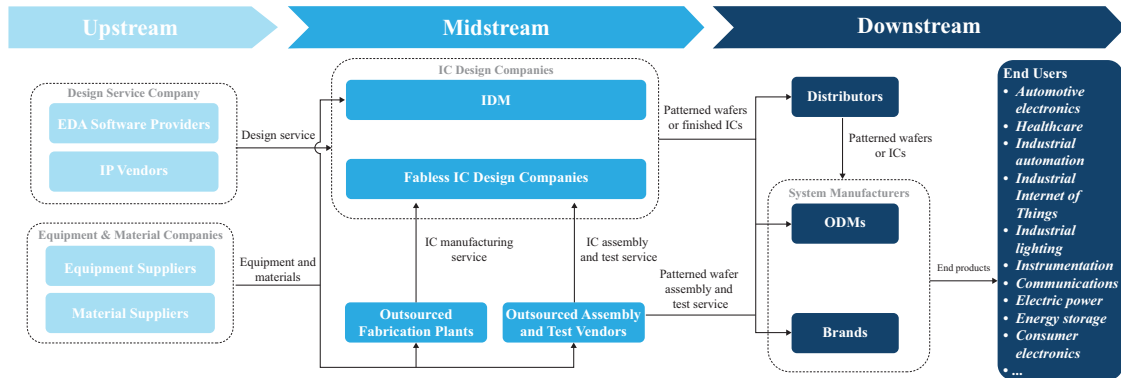
According to Frost & Sullivan, the upstream market players on the value chain of the IC industry are service and solution providers of supporting technologies and tools, including EDA software (a specialized software developed for IC design), IP module (intellectual property module, which, in the context of IC design, refers to a reusable and verified IC layout design with a defined function), IC equipment and IC materials. The midstream market players on the value chain include companies engaging in IC design, IC manufacturing and IC assembly and test, covering the core stages of the IC industry. IC design companies typically consist of companies operating with an IDM model, where they are involved in the whole process of design, manufacturing, packaging, testing and subsequent sales of the finished products, and a fabless model, where they produce their own designs of IC products and outsource IC manufacturing to foundries. The downstream market players on the value chain are distributors, system manufacturers and end users. Major end users include companies engaging in consumer electronics, industrial automation and instrumentation, energy management, automotive and others, as well as individual consumers.

In addition to direct purchasing products from IC design companies, certain downstream market players, such as system manufacturers who use IC products to further produce end products, may purchase from specialized IC distributors given their capabilities to provide one-stop IC supply solutions. IC distributors normally maintain an extensive portfolio of IC products, and are able to provide after-sales or other related services to support their customers' product management. Moreover, due to the numerous types of IC products and their broad range of application scenarios (in particular, analog IC products) and considering the high transaction costs arising from the direct sale business model of IC companies, it is common in the industry for IC design companies to cooperate with IC distributors for sales and marketing of their products, according to Frost & Sullivan.

The IC distributor market in China is highly fragmented, with the top ten market players accounting for approximately 6.0% in terms of revenue in 2022, according to Frost & Sullivan. There are numerous large-scale multinational and national IC distributors who generally focus on the distribution of comprehensive IC products, and also other smaller, specialized distributors who generally focus on narrower markets or particular sectors. As a result, the distributorship model itself does not intensify competition among IC design companies, according to Frost & Sullivan. Despite that the ability to establish stable business partnerships with industry-leading IC distributors is essential to an IC design company, the key to its overall competitiveness still lies in the strengths of its products.

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The following chart illustrates the major market players on the entire value chain of the IC industry:



Source: Frost & Sullivan Report

### ***IC Design: Component with High Economic Value in the IC Industry***

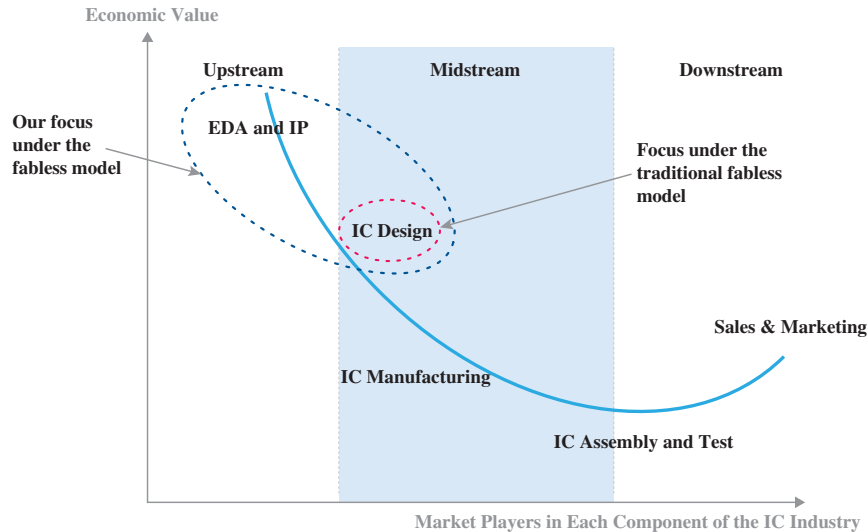
According to Frost & Sullivan, the economic value of each component of the IC industry is defined as the average profitability and efficiency of generating profits of market players in each component. Return-on-equity (ROE) is considered a reasonable metric to measure such profitability and efficiency of generating profits. Over the past two years, the ROE of EDA and IP service providers has been around 30%, IC design companies’ ROE has been around 24%, IC manufacturers’ ROE has been around 20%, assembling and testing companies’ ROE has been around 15% and distributors’ ROE has been around 18%, according to Frost & Sullivan. IC design is at the core of the entire value chain with high economic value in that it directly affects the performance of IC products. Therefore, companies operating with a fabless model usually achieve higher profitability than most of the other market players on the value chain. According to Frost & Sullivan, the average gross profit margin for the world’s ten largest\* fabless companies in 2022 was 53.7%, slightly more profitable than the world’s ten largest\* IDM companies, the latter of which reached 51.4% in the same year.

\* The world’s ten largest fabless/IDM companies were determined in terms of revenue in 2022.

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The following chart illustrates the economic value of market players in each component of the IC industry:

### Economic value of market players in each component of the IC industry



Source: Frost & Sullivan Report

According to Frost & Sullivan, the economic value of EDA and IP service providers is the highest among all market players in the IC industry, as EDA software and IP modules are critical and lay the foundation to IC design. Followed by IC design companies, the economic value of which is also high as IC design directly affects the performance of IC products. The economic value of IC manufacturers is slightly lower than that of IC design companies but higher than that of distributors, because IC manufacturing capabilities are also essential to the completion and subsequent sales of IC products. Assembling and testing companies have the lowest economic value, because the assembling and testing processes have limited add-on value and do not have high requirements of specific technical skills. Our fabless model and our possession of the only full-stack analog IC design platform in China that has achieved technical breakthroughs in both EDA software and IP module design have collectively enabled us to take up the two components with the highest economic value in the entire value chain.

### ***EDA and IP: Cornerstones to IC Design***

Given the complexity of IC design, EDA software that enables electronic computer-aided design and simulation of layout, and IP modules that can be incorporated into layout to achieve specific functions, are cornerstones to IC design companies.

- *EDA underpins IC design by providing essential support.*

The significance of EDA tools lies in their ability to guarantee design accuracy, enhance performance of designed products, and shorten both IC design cycles and product testing and verification periods.

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In recent years, due to the significant advancements in AI and related technologies, IC design process has transitioned towards a smarter, more automated direction. By employing intelligent and automated EDA software, IC design engineers can now accomplish their goals more efficiently with a higher degree of precision. As the pace of development of the analog EDA market lags behind that of digital EDA market, more opportunities are created. Meanwhile, in the absence of timely and individual support from third-party EDA vendors, self-developed EDA is crucial to rapidly adapting to changes in downstream customers’ demand.

- *IP is an integral component of IC design.*

By incorporating multiple IP modules into complex ICs, design engineers can circumvent the need for repetitive work, effectively shorten design cycles and boost IC design success rates. In addition, as different IP modules with multiple functionalities are developed from and will be adapted to manufacturing processes, IC design companies can align their design with foundries’ manufacturing processes, achieving products with optimal performance and high reliability and efficiency.

In the long run, low-cost, standardized IC designs depend on the long-term development of essential and foundational IP technologies. By possessing a diverse and comprehensive IP portfolio, IC design companies can expand their design capabilities. This, in turn, allows them to provide downstream customers with a wider range of choices and ultimately strengthens their competitive position in the market.

With the continuous evolution and increasing importance of EDA and IP, IC design companies, especially analog IC design companies equipped with self-developed EDA tools and profound IP modules, will be highly valued.

### **Market Segmentation**

In terms of downstream demand for IC products, the IC market in China can be further segmented by delivery forms (including patterned wafers and finished ICs) and types (including digital ICs and analog ICs).

#### ***Segmentation by Delivery Form: Patterned Wafers and Finished ICs***

Patterned wafers are wafers with built-on circuits that become finished ICs after packaging and testing processes. Compared to traditional IC design companies that typically provide finished ICs, patterned wafer suppliers cater to the flexible needs of downstream customers. These downstream customers primarily consist of small- to medium-scale IC design companies or system integrators.

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In recent years, there has been a market trend among the downstream customers shifting their demand from finished ICs to patterned wafers. Such trend mainly arise from the following reasons:

- *Increase the efficiency in launching finished IC products.* It is time-costly and expensive for small- to medium-scale IC design companies to rely on their in-house design team for design and development of IC products and communication of complicated parameter requirements of manufacturing processes with foundries, especially considering the diversified types of products and small demand of a single type of product in the long-tail analog IC sector. By purchasing patterned wafers with built-on circuits, IC design companies with limited design capacity and operational scale are able to focus on provision, sales and marketing of their self-branded finished IC products in an efficient and effective manner.
- *Provide flexible packaging and assembling options.* System integrators use bare dies that are derived from patterned wafers. With advanced packaging technologies, such as SiP or CoB, patterned wafers of different functions can be packaged in a single IC, maintaining a smaller size while reaching higher integration level. Therefore, system integrators purchase patterned wafers rather than finished ICs for flexibility in their subsequent assembly and test and prevention of repeated packaging wastes. Moreover, the assembly and test processes are standardized and inexpensive. System integrators can increase their competitiveness in the price-sensitive market as they lower their costs by purchasing patterned wafers instead of finished ICs.
- *Achieve customized functions.* Patterned wafers are chiplet-ready. They can be fabricated into small, modular chips that can be combined to form a more complex chip. This provides downstream customers with possibilities to achieve their customized functions, giving them more design flexibility and optimizing their products' performance.

According to Frost & Sullivan, the add-on value of packaging and testing processes does not have a comparably high add-on value of design process. This results in a lower gross profit margin of a finished IC product in spite of its slightly higher selling price, as compared to a patterned wafer.

### *Segmentation by Type: Digital ICs and Analog ICs*

Digital ICs are specifically designed to process digital signals, the operations of which are based on digital logic. Digital ICs are used in applications that have well defined signals – high and low. These two working states tend to represent binary data. Digital circuits manipulate the input signals to get the desired outcome. Digital ICs can perform a wide variety of functions, including data storage, data processing, and data communication. Examples of digital ICs include microprocessors, memory chips, and application-specific integrated circuits (ASICs). Compared to digital ICs that process binary digital signals, analog ICs process continuous physical analog signals observed in the nature, enabling them to work with varying signal

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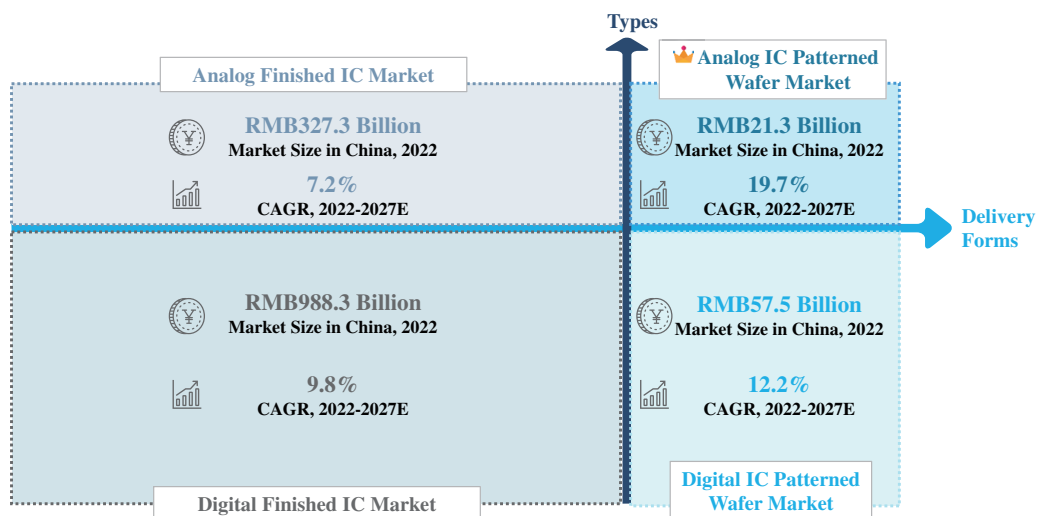
levels. Analog ICs are used in applications where the signals are continuous and can change instantaneously. The parameters of these signals such as amplitude and frequency keep changing. Analog ICs are used to amplify, filter, or otherwise manipulate real world signals. Examples of analog ICs include operational amplifiers (op-amps), analog-to-digital converters (ADCs), and digital-to-analog converters (DACs). As digital ICs and analog ICs are used in different applications for different purposes and operate in different ways, there is no overlapping, competition, or replacement relationships between them, according to Frost & Sullivan.

The design of digital ICs and analog ICs are substantially different. When designing digital ICs, engineers focus on constantly enhancing computational capabilities by increasing the number of logic gates and boosting integration levels. Conversely, analog IC design revolves around the actual circuit layout, which involves fine-tuning and making trade-offs based on specific product requirements. As such, well functioned supporting tools for analog IC design, such as EDA software and IPs, are more scarce than those for digital IC design, leading to a more heavily reliance on manual input and skilled engineers in analog IC design.

### Our Market Position in the IC Industry in China

We have placed a strong emphasis on the analog IC patterned wafer market, which represents a key area of growth at the intersection of the patterned wafer and analog IC markets. According to Frost & Sullivan, the analog IC patterned wafer market in China will experience significant and consistent expansion from 2022 to 2027. The size of the analog IC patterned wafer market in China is expected to reach RMB52.2 billion by 2027 at a notable CAGR of 19.7% from 2022 to 2027, significantly exceeding the pace of development of the other three sub-markets in the IC industry in China.

The following chart illustrates the market size and expected growing pace of all the four sub-markets in the IC industry in China:



Source: Frost & Sullivan Report



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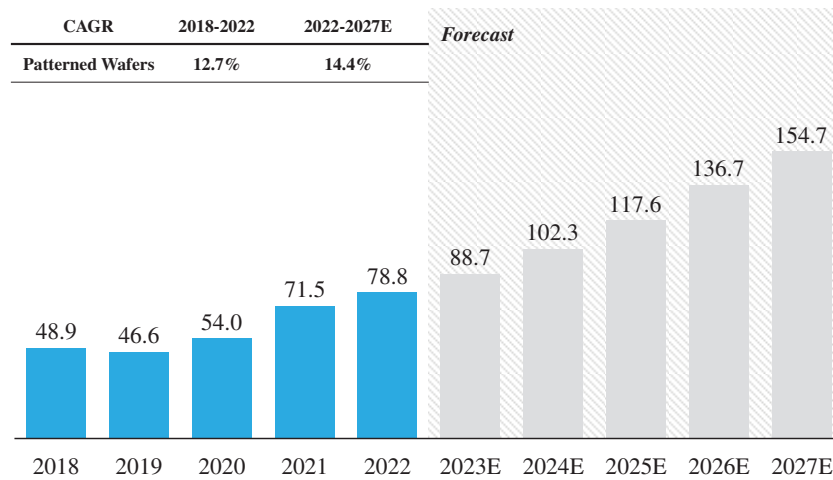
### THE PATTERNED WAFER MARKET IN CHINA

#### Overview

According to Frost & Sullivan, the patterned wafer market in China has become an emerging trend, benefiting from substantial market demands and favorable industry policies. The size of the patterned wafer market in China has grown from RMB48.9 billion in 2018 to RMB78.8 billion in 2022 at a CAGR of 12.7% from 2018 to 2022, and is expected to reach RMB154.7 billion by 2027 at a CAGR of 14.4% from 2022 to 2027.

The following chart shows the market size of patterned wafers in China:

**Market Size of Patterned Wafers in China, by Revenue  
RMB in Billions, 2018-2027E**



Source: Frost & Sullivan Report

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### Competitive Landscape of the Patterned Wafer Market in China

The patterned wafer market in China is highly fragmented, composed of a large number of small to medium scaled patterned wafer providers. According to Frost & Sullivan, in 2022, we ranked the fourth among all companies of the patterned wafer market in China in terms of revenue, accounting for a market share of approximately 0.4%. The following chart demonstrates the revenue and market share of the top five companies of the patterned wafer market in 2022:

#### Top 5 Companies of the Patterned Wafer Market in China, by Revenue

Ranking	Market Player	Revenue in 2022 (RMB in millions)	Market Share
1	Company A <sup>(1)</sup>	618.8	0.8%
2	Company B <sup>(2)</sup>	473.1	0.6%
3	Company C <sup>(3)</sup>	412.3	0.5%
4	BaTeLab (貝克微)	352.5	0.4%
5	Company D <sup>(4)</sup>	330.1	0.4%

Source: Frost & Sullivan Report

Notes:

- (1) Company A is a global semiconductor company headquartered in the U.S. and listed on the NASDAQ in 1985. It operates with a fabless model to design various ICs.
- (2) Company B is a global semiconductor company headquartered in the U.S. and listed on the NASDAQ in 1971. It operates with a fabless model to design various ICs.
- (3) Company C is a global semiconductor company headquartered in the U.S. and listed on the NASDAQ in 2012. It operates with an IDM model to design and manufacture semiconductors and various ICs.
- (4) Company D is a global semiconductor company headquartered in the South Korea and listed on the Korea Stock Exchange. It operates with an IDM model to design and manufacture semiconductors and various ICs.

The unnamed competitors in the above and following charts include (in alphabetical order): 3PEAK Inc., Ltd., Hangzhou Silan Microelectronics Co., Ltd., Intel Corporation, Joulwatt Technology Co., Ltd., NOVOSENSE Microelectronics, Qualcomm Technologies, Inc., SG Micro Corp, SK Hynix Semiconductor Inc., STMicroelectronics N.V. and Texas Instruments Inc.

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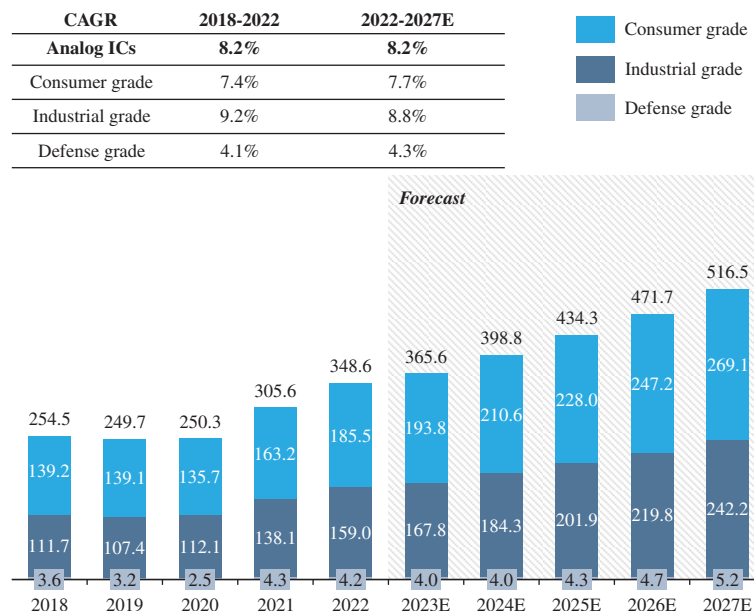
### THE ANALOG IC MARKET IN CHINA

#### Overview

According to Frost & Sullivan, China has the largest market for analog ICs. Driven by the end market applications, the analog IC market in China is growing rapidly. The market size of the analog IC market in China increased from RMB254.5 billion in 2018 to RMB348.6 billion in 2022 at a CAGR of 8.2% from 2018 to 2022, and is expected to reach RMB516.5 billion in 2027 at a CAGR of 8.2% from 2022 to 2027. Analog ICs can be roughly divided into three categories, namely consumer grade, industrial grade and defense grade. Consumer grade ICs are ICs that can work at a range of temperature conditions from 0°C to 70°C. They are designed for products of daily-use consumer electronics, such as smartphones, televisions, and laptops. Industrial grade ICs are ICs that can work at a range of temperature conditions from -40°C to 85°C. They are designed for use in a wide range of industrial application scenarios, and normally have a better performance in quality and reliability than consumer grade ICs. Defense grade ICs are ICs that can work at a range of temperature conditions from -55°C to 125°C. They are designed for use in military applications, such as radars, communication systems and weapon systems. The harsh use scenarios place the highest requirements on defense grade ICs. Compared to the other categories, industrial grade analog IC market grows at the fastest pace from 2018 to 2022 and from 2022 to 2027, respectively, demonstrating great potentiality.

The following chart demonstrate the market size of analog ICs in China:

**Market Size of Analog ICs in China, by Revenue**  
**RMB in Billions, 2018-2027E**



Source: Frost & Sullivan Report

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### The Industrial Grade Analog IC Market in China

#### Overview

The industrial grade ICs are typically used for specific applications, including automotive electronics, healthcare, industrial automation, industrial Internet of Things, industrial lighting, instrumentation, communications, electric power, energy storage and consumer electronics sectors, which require high performance, durability, and stability under harsh conditions. Benefiting from the trend of intelligent automation and digital transformation in industrial applications, the demand for industrial grade analog ICs is expected to boost, leading to a growing market size. According to Frost & Sullivan, the market size of the industrial grade analog IC market in China reached RMB159.0 billion in 2022, and is expected to reach RMB242.2 billion by 2027 at a CAGR of 8.8%.

#### Competitive Landscape of the Industrial Grade Analog IC Market in China

The industrial grade analog IC market in China is relatively fragmented, characterized by a large number of market players. According to Frost & Sullivan, we ranked the fifth among all fabless companies in China of the industrial grade analog IC market in terms of revenue in 2022, accounting for a market share of approximately 0.5%. As the market demand continues to grow, it is anticipated that future integration will give rise to the market share of core market players with significant capabilities.

The following chart shows the revenue and market share of the top five fabless companies of the industrial grade analog IC market in terms of revenue in 2022:

#### Top 5 Fabless Companies of the Industrial Grade Analog IC Market in China, by Revenue

Ranking	Market Player (Fabless Model)	Revenue in 2022 (RMB in millions)	Market Share
1	Company E <sup>(1)</sup>	1,148.3	1.7%
2	Company F <sup>(2)</sup>	1,089.1	1.6%
3	Company G <sup>(3)</sup>	916.8	1.4%
4	Company H <sup>(4)</sup>	451.2	0.7%
5	BaTeLab (貝克微)	352.5	0.5%

Source: Frost & Sullivan Report

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*Notes:*

- (1) Company E is a semiconductor company headquartered in China and listed on the SSE STAR Market in 2020. It operates with a fabless model to design various ICs.
- (2) Company F is a semiconductor company headquartered in China and listed on the SSE STAR Market in 2022. It operates with a fabless model to design various ICs.
- (3) Company G is a semiconductor company headquartered in China and listed on the SSE STAR Market in 2022. It operates with a fabless model to design various ICs.
- (4) Company H is a semiconductor company headquartered in China and listed on the Shenzhen Stock Exchange ChiNext in 2017. It operates with a fabless model to design various ICs.

According to Frost & Sullivan, we enjoy obvious competitiveness in technical capabilities, especially in-depth capabilities in automated IC design, product category coverage and downstream application coverage, as compared to other market players in China. The following graph shows a comparison of core capabilities of leading industrial grade analog IC design companies operating with a fabless model in China:

### Core Capabilities of Leading Industrial Grade Analog IC Design Companies (Fabless) in China

	Company E	Company F	Company G	Company H	BaTeLab (貝克微)
Automated IC Design Capabilities <sup>(1)</sup>					
Number of Patents and Proprietary Rights					
Product Category Coverage of Industrial-grade Analog ICs					
Downstream Application Coverage of Industrial-grade Analog ICs					

Most competitive  
 Least competitive

*Note:*

- (1) Automated IC design capabilities typically include capabilities that can realize efficient standardized design of analog IC products, such as EDA software and IP modules.

Source: Frost & Sullivan Report

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According to Frost & Sullivan, we have robust automated IC design capabilities as compared to our competitors due to our proprietary EDA software and IP modules. We have built the only full-stack analog IC design platform in China that has achieved technical breakthroughs in both EDA software and IP module design, according to Frost & Sullivan. See “Business – Our Analog IC Design Platform” for details. Moreover, we possess a comprehensive IP coverage. As of the Latest Practicable Date, we possessed over 300 patents and proprietary rights of IC layout design, while two of our major competitors possessed approximately 700 to 1,000 patents and proprietary rights of IC layout design, and the other two major competitors possessed approximately 180 to 300 patents and proprietary rights of IC layout design. Overall, we stand out among major industrial grade analog IC design companies in China in terms of core design capabilities.

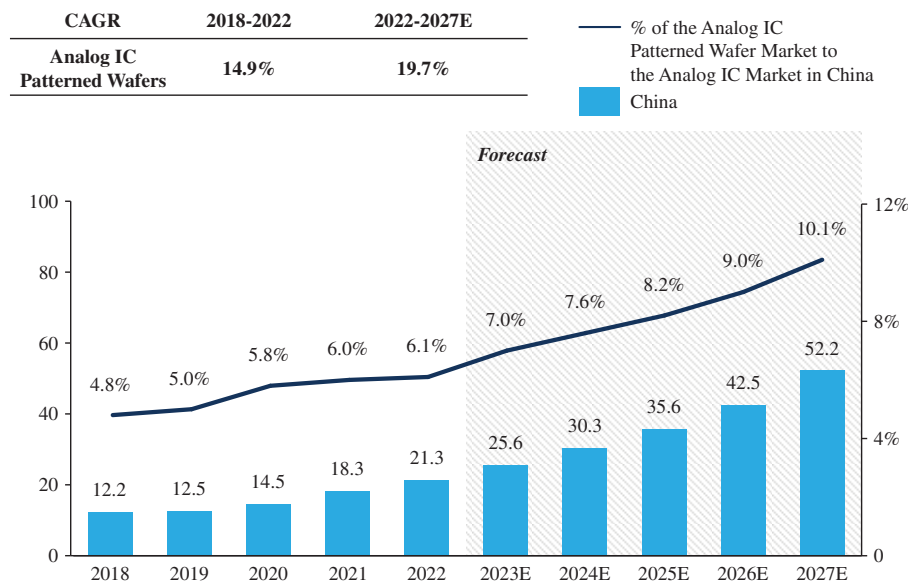
### THE ANALOG IC PATTERNED WAFER MARKET IN CHINA

#### Overview

Benefiting from substantial market demands and favorable industry policies, the analog IC patterned wafer market in China demonstrates a positive development trend and steadily growing market scale due to the long lifecycle and dispersed application scenarios of analog IC patterned wafers. According to Frost & Sullivan, the market size of the analog IC patterned wafer market in China has grown from RMB12.2 billion in 2018 to RMB21.3 billion in 2022 at a CAGR of 14.9% from 2018 to 2022, and is expected to reach RMB52.2 billion by 2027 at a CAGR of 19.7% from 2022 to 2027. Furthermore, the proportion and significance of the analog IC patterned wafer market among the entire analog IC market in China has continued to increase, accounting for 4.8% in 2018 and is expected to reach 10.1% in 2027.

The following chart illustrates the market size of analog IC patterned wafers in China:

**Market Size of Analog IC Patterned Wafers in China, by Revenue  
RMB in Billions, 2018-2027E**



Source: Frost & Sullivan Report

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### Competitive Landscape of the Analog IC Patterned Wafer Market in China

Frost & Sullivan has advised that it has taken into consideration all companies, whether domestic or international, that provide analog IC patterned wafers in China in preparing the competitive landscape. According to Frost & Sullivan, we enjoy a prominent position in the analog IC patterned wafer market in China, ranking the first in terms of revenue generated from analog IC patterned wafers in 2022 with a market share of 1.7%. The analog IC patterned wafer market in China is a relatively fragmented market, with the aggregate market share of the top five companies accounting for only 5.0% in 2022. Small scaled patterned wafer providers may fail to meet the increasing demands of downstream customers arising from the more and more diverse use scenarios of patterned wafers, enabling the top players in the market to achieve significant first mover advantages. As a result, the market share of leading companies is expected to further expand.

The following chart shows the revenue and market share of the top five analog IC patterned wafer companies in China:\*

#### Top 5 Analog IC Patterned Wafer Companies in China, by Revenue

Ranking	Market Player	Revenue in 2022 (RMB in millions)	Market Share
1	BaTeLab (貝克微)	352.5	1.7%
2	Company C <sup>(1)</sup>	263.1	1.2%
3	Company I <sup>(2)</sup>	149.6	0.7%
4	Company E <sup>(3)</sup>	147.6	0.7%
5	Company J <sup>(4)</sup>	139.5	0.7%

Source: Frost & Sullivan Report

\* In preparing the competitive landscape of analog IC patterned wafer market in China, Frost & Sullivan has taken into account the direct and indirect competitions from other sub-markets in the IC industry and the imported products in the global IC markets to the extent applicable. IC products of different functions and application scenarios have different specifications and are irreplaceable, and only those products with the same functions and application scenarios can compete, directly or indirectly, with each other. Frost & Sullivan has not taken into account the companies providing products with fundamentally different specifications or functions from those of our products (such as the companies focusing on the design of digital ICs only), or different delivery forms (such as the companies focusing on providing chip products only), but has taken into account all companies, whether domestic or international, that provide analog IC patterned wafers. Frost & Sullivan further advises that, in preparing the competitive landscape of industrial grade analog ICs in China, it has taken into account all companies, whether domestic or international, that provide industrial grade analog ICs (including patterned wafers and chip products), due to the overlap of downstream customers of these products to a certain extent. See “– The Analog IC Market in China – The Industrial Grade Analog IC Market in China – Competitive Landscape of the Industrial Grade Analog IC Market in China.”

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*Notes:*

- (1) Company C is a global semiconductor company headquartered in the U.S. and listed on the NASDAQ in 2012. It operates with an IDM model to design and manufacture semiconductors and various ICs.
- (2) Company I is a global semiconductor company headquartered in Switzerland and listed on the Euronext Paris in 1994. It operates with an IDM model to design and manufacture semiconductors and various ICs.
- (3) Company E is a semiconductor company headquartered in China and listed on the SSE STAR Market in 2020. It operates with a fabless model to design various ICs.
- (4) Company J is a semiconductor company headquartered in China and listed on the Shanghai Stock Exchange in 2003. It operates with an IDM model to design and manufacture semiconductors and various ICs.

### **Market Drivers of the Analog IC Patterned Wafer Market in China**

#### ***Surge in IC Design Companies in China Driving Growth in the Analog IC Patterned Wafer Market***

IC design companies play a vital role in the downstream market of analog IC patterned wafers. According to Frost & Sullivan, in 2022, the self-sufficiency rate of analog IC in China was only 13%. This presents significant potential for domestic analog IC design companies to step in and substitute imports to meet downstream customers’ increasing demands. The Chinese government has also launched a series of favorable policies to encourage the development of IC design companies and the localization of IC products. These policies include regular tax benefits applicable to companies engaging in IC design, and industry promotion and support to IC design and electronics companies. Specifically, the 14th Five-Year Plan for National Informatization (《“十四五”國家信息化規劃》) promulgated by the Central Cyberspace Affairs Commission in December 2021 promotes the innovation and acceleration, among others, of IC design tools. The Announcement on Enterprise Income Tax Policies for the Integrated Circuit Design and Software Industries (《關於集成電路設計和軟件產業企業所得稅政策的公告》) promulgated by the MOF and STA in May 2019 includes tax exemptions and preferential taxes for IC design companies that meet certain conditions for a maximum of five years. The Three-Year Action Plan for Expanding and Upgrading Information Consumption (2018-2020) (《擴大和升級信息消費三年行動計劃(2018-2020年)》) issued by the NDRC and the MIIT in August 2018 supports and encourages the development of intelligent EVs, among others, and further promotes the R&D of key technologies and products in the designing and manufacturing processes, such as automotive ICs and autonomous driving operating systems. Driven by such demand along with supportive industry funding and favorable government policies, the number of IC design companies in China has grown rapidly over the past few years. As domestic IC design companies who cannot afford high R&D costs tend to cooperate with patterned wafer suppliers in the course of product development instead of performing in-house IC design to maintain a more efficient operation, the demand for analog IC patterned wafers correspondingly rises, making domestic analog patterned wafer providers more popular among downstream customers.



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### *Patterned Wafers Effectively Meeting Flexible Packaging Demand*

Advanced packaging technologies have emerged in recent years as new ways to continue improving the performance and functionality of ICs. As packaging technology continues to evolve, advanced packaging techniques such as SiP and CoB have become more widely used. Compared to traditional packaging methods that use pin connections, SiP and CoB are mainly processed on wafers. These technologies enable the integration of multiple unpackaged dies sliced from patterned wafers with diverse functions into a single package, providing significant benefits in terms of power consumption, performance, and form factor. Downstream customers who adopt these packaging techniques can avoid repetitive packaging of components and reduce production costs by purchasing patterned wafers. Furthermore, these techniques enable greater control over IC manufacturing process, leading to improved quality and consistency of the finished IC products, and in turn leading to an increasing demand for patterned wafers.

### *Development of New Industries and Electric Trends Boosting Analog IC Patterned Wafer Market*

With the development of new industries such as big data, the Internet of Things, electric vehicles, cloud computing and 5G communication, demand for electronic devices is expected to rapidly increase in both quantity and variety. Industrial grade analog ICs, due to their reliable performance at a wide range of temperatures, are being increasingly applied in different downstream applications. In the future, with the explosion of demand in these emerging application fields, the analog IC patterned wafer industry is expected to maintain a high momentum in the medium and long run. In specific, the rising application of automotive electrification and the increasing demand for industrial energy conservation are expected to lead the upgrading of analog IC patterned wafers. The ongoing transition towards electrification in the automotive industry is expanding the application limits of analog ICs in this field, subsequently increasing their value per vehicle. As new energy vehicles continue to gain popularity and industries undergo digital transformation, the analog IC patterned wafer market, especially industrial grade analog IC segments, is likely to experience an upward trend.

### **Entry Barriers of the Analog IC Patterned Wafer Market in China**

#### *Design Efficiency Leading to Strong Competitive Edges*

In the highly fragmented market of analog IC patterned wafers, design efficiency is a key element for the market players to maintain their competitive advantages. Gaining self-sufficiency and control over core technologies, such as EDA and IP, is vital for IC design companies in order to boost design efficiency and establish a strong competitive edge. By deepening their technical expertise and mastery, these companies can make low-cost and standardized IC design more feasible, ultimately catering to a diverse range of user requirements more effectively.

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### ***First Mover Advantages in Forming Economies of Scale***

Downstream customers in the analog IC patterned wafer market tend to choose reliable, industry-leading suppliers due to the long lifecycle nature of analog products. This leads to strong reluctance to switch patterned wafer suppliers. As a result, established leading companies with first mover advantages are better positioned to form economies of scale, which in turn enhances their overall competitiveness.

### ***Maintaining an Extensive and Versatile Product Portfolio***

The market of analog IC patterned wafers is quite diverse, encompassing a multitude of products with unique performance specifications designed for different application needs. It is essential for analog IC patterned wafer design companies, especially industrial grade analog IC patterned wafer design companies, to maintain an extensive and versatile product portfolio to address the wide-ranging requirements from their downstream customers. This diverse product offering not only helps meet downstream customers’ demands but also serves as a critical factor in maintaining a competitive edge in the market.

### ***Customer and Brand Recognition***

To ensure the successful market launch of products, support from existing customers is necessary, along with continuous expansion of new customers and sales channels to build brand recognition. Analog IC patterned wafer suppliers, especially industrial grade analog IC patterned wafer suppliers that can enter the downstream supply chain, have gone through a long process of selection and brand recognition building. It is very challenging for new entrants to be listed among the supplier candidates of downstream customers.

### ***Collaboration with Other Players in the Value Chain***

For analog IC patterned wafer design companies, the accumulation of resources from collaborating with other players in the value chain, including channel partners and foundries, is the foundation for survival and development. Wafer production lines with advanced processing technologies are relatively scarce. To ensure product quality, control costs, and maintain stable production capacity supply, analog IC patterned wafer design companies need to establish close relationships with major players in the value chain.

### **Future Trends of the Analog IC Patterned Wafer Market in China**

#### ***Growing Importance of EDA and IP for Analog IC Patterned Wafer Design Companies***

As market demand continues to change and technologies continue to upgrade, the ability for analog IC patterned wafers design companies to perform independent R&D activities is becoming increasingly important for their competitiveness. With such ability, analog IC patterned wafer design companies can provide cost-effective patterned wafer solutions, which is the key factor IC design companies will take into account when choosing patterned wafer

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providers. Analog IC patterned wafers design companies equipped with in-house EDA software and IP libraries can quickly improve design efficiency, thus reducing product development cycles and costs. As a result, it is expected that more and more analog IC patterned wafer design companies will choose to develop in-house EDA software and accumulate IP libraries so as to provide cost-effective solutions in an efficient manner.

### *Increasing Proportion of Industrial Grade Analog IC Patterned Wafers*

Recently, the application scenarios of analog IC patterned wafers are shifting from consumer electronics to high-performance sectors such as industrial and automotive. The competition in the consumer grade patterned wafer market is constantly intensifying, squeezing profit margins. Meanwhile, gross profit margins of industrial grade analog IC patterned wafer markets are expected to increase due to the high technology requirements in these sectors. The application scenarios of analog IC patterned wafers is anticipated to shift from the low-end consumer electronics market to the high-end industrial and automotive markets, leading to an increasing proportion of industrial grade products in the analog IC patterned wafer market.

### *Prominent Demand for Differentiated Patterned Wafer Design*

As new and diverse scenarios continue to emerge, scenario demands are becoming increasingly differentiated and personalized. Standardized patterned wafers are struggling to keep up with the specific requirements of these scenarios, such as high processing power or low power consumption, leading to limitations in their applications. As a result, more and more manufacturers are seeking differentiation through the procurement of customized patterned wafers.

## RAW MATERIAL PURCHASE PRICE IN THE ANALOG IC PATTERNED WAFER MARKET

### **Factors Affecting the Raw Material Purchase Price**

For companies operating with a fabless model, the raw material purchase price is that of untested foundry-manufactured patterned wafers. In recent years, untested patterned wafer purchase price, average selling price and gross profit margin of analog IC patterned wafers are impacted by the composition of several factors, including, among others, price of manufacturers’ direct raw materials (in particular, silicon wafers), specifications, parameters and processes of products, foundry’s capacity, and downstream application scenarios. The purchase price of untested patterned wafers is primarily affected by manufacture processes adopted by foundries that fabricate silicon wafers into ICs or patterned wafers with specific functions and application scenarios as well as the market demand of foundries’ manufacturing capacity. As a result, fluctuations in the price of manufacturers’ direct raw materials (i.e. silicon wafers) alone do not have a direct impact on the average selling price and gross profit margin of products in the analog IC patterned wafer market, especially for companies operating

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with a fables model who do not directly purchase raw materials for purposes of manufacturing. The fluctuations in the price of each of the factors above may have an impact on the average overall purchase price and average selling price of analog IC patterned wafer products.

### **Recent Trend of Raw Material Purchase Price**

According to Frost & Sullivan, the untested patterned wafer purchase price primarily depends on the specific manufacturing processes that fabricate silicon wafers into ICs with specific functions and application scenarios as well as the market demand of foundries' manufacturing capacity. Generally speaking, more complicated manufacturing processes adopted by foundries in accordance with the specific IC design requirements lead to higher prices of untested patterned wafers. A patterned wafer with more stringent requirements for size and integration level costs a higher purchase price. Therefore, the purchase price vary among companies with different product offerings in the industry. With the overall advancement in manufacturing process technologies in recent years, such price shows an upward trend. Specifically, the industry average raw material purchase price of untested foundry-manufactured analog IC patterned wafers was approximately RMB2,500 to RMB4,500 in 2020, RMB2,800 to RMB5,000 in 2021, and RMB3,000 to RMB5,300 in 2022, respectively, which was primarily due to (i) a switch in the downstream market demand from consumer grade IC products to industrial grade IC products (which have higher unit prices), and (ii) the overall shortage in manufacturing capacity from the second half of 2020 to the first half of 2021 due to the rapid growth in market demand for IC products. Although the shortage in manufacturing capacity has been eased since the second half of 2021, due to the continuous switch from consumer grade IC products to industrial grade IC products, the industry untested patterned wafer purchase price is expected to experience a slight increase in the next three years.

### **Recent Trend of Silicon Wafer Purchase Price**

According to Frost & Sullivan, the price of silicon wafers experienced an overall increase from 2020 to 2022. The purchase price of silicon wafers increased from US\$0.9 per square inch in 2020 to US\$1.0 per square inch 2021 and further to US\$1.3 per square inch in 2022. Due to weak demand and the consequent oversupply, the purchase price of silicon is expected to decrease from US\$1.3 per square inch in 2022 to US\$1.0 per square inch in 2023, and continue to decrease to US\$0.7 per square inch in 2024, according to Frost & Sullivan. Such oversupply is expected to last until 2025, with an expected purchase price of silicon wafers being US\$0.9 per square inch in 2025, according to Frost & Sullivan. However, due to an insignificant portion (typically no more than 4.5%) that the silicon wafer purchase price accounts for in the untested patterned wafer purchase price, the fluctuations in the price of silicon wafers do not have a material adverse impact on the purchase price of untested patterned wafers.