

## Editorial Introduction:

China's IC industry has been flourishing in recent years, huge market demand together with government investments are the major driving forces for this development. The status and development momentum of the Chinese IC industry also attracted wide interest and attention of international counterparts. A group of domestic IC experts are invited by the JoMM to write a series of articles about China's IC industry, including the history, current status, development, and related government policies. Information in these articles is all from public data from recent years. The purpose of these articles is to enhance mutual understanding between the Chinese domestic IC industry and international IC ecosystem.

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# Recent Progress of the Integrated Circuit Industry in China

## — Overview of the Manufacturing Industry

### 1. Introduction

At present, the global chip market is dominated by the U.S., Japanese and European companies, and the high-end market is almost monopolized by these three major regions. In the field of high-end chips, domestic manufacturers have not yet formed in scale, so manufacturing industry is still dominated by original equipment manufacturer (OEM). In terms of geographical distribution, the Asia-Pacific region accounts for half of the global semiconductor market. According to the data, in 2018, the sales volume of China's semiconductor chip market reached 194.2 billion US dollars, with a year-on-year growth of 16.89%, ranking the first place. At the meantime, the market size of North America was 56.7 billion, with a year-on-year growth of 15.86%, ranking the second place. Despite China's chip market is the largest and fastest growing market in the world, it still heavily depends on foreign countries.

In 2018, China imported about 417.569 billion ICs (chips), including 166.9 billion semiconductor IC chips, with a year-on-year increase of 15.65%, making China the world's largest chip importer. Meanwhile, China exported 217.1 billion semiconductor chips, including 15.7 billion semiconductor IC chips, with a year-on-year increase of 25%<sup>[1]</sup>. China is also an important chip exporter in the world. But at the same time, it is also clear that China's total exports of chips slightly exceed 50% of the total imports, but the export earnings are only slightly more than a quarter of the import value.

China is a global electronic manufacturing base with the most perfect industrial chain and huge

consumer market. After the trade issues of Huawei and ZTE, it could be expected that there will be more policy support for IC industry. As the domestic semiconductor industry enters the intensive construction period and domestic enterprises increase research and development driven by national policies and market demand, China is expected to speed up the localization of ICs and gradually realize the substitution from low-end to high-end, and thus reduce the import of ICs and the dependence on other countries.

In recent years, driven by the national policy and market application, China's IC industry has maintained a rapid growth and continues to maintain the global leading position of growth rate. In the first half of 2019, the sales volume of China's IC industry was 304.82 billion RMB<sup>[2]</sup>, with a year-on-year increase of 11.8%. According to analysis of institutions, with the continuous deepening of China's industrialization and informatization, the rising information consumption and the acceleration of smart city construction, and with the gradual development of cloud computing, big data, Internet of Things (IoT) and other fields, it is expected that the China's IC market will maintain a stable growth in the next three years. It also pointed out that in the next few years, China's IC industry will present the following trends<sup>[2-6]</sup>:

### 2. China's IC Design Industry Moves Towards High End

From the demand point of view, artificial intelligence applications are rapidly popularized. As

the demand for chips of artificial intelligence applications is far more than that of traditional applications, it is expected to become an important driving force for the development of IC Design in the future. From the perspective of supply, Chinese IC design enterprises have covered a wide range of products, including smart phone SOC, baseband chip, fingerprint identification and bank security chip, etc., and they are also among the world's top in some subdivided fields. However, in the field of high-end chips, especially in the field of PC and server chips, the share of Chinese chips is relatively low, and there is an obvious gap with international giants. In the future, with the technological progress of China's chip design industry, high-end IC design will have a bright future.

### 3. Global IC Industry Migrates to Developing Countries Including China

From the region point of view, the global IC industry is undergoing third major shifts, namely, the transfer from the developed countries such as the US, Japan and Europe to China, Southeast Asia and other developing countries and regions. In recent years, driven by the demand of downstream communication, consumer electronics, automotive electronics and other electronic products, the demand of integrated circuit market in developing countries led by China continues to increase rapidly, and has become one of the most influential markets in the world. Driven by this, the integrated circuit industry in developing countries has developed rapidly and its overall strength has been significantly improved. In the future, with the wave of intelligent upgrading of manufacturing industry, the demand for high-end chips will continue to grow, which will further stimulate the development and industrial migration process of integrated circuit industry in developing countries.

### 4. The Localization Process of Packaging and Testing Industry Is Accelerated

In recent years, China's testing equipment manufacturers have achieved rapid development. At present, some products of enterprises represented by Changchuan technology, North Huachuang and Beijing Huafeng have entered the supply system of domestic first-line packaging and testing enterprises. In the future, it is expected to strengthen them through continuous technology upgrading and extension

merger and acquisition, and thus accelerate the localization process of packaging and testing industry.

Since 2019, China's integrated circuit industry has advanced greatly. Huawei released the baseband chip of Baron 5000 for 5G mobile phones and Kylin 990, the first SOC integrated 5g mobile phone chip in the world; mass production of domestic DRAM memory in CXMT of Hefei; mass production of 64 layer 3D NAND flash memory of Yangtze Memory; progress in the separation of Feiteng and Loongson, China's local CPU project; and the official mass production of 14nm process of SMIC in February 2020. This is of great significance to break the monopoly of domestic chips and bring new opportunities to domestic chips in China.

In 2019, the scale of China's IC design industry is 294.77 billion RMB, the chip manufacturing industry is 214.91 billion RMB, and the packaging and testing industry is 249.45 billion RMB. It is predicted that the scale of China's IC design, chip manufacturing, packaging and testing industry will reach 354.61 billion RMB, 262.35 billion RMB and 284.12 billion RMB respectively in 2020, as shown in Figure 1.

In 2019, China's integrated circuit output volume is 20.82 billion, a year-on-year increase of 7.2%. As of March 2020, China's integrated circuit output volume is 21.21 billion, an increase of 20% over the same period last year. China's integrated circuit output volume is 50.82 billion from January to March 2020, and 34.520 billion in the same period last year, with an increase of 16%, as shown in Figure 2.

#### 4.1. Import

China's integrated circuit import volume reaches 455.134 billion in 2019, with a cumulative increase of 6.6%. As of March 2020, China's import volume of integrated circuits was 45.31 billion, an increase of 43.9% year-on-year. From January to March 2020, China's import volume of integrated circuits reaches 116.1 billion, an increase of 29.645 billion over the same period of last year, with an increase of 32.5%, as shown in Figure 3.

The import amount of China's integrated circuits in the whole year of 2019 reached US \$305.55 billion, a cumulative decrease of 2.1%. As of March 2020, China's imports of integrated circuits amounted to US \$29.096 billion, with a year-on-year increase of 19.6%. From January to March 2020, China's integrated circuit import amount reached US \$72.105 billion, with an increase of US \$7.129 billion compared with the same period of last year, with an

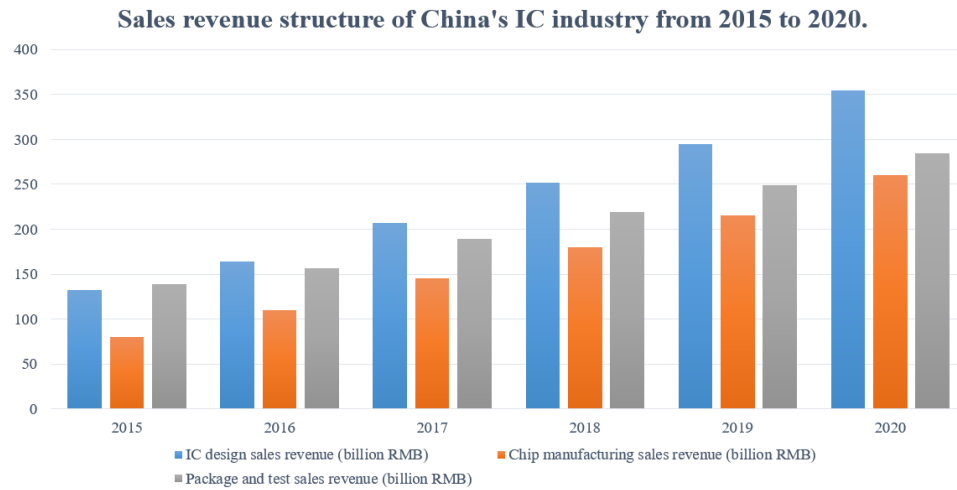


Figure 1. Sales revenue structure of China's IC industry from 2015 to 2020<sup>[1]</sup>.

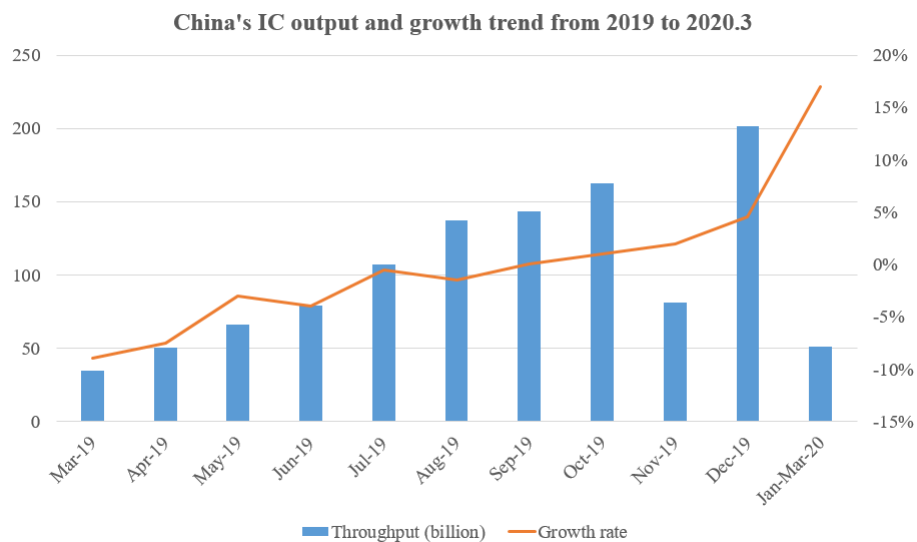
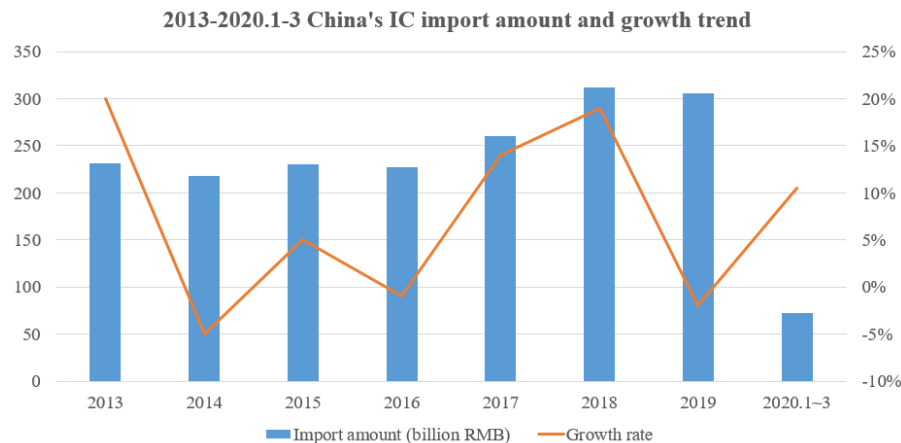


Figure 2. China's IC output and growth trend from 2019 to 2020.3<sup>[2]</sup>.



Figure 3. 2013-2020.1-3 China's IC import volume and growth trend<sup>[2]</sup>.

Figure 4. 2013-2020.1-3 China's IC import amount and growth trend<sup>[2]</sup>.Figure 5. China's IC export volume and growth trend from 2013 to Mar. 2020<sup>[2]</sup>.

increase of 10.6%; the average import price of China's integrated circuits from January to March 2020 is 621.06 million US dollars per billion units, as shown in Figure 4.

#### 4.2. Export

In terms of exports, China's export volume of integrated circuits reached 218.697 billion in 2019, with a cumulative increase of 0.7%. As of March 2020, China's integrated circuit export volume was 20.51 billion, with a year-on-year increase of 18.3%. From January to March 2020, China's integrated circuit export volume reached 53.22 billion, an increase of 7.232 billion over the same period of last year, with a cumulative increase of 15.4%, as shown in Figure 5.

In terms of export value, China's integrated circuit export value in 2019 reached US \$101.5778 billion, with a cumulative increase of 20%. As of March 2020, China's integrated circuit export value was 8.790 billion US dollars, an increase of 10.6% year on year. From January to March 2020, China's

integrated circuit export value reached 23.954 billion US dollars, an increase of 2.076 billion US dollars compared with the same period of last year, with a cumulative increase of 9.5%; the average export price of China's integrated circuits from January to March 2020 is 450.257 million US dollars per billion units, as shown in Figure 6.

#### 4.3. Development Trend

Emerging technologies will become the future core products of IC industry. Many new spots and future core products in the integrated circuit industry focus on cloud computing, Internet of things, big data, industrial Internet, 5g; strategic guidelines include made in China 2025 (Intelligent Manufacturing), Internet, big data; artificial intelligence and AI technology make aircraft, UAVs, new energy vehicles / intelligent connected vehicles, unmanned driving and so on. Similarly, as an important part of semiconductor industry, the third generation semiconductor industry has become one of the

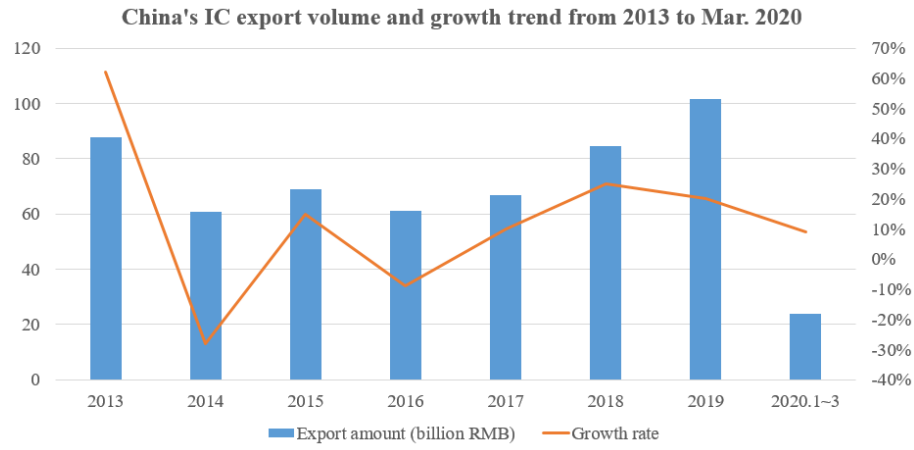


Figure 6. China's IC export volume and growth trend from 2013 to Mar. 2020<sup>[2]</sup>.

focuses of science and technology competition in various countries.

At present, international manufacturers are actively promoting the commercialization of silicon carbide (SiC) and gallium nitride (GaN) new devices, and the product performance is improving day by day, and the application is gradually extensive. In China, it is still 4-inch, 6-inch products have been developed and small batch supply has been realized; domestic GaN substrate is still mainly 2-inch. According to Casa statistics, the scale of SiC and GaN power electronic devices in the domestic market in 2018 is about 2.8 billion RMB, with a year-on-year growth of 56%. It is expected that the compound growth rate in the next five years will be 38%. The market scale of GaN microwave RF application is about 2.449 billion RMB, and the compound growth rate is expected to reach 60% in the next five years. Benefiting from the policies of the whole semiconductor industry, the favor of the capital market, the active promotion of local governments and the extensive entry of enterprises, the third generation semiconductor industry has developed steadily.

Semiconductor industry is the cornerstone of modern information society. It is a strategic, basic and leading industry supporting the current economic and social development and ensuring national security. Generally speaking, China's semiconductor technology and industry have advanced a lot, but there is still a certain gap between China and foreign top level in material and device performance, so the localization ability still needs to be further improved.

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