

US to Curb China's Semiconductor Technology Development

Stopping China's chip autonomy ambitions already seems impossible.

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The US has imposed new export restrictions affecting China's semiconductor industry. The new ban includes export restrictions of Equipment Data Acquisition (EDA) and diamond - used for semiconductor substrates instead of silicon and is the latest generation chip. The Bureau of Industry and Security (BIS) of the US Department of Commerce has announced new export control measures for national security reasons. Although the document does not mention China, it is clear that the decision was made to prevent the Asian country from accessing advanced technology.

US President Joe Biden signed on August 9 the “Science and CHIPS Act of 2022” to create an impetus to produce semiconductors in the US. Under the law, \$52 billion is allocated in subsidies to leading chipmakers to develop manufacturing in the US. This law has two goals:

- *to increase the US share of the global chip market as the country currently accounts for no more than 12% of global semiconductor chip production; and,*
- *to prevent US investments from contributing directly or indirectly to the development of manufacturing in China.*

In the past, Washington forced Dutch consortium ASML - which has a monopoly position in the manufacture of extreme ultraviolet lithography (EUV) systems - to stop exporting EUV machines to China. The company complied with the demand, but in the end, it was not enough to hold back the growth of China's semiconductor industry. China is the production platform for end products for all the leading manufacturers, such as Intel, TSMC and Texas Instruments. All these companies have their own chip testing and packaging facilities in China.

Chip companies in China, such as SMIC, continue to develop and master new technologies. Recently, the press reported that China's SMIC was able to master the

production of chips based on the 7nm process. Furthermore, SMIC is using ASML equipment of previous generations: Deep ultraviolet (DUV) lithography is not prohibited. The US tried to persuade ASML to ban the export of DUV systems to China, but the Dutch company is thus far resisting pressure since China accounts for about 16% of ASML sales, which is the third largest market after South Korea and Taiwan. In addition, ASML emphasises that DUV equipment has been sold on the global market for a long time and China has been able to create a significant reserve of it.

Washington realizes that the existing bans on the Chinese semiconductor industry are no longer effective – China can still move forward in making next-generation chips. Indeed, the ban on providing chip manufacturing technology using the 28nm process, or even the 10nm process, looks ridiculous when China has just produced chips based on the 7nm process. As a result, the US made the decision to ban the supply of promising technologies that no major manufacturers were using yet.

A microchip is a collection of electrical circuits containing semiconductor components. In modern chips there are billions of such components. In order to reduce the size of the chip and reduce power consumption, the transistors on the chip are getting denser, and the silicon wafer itself is becoming thinner, i.e. “nanotechnology”. The problem is that it is impossible to reduce the size of silicon wafers to infinity – essentially new microprocessor architectures and materials are needed to make silicon wafers.

In addition, diamonds and gallium oxide will be used to make chips. Unlike silicon, such materials can withstand higher voltage, frequency and temperature loads. Because of this, it will be possible to multiply the density of transistors and connections on a chip. With this development, Samsung has announced that it will start manufacturing chips on the 3nm process using Gate-All-Around technology. Widespread use of the new technology is expected no earlier than 2024-2025.

The export restrictions imposed by the BIS are all aimed at such promising technologies and attempts to restrict China from accessing it. Importantly, it is probably a long time before these technologies become widely used. Therefore, in the short term, such restrictions will not have any significant impact on the development of China’s semiconductor industry.

Limitations are related to 3nm process technology, and China currently produces the majority of 28nm chips – technology of a previous generation. In fact, currently, there is a great demand for chips manufactured according to this technology and manufacturers receive their largest income from this product.

The long-term effects of these restrictions on China will depend on how the country develops its own industry. China’s long-term goal is to develop its own technologies and this is not hinged on the successes of Western developers, but China’s own scientific thought. The Asian Giant is completely capable of coming up with breakthrough solutions.

Huawei, as an example, conquered the global market after the company developed its own SingleRAN radio access technology, which allows operators to support all communications standards according to 2G, 3G and 4G standards. In the semiconductor industry, China is developing its own technology to use silicon carbide in chip production – a task outlined in the five-year plan to develop smart manufacturing.

Besides, China can get out of this situation by using old equipment to make next-generation

chips, as happened with DUV equipment. This will increase production costs but China spares no expense in Research and Development in promising industries and technologies. Last year, China allocated 2.44% of GDP - a record 2.79 trillion-yuan (\$441.3 billion) budget to Research and Development. This makes it nearly impossible for the US to stop China from developing its own technology.

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