GlobalFoundries. Decline or renovation of the world's top chip maker?

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GlobalFoundries (GF), a multinational company with Arab oil capital, decided exactly 10 years after its birth to change and withdraw from the race for advanced microelectronics technologies. Its story is instructive and shows that money, and even very big money, is far from everything in high-tech industries.

Football motives and analogies for microelectronics

Large financial investments of rich people do not always lead to the achievement of the desired commercial and image result. In addition to cash investments, the right choice of a strategic direction of activity and the formation of a team of managers are equally important. And even the presence in this team of well-known and professional personalities does not guarantee success over a long distance. The most indicative confirmation of this thesis is the football investments of wealthy people. Russian oligarch Suleiman Kerimov, who is not a passionate football fan, has made big investments in the "Anji" football club in Makhachkala. He attracted well-known football players and coaches with large salaries and even achieved some modest domestic results. But, unlike the owner of Krasnodar football club, Sergey Galitsky, Kerimov only wanted to increase his own image with these investments. The result with "Anji" was negative in all directions.

Karimov did not intend to turn football into a part of his life, like Galitsky, or to realize his long-term dream as a hobby, like Roman Abramovich in London's Chelsea. Kerimov wanted with the help of the football Anji and to increase his own image to get secret control in Dagestan. And this means that his project was initially positioned as temporary and tactical.

Abramovich has invested more than three billion pounds in Chelsea, but due to affiliation with the Russian authorities, he has not been able to get a British visa and attend matches with his club for the second year. His search for a new owner for Chelsea (to fix the losses) has not yet yielded any results, and a decrease in investment in the club leads to a gradual deterioration in sports results, the sale of leading players and a drop in the club's value.

The wealthy Arab sheikhs also invest big oil money in football clubs - the Paris PSG and the English Manchester City. Both clubs win their domestic championships, but so far, they have not managed to win the main coveted trophy for their owners - to win the European Champions League. The PSG club's purchase of Brazilian Neymar from the

Spanish "Barcelona" for an unimaginable € 220 million contributed to the transfer price of the players, but the PSG didn't help. Two seasons later, Neymar said he did not want to play in a French club. This did not add the image advantages of PSG and its wealthy owners. After a while, the moment will come when these gigantic expenses will cease to give the expected return and this bubble will burst. But all these cases, with the exception of Galitsky, are united by the fact that light raw materials were invested in football, sometimes even easy money, and the object of investments was not considered as part of life and business, but rather, as entertainment. And as you know, they do not spare money on entertainment.

The story of GlobalFoundries (GF), a semiconductor company based on and developing on the basis of gigantic oil Arab money, may confirm all of the above. The birth of GlobalFoundries was preceded by major structural deformations and changes in the global electronics industry and microelectronics. The increasing complexity of electronic products and technologies for their creation and the associated huge investments and investments have drawn a line under the future of huge multidisciplinary

international corporations. Microelectronics from the 2000s began to switch to a narrow-profile specialization, first dividing the production of chips with assembly and testing. Then this process went even further, and microelectronics companies narrowed their focus according to the product creation cycle: development (fabless), chip manufacturing (wafer foundry), assembly, testing and even qualifications. And most of the mergers, purchases, sales of semiconductor companies in the world in recent years are taking into account this trend. This also led to the formation of GlobalFoundries in 2009.

The history of the rise and fall of GlobalFoundries

In 2008, the American company AMD (Intel's ongoing competitor) announced a partnership with the investment company Advanced Technology Investment Company (ATIC), owned by the government of Abu Dhabi. The main goal of the partnership was to separate chip production from AMD and create an independent company. On March 2, 2009, GlobalFoundries was established with headquarters in California. ATIC, with the help of oil money, gained control of GlobalFoundries, while AMD got an 8.8% stake. Under a general agreement, AMD was not only one of the shareholders, but also the main strategic partner and customer of GF products.

In January 2010, Chartered Semiconductor Manufacturing, a chip maker from Singapore, was merged with GF. In March 2012, ATIC acquired an 8.8% stake from AMD and gained full control of GlobalFoundries.

The history of GlobalFoundries from 2009 to 2018 is a confrontation and competition between the Taiwanese TSMC and GF in the global technology market and between Intel and AMD in the microprocessor market. A separate superstructure over these peaks is the ambitions of the wealthy Arab sheikhs and the UAE government. The highly successful projects for the construction of the artificial islands of Palm Jumeirah in Dubai, the world's tallest skyscraper in the world, Burj Khalifa, the only 7-star Burj al Arab hotel in the world and many world attractions of Abu Dhabi, have created confidence among rich Arabs that the UAE is worthy of the prefix projects “First in the world”, “best in the world”, etc. In 2012, the construction project for the new GlobalFoundries wafer fab in Abu Dhabi was even announced. The author of this article in one of his publications even expressed doubts about the appropriateness of this step. But the problem is that the commercial construction business cannot be put on a par with high-tech microelectronics. In construction, delay and violation of deadlines is not catastrophic and, in many cases, even leads to an increase in the commercial value of real estate. In Hi-Tech industries and in microelectronics, being late leads to rapid obsolescence of products and technologies. And problems only by the correct selection or replacement of personnel and management systems are not solved. Much more important is the correct choice of a long-term development strategy and its implementation. And with this, as it turned out, GF has problems.

The initial goal of separating chip production from AMD and the formation of GF was to create an innovative, competitive with the TSMC production of wafers according to the foundation model. The strategy was to create the most advanced technologies for many global customers, including Apple, Xilinx, Qualcomm and others.

The presence of a strategic partner and the main customer of AMD with wide investment support from the UAE promised this project success. Externally, up to 2017, it seemed that GlobalFoundries was quite successfully implementing the development of the most advanced technical processes and was in competition with TSMC. In the list of the top 10 global chip manufacturers, GF constantly ranked second, although in terms of sales it lagged far behind TSMC (Table 1). But there was no such big lag in the development of new advanced technologies. Over the years, GF has not become an open public company, as opposed to TSMC. It also did not become profitable and constantly created losses from year to year, and sales volumes

grew weakly (Fig. 1). For comparison, in 2018, TSMC revenue amounted to $ 38.5 billion, and net profit - $ 11.4 billion, which is 2.3% higher than its 2017 figure.

These losses, as well as constantly growing financial investments for the development of new technologies to maintain the status of GF as the main competitor of TSMC, had to be covered by Arab investors. But GF was not able to implement the strategy of attracting new customers, whose orders could pay off the gigantic costs of mastering new technologies. AMD is the only major GF customer. TSMC, Samsung, Intel, GlobalFoundries are in the list of world companies that own the 14 nm manufacturing process, and only a few months ago UMC joined them. In 2016, AMD signed a five- year general agreement with GF, which guaranteed AMD implementation of GF technologies up to 7 nm. At the same time, AMD, if necessary, could take advantage of other proposals, which subsequently happened according to the 7 nm process technology, when AMD used the 6th amendment to the agreement. Under this agreement, AMD planned to buy $ 650 million worth of chips with chips from GF in 2016, but actually spent $ 700 million in 2016 and $ 1.1 billion in 2017. At the same time, the agreement imposes certain restrictions on AMD regarding the guaranteed minimum volume of orders per year and fines for their non-fulfillment. Thus, 10 years after the formation of GF, the general partnership of the two companies, which was to give them advantages over competitors, primarily AMD over Intel and GF over TSMC, it became a burden for them, especially for AMD. Due to GF's refusal to develop new 7-nm technologies, AMD initiates the 7th amendment to the agreement, avoiding fines and restrictions for new manufacturing processes. In 2020, the agreement expires and AMD can become independent of obligations. Intel, AMD's main competitor, has had serious problems for several years with the development of new 10 and 7 nm manufacturing processes and with the introduction of new processors to the market. And AMD makes good use of it. According to the results of the second quarter of 2019, AMD increased its share in all segments of the processor market - up to 17.1% in the desktop segment, up to 14.1% in the mobile and 3.4% in the server one. And in many respects, this was achieved due to the fact that while Intel was slowing down, AMD made a bet on products using the new 10 and 7-nm technologies from TSMC.

Unfortunately, for the company GF, which has not achieved diversification of its client base, this is a logical result.

Asset buying followed by sales and staff reductions

Since its founding, GF has pursued a rather aggressive policy of expanding its manufacturing base around the world. Of course, the size of these acquisitions does not compare with those observed on the global semiconductor market in the past 3-4 years. year 2009. GF buys Chartered Semiconductor, a Singapore-based company, with its two factories producing 300- and 200-mm wafers. The total investment of 3.1 billion dollars.

2011. GF announced its intention to start building a semiconductor production facility in Abu Dhabi (UAE) in 2012 and investing $ 6-8 billion in it. The start of the chip production was due to begin in 2015.

2012. There was information on the market that GF agreed to buy the financially insolvent Taiwanese company ProMOS Tehnology with a 300 mm fab for $ 0.7-1 billion. However, in reality, it didn't come to the purchase of ProMOS and GF bought only equipment.

2013. GF sent an application for the purchase of equipment of the fab RZ for the production of DRAM chips on 300 mm wafers of Powerchip Tehnology.

2015. GF completes acquisition of IBM's microelectronic business. All existing factories in the USA in New York and Vermont switched to GF, which also received the exclusive right to supply chips for IBM for 10 years. GF also received rights to 16 thousand patents for the

production of microelectronics, including RF SOI and SiGe technologies. The amount of the transaction is 1.3 billion dollars.

February 2017. Plans were announced for the construction of a Fab 11 in the Chinese city of Chengdu for the production of 300 mm wafers using the 22FDX process (22 nm FD-SOI). The project should be implemented with the support of the Chinese authorities with a mutual investment of $ 10 billion. The 22FDX process is already in use at the GF fab in Dresden (Germany), but a more modern 12FDX process (12 nm FD-SOI) is already being developed there. It was announced that in the next three years, the productivity of the fab in Dresden should be increased by 40%, in Singapore - by 35%, and in the USA - by 20%. The start of the enterprise in China is scheduled for the first half 2019, the Chinese authorities attach great importance to this project, as the implementation and development of new technologies 22FDX and 12FDX will significantly increase China's capabilities in its own production of products that were previously purchased abroad. To control and supervise the construction of this factory, GF's main Chinese construction partner, Tsinghua Unigroup, even decided to recruit Sun Shin-wei, the former director of the Taiwanese company UMC, who is the closest competitor for second place in the top 10 world chip makers. During a meeting with US President Donald Trump, the head of GF emphasized that the company has invested $ 13 billion in US fabs over the past 8 years and created 9,000 jobs. But Trump was unsatisfied with GF's decision to invest in the construction of a new plant in China. But 2019 was the year of GF asset sales.

January 2019. Taiwanese company Vanguard International Semiconductor Corp. (VIS) has confirmed the acquisition by GF of a Fab 3E in Singapore. A MEMS fab with a capacity of 35,000 plates per month with a diameter of 200 mm will be sold and completed before the end of 2019 for $ 236 million.

April 2019. GF and ON Semiconductor announced an agreement whereby ON Semi buys a 300 mm Fab 10 plant in New York from GF for $ 430 million. $ 100 million will be paid at the time of signing the agreement, and ON Semi will pay $ 330 million. at the end of 2022, when it gains full control over the factory, and employees move to ON Semi. In fact, ON Semi gains immediate access to 45 and 65 nm CMOS technology to produce its own products, which will be produced by GF until 2022. This will significantly strengthen the position of ON Semi, which previously had only a 180nm process. Earlier this year, GF acquired this fab from IBM.

May 2019. GF and Marvell announce the sale of Avera Semiconductor's GF. Most recently, in November 2018, GF spin-off ASIC, a division previously acquired from IBM, into Avera Semiconductor. Avera employs about 800 engineers, and the company has an extensive portfolio of IP blocks, including an ARM core and others. Marvell will pay GF $ 650 million by the end of 2020 and another $ 90 million over the next 15 months. Marvell is also committed to ordering chips from GF.

August 2019. GF has decided to sell the Fab 9 in Vermont, USA, for the production of photomasks along with intellectual property to Toppan Photomasks. Under the terms of the agreement, Toppan will provide GF mask manufacturing services in the coming years.

In June 2018, GF announced a 5% staff reduction that would affect 900 of the company's 18,000 people. This mainly affects enterprises in Vermont (USA) and in Dresden (Germany).

Such a rapid, more reminiscent of an auction, sale of assets and the dismissal of personnel does not resemble business reconfiguration, but more disappointment in its 10-year results, as well as attempts to get rid of it.

Obviously, in the current 2019, GF will concede second place in the top 10 of Taiwanese company UMC, and in 2020-2021. for the first time in recent years, there may be a chance of making a profit, not a loss.

In late 2018 and early 2019, persistent rumors spread in the semiconductor market that the Arab owners of GF are looking for a buyer to sell the company in whole or in part. These rumors intensified after the visit of Crown Prince Abu Dhabi Sheikh Mohammed Ben Zayed to Singapore's GF enterprises in February 2019. GF hastened to refute this information, citing the fact that it was part of a technological tour and the sheikh also visited Samsung, where he got acquainted with its advanced technological line. But it is South Korean companies Samsung and SK Hynix that rumors attribute the desire to acquire GF. Both companies are among the world's leading manufacturers of memory chips, and the acquisition of GF would allow them to increase their share in the global market. But the decline in the market and prices of memory chips, which began in 2018 and continued in 2019, has already led to their overproduction and overstocking of warehouses. The range and types of GF products are significantly different from Samsung and SK Hynix. Therefore, even if these companies have intentions to acquire GF, its cost and time of purchase are inappropriate.

However, there are practically no chances to sell the GF entirely. The only private company able to acquire GF is TSMC. However, the Taiwanese chip maker already controls half of the global contract wafer production, and such a deal will not be approved by the antitrust authorities. In addition, TSMC has no desire to buy. But who would have bought the GF without a doubt is China. Celestial Empire would receive not only a powerful production base around the world, but also access to the most modern technologies. In 2015, China, through Hua Capital Management, even turned to GF with a proposal to purchase, but was refused. Such a deal, even before the outbreak of a trade war with China and the blocking of Huawei, will never be allowed by US regulatory authorities. But China has every chance of getting a fully constructed joint venture with GF in Chengdu. Probably making sure that there was no chance of selling the GF entirely, the Arab owners decided to sell the GF in parts, and concentrate and compact the most competitive 22, 14, 12 nm technologies at enterprises in the USA, Germany, and Singapore.

GlobalFoundries Strategy Change

One of the signs of the upcoming changes in the GF was the change of CEO in March 2018. Thomas Caulfield succeeded Sanjay Jah, who held this post for more than four years. Caulfield moved to GF as Senior Vice President in 2014 with the accession of IBM, where he worked for 17 years in various leadership positions.

In August 2018, GF announced a change in its development strategy. The company decided to develop not in depth, but in breadth. The main thing in this statement was the cessation of all work and research on the new 7-nm process. Earlier, GF planned to release the first samples using 7-nm technology in the fourth quarter of 2018. The initial deadline was the beginning of 2018, but then the deadline was postponed. This transfer was not critical since competitors did the same. The main competitors for this technology were TSMC and Samsung. By the time the decision was made to stop working on 7-nm technology, it was already known that AMD, a strategic partner of GF, was already developing its new products for the 7-nm process at TSMC. And AMD was the only potential GF customer for this technology.

Simultaneously with the cessation of work on 7 nm GF, all prospecting and development work on the next generations of 5 and 3 nm technologies were mothballed. And although the GF management reported that the cessation of work was not due to technological, but to economic reasons, this situation was very reminiscent of the story with the development of 14 nm technology. Earlier, GF tried to independently master the 14-nm technology but did not succeed in this and in mid- 2014 bought a license for it from Samsung. It was with its help that in 2015 the first samples of new AMD microprocessors were obtained. In addition to the cessation of work on new technological processes, GF management reported a 5% reduction in company personnel.

Having abandoned 7nm technology, GF decided to concentrate on diversifying and reconfiguring 12-14 nm FinFET and 22FDX, 12FDX technologies from purely digital to differentiated offers for customers. In addition, GF decided to create a subsidiary for the ASIC business to develop and provide IP clients and work independently with other silicon factories. However, the last idea was destined to exist only about nine months. In May 2019, the formed subsidiary Avera Semiconductor was sold to Marvell.

In December 2018, GF announced the launch of Vermont chips for the 90 nm SiGe process 9 HP on 300 mm wafers. SiGe technology, together with patents, was previously purchased from IBM and mastered according to 130 nm standards on 200 mm diameter plates in the same place in Vermont.

The transition to new design standards in SiGe technology allows increasing the operating frequency of transistors with heterojunction from 340 to 370 GHz, which will be in demand in 5G communication systems, optical transceivers and radars.

GF sees silicon photonics as yet another area of business and product diversification. Such chips are supposed to be produced first according to the standards of 90 nm on 300 mm wafers, and then according to the 45-nm process technology.

It is still difficult to predict how such a sharp turnaround in the GF business will end, but one conclusion can be made unequivocally. GF could not stand the technological competition with TSMC, Samsung and even Intel, and retired. Its 10-year-old concept turned out to be untenable and now the company is trying to leave the market field, which is played not only by the three companies mentioned above, but also by its two closest competitors - UMC and SMIC. There is no certainty that on this truncated field GF will not lose either. In electronics, not everyone decides money, and the main investor seems to have lost interest in this business and wants to record losses, not profit.

GF lawsuit against TSMC and worldwide electronics

After losing the market and technology battle of TSMC, GF is trying to win on the court. In August 2019, GF accused TSMC of infringing intellectual property and illegally using 16 patents owned by GF. In lawsuits filed in the USA and Germany, TSMC clients must also be defendants, including Apple, Broadcom, Mediatek, NVIDIA, Qualcomm, Xilinx and other, that is, all top players of world semiconductor microelectronics. As a dessert, GF has also joined some consumer goods manufacturers. Almost all the grandees of the global electronic industry are listed, about 16 companies in total.

As far as the name of these patents can be judged, they cover the methods of forming interconnects, FinFET structures, MIM capacitors, etc. GF believes that these solutions were used by TSMC in processes of 7,10,12,16 and 28 nm. And since these technologies were used to manufacture and supply microcircuits for the above companies in the USA and Germany, their import into these countries should be prohibited, and the buyers themselves should also act as defendants. Earlier in 2017, GF already appealed to the antitrust services of the United States and the European Union with TSMC accusations of unfair competition and abuse of monopoly position in the market. GF claimed that TSMC demanded that customers have exclusivity of supplies, discounts for loyalty and threatened them with restrictions on access to TSMC products. The Taiwanese chip maker has already responded that GF’s allegations are unfounded. TSMC annually invests billions of dollars in innovation and in the independent development of its own technologies. According to their statement, TSMC has created one of the world's largest semiconductor portfolios of more than 37,000 patents and one of the best in the top 10 patent grants in the United States over the past 3 years from 2016. TSMC regrets that GF is resorting to groundless lawsuits, rather than competing in the technology market.

Experts have different perspectives on the prospects for these lawsuits. Some believe that these lawsuits have little chance to ban imports to these regions, and patents relate to overly common semiconductor manufacturing methods. Therefore, the court is likely to refuse GF. At the same time, the lawsuit may have some prospects in the United States. GF is registered as an American company, and in the USA, it is not very happy that TSMC not only does not join the boycott of China, but even expands cooperation with it. But amid the recession in the semiconductor market in 2019, the trade war between the United States and China, the confrontation between Japan and South Korea, this lawsuit may bring down prospects for the restoration of the semiconductor market in 2020. And the author is inclined to agree with this. Bad news this year was enough.

Conclusions

GlobalFoundries stopped working on the most advanced microelectronics technologies and thereby drew a line under an ineffective 10-year strategy, ambitious plans with huge investments, but without market returns and focusing on only one large customer. With its history, GF has confirmed that money alone doesn't solve everything in business, and especially in microelectronics.

GF's losing the technology race is a bad sign for the global semiconductor market. Simultaneously with the reduction of design technological standards being mastered in production, the number of world companies possessing them is decreasing. If 19 companies owned the most advanced technological processes at one time, 65 nm - 14 companies, 28 nm - 6 companies, 14 nm - 5 companies, then only two companies possess 7-nm technology (TSMC, Samsung). It is possible that according to the 3 nm process technology, only TSMC will have a monopoly for several years. But monopoly and lack of competition do not contribute but hinder the development of innovation.

In contrast to GF, TSMC is a global example of a very successful and timely investment in new technologies and especially in the most advanced 7 nm process technology. It is expected that TSMC revenue from orders for 7-nm technology in 2019 will amount to $ 8.9 billion, and its share in the revenues of Q4 2019 will amount to an incredible 33%, reaching almost $ 3.5 billion. But TSMC's monopoly position on the global market for this process is already slowing down the release of the most advanced products. TSMC does not cope with a large number of orders for 7-nm technology and their lead time has increased from two to six months. The loser is AMD, which orders EPYC, Ryzen, and Radeon graphics chips for TSMC. Failure to meet the deadlines affects the release of Qualcomm Snapdragon 855 mobile processors, Xilinx Versal matrices, as well as Huawei and Mediatek products. One can only rely on the assurances of TSMC on the immediate measures and investments to solve these problems.

GF has already lost a lot in battles in the semiconductor market. Now they, having taken charge of everyone, risk losing not only customers, but also their goodwill.

The next 2020-2021 will already answer the question whether the GlobalFoundries renovation will take place or whether its remnants, in whole or in part, will be absorbed by one of the world's electronics giants and the company will not even have a name.

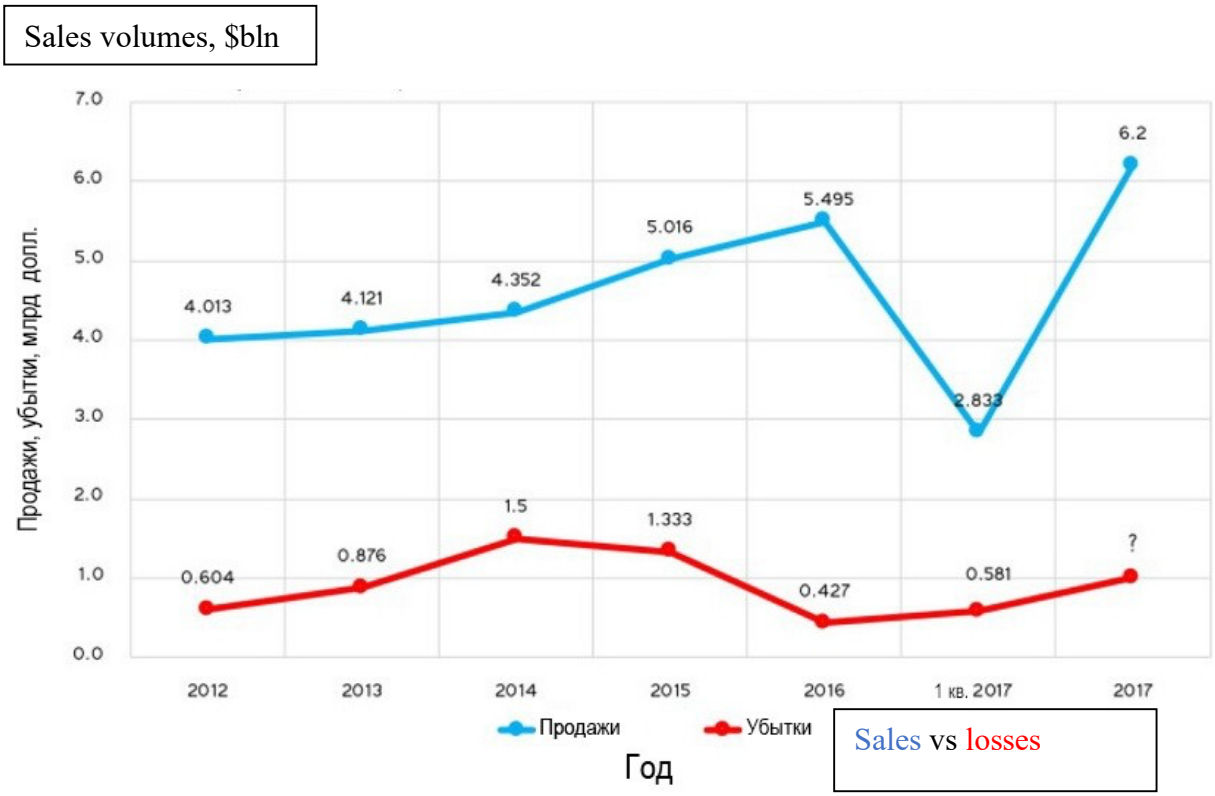

Fig. 1. Sales and losses of GlobalFoundries in 2012-2017

Table 1. Top-10 of the world's pure play foundries.

Company (country), sales volumes, million dollars	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
TSMC (Taiwan)	17 167 (1)	20 113 (1)	25 138 (1)	26 574 (1)	29 488 (1)	32 040 (1)
GlobalFoundries (USA)	4 560 (2)	4 550 (2)	4 355 (2)	5 019 (2)	5 545 (2)	5 407 (2)
UMC (Taiwan)	3 730 (3)	4 172 (3)	4 331 (3)	4 464 (3)	4 582 (3)	4 898 (3)
SMIC (China)	1 682 (4)	2 069 (4)	1 970 (4)	2 236 (4)	2 921 (4)	3 099 (4)
Powerchip (Taiwan)	-	862 (5)	1 291 (5)	1 268 (5)	1 275 (5)	1 035 (6)
TowerJazz (Israel)	644	505 (8)	828 (6)	961 (6)	1 249 (6)	1 388 (5)
Vanguard (Taiwan)	582	712 (6)	790 (7)	736 (7)	800 (7)	817 (7)
HuaHoug Semi (China)	-	555 (7)	665 (8)	650 (8)	712 (8)	807 (8)
Dongbu HiTek (S.Korea)	540	-	541 (9)	593 (9)	672 (9)	676 (9)
XFAB (Europe)	-	-	330 (10)	331 (11)	510 (10)	515 (10)

Rating position is given in parentheses