MAGNACHIP SEMICONDUCTOR Corp
Form 10-K
February 22, 2019
Table of Contents

UNITED STATES

SECURITIES AND EXCHANGE COMMISSION

WASHINGTON, D.C. 20549

FORM 10-K

(Mark One)

ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2018

or

TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the transition period from _____ to _____

Commission File Number 001-34791

MagnaChip Semiconductor Corporation

(Exact name of registrant as specified in its charter)

Delaware	**83-0406195**
(State or Other Jurisdiction of	**(I.R.S. Employer**
Incorporation or Organization)	**Identification No.)**

c/o MagnaChip Semiconductor S.A.

1, Allée Scheffer, L-2520

Luxembourg, Grand Duchy of Luxembourg

(Address of principal executive offices) (Zip Code)

Registrant s telephone number, including area code: (352) 45-62-62

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	**Name of each exchange on which registered**
Common Stock, par value $0.01 per share	**New York Stock Exchange**

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes No

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes No

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes No

Indicate by check mark whether the registrant has submitted electronically, every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files. Yes No

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant s knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K.

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, smaller reporting company, or an emerging growth company. See the definitions of large accelerated filer, accelerated filer, smaller reporting company, and emerging growth company in Rule 12b-2 of the Exchange Act.

Large Accelerated Filer	Accelerated Filer
Non-Accelerated Filer	Smaller Reporting Company

Emerging growth company
If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act.

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act). Yes No

State the aggregate market value of the voting and non-voting common equity held by non-affiliates computed by reference to the price at which the common equity was last sold, or the average bid and asked price of such common equity, as of the last business day of the registrant s most recently completed second fiscal quarter. $280,313,167.

As of February 15, 2019, the registrant had 34,091,378 shares of common stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant s definitive proxy statement relating to its 2019 annual meeting of stockholders will be incorporated by reference into Part III of this Annual Report on Form 10-K or included by amendment to this report within 120 days after the end of the fiscal year to which this report relates.

Table of Contents

MAGNACHIP SEMICONDUCTOR CORPORATION AND SUBSIDIARIES

FORM 10-K FOR THE YEAR ENDED DECEMBER 31, 2018

TABLE OF CONTENTS

Table of Contents

PART I

INDUSTRY AND MARKET DATA

We have made statements in this Annual Report on Form 10-K for the year ended December 31, 2018 (this Report) regarding our industry and our position in the industry based on our experience in the industry and our own views of market conditions, but we have not independently verified those statements. We do not have any obligation to announce or otherwise make publicly available updates or revisions to forecasts contained in these documents.

Statements made in this Report, unless the context otherwise requires, include the use of the terms us, we, our, the Company and MagnaChip refer to MagnaChip Semiconductor Corporation and its consolidated subsidiaries. The term Korea refers to the Republic of Korea or South Korea.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

We have made certain forward-looking statements in this Report within the meaning of Section 21E of the Securities Exchange Act of 1934, as amended (the Exchange Act), and Section 27A of the Securities Act of 1933, as amended (the Securities Act), that involve risks and uncertainties. Forward-looking statements give our current expectations and projections relating to our financial condition, results of operations, plans, objectives, future performance and business. You can identify these statements by the fact that they do not relate strictly to historical or current facts. These statements may include words such as anticipate, estimate, expect, project, intend, plan, believe and other words a of similar meaning in connection with any discussion of the timing or nature of future operating or financial performance or other events. All statements other than statements of historical facts included in this Report that address activities, events or developments that we expect, believe or anticipate will or may occur in the future are forward-looking statements.

These forward-looking statements are largely based on our expectations and beliefs concerning future events, which reflect estimates and assumptions made by our management. These estimates and assumptions reflect our best judgment based on currently known market conditions and other factors relating to our operations and business environment, all of which are difficult to predict and many of which are beyond our control. Although we believe our estimates and assumptions to be reasonable, they are inherently uncertain and involve a number of risks and uncertainties that are beyond our control. In addition, management s assumptions about future events may prove to be inaccurate. Management cautions all readers that the forward-looking statements contained in this Report are not guarantees of future performance, and we cannot assure any reader that those statements will be realized or the forward-looking events and circumstances will occur. Actual results may differ materially from those anticipated or implied in the forward-looking statements due to the factors listed in the Risk Factors, Management s Discussion and Analysis of Financial Condition and Results of Operations and Business sections and elsewhere in this Report.

All forward-looking statements speak only as of the date of this Report. We do not intend to publicly update or revise any forward-looking statements as a result of new information or future events or otherwise, except as required by law. These cautionary statements qualify all forward-looking statements attributable to us or persons acting on our behalf.

Table of Contents

Item 1. Business

General

We are a designer and manufacturer of analog and mixed-signal semiconductor platform solutions for communications, Internet of Things (IoT) applications, consumer, industrial and automotive applications. We provide technology platforms for analog, mixed-signal, power, high voltage, non-volatile memory, and Radio Frequency (RF) applications. We have a proven record with about 40 years of operating history, a portfolio of approximately 3,000 registered patents and pending applications and extensive engineering and manufacturing process expertise. Our business is comprised of two operating segments: Foundry Services Group and Standard Products Group. Our Foundry Services Group provides specialty analog and mixed-signal foundry services mainly for fabless and Integrated Device Manufacturer (IDM) semiconductor companies that primarily serve communications, IoT, consumer, industrial and automotive applications. Our Standard Products Group is comprised of two business lines: Display Solutions and Power Solutions. Our Display Solutions products provide panel display solutions to major suppliers of large and small rigid and flexible panel displays, mobile, automotive applications and home appliances. Our Power Solutions products include discrete and integrated circuit solutions for power management in communications, consumer and industrial applications.

Our wide variety of analog and mixed-signal semiconductor products and manufacturing services combined with our mature technology platform allow us to address multiple high-growth end markets and to rapidly develop and introduce new products and services in response to market demands. Our design center and substantial manufacturing operations in Korea place us at the core of the global electronics device supply chain. We believe this enables us to quickly and efficiently respond to our customers needs and allows us to better serve and capture additional demands from existing and new customers.

We have a long history of supplying and collaborating on product and technology development with leading innovators in the consumer electronics market. As a result, we have been able to strengthen our technology platform and develop products and services that are in high demand by our customers and end consumers. We sold over 2,000 distinct products in each of the years ended December 31, 2018 and December 31, 2017, with a substantial portion of our revenues derived from a concentrated number of customers. Our largest Foundry Services Group customers include some of the leading semiconductor companies that design analog and mixed-signal products for communications, IoT, consumer, industrial and automotive applications.

Our business is largely driven by innovation in the consumer electronics markets and the growing adoption by consumers worldwide of electronic devices for use in their daily lives. The consumer electronics market is large and growing rapidly, largely due to consumers increasingly accessing a wide variety of rich media content, such as high definition audio and video, mobile devices, televisions and games on advanced consumer electronic devices. Electronics manufacturers are continuously implementing advanced technologies in new generations of electronic devices using analog and mixed-signal semiconductor components, such as display drivers that enable display of high resolution images, encoding and decoding devices that allow playback of high definition audio and video, and power management semiconductors that increase power efficiency, thereby improving heat dissipation and extending battery life.

For the year ended December 31, 2018, we generated net sales of $750.9 million, net loss of $3.9 million, Adjusted EBITDA of $84.3 million and Adjusted Net Income of $27.1 million. See Item 6. Selected Financial Data and Item 7. Management s Discussion and Analysis of Financial Condition and Results of Operations elsewhere in this Report for an explanation of our use of Adjusted EBITDA and Adjusted Net Income and a reconciliation to net income (loss) prepared in accordance with United States Generally Accepted Accounting Principles (US GAAP).

Table of Contents

Our History

Our business was named MagnaChip Semiconductor when it was acquired from SK hynix Inc., formerly known as Hynix Semiconductor, Inc. (SK hynix), in October 2004. We refer to this acquisition as the Original Acquisition.

On March 10, 2011, we completed our initial public offering. In connection with our initial public offering, we converted from a Delaware limited liability company to a Delaware corporation.

Our Products and Services

Our Display Solutions line of products provides flat panel display solutions to major suppliers of large and small flat panel displays. These products include source and gate drivers and timing controllers that cover a wide range of flat panel displays used in high definition (HD), full high definition (FHD), ultra high definition (UHD), light emitting diode (LED), 3D and organic light emitting diodes (OLED) televisions and displays, notebooks and mobile communications and entertainment devices. Our Display Solutions line of products support the industry s most advanced display technologies, such as OLEDs, and low temperature polysilicons thin film transistor (LTPS TFT), as well as high-volume display technologies such as amorphous silicon thin film transistors (a-Si TFTs). Our Display Solutions products represented 34.1%, 30.8% and 41.0% of our net sales for the fiscal years ended December 31, 2018, 2017 and 2016, respectively.

We expanded our business and market opportunity by establishing our Power Solutions product line in late 2007. We have introduced a number of power management semiconductor products, including discrete and integrated circuit solutions for power management in high-volume consumer applications. These products include metal oxide semiconductor field effect transistors (MOSFETs), insulated-gate bipolar transistors (IGBTs), AC-DC converters, DC-DC converters, LED drivers, switching regulators and linear regulators for a range of devices, including televisions, smartphones, mobile phones, desktop PCs, notebooks, tablet PCs, other consumer electronics, and industrial applications such as power suppliers, e-bike, photovoltaic inverter, LED lighting, motor drive and home appliances. Our Power Solutions products represented 22.5%, 22.0% and 19.1% of our net sales for the fiscal years ended December 31, 2018, 2017 and 2016, respectively.

Through our Foundry Services Group, we also offer foundry services to fabless analog and mixed-signal semiconductor companies and IDMs that require differentiated, specialty analog and mixed-signal process technologies. Our process technologies are optimized for analog and mixed-signal devices and include standard complementary metal-oxide semiconductor (CMOS), high voltage CMOS, ultra-low leakage high voltage CMOS and bipolar complementary double-diffused metal oxide semiconductor (BCDMOS) and electronically erasable programmable read only memory (EEPROM). Our Foundry Services Group customers use us to manufacture a wide range of products, including display drivers, LED drivers, audio encoding and decoding devices, microcontrollers, touch screen controllers, RF switches, park distance control sensors for automotive, electronic tag memories and power management semiconductors. Our Foundry Services Group business represented 43.3%, 47.1% and 39.8% of our net sales for the fiscal years ended December 31, 2018, 2017 and 2016, respectively.

We manufacture the majority of our products at our two fabrication facilities located in Korea. We have approximately 508 proprietary process flows we can utilize for our products and offer to our Foundry Services Group customers. Our manufacturing base serves both our display driver and power management businesses and Foundry Services Group customers, allowing us to optimize our asset utilization and leverage our investments across our product and service offerings. Analog and mixed-signal manufacturing facilities and processes are typically distinguished by design and process implementation expertise rather than the use of the most advanced equipment. These processes also tend to migrate more slowly to smaller geometries due to technological barriers and increased costs. For example, some of our products use high-voltage technology that requires larger geometries and that may not migrate to smaller geometries for several years, if at all. As a result, our manufacturing base and strategy do not require substantial investment in leading edge process equipment, allowing us to utilize our facilities and equipment over an extended period of time with moderate required capital investments.

Table of Contents

Market Opportunity

The semiconductor market is large and is expanding its applications. Growth in this market is being driven by consumers seeking to enjoy a wide variety of rich media content, such as high definition audio and video, mobile devices, televisions and games. Electronics device manufacturers recognize that the consumer entertainment experience plays a critical role in differentiating their products. To address and further stimulate consumer demand, electronics manufacturers have been driving rapid advances in the technology, functionality, form factor, cost, quality, reliability and power consumption of their products. Electronics manufacturers are continuously implementing advanced technologies in new generations of electronic devices using analog and mixed-signal semiconductor components, such as display drivers that enable display of high resolution images, encoding and decoding devices that allow playback of high definition audio and video, and power management semiconductors that increase power efficiency, thereby improving heat dissipation and extending battery life. These advanced generations of consumer devices are growing faster than the overall electronics device market.

The user experience delivered by a consumer electronic device is substantially driven by the quality of the display, audio and video processing capabilities and power efficiency of the device. Analog and mixed-signal semiconductors enable and enhance these capabilities. Examples of these analog and mixed-signal semiconductors include display drivers, timing controllers, audio encoding and decoding devices, or codecs, and interface circuits, as well as power management semiconductors such as voltage regulators, converters and switches.

Requirements of Leading Electronic Devices Manufacturers

We believe our target customers view the following characteristics and capabilities as key differentiating factors among available analog and mixed-signal semiconductor suppliers and manufacturing service providers:

Broad Offering of Differentiated Products with Advanced System-Level Features and Functions. Leading electronic devices manufacturers seek to differentiate their products by incorporating innovative semiconductor products that enable unique system-level functionality and enhance performance. These consumer electronics manufacturers seek to closely collaborate with semiconductor solutions providers that continuously develop new and advanced products, technologies, and manufacturing processes that enable state of the art features and functions, such as bright and thin displays, small form factor and energy efficiency.

Fast Time-to-Market with New Products. As a result of rapid technological advancements and short product lifecycles, our target customers typically prefer suppliers who have a compelling pipeline of new products and capacity to leverage a substantial intellectual property and technology base to accelerate product design and manufacturing when needed.

Nimble, Stable and Reliable Manufacturing Services. Fabless semiconductor providers who rely on external manufacturing services often face rapidly changing product cycles. If these fabless companies are unable to meet the demand for their products due to issues with their manufacturing services providers, their profitability and market share can be significantly impacted. As a result, they prefer foundry service providers that can increase production quickly and meet demand consistently through periods of constrained industry capacity. Furthermore, many fabless semiconductor providers serving the consumer electronics and industrial sectors need specialty analog and mixed-signal manufacturing capabilities to address their product performance and cost requirements.

Ability to Deliver Cost Competitive Solutions. Electronics manufacturers are under constant pressure to deliver cost-competitive solutions. To accomplish this objective, they need strategic semiconductor suppliers that have the ability to provide system-level solutions, highly integrated products and a broad product offering at a range of price points and have the design and manufacturing infrastructure and logistical support to deliver cost competitive products.

Focus on Delivering Highly Energy-Efficient Products. Consumers increasingly seek longer run-time, environmentally friendly and energy-efficient consumer electronic products. In addition, there is increasing

Table of Contents

regulatory focus on reducing energy consumption of consumer electronic products. As a result of global focus on more environmentally friendly products, our customers are seeking analog and mixed-signal semiconductor suppliers that have the technological expertise to deliver solutions that satisfy these ever increasing regulatory and consumer power efficiency demands.

Our Competitive Strengths

Designing and manufacturing analog and mixed-signal semiconductors capable of meeting the evolving functionality requirements for electronics devices are challenging. In order to grow and succeed in the industry, we believe semiconductor suppliers must have a broad, advanced intellectual property portfolio, product design expertise, comprehensive product offerings and specialized manufacturing process technologies and capabilities. Our competitive strengths enable us to offer our customers solutions to solve their key challenges. We believe our strengths include:

Advanced Analog and Mixed-Signal Semiconductor Technology and Intellectual Property Platform. We believe we have one of the broadest and deepest analog and mixed-signal semiconductor technology platforms in the industry. Our long operating history, large patent portfolio, extensive engineering and manufacturing process expertise and wide selection of analog and mixed-signal intellectual property libraries allow us to leverage our technology and develop new products across multiple end markets. Our product development efforts are supported by a team of 419 engineers as of the date of this Report. Our platform allows us to develop and introduce new products quickly as well as to integrate numerous functions into a single product. For example, we were one of the first companies to introduce a commercial OLED display driver for mobile phones.

Established Relationships and Close Collaboration with Leading Global Electronics Companies. We have a long history of supplying and collaborating on product and technology development with leading innovators in the consumer electronics market. Our close customer relationships have been built based on many years of close collaborative product development which provides us with deep system level knowledge and key insights into our customers needs. As a result, we are able to continuously strengthen our technology platform in areas of strategic interest for our customers and focus on those products and services that our customers and end consumers demand the most.

Longstanding Presence in Asia and Proximity to Global Electronics Devices Supply Chain. Our presence in Asia facilitates close contact with our customers and fast response to their needs, and enhances our visibility into new product opportunities, markets and technology trends. Our design center and substantial manufacturing operations in Korea place us close to many of our largest customers and to the core of the global electronics devices supply chain. We have active applications, engineering, product design and customer support resources, as well as senior management and marketing resources, in geographic locations close to our customers. This allows us to strengthen our relationship with customers through better service, faster turnaround time and improved product design collaboration. We believe this also helps our customers to deliver products faster than their competitors and to solve problems more efficiently than would be possible with other suppliers.

Broad Portfolio of Product and Service Offerings Targeting Large, High-Growth Markets. We continue to develop a wide variety of analog and mixed-signal semiconductor solutions for multiple high-growth electronics device end markets. We believe our expanding product and service offerings allow us to provide additional products to new and existing customers and to cross-sell our products and services to our established customers. For example, we have leveraged our technology expertise and customer relationships to develop and grow power management solutions to customers. Our power management solutions enable our customers to increase system stability and improve heat dissipation and energy use, resulting in improved system efficiency and system cost savings for our customers, as well as environmental benefits. We have been able to sell these new products to our existing customers as well as expand our customer base.

Table of Contents

Distinctive Analog and Mixed-Signal Process Technology Expertise and Manufacturing Capabilities. We have developed specialty analog and mixed-signal manufacturing processes such as high voltage CMOS, power and embedded memory. These processes enable us to flexibly ramp mass production of display, power and mixed-signal products, and shorten the duration from design to delivery of highly integrated, high-performance analog and mixed-signal semiconductors.

Highly Efficient Manufacturing Capabilities. Our manufacturing strategy is focused on optimizing our asset utilization across our display driver and power management products as well as our foundry services, which enables us to maintain the price competitiveness of our products and services through our low-cost operating structure and improve our operational efficiency. We believe the location of our primary manufacturing and research and development facilities in Asia and the relatively low need for ongoing capital expenditures provide us with a number of cost advantages. We offer specialty analog process technologies that do not require substantial investment in leading edge, smaller geometry process equipment. We are able to utilize our manufacturing base over an extended period of time and thereby minimize our capital expenditure requirements.

Our Strategy

Our objective is to grow our business, cash flow and profitability and to continue strengthening our position in the semiconductor industry as a leading provider of analog and mixed-signal semiconductor products and services for high-volume markets. Our business strategy emphasizes the following key elements:

Leverage Our Advanced Analog and Mixed-Signal Technology Platform to Innovate and Deliver New Products and Services. We intend to continue to utilize our extensive patent and technology portfolio, analog and mixed-signal design and manufacturing expertise and specific end-market applications and system-level design expertise to deliver products with high levels of performance by utilizing our systems expertise and leveraging our deep knowledge of our customers needs.

Increase Business with Existing Customers. We have a global customer base consisting of leading consumer electronics OEMs that sell into multiple end markets. We intend to continue to strengthen our relationships with our customers by collaborating on critical design and product development in order to improve our design-win rates. We seek to increase our customer penetration by more closely aligning our product roadmap with those of our key customers and take advantage of our broad product portfolio, our deep knowledge of customer needs and existing relationships to sell more existing and new products. For example, two of our largest display driver customers have display modules in production using our power management products. These power management semiconductor products have been purchased and evaluated via their key subcontractors for LCD backlight units and LCD integrated power supplies.

Broaden Our Customer Base. We expect to continue to expand our global design centers, local application engineering support and sales presence, particularly in China, Hong Kong, Taiwan and Macau, or collectively, Greater China, and other high-growth geographies, to penetrate new accounts. In addition, we intend to introduce new products and variations of existing products to address a broader customer base. In order to broaden our market penetration, we are complementing our direct customer relationships and sales with an improved base of distributors, especially to aid the growth of our power management business.

Drive Execution Excellence. We intend to improve our execution through a number of management initiatives, new processes for product development, customer service and personnel development. We expect these ongoing initiatives will contribute to improvement of our new product development and customer service as well as enhance our commitment to a culture of quick action and execution by our workforce. In addition, we have focused on improving our manufacturing efficiency during the past several years.

Optimize Asset Utilization, Return on Capital Investments and Cash Flow Generation. We intend to keep our capital expenditures relatively low by maintaining our focus on specialty process technologies that do not require substantial investment in frequent upgrades to the latest manufacturing equipment. By utilizing

Table of Contents

our manufacturing facilities for our Display Solutions and Power Solutions products and our Foundry Services Group customers, we seek to maximize return on our capital investments and our cash flow generation.

Our Technology

We continuously strengthen our advanced analog and mixed-signal semiconductor technology platform by developing innovative technologies and integrated circuit building blocks that enhance the functionality of electronics devices through brighter, thinner displays, enhanced image quality, smaller form factor and longer battery life. We seek to further build our technology platform through proprietary processes and selective licensing and acquisition of complementary technologies, as well as disciplined process improvements in our manufacturing operations. Our goal is to leverage our experience and development initiatives across multiple end markets and utilize our understanding of system-level issues our customers face to introduce new technologies that enable our customers to develop more advanced, higher performance products.

Our display technology portfolio includes building blocks for display drivers and timing controllers, processor and interface technologies, as well as sophisticated production techniques, such as chip-on-glass (COG) and chip-on-film (COF) for rigid, flexible bezel-less, edge type, and trench type OLED displays. Our advanced display drivers incorporate LTPS TFT and OLED panel technologies that enable the highest resolution displays. Furthermore, we are developing a broad intellectual property portfolio to improve the power efficiency of displays, including the development of our contents-based automatic brightness control (CABC), automatic current limit (ACL) and optical compensation technology for OLED displays.

We have a long history of specialized process technology development and have a number of distinctive process implementations. We have approximately 508 process flows we can utilize for our products and offer to our Foundry Services Group customers. Our process technologies include standard CMOS, high voltage CMOS, ultra-low leakage high voltage CMOS, low noise CMOS with embedded bipolar-CMOS-DMOS(BCD) and BCDMOS and radio frequency silicon on insulator (RFSOI). Our manufacturing processes incorporate embedded memory solutions, such as static random access memory (SRAM), one-time programmable (OTP) memory, multiple-time programmable (MTP) memory, electrical fuse, and EEPROM. More broadly, we focus extensively on processes that reduce die size across all of the products we manufacture, in order to deliver cost-effective solutions to our customers.

Expertise in ultra-high voltage (UHV), high voltage and deep trench BCDMOS process technologies, low power analog and mixed-signal design capabilities and packaging know-how are key requirements in the power management market. We are currently leveraging our capabilities in these areas with products such as AC-DC converters, DC-DC converters, LED drivers, linear regulators and analog switches, power MOSFETs and IGBTs. We believe our system-level understanding of applications such as LCD televisions and smartphones will allow us to more quickly develop and customize power management solutions for our customers in these markets.

Products and Services by Business Line

Our broad portfolio of products and services addresses multiple high-growth, consumer-focused end markets. A key component of our product strategy is to supply multiple related product and service offerings to each of the end markets that we serve.

Foundry Services

We provide specialty analog and mixed-signal foundry services to fabless semiconductor companies and IDMs that serve communications, IoT, consumer, industrial and automotive applications. We manufacture wafers based on our customers product designs. We do not market these products directly to end customers but rather supply manufactured wafers and products to our customers to market to their end customers. We offer

Table of Contents

approximately 508 process flows to our Foundry Services Group customers. We also often partner with key customers to jointly develop or customize specialized processes that enable our customers to improve their products and allow us to develop unique manufacturing expertise.

Our Foundry Services Group targets customers who require differentiated, specialty analog and mixed-signal process technologies such as high voltage CMOS, non-volatile memory and power. We refer to our approach of delivering specialized services to our customers as our application-specific technology strategy. We differentiate ourselves through the depth of our intellectual property portfolio, ability to customize process technology to meet the customers requirements effectively, long history in this business and reputation for excellence.

Our Foundry Services Group customers vary from small fabless companies to large IDMs who serve communications, IoT, consumer, industrial and automotive applications.

Process Technology Overview

Mixed-Signal. Mixed-signal process technology is used in devices that require conversion of light and sound into electrical signals for processing and display. Our mixed-signal processes include advanced technologies such as low-noise process using triple gate, which allows die size reduction at any given performance level.

Power. Power process technology, such as BCD, includes high-voltage capabilities as well as the ability to integrate functionalities, such as self-regulation, internal protection and other intelligent features. Unique process features, such as deep trench isolation, are suited for chip shrink and device performance enhancement.

High Voltage CMOS. High-voltage CMOS process technology facilitates the use of high-voltage levels in conjunction with smaller transistor sizes. This process technology includes several variations, such as bipolar processes, which use transistors with qualities well suited for amplifying and switching applications, mixed-mode processes, which incorporate denser, more power efficient FETs, and thick metal processes.

Non-Volatile Memory. Non-volatile memory (NVM), process technology enables the integration of non-volatile memory cells that allow retention of the stored information even when power is removed from the circuit. This type of memory is typically used for long-term persistent storage.

The table below sets forth the key process technologies in Foundry Services Group that we currently offer to customers:

Process	Technology	Device	Application
Mixed-Signal	0.13-0.5µm	Analog to digital converter	Smartphones
	Low noise	Digital to analog converter	Tablet PCs
	Ultra low power	Audio codec	Notebooks
	Triple gate	Chipset	PC peripherals
	RF SOI	RF switch	DVD players
	0.13µm Slim*	Digital tunable capacitor	LCD TVs
	0.18µm Slim	Fingerprint sensor	

8

Table of Contents

Process	Technology	Device	Application
Power	0.13*-0.35μm	Power management	Smartphones
	BCD 40V-120V*	LED driver	Tablet PCs
	Deep trench isolation	High power audio amp	Notebooks
	MOSFET	Power Over Ethernet	LCD TVs
	Ultra high voltage	DC/DC converter	LED lighting
	Thick metal	USB type-C	LCD monitors
	Slim BCD 100V*	Wireless power charger	Automotive
	Simplified UHV		
High-Voltage CMOS	0.11-0.35μm	Display driver	Smartphones
	18V-45V	CSTN driver	Tablet PCs
	Bipolar		LCD TVs
			Desktop PCs
			LCD monitors
NVM	0.11*-0.35μm	Microcontroller	Smartphones
	EEPROM, Ultra low leakage	Touch screen controller	Tablet PCs
	Slim flash, Ultra low leakage	Electronic tag memory	Industrial applications
	eFlash	Hearing aid controller	Medical equipment
	OTP	Fingerprint sensor	Automotive
	MTP	Auto Focus IC	

* In customer qualification stage

Display Solutions

Display Driver Characteristics. Display drivers deliver defined analog voltages and currents that activate pixels to exhibit images on displays. The following key characteristics determine display driver performance and end-market application:

Resolution and Number of Channels. Resolution determines the level of detail displayed within an image and is defined by the number of pixels per line multiplied by the number of lines on a display. For large displays, higher resolution typically requires more display drivers for each panel. Display drivers that have a greater number of channels, however, generally require fewer display drivers for each panel and command a higher selling price per unit. Mobile displays, conversely, are typically single chip solutions designed to deliver a specific resolution. We cover resolutions ranging from VGA (640 x 480) to UHD (3840 x 2160).

Color Depth. Color depth is the number of colors that can be displayed on a panel. For example, for TFT-LCD panels, 262 thousand colors are supported by 6-bit source drivers; 16 million colors are supported by 8-bit source drivers; and 1 billion colors are supported by 10-bit source drivers.

Operational Voltage. Display drivers are characterized by input and output voltages. Source drivers typically operate at input voltages from 1.62 to 3.6 volts and output voltages between 9 and 18 volts. Gate drivers typically operate at input voltages from 1.62 to 3.6 volts and output voltages from 30 to 45 volts. Lower input voltage results in lower power consumption and electromagnetic interference (EMI).

Gamma Curve. The relationship between the light passing through a pixel and the voltage applied to the pixel by the source driver is referred to as the gamma curve. The gamma curve of the source driver can correct some imperfections in picture quality in a process generally known as gamma correction. Some advanced display drivers feature up to three independent gamma curves to facilitate this correction.

Driver Interface. Driver interface refers to the connection between the timing controller and the display drivers. Display drivers increasingly require higher bandwidth interface technology to address the larger data transfer rate necessary for higher definition images. The principal types of interface technologies are embedded

Table of Contents

clock point to point interface (EPI), advanced intra panel interface (AIPI), mini-low voltage differential signaling (m-LVDS), unified standard interface for notebook and monitor (USI-GF), unified standard interface (USI), unified standard interface for TV (USI-T) and mobile industry processor interface (MIPI).

Package Type. The assembly of display drivers typically uses COF and COG package types.

Large Display Solutions. We provide display solutions for a wide range of flat panel display sizes used in LCD televisions, including ultra-high definition televisions, or UHD TVs, FHD TVs, HD TVs, LED TVs, 3D TVs, OLED TVs, LCD monitors, notebooks, tablet PCs, public information displays and automotive.

Our large display solutions include source and gate drivers and timing controllers with a variety of interfaces, voltages, frequencies and packages to meet customers needs. These products include advanced technologies such as high channel count, with products in mass production to provide up to 1,542 channels. Our large display solutions are designed to allow customers to cost-effectively meet the increasing demand for high resolution displays. We focus extensively on reducing the die size of our large display drivers and other solutions products to reduce costs without having to migrate to smaller geometries. For example, we have implemented several solutions to reduce die size in large display drivers, such as optimizing design schemes and design rules and applying specific technologies that we have developed internally. We have recently introduced a number of new large display drivers with reduced die size.

The table below sets forth the features of our products, both in mass production and in customer qualification, which is the final stage of product development, for large-sized displays:

Product	Key Features	Applications
TFT-LCD Source Drivers	480 to 1,542 output channels	UHD/HD/LED/3D TVs
	6-bit (262 thousand colors), 8-bit (16 million colors), 10-bit (1 billion colors)	Notebooks
	Output voltage ranging from 9V to 18V	LCD/LED monitors
	Low power consumption and low EMI	Automotive
	COF package types	
	EPI, m-LVDS, AIPI, USI interface technologies	
TFT-LCD Gate Drivers	272 to 960 output channels	Tablet PCs
	Output voltage ranging from 30V to 45V	HD/LED/3D TVs
	COF and COG package types	Notebooks
		Automotive
Timing Controllers	Wide range of resolutions	Tablet PCs
	EPI, m-LVDS, MIPI, USI-T interface technologies	Public information display
	Input voltage ranging from 1.6V to 3.6V	
OLED Source Drivers	960 output channels	OLED TVs
	10 bit (1 billion colors)	

Output voltage: 18V

COF package type

EPI interface technology

Table of Contents