ALPHA & OMEGA SEMICONDUCTOR Ltd
Form 10-K
August 23, 2018
UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

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FORM 10-K

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(MARK ONE)
x ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended June 30, 2018
OR
o 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 001-34717

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Alpha and Omega Semiconductor Limited
(Exact name of Registrant as Specified in its Charter)

Bermuda	77-0553536
(State or Other Jurisdiction of Incorporation or Organization)	(I.R.S. Employer Identification Number)

Clarendon House, 2 Church Street
Hamilton HM 11, Bermuda
(Address of Principal Registered
Offices including Zip Code)
(408) 830-9742
(Registrant's Telephone Number, Including Area Code)

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

Title of each class	Name of each exchange on which registered
Common Shares, $0.002 par value per share	The NASDAQ Global Select Market

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 o No x
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 o No x
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 x No o
Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted 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 and post such files). Yes x No o
Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K 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. x

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer or smaller reporting company. See definitions of “large accelerated filer,” “accelerated filer” and “smaller reporting company” in Rule 12b-2 of the Exchange Act. (Check one):

Large accelerated filer o	Accelerated filer x	Non-accelerated filer o (Do not check if a smaller reporting company)
Smaller reporting company o	Emerging growth company o	

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. o

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

The aggregate market value of the voting shares held by non-affiliates of the registrant as of December 29, 2017 was approximately $317 million based on the closing price of the registrant's common share as reported on the NASDAQ Global Select Market on December 29, 2017 (the last business day of the registrant's most recently completed second fiscal quarter). The common shares of the registrant held by each executive officer and director and certain affiliated shareholders who beneficially owned 10% or more of the outstanding common stock of the registrant have been excluded in such calculation as such persons and entities may be deemed to be affiliates of the registrant. This determination of affiliate status is not necessarily a conclusive determination for other purposes.

There were 23,862,847 shares of the registrant's common shares outstanding as of July 31, 2018.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Proxy Statement for the registrant's 2018 Annual General Meeting of Shareholders are incorporated by reference into Part III of this Form 10-K to the extent stated herein. The Definitive Proxy Statement is expected to be filed within 120 days of the registrant's fiscal year ended June 30, 2018.

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PART I

Item 1. Business

Forward Looking Statements

This Annual Report on Form 10-K and the documents incorporated herein by reference contain forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended, which are subject to the "safe harbor" created by those sections. Forward-looking statements are based on our management's beliefs and assumptions and on information currently available to our management. In some cases, you can identify forward-looking statements by terms such as "may," "will," "should," "could," "intend," "would," "expect," "plan," "anticipate," "believe," "estimate," "project," "predict," "potential" and expressions intended to identify forward-looking statements. These statements involve known and unknown risks, uncertainties and other factors, which may cause our actual results, performance, time frames or achievements to be materially different from any future results, performance, time frames or achievements expressed or implied by the forward-looking statements. We discuss many of these risks, uncertainties and other factors in this Annual Report on Form 10-K in greater detail in Item 1A."Risk Factors." Given these risks, uncertainties and other factors, you should not place undue reliance on these forward-looking statements. Also, these forward-looking statements represent our estimates and assumptions only as of the date of this filing. You should read this Annual Report on Form 10-K in its entirety and with the understanding that our actual future results may be materially different from what we expect. We hereby qualify our forward-looking statements by these cautionary statements. Except as required by law, we assume no obligation to update these forward-looking statements publicly, or to update the reasons actual results could differ materially from those anticipated in these forward-looking statements, even if new information becomes available in the future.

Overview

We are a designer, developer and global supplier of a broad portfolio of power semiconductors. Our portfolio of power semiconductors includes approximately 1,900 products, and has grown significantly with the introduction of 200 new products during the fiscal year ended June 30, 2018, and over 80 and 90 new products in each of the fiscal years ended June 30, 2017 and 2016, respectively. Our teams of scientists and engineers have developed extensive intellectual properties and technical knowledge that encompass major aspects of power semiconductors, which we believe enable us to introduce and develop innovative products to address the increasingly complex power requirements of advanced electronics. We have an extensive patent portfolio that consists of 722 patents and 108 patent applications in the United States as of June 30, 2018. We differentiate ourselves by integrating our expertise in technology, design, manufacturing capability and advanced packaging to optimize product performance and cost. Our portfolio of products targets high-volume applications, including personal computers, flat panel TVs, smart phones, battery packs, quick chargers, home appliances, consumer and industrial motor controls and power supplies for TVs, computers, servers and telecommunications equipment.

During the fiscal year ended June 30, 2018, we continued our diversification strategy by developing new silicon and packaging platforms to expand our serviceable available market, or SAM and offer higher performance products. Our metal-oxide-semiconductor field-effect transistors, or MOSFET, portfolio expanded significantly across a full range of voltage applications. We also developed new technologies and products designed to penetrate into markets beyond our MOSFET computing base, including the consumer, communications and industrial markets as well as power IC for the next generation computing applications.

Our business model leverages global resources, including research and development and manufacturing in the United States and Asia. Our sales and technical support teams are localized in several growing markets primarily in Asia. We operate a 8-inch wafer fabrication facility located in Hillsboro, Oregon, or the Oregon fab, which enables us to accelerate proprietary technology development, new product introduction and improve our financial performance. To meet the market demand for the more mature high volume products, we also utilize the wafer manufacturing capacity of selected third party foundries. For assembly and test, we primarily rely upon our in-house facilities in China. In

addition, we utilize subcontracting partners for industry standard packages. We believe our in-house packaging and testing capability provides us with a competitive advantage in proprietary packaging technology, product quality, costs and sales cycle time.

On March 29, 2016, we entered into a joint venture contract (the "JV Agreement") with two investment funds affiliated with the municipalities of Chongqing (the "Chongqing Funds"), pursuant to which we and Chongqing Funds form a joint venture, (the "JV Company"), for the purpose of constructing a power semiconductor packaging, testing and wafer fabrication facility in the Liangjiang New Area of Chongqing, China (the "JV Transaction"). The total initial capitalization of the JV Company is $330.0 million (the "Initial Capitalization"). As of June 30, 2018, we own 51%, and the Chongqing Funds own 49%, of the equity interest in the JV Company. The JV Company substantially completed its assembly and testing and 12-inch

wafer fab facilities during the quarter ended June 30, 2018. We expect to commence limited mass production for assembly and testing in the second half of calendar year 2018, and trial production for the 12-inch wafer fabrication facility toward the end of calendar year 2018.

In September 2017, we entered into a license agreement with STMicroelectronics International N.V. ("STMicro"), which allows us to develop and market certain digital power multi-phase controller products and enter into new markets, primarily in server and telecommunications. We are in the process of developing this new digital power business. We hired approximately two-thirds of the team that we plan to build. The team has been engaging with potential customers in product designs.

We were incorporated in Bermuda on September 27, 2000 as an exempted limited liability company. The address of our registered office is Clarendon House, 2 Church Street, Hamilton HM 11, Bermuda. Our agent for service of process in the U.S. for the purpose of our securities filings is our Chief Executive Officer, Mike F. Chang, c/o Alpha and Omega Semiconductor Incorporated, 475 Oakmead Parkway, Sunnyvale, CA 94085. Telephone number of our agent is (408) 830-9742.

We have incorporated various wholly-owned subsidiaries in different jurisdictions, and a subsidiary (the JV Company) in which we have a controlling interest. Please refer to Exhibit 21.1 for a complete list of our subsidiaries.

Our industry

Semiconductors are electronic devices that perform a variety of functions, such as converting or controlling signals, processing data and delivering or managing power. With advances in semiconductor technology, the functionality and performance of semiconductors have generally increased over time, while size and cost have generally decreased. These advances have led to a proliferation of more complex semiconductors being used in a wide variety of consumer, computing, communications and industrial markets and have contributed to the growth of the semiconductor industry.

Analog semiconductors

The semiconductor industry is segmented into analog and digital. Analog semiconductors process light, sound, motion, radio waves and electrical currents and voltages. In contrast, digital semiconductors process binary signals represented by a sequence of ones and zeros.

As a result of these fundamental differences, the analog semiconductor industry is distinct from the digital semiconductor industry in terms of the complexity of design and the length of product cycle. Improper interactions between analog circuit elements can potentially render an electronic system inoperable. Experienced engineers engaged in the design process are necessary because computer-aided design cannot fully model the behavior of analog circuitry. Therefore, experienced analog engineers with requisite knowledge are in great demand but short supply worldwide. In addition, analog semiconductors tend to have a longer product life cycle because original design manufacturers, or ODMs and original equipment manufacturers, or OEMs typically design the analog portions of a system to span multiple generations of their products. Once designed into an application, the analog portion is rarely modified because even a slight change to the analog portion can cause unexpected interactions with other components, resulting in system instability.

Power semiconductors

Power semiconductors are a subset of the analog semiconductor sector with their own set of characteristics unique to power architecture and function. Power semiconductors transfer, manage and switch electricity to deliver the appropriate amount of voltage or current to a broad range of electronic systems and also protect electronic systems from damage resulting from excessive or inadvertent electrical charges.

Power semiconductors can be either discrete devices, which typically comprise only a few transistors or diodes, or ICs, which incorporate a greater number of transistors. The function of power discrete devices is power delivery by switching, transferring or converting electricity. Power transistors comprise the largest segment of the power discrete

device market. Power ICs, sometimes referred to as power management ICs, perform power delivery and power management functions, such as controlling and regulating voltage and current and controlling power discrete devices.

The growth of the power semiconductor market in recent years has several key drivers. The proliferation of computer and consumer electronics, such as notebooks, tablets, smart phones, flat panel displays and portable media players created the need for sophisticated power management to improve power efficiency and extend battery life. The evolution of these products is characterized by increased functionality, thinner or smaller form factors and decreasing prices. Our Power IC and low voltage (5V-40V) MOSFET products address this market. In the area of AC-DC power supplies for electronic equipment, data centers

and servers, the market is characterized by a continuous demand for energy conservation through higher efficiency, which is driving the need for our medium voltage (40V-400V) and high voltage (500V-1000V) MOSFET products. The increased application of power semiconductors to control motors in white goods and industrial applications, is driving demand for Insulated Gate Bipolar Transistors, or IGBTs. IGBTs are also being used in renewable energy and automotive applications.

The evolution toward smaller form factors and complex power requirements in the low voltage areas has driven further integration in power semiconductors, resulting in power ICs that incorporate the functionalities of both power management and power delivery in a single device. Power ICs can be implemented by incorporating all necessary power functions either on one piece of silicon or multiple silicon chips encapsulated into a single device. Additionally, the advancement in semiconductor packaging technology enables increased power density and shrinking form factors.

Power semiconductor suppliers develop and manufacture their products using various approaches which tend to fall across a wide spectrum of balancing cost savings with proprietary technology advantages. At one end of the spectrum are integrated design manufacturers, or IDMs, which own and operate the equipment used in the manufacturing process and design and manufacture products at their in-house facilities. IDMs exercise full control over the implementation of process technologies and have maximum flexibility in setting priorities for their production and delivery schedules. At the other end of the spectrum are completely-outsourced fabless semiconductor companies, which rely entirely on off-the-shelf technologies and processes provided by their manufacturing partners. These companies seek to reduce or eliminate fixed costs by outsourcing both product manufacturing and development of process technologies to third parties. Our model seeks to achieve the best balance between technological advancement and cost effectiveness by using a dedicated in-house technology laboratory to drive rapid new product developments, while utilizing third-party foundry capacity for mature products. This is particularly important in the development of power semiconductor products due to the unique nature of their technology. While digital technologies are highly standardized in leading foundries, power semiconductor technologies tend to be more unique as they seek to accommodate a wider range of voltage applications. Accordingly, third-party foundries, which are primarily designed and established for digital technologies, can be limited when it comes to the development of new power semiconductor technologies.

Our strategies

Our strategy is to advance our position as a designer, developer and global supplier of a broad portfolio of power semiconductors. To accomplish this, we have adopted a strategy that allows us to accelerate the development of our proprietary technology at our Oregon fab, bring new products to market faster, and improve our financial performance in the long run. This model also provides quicker response to our customer demands, enhances relationships with strategic customers, and provides flexibility in capacity management and geographic diversification of our wafer supply chain. Our in-house manufacturing capability allows us to retain a higher level of control over the development and application of our proprietary process technology, thereby reducing certain operational risks and costs associated with utilizing third-party foundries. In addition, we expect to expand our manufacturing capacity through the JV Transaction, which we believe will also allow us to expand and diversify our markets in China, as well as to accelerate the development of our proprietary process technology through our Chongqing manufacturing facilities.

In addition to our products targeting the PC market, we execute our strategies of diversifying our portfolio of products and expanding into other market segments, including the consumer, communications, power supplies and industrial market segments, and improving gross margin and profit by implementing cost control measures. We have been making progress in reducing our reliance on the PC market, but we are also committed to continue to support our PC business by expanding bill-of-material content, expanding market share, and acquiring new customers.

We plan to further expand the breadth of our product portfolio to increase our total bill-of-materials within an electronic system and to address the power requirements of additional electronic systems. Our product portfolio currently consists of approximately 1,900 products and we have introduced over 200 new products in this past fiscal

year. We will continue to leverage our expertise to further increase our product lines, including higher performance power ICs, IGBTs and high, medium and low voltage MOSFETs, in order to broaden our addressable market and improve our margin profile. We are also in the process of developing a digital power controller product line based on the technology that we licensed from STMicro. We believe that our increased product offerings will allow us to penetrate new end-market applications and provide us with an important competitive advantage. OEMs and ODMs generally prefer to limit their supplier base to a smaller set of vendors capable of providing a comprehensive menu of products across multiple electronic platforms.

Leverage our power semiconductor expertise to drive new technology platforms

We believe that the ever-increasing demand for power efficiency in power semiconductors requires expertise in and a deep understanding of the interrelationship among device physics, process technologies, design and packaging. We also believe that engineers with experience and understanding of these multiple disciplines are in great demand but short supply. Within this context, we believe that we are well positioned to be a leader in providing total power management solutions due to our extensive pool of experienced scientists and engineers and our strong IP portfolio. Accordingly, we intend to leverage our expertise to increase the number of power discrete technology platforms and power IC designs, including future digital power controller products that are currently under development, to expand our product offerings and deliver complete power solutions for our targeted applications. In addition, our ability to develop new technology is enhanced by the operation of our own manufacturing facilities in Oregon and Chongqing, including the new 12-inch fab that is near completion.

Increase direct relationships and product penetration with OEM and ODM customers

We have developed direct relationships with key OEMs who are responsible for branding, designing and marketing a broad array of electronic products, as well as ODMs who have traditionally been responsible for manufacturing these products. While OEMs typically focus their design efforts on their flagship products, as the industry has evolved, ODMs are increasingly responsible for designing portions, or entire systems, of the products they manufacture for the OEMs. In addition, several ODMs are beginning to design, manufacture and brand their own proprietary products which they sell directly to consumers. We intend to strengthen our existing relationships and form new ones with both OEMs and ODMs by aligning our product development efforts with their product requirements, increasing the number of our products used within their systems, and leveraging our relationships to penetrate their other products. In addition, we are refocusing our research and development efforts to respond more directly to the market demand by designing and developing new products based on feedback from our customers, which also allows us to reduce time-to-market and sales cycles.

Leverage global business model for cost-effective growth

We intend to continue to leverage our global resources and regional strengths. We will continue to deploy marketing, sales and technical support teams in close proximity to our end customers. We plan to further expand and align our technical marketing and application support teams along with our sales team to better understand and address the needs of our end customers and their end-market applications, in particular for those with the new technology platforms developed in this past year and in the future. This will assist us in identifying and defining new technology trends and products and to help us gain additional design wins. In addition, we have established a joint venture with investment funds affiliated with the municipalities of Chongqing, China for the purpose of constructing a power semiconductor packaging, testing and wafer fabrication and we have made significant progress in the past fiscal year towards the completion of the joint venture facilities and commencement of production. We expect our collaboration with Chongqing will, in the long term, reduce the cost of manufacturing our products and accelerate the development of new products, while allowing us to gain valuable access to new customers in China.

Our products

To serve the large and diverse analog market for power semiconductors, we have created a broad product portfolio consisting of two major categories: power discretes and power ICs.

Our power discretes products consist primarily of low, medium and high voltage power MOSFETs. Our low voltage MOSFET series is based on our proprietary silicon and package technologies, with deep application know how in various market segments. We have precisely defined technology platforms to address different requirements from various applications. Our medium voltage MOSFETs provide best optimized performance with high efficiency, high robustness and high reliability, and are widely used in applications such as TV backlighting, telecom power supplies, and industrial applications. We expanded our high voltage MOSFET portfolio by releasing our newest aMOS5 technology platform targeted to address robust consumer and industrial applications. Our high-voltage portfolio includes our proprietary insulated-gate bipolar transistor ("IGBT") technology, which we developed highly robust and easy-to-use solutions designed for industrial motor control and white goods applications.

Our power ICs deliver power as well as control and regulate the power management variables, such as the flow of current and level of voltage. We continued to expand our EZBuck power IC family with products that feature lower on-resistance, less power consumption, small footprint and thermally enhanced packages. While we derive the majority of our revenue from the sales of power discretes products, sales of power ICs continue to gain traction during the past years.

The following table lists our product families and the principal end uses of our products:

Product Family	Description	Product Categories within Product Type	Typical Application
Power Discretes	Low on-resistance switch used for routing current and switching voltages in power control circuits High power switches used for power circuits	DC-DC for CPU/GPU DC-AC conversion AC-DC conversion Load switching Motor control Battery protection Power factor correction	Smart phone chargers, battery packs, notebooks, desktop and servers, data centers, base stations, graphics card, game boxes, TVs, AC adapters, power supplies, motor control, power tools, E-vehicles, white goods and industrial motor drives, UPS systems, solar inverters and industrial welding
Power ICs	Integrated devices used for power management and power delivery	DC-DC Buck conversion DC-DC Boost conversion Smart load switching DrMOS power stage	Flat panel displays, TVs, Notebooks, Ultrabooks, servers, DVD/Blu-Ray players, set-top boxes, and networking equipment
	Analog power devices used for circuit protection and signal switching	Transient voltage protection Analog switch Electromagnetic interference filter	Notebooks, Ultrabooks, desktop PCs, tablets, flat panel displays, TVs, smart phones, and portable electronic devices

Power discrete products

Power discretes are used across a wide voltage and current spectrum, requiring them to operate efficiently and reliably under harsh conditions. Due to this wide applicability across diverse end-market applications, we market general purpose MOSFETs that are used in multiple applications as well as MOSFETs targeted for specific applications.

Our current power discrete product line includes industry standard trench MOSFETs, SRFETs, XSFET, electrostatic discharge, protected MOSFETs, high and mid-voltage MOSFETs and IGBTs.

Power IC products

In addition to the traditional monolithic or single chip design, we employ a multi-chip approach for the majority of our power ICs. This multi-chip technique leverages our proprietary MOSFET and advanced packaging technologies to offer integrated solutions to our customers. This allows us to update product portfolios by interchanging only the MOSFETs without changing the power management IC, thereby reducing the time required for new product introduction and providing optimal solutions to our customers. We believe that our power IC products improve our competitive position by enabling us to provide higher power density solutions to our end customers than our competitors.

The incorporation of both power delivery and power management functions tends to make power ICs more application specific because these two functions have to be properly matched to a particular end product. We have local technical marketing and applications engineers who closely collaborate with our end customers to help ensure that power IC specifications are properly defined at the beginning of the design stage.

New Product Introduction

We introduced several new products based on our proprietary technology platform and continue to expand our product family by introducing new solutions to computing, battery protection, and smart phone fast chargers. During the fourth quarter of fiscal year of 2018, we introduced new family of EZBuck™ regulators featuring I2C control. The new devices provide a compact, efficient power converter solution for next-generation chipsets and FPGAs used in high-end TVs, set-top boxes, data storage systems, servers and other embedded systems. We also introduced the AONX38168, which utilizes the latest 25V N-

Channel MOSFET technology platform, combining the low-side and high-side in a leadless surface mount package to offer high power density for server and telecommunication markets. During the third quarter of fiscal year of 2018, we introduced AONE36132, a 25V N-Channel MOSFET in a compact dual DFN 3.3x3.3 package, offering lower switch node ringing and lower parasitic inductance. Also we introduced a new Type-C Power Delivery compliant load switch with up to 28V over-voltage protection. This new device offers low RDS(ON) (40mohm) in a thermally enhanced 3x3mm DFN package, making it an ideal solution for the latest notebooks, ultrabooks, desktops, monitors, dockings/dongles, and Thunderbolt/USB Type-C PD applications. During the second quarter of fiscal year of 2018, we introduced AONR21357, which uses the improved P-Channel MOSFET process to achieve low power loss and reliable startup. This new P-Channel MOSFET is ideal for load switch applications in Notebook Adapter-In/ Battery In sockets. We also released AONS66916 production utilizing the latest Alpha Shield Gate Technology Generation 2 (AlphaSGT2), which enables higher efficiency and robustness to critical high density telecom and server applications. During the first quarter of fiscal year of 2018, we released AOTF190A60L, the first product in the new AMOS5TMHV MOSFET platform. This device provides high-efficiency performance in an easy-to-use solution optimized for server power supplies, high-end computers, charging stations and other high-performance applications. We also introduced AOZ5131QI, the latest generation of power modules. The new device enables high power-density voltage regulator solutions ideal for CPU and GPU power regulation in notebook PCs, servers, and graphic cards. In addition, we expanded our recently launched fast turn-off switched 650V H-series IGBT family with a 1200V rating. The new AOK40B120H1has been developed to address needs of industrial welding and high-frequency converters with 3-phase AC or high voltage DC input. The device offers excellent performance in high switching frequency applications, which can be a perfect fit for high voltage industrial welding machines.

Distributors and customers

We have developed direct relationships with key OEMs, including Dell Inc., Hewlett-Packard Company, LG Electronics, Inc. and Samsung Group, most of which we serve through our distributors and ODMs. We sell to Samsung Group directly which accounted for 5.1%, 10.6% and 12.3% of our revenue for the fiscal years ended June 30, 2018, 2017 and 2016, respectively. In addition, based on our historical design win activities, our power semiconductors are also incorporated into products sold to certain OEMs.

Through our distributors, we provide products to ODMs who traditionally are contract manufacturers for OEMs. As the industry has evolved, ODMs are increasingly responsible for designing portions, or entire systems, of the products they manufacture for the OEMs. In addition, several ODMs are beginning to design, manufacture and brand their own proprietary products, which they sell directly to consumers. Our ODM customers include Compal Electronics, Inc., Foxconn, Quanta Computer Incorporated, Pegatron, Wistron Corporation and AOC International.

In order to take advantage of the expertise of end-customer fulfillment logistics and shorter payment cycles, we sell most of our products to distributors. In general, under the agreements with our distributors, they have limited rights to return unsold merchandise, subject to time and volume limitations. As of June 30, 2018, 2017 and 2016, our two largest distributors were WPG Holdings Limited, or WPG, and Promate Electronic Co. Ltd., or Promate. Sales to WPG and Promate accounted for 35.2% and 28.3% of our revenue, respectively, for the fiscal year ended June 30, 2018, 35.8% and 26.9% of our revenue, respectively, for the fiscal year ended June 30, 2017, and 37.2% and 23.8% of our revenue, respectively, for fiscal year ended June 30, 2016, respectively.

Sales and marketing

Our marketing division is responsible for identifying high growth markets and applications where we believe our technology can be effectively deployed. We believe that the technical background of our marketing team, including application engineers, helps us better define new products and identify potential end customers and geographic and product market opportunities. For example, as part of our market diversification strategy, we have deployed and plan to recruit more for our new market segments, field application engineers, or FAEs, who provide real-time and on-the-ground responses to our end customer needs. FAEs work with our end customers to understand their requirements, resolve technical problems, strive to anticipate future customer needs and facilitate the design-in of our products into the end products of our customers. We believe this strategy increases our share of revenue opportunities within the applications we currently serve, as well as in new end-market applications.

Our sales team consists of sales persons, field application engineers, customer service representatives and customer quality engineers who are responsible for key accounts. We strategically position our team near our end customers through our offices in Taipei, Hong Kong, Shenzhen, Shanghai, Tokyo, Seoul, Heilbronn, Germany, and Sunnyvale, California, complemented by our applications centers in Sunnyvale and Shanghai. In addition, our distributors and sales representatives assist us in our sales and marketing efforts by identifying potential customers, sourcing additional demand and promoting our products, in which case we may pay a sales commission to these distributors.

Our sales cycle varies depending on the types of products and can range from six to eighteen months. In general, our traditional power discrete products in the PC and TV applications are moving more rapidly through the design and marketing processes, therefore they generally have shorter sales cycle. In contrast, our newer Power IC and IGBT products, mostly in the power supply, home appliance and industrial applications, require a more extended design and marketing timeline and thus have longer sales cycle. Typically, our sales cycle for all products comprises of the following steps:

- identification of a customer design opportunity;
- qualification of the design opportunity by our FAEs through comparison of the power requirements against our product portfolio;
- provision of a product sample to the end customer to be included in the customer's pre-production model with the goal of being included in the final bill of materials; and
- placement by the customer, or through its distributor, of a full production order as the end customer increases to full volume production.

Competition

The power semiconductor industry is characterized by fragmentation with many competitors. We compete with different power semiconductor suppliers, depending on the type of product lines and geographical area. Our key competitors in power discretes and power ICs are primarily headquartered in the United States, Japan, Europe and Taiwan. Our major competitors in power discretes include Infineon Technologies AG, MagnaChip Semiconductor Corporation, ON Semiconductor Corp., STMicroelectronics N.V., Toshiba Corporation, Diodes Incorporated and Vishay Intertechnology, Inc. Our major competitors for our power ICs include Global Mixed-mode Technology Inc., Monolithic Power Systems, Inc., Richtek Technology Corp., Semtech Corporation and Texas Instruments Inc..

Our ability to compete depends on a number of factors, including:

- our success in expanding and diversifying our serviceable markets, and our ability to develop technologies and product solutions for these markets;
- our capability in quickly developing and introducing proprietary technology and best in class products;
- the performance and cost-effectiveness of our products relative to that of our competitors;
- our ability and capacity to manufacture, package and deliver products in large volume on a timely basis at a competitive price;
- our success in utilizing new and proprietary technologies to offer products and features previously not available in the marketplace;
- our ability to recruit and retain analog semiconductor designers and application engineers; and
- our ability to protect our intellectual property.

Some of our competitors have longer operating histories, more brand recognition, and significantly greater financial, technical, research and development, sales and marketing, manufacturing and other resources. However, we believe that we can compete effectively through our integrated and innovative technology platform and design capabilities, including our multi-chip approach to power IC products, strategic global business model, expanding portfolio of products, diversified and broad customer base, and excellent on-the-ground support and quick time to market for our products.

Seasonality

As we provide power semiconductors used in consumer electronic products, our business is subject to seasonality. Our sales seasonality is affected by a number of factors, including global and regional economic conditions as well as the PC market conditions, revenue generated from new products, changes in distributor ordering patterns in response to channel inventory adjustments and end customer demand for our products and fluctuations in consumer purchase patterns prior to major holiday seasons.

Backlog

Our sales are made primarily pursuant to standard purchase orders from distributors and direct customers. The amount of backlog to be shipped during any period depends on various factors, and all orders are subject to cancellation or modification, usually with no penalty to customers. The quantities actually purchased by customers, as well as shipment schedules, are frequently revised to reflect changes in both the customers' requirements and in manufacturing availability. Therefore, our backlog at any point in time is not a reliable indicator of our future revenue.

Research and development

Because we view technology as a competitive advantage, we invest significant time and capital into research and development to address the technology intensive needs of our end customers. Our research and development expenditures for the fiscal years of 2018, 2017 and 2016 were $37.3 million, $29.8 million and $26.0 million, respectively. Our research and development expenditures primarily consist of personnel compensation, prototypes, engineering materials, simulation and design tools and test and analyzer equipment. Our new product development efforts continue to focus on developing products with higher speed, higher efficiency and reliability, higher power density, greater performance and lower costs. We have research and development teams in Silicon Valley (Sunnyvale, California), Oregon, Taipei, Taiwan, and Shanghai, China. We believe that these diverse research and development teams enable us to develop leading edge technology platforms and new products. Our areas of research and development focus include:

Packaging technologies: Consumer demand for smaller and more compact electronic devices with higher power density is driving the need for advanced packaging technology. Our group of dedicated packaging engineers focuses on smaller form factor, higher power output with efficient heat dissipation and cost-effectiveness. We have invested resources to develop and enhance our proprietary packaging technologies, including the establishment of our in-house packaging and testing facilities. We believe that our efforts to develop innovative packaging technologies will continue to provide new and cost-effective solutions with higher power density to our customers. During the fiscal year ended June 30, 2018, we continued our diversification strategies by developing new silicon and packaging platforms to expand our SAM and offer higher performance products.

Process technology and device physics: We focus on specialized process technology in the manufacturing of our products, including vertical DMOS, Shielded Gate Trench, Trench field stop IGBTs, charge-balance high voltage MOSFETs, Schottky Diode and BCDMOS processes. Our process engineers work closely with our design team to deploy and implement our proprietary manufacturing processes at our Oregon fab, and more recently, at the Chongqing manufacturing facility under the JV, as well as the third-party foundries that fabricate our wafers. We also expect our Chongqing manufacturing facility under the JV, including the 12-inch fab, will provide us with enhanced ability to develop and accelerate new process technology for advanced products. To improve our process technology, we continue to develop and enhance our expertise in device physics in order to better understand the physical characteristics of materials and the interactions among these materials during the manufacturing process.

New products and new technology platforms: We also invest significantly in the development of new technology platforms and introduction of new products. Because power management affects all electronic systems, we believe that developing a wide portfolio of products enables us to target new applications in addition to expanding our share of power management needs served within existing applications.

As a technology company, we will continue our significant investment in research and development in our low voltage and high voltage power discretes and power ICs by developing new technology platforms and new products that allow for better product performance, more efficient packages and higher levels of integration.

Operations

The manufacture of our products is divided into two major steps: wafer fabrication and packaging and testing.

Wafer fabrication

Our Oregon fab allows us to accelerate the development of our technology and products, as well as to provide better services to our customers. We allocate our wafer production between our in-house facility and third-party foundries,

although in the past three years, we have gradually reduced our reliance on third-party foundries and increased allocation of capacity to our Oregon fab. Currently our main third-party foundry is Shanghai Hua Hong Grace Electronic Company Limited, ("HHGrace"), or formerly HHNEC, located in Shanghai. HHGrace has been manufacturing wafers for us since 2002. HHGrace manufactured 15.4%, 18.6% and 25.0% of the wafers used in our products for the fiscal years ended June 30, 2018, 2017 and 2016, respectively.

On March 29, 2016, we entered into the JV agreement with two investment funds affiliated with the municipalities of Chongqing for the purpose of constructing a power semiconductor packaging, testing and 12-inch wafer fabrication facility in the Liangjiang New Area of Chongqing. We substantially completed our assembly and testing and 12-inch wafer fab facilities during the quarter ended June 30, 2018. We expect to commence limited mass production for assembly and testing in the second half of calendar year 2018, and the trial production of the 12-inch wafer fabrication facility toward the end of calendar year 2018. We believe the joint venture will increase and diversify our customer base, particularly in China, and accelerate the development of proprietary process technology.

Packaging and testing

Completed wafers from the foundries are sent to our in-house packaging and testing facilities or to our subcontractors, where the wafers are cut into individual die, soldered to lead frames, wired to terminals and then encapsulated in protective packaging. After packaging, all devices are tested in accordance with our specifications and substandard or defective devices are rejected. We have established quality assurance procedures that are intended to control quality throughout the manufacturing process, including qualifying new parts for production at each packaging facility, conducting root cause analysis, testing for lots with process defects and implementing containment and preventive actions. The final tested products are then shipped to our distributors or customers.

Our in-house and wholly-owned packaging and testing facilities are located in Shanghai, China which handle most of our packaging and testing requirements for our products. During the quarter ended September 30, 2016, we fulfilled our obligations to contribute certain packaging equipment as required by the JV agreement by transferring the legal titles of such equipment to the JV Company and we expect the JV Company to handle a portion of our packaging and testing requirement following the commencement of production. We continuously increase the outsourcing portion of our packaging and testing requirements to other contract manufacturers to minimize the effect of market fluctuation. Our facilities have the combined capacity to package and test over 600 million parts per month and have available floor space for new package introductions. We believe our ability to package and test our products internally represents a strategic advantage as it protects our proprietary packaging technology, increases the rate of new package introductions, reduces operating expenses and ultimately improves our profit margins.

Quality assurance

Our quality assurance practices aim to consistently provide our end customers with products that are reliable, durable and free of defects. We strive to do so through design for manufacturing, and continuous improvement in our product design and manufacturing and close collaboration with our manufacturing partners. Our manufacturing operations in China and our manufacturing facility in Oregon are certified to the ISO9001 and IATF16949:2016. These Quality Management System certifications are in recognition of our quality assurance standards. Both ISO9001 and IATF16949:2016 are sets of criteria and procedures established by International Organization of Standardization for developing a fundamental quality management system and focusing on continuous improvement, defect prevention and the reduction of variation and waste. Our products are also in compliance with Restrictions on the use of Hazardous Substances, or RoHS 2.0.

We maintain a supplier management and process engineering team in Shanghai that works with our third-party foundries and packaging and testing subcontractors to monitor the quality of our products, which is designed to ensure that manufacturing of our products, is in strict compliance with our process controls, monitoring procedures and product requirements. We also conduct periodic reviews and annual audits to ensure supplier performance. For example, we examine the results of statistical process control systems, implement preventive maintenance, verify the status of quality improvement projects and review delivery time metrics. In addition, we rate and rank each of our suppliers every quarter based on factors such as their quality and performance. Our facility in Oregon integrates manufacturing process controls through our manufacturing execution system coupled with wafer process controls that include monitoring procedures, preventative maintenance, statistical process control, and testing to ensure that finished wafers delivered will meet and exceed quality and reliability requirements. All materials used to manufacture wafers are controlled through a strict qualification process.

Our manufacturing processes use many raw materials, including silicon wafers, gold, copper, molding compound, petroleum and plastic materials and various chemicals and gases. We obtain our raw materials and supplies from a large number of sources. Although supplies for the raw materials used by us are currently adequate, shortages could occur in various essential materials due to interruption of supply or increased demand in the industry.

Intellectual property rights

Intellectual property is a critical component of our business strategy, and we intend to continue to invest in the growth, maintenance and protection of our intellectual property portfolio. We own significant intellectual property in many aspects of

power semiconductor technology, including device physics and structure, wafer processes, circuit designs, packaging, modules and subassemblies. We have also entered into intellectual property licensing agreements with other companies, including On Semiconductor Corp. and Giant Semiconductor Corporation, to use selected third-party technology for the development of our products, although we do not believe our business is dependent to any significant degree on any individual third-party license agreement. On September 5, 2017, we entered into a license agreement with STMicroelectronics International N.V. (“STMicro”), pursuant to which STMicro granted us a world-wide, royalty-free and fully-paid license to use its technologies to develop, market and distribute certain digital multi-phase controller products, which have been offered previously by STMicro. This license agreement allows us to develop a new digital power business that will design and offer a full suite of advance digital power controller products.

While we focus our patent efforts in the United States, we file corresponding foreign patent applications in other jurisdictions, such as China and Taiwan, when filing is justified by cost and strategic importance. The patents are increasingly important to remain competitive in our industry, and a strong patent portfolio will facilitate the entry of our products into new markets. As of June 30, 2018, we had 722 patents issued in the United States, of which 9 were acquired, 2 were licensed and 711 were based on our research and development efforts, and these patents are set to expire between 2018 and 2037. Within these patents, 4 patents will expire in 2018. We do not expect that the expiration of these 4 patents will have a material adverse impact on our patent position. We also had a total of 667 foreign patents, including 259 Chinese patents, 383 Taiwanese patents, 17 Korean patents, 4 Hong Kong patents and 4 Japanese patents as of June 30, 2018. Substantially all of our foreign patents were based on our research and development efforts. These foreign patents will expire in the years between 2018 and 2037. In addition, as of June 30, 2018, we had a total of 278 patent applications, of which 108 patents were pending in the United States, 93 patents were pending in China, 45 patents were pending in Taiwan and 32 patents were pending in other countries.

As our technologies are deployed in new applications and as we diversify our product portfolio based on new technology platforms, we may be subject to new potential infringement claims. Patent litigation, if and when instituted against us, could result in substantial costs and a diversion of our management's attention and resources. However, we are committed to vigorously defending and protecting our investment in our intellectual property. Therefore, the strength of our intellectual property program, including the breadth and depth of our portfolio, will be critical to our success in the new markets we intend to pursue.

In addition to patent protection, we also rely on a combination of trademark, copyright (including mask work protection), trade secret laws, contractual provisions and similar laws in other jurisdictions. We also enter into confidentiality and invention assignment agreements with our employees, consultants, suppliers, distributors and customers and seek to control access to, and distribution of, our proprietary information.

Environmental matters

The semiconductor production process, including the semiconductor wafer manufacturing and packaging process, generates air emissions, liquid wastes, waste water and other industrial wastes. We have installed various types of pollution control equipment for the treatment of air emissions and liquid waste and equipment for recycling and treatment of water in our packaging and testing facilities in China and wafer manufacturing facility in Oregon, USA. Waste generated at our manufacturing facilities, including but not limited to acid waste, alkaline waste, flammable waste, toxic waste, oxide waste and self-igniting waste, is collected and sorted for proper disposal. Our operations in China are subject to regulation and periodic monitoring by China's State Environmental Protection Bureau, as well as local environmental protection authorities, including those under the Shanghai Municipal Government, which may in some cases establish stricter standards than those imposed by the State Environmental Protection Bureau. Our operation in Oregon is subject to Oregon Department of Environmental Regulations, Federal Environmental Protection Agency laws and regulations, and local jurisdictional regulations. We believe that we have been in material compliance with applicable environmental regulations and standards and have not had a material or adverse effect on our results of operations from complying with these regulations.

We have implemented an ISO 14001 environmental management system in our manufacturing facilities in China and Oregon. We also require our subcontractors, including foundries and assembly houses, to meet ISO14001 standards. We believe that we have adopted pollution control measures for the effective maintenance of environmental protection standards consistent with the requirements applicable to the semiconductor industry in China and the U.S.

Our products sold in worldwide are subject to RoHS in Electrical and Electronic Equipment, which requires that the products do not contain more than agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl and polybrominated diphenyl ether flame retardants. Our manufacturing facilities in China also obtained QC080000 certification, which is an IECQ Certificate of Conformity Hazardous Substance Process Management for European Directive

2002/95/EC requirements and a Certificate of Green Partner for Sony Green Partner Program. We avoid using these restricted materials to the extent possible when we design our products.

We are also subject to SEC rules that require diligence, disclosure and reporting on whether certain minerals and metals, known as conflict minerals, used in our products originate from the Democratic Republic of Congo and adjoining countries. As of June 30, 2018, 2017 and 2016, we were in compliance with the related conflict minerals rule.

Employees

As of June 30, 2018, we had approximately 3,340 employees, of which approximately 590 were located in the United States, 2,630 were located in China, and 120 were located in other parts of Asia. None of our employees is represented by a collective bargaining agreement. We consider our relationships with our employees to be good.

Executive Officers

The following table lists the names, ages and positions of our executive officers as of July 31, 2018. There are no family relationships between any executive officer.

Name	Age	Position
Mike F. Chang, Ph.D.	73	Chairman of the Board and Chief Executive Officer
Yueh-Se Ho, Ph.D.	66	Director and Chief Operating Officer
Yifan Liang	54	Chief Financial Officer and Corporate Secretary
Daniel Kuang Ming Chang	63	Senior Vice President of Strategic Business and World-wide Applications Engineering

Mike F. Chang, Ph.D., is the founder of our company and has served as our Chairman of the Board and Chief Executive Officer since the incorporation of our company. Dr. Chang has extensive experience in both technology development and business operations in the power semiconductor industry. Prior to establishing our company, Dr. Chang served as the Executive Vice President at Siliconix Incorporated, a subsidiary of Vishay Intertechnology Inc., a global manufacturer and supplier of discrete and other power semiconductors, or Siliconix, from 1998 to 2000. Dr. Chang also held various management positions at Siliconix from 1987 to 1998. Earlier in his career, Dr. Chang focused on product research and development in various management positions at General Electric Company from 1974 to 1987. Dr. Chang received his B.S. in electrical engineering from National Cheng Kung University, Taiwan, and M.S. and Ph.D. in electrical engineering from the University of Missouri.

Yueh-Se Ho, Ph.D., is a co-founder of our company and has served as our Chief Operating Officer since January 2006 and our director since March 2006. Dr. Ho has held various operational management positions in our company since our inception, including the Vice President of Worldwide Operations from 2003 to 2006 and the Vice President of Back End Operations from 2000 to 2003. Prior to co-founding our company, Dr. Ho served as the Director of Packaging Development and Foundry Transfer at Siliconix from 1998 to 2000. Dr. Ho received his B.S. in chemistry from Tamkang University, Taiwan, and Ph.D. in chemistry from the University of Pittsburgh.

Yifan Liang has been serving as our Chief Financial Officer since August 2014 and Corporate Secretary since November 2013. Mr. Liang served as our Interim Chief Financial Officer from November 2013 to August 2014, our Chief Accounting Officer since October 2006, and our Assistant Corporate Secretary from November 2009 to November 2013. Mr. Liang joined our company in August 2004 as our Corporate Controller. Prior to joining us, Mr. Liang held various positions at PricewaterhouseCoopers LLP, or PwC, from 1995 to 2004, including Audit Manager in PwC's San Jose office. Mr. Liang received his B.S. in management information system from the People's University of China and M.A. in finance and accounting from the University of Alabama.

Daniel Kuang Ming Chang has been serving as our Senior Vice President of Business Development and World-wide Applications Engineering since November 13, 2017. Mr. Chang served as our Senior Vice President of Marketing from August 3, 2015 to November 12, 2017, our Vice President of Power IC Product Line and Applications Engineering from October 2011 to August 2, 2015, our Vice President of Strategic Marketing and Applications

Engineering from May 2010 to October 2011, and our Director of Strategic Marketing and Applications Engineering from February 2009 to April 2010. Prior to joining our company, Mr. Chang served as Vice President of new product line at Richtek Inc, a power management company in Taiwan, from 2005 to 2009. He also served as Vice President of System Engineering at Lovoltech Inc, a startup semiconductor company in Sunnyvale, California from 2001 to 2005. Mr. Chang received his M.S. in physics from National Tsing Hua University of Taiwan, and a B.S. in electrical engineering from Taiwan National University.

Available Information

Our filing documents and information with the Securities and Exchange Commission (the "SEC") are available free of charge electronically through our Internet website, www.aosmd.com. as soon as reasonably practicable after we electronically file such material with, or furnish it to, the SEC. Additionally, these filings may be obtained by visiting the Public Reference Room of the SEC at 100 F Street, NE, Washington, DC 20549 or by calling the SEC at 1-800-SEC-0330, by sending an electronic message to the SEC at publicinfo@sec.gov. In addition, the SEC maintains a website (www.sec.gov) that contains reports, proxy statements, and other information that we file electronically.

Item 1A. Risk Factors
Risks Related to Our Business

Our joint venture with the Chongqing government may not succeed as expected.

In March 2016, we entered into a joint venture contract (the "JV Agreement") with two investment funds owned by the municipalities of Chongqing, China (the "Chongqing Funds"), pursuant to which we and the Chongqing Funds formed a joint venture (the "JV Company") for the purpose of constructing a power semiconductor packaging/testing and wafer fabrication facility. The JV Company is expected to commence assembly and testing mass production in the second half of calendar year 2018, and trial production of the 12-inch wafer fabrication facilities toward the end of calendar year 2018. The initial ramp up of the JV Company's operations is costly and for the short term will negatively impact our results of operations. While we believe the JV Transaction will enhance our ability to accelerate growth and improve our profitability, there is no guarantee that it will succeed as we initially expected. We may encounter unanticipated difficulties and obstacles that may delay or prevent the commencement of the JV Company's operation, some of which are outside of our control. These difficulties may include unexpected costs and delays in transferring our assembly and testing operations to the new facility; inability to coordinate and integrate the labor forces; failure of the Chongqing Funds to meet their obligations under the JV Agreement, such as delays in capitalizing the JV Company based on our original timeline; and inability to provide customers with required services.

Even after the JV Company commences operation, we may not fully realize the anticipated benefits of the project, such as cost savings, improvement in working capital, increased gross margin, revenue and profitability, enhanced market share for our products; and increased diversification of our products and customers. The establishment and operation of a new manufacturing facility involve significant risks and challenges, including, but are not limited to, the following:

- Inability to gain or sustain sufficient new customers and market shares to offset the additional costs of building and operating a new facility;
- Lack of sufficient control over the operation and finances of the joint venture;
- Insufficient personnel with requisite expertise and experiences to operate a 12-inch fabrication facility;
- High cost and unexpected expenses relating to upgrading and improving the packaging and testing and fabrication facilities;
- Inability to fully integrate the joint venture with our existing fabrication facility in Oregon, and inability to fully utilize both fabrication facilities;
- Failure of Chongqing Funds to meet its obligations under the JV Agreement;
- Difficulties in protecting and enforcing our intellectual property rights;
- Difficulties in maintaining international communications and coordination between our locations in the U.S. and China;
- Inability to take advantage of the expected tax savings;
- Changes or uncertainties in economic, legal, regulatory, social and political conditions in China, and lack of transparency and certainty in the Chinese regulatory process;
- Labor disputes and difficulties in recruiting new employees; and
- Additional costs and complexity with compliance of local and state regulations of Chongqing.

In addition, we may be subject to the risk of under-utilization of the facilities at the JV Company. The operation of the JV Company's facilities, including the assembly and testing facilities and the fab, requires significant fixed cost. In order to manage the capacity of the wafer fabrication facility efficiently, we must perform a forecast of long-term market demand and general economic conditions for our products. Because market conditions may vary significantly and unexpectedly, our forecast may change significantly at any time, and we may not be able to make timely adjustments to our fabrication capacity in response to these changes. If our forecast is incorrect or if we are not able to fully utilize the capacities of the facilities at the JV Company, we may not be able to absorb the cost of operation, which will adversely affect our results of operations.

Any of the foregoing risks could materially reduce the expected return of our investment in the JV Transaction and adversely affects our business operations, financial performance and the trading price of our shares.

Possible new tariffs on imported goods from China could adversely affect our business operations.

The President of the United States has recently ordered U.S. government agencies to consider a proposed 25% tariff on a wide range of goods and materials imported from China, in addition to the U.S. tariffs already imposed. These goods may include products and applications, including consumer electronics, that incorporate our power discrete and power IC products. In response, China announced a plan to impose tariffs on certain American products if these additional U.S. tariffs are imposed. The resulting trade war could have a significant adverse effect on world trade and the world economy. While it is too early to predict if the additional potential U.S. tariffs will be imposed, or how the recently enacted tariffs will impact our business, we believe that the imposition of the potential additional tariffs by the U.S. government on products incorporating our power semiconductors could deter our U.S. customers from purchasing our products originating from China. If so, this could reduce demand for our power semiconductor products or result in pricing adjustments that would lower our gross margin, which could have a material adverse effect on our business and results of operations.

We may not be able to successfully develop our digital power business.

In September 2017, we entered into a license agreement with STMicro, which allows us to develop and market certain digital power multi-phase controller products and enter into a new market, primarily in the computer server segment. We are in the process of developing this new digital power business and expect to incur significant startup costs, including costs relating to the hiring and compensation of qualified engineers and technical staff; development of marketing and sales infrastructure, particularly in the computer server market; and other research and development and management activities. We do not expect this new business to generate sufficient revenue to offset our costs in the short term, and there is no guarantee that our attempt to develop a profitable digital business will ultimately succeed. The success of our new digital power business depends on a number of factors, including the following:

- competition from other companies with greater resources and experiences in the digital power market;
- the availability of and our ability to recruit and attract qualified personnel;
- our lack of experience and reputation in the digital power market;
- difficulties in designing products acceptable to customers; and
- sales and marketing capability.

Any one of these factors may negatively impact our ability to create a successful digital power business, which would adversely affect our financial condition and results of operations.

The decline of personal computing (“PC”) markets may have a material adverse effect on our results of operations.

A significant amount of our revenue is derived from sales of products in the PC markets such as notebooks, motherboards and notebook battery packs. Our revenue from the PC markets accounted for approximately 41.6%, 39.1% and 38.5% of our total revenue for the years ended 2018, 2017 and 2016, respectively. The increasing popularity of smaller, mobile computing devices such as tablets and smart phones with touch interfaces is rapidly changing the PC markets both in the United States and abroad. In the past, we experienced a significant reduction in the demand for our products due to the declining PC markets, which had negatively impacted our revenue, profitability and gross margin. The decline of the PC markets also adversely affected our ability to adjust inventory levels in response to the lower shipments, which had negatively impacted our gross margins.

Our diversification into different market segments may not succeed according to our expectations and may expose us to new risks and place significant strains on our management, operational, financial and other resources.

As part of the growth strategy to diversify our product portfolio and in response to the rapid decline of the PC markets, we have been developing new technologies and products designed to penetrate into other markets and applications, including merchant power supplies, flat panel TVs, smart phones, tablets, gaming consoles, lighting,

datacom, telecommunications, home appliances and industrial motor controls. However, there is no guarantee that these diversification efforts will be successful. As a new entrant to some of these markets, we may face intense competition from existing and more established providers and encounter other unexpected difficulties, any of which may hinder or delay our efforts to achieve success. In addition, our new products may have long design and sales cycles, therefore if our diversification efforts fail to keep pace with the declining PC markets, we may not be able to alleviate its negative impact on our results of operations.

Our diversification into different market segments may place a significant strain on our management, operational, financial and other resources. To manage this diversification effectively, we will need to take various actions, including:

- enhancing management information systems, including forecasting procedures;
- further developing our operating, administrative, financial and accounting systems and controls;
- managing our working capital and sources of financing;
- maintaining close coordination among our engineering, accounting, finance, marketing, sales and operations organizations;
- retaining, training and managing our employee base;
- enhancing human resource operations and improving employee hiring and training programs;
- realigning our business structure to more effectively allocate and utilize our internal resources;
- improving and sustaining our supply chain capability; and
- managing both our direct and distribution sales channels in a cost-efficient and competitive manner.

Our failure to execute any of the above actions successfully or timely may have an adverse effect on our business and financial results.

Our operating results may fluctuate from period to period due to many factors, which may make it difficult to predict our future performance.

Our periodic operating results may fluctuate as a result of a number of factors, many of which are beyond our control. These factors include, among others:

- a deterioration in general demand for electronic products, particularly the PC market, as a result of global or regional financial crises and associated macro-economic slowdowns, and/or the cyclicality of the semiconductor industry;
- a deterioration in business conditions at our distributors and /or end customers;
- adverse general economic conditions in the countries where our products are sold or used;
- the emergence and growth of markets for products we are currently developing;
- our ability to successfully develop, introduce and sell new or enhanced products in a timely manner and the rate at which our new products replace declining orders for our older products;
- the anticipation, announcement or introduction of new or enhanced products by us or our competitors;
- the amount and timing of operating costs and capital expenditures, including expenses related to the maintenance and expansion of our business operations and infrastructure;
- the announcement of significant acquisitions, disposition or partnership arrangements;
- changes and delays in our JV Transaction;
- operation of the JV Company;
- changes in the utilization of our in-house manufacturing capacity;
- supply and demand dynamics and the resulting price pressure on the products we sell;
- the unpredictable volume and timing of orders, deferrals, cancellations and reductions for our products, which may depend on factors such as our end customers' sales outlook, purchasing patterns and inventory adjustments based on general economic conditions or other factors;
- changes in the selling prices of our products and in the relative mix in the unit shipments of our products, which have different average selling prices and profit margins;
- changes in laws and regulations affecting our business operations;
- changes in costs associated with manufacturing of our products, including pricing of wafer, raw materials and assembly services;
- announcement of significant share repurchase programs;
- our concentration of sales in consumer applications and changes in consumer purchasing patterns and confidence; and
- the adoption of new industry standards or changes in our regulatory environment.

Any one or a combination of the above factors and other risk factors described in this section may cause our operating results to fluctuate from period to period, making it difficult to predict our future performance. Therefore, comparing our

operating results on a period-to-period basis may not be meaningful, and you should not rely on our past results as an indication of our future performance.

Our revenue may fluctuate significantly from period to period due to ordering patterns from our distributors and seasonality.

Demand for our products from our end customers fluctuates depending on their sales outlooks and market and economic conditions. Accordingly, our distributors place purchase orders with us based on their forecasts of end customer demand. Because these forecasts may not be accurate, channel inventory held at our distributors may fluctuate significantly due to the difference between the forecasts and actual demand. As a result, distributors adjust their purchase orders placed with us in response to changing channel inventory levels, as well as their assessment of the latest market demand trends. A significant decrease in our distributors' channel inventory in one period may lead to a significant rebuilding of channel inventory in subsequent periods, or vice versa, which may cause our quarterly revenue and operating results to fluctuate significantly.

In addition, because our power semiconductors are used in consumer electronics products, our revenue is subject to seasonality. Our sales seasonality is affected by a number of factors, including global and regional economic conditions as well as the PC market conditions, revenue generated from new products, changes in distributor ordering patterns in response to channel inventory adjustments and end customer demand for our products and fluctuations in consumer purchase patterns prior to major holiday seasons. In recent year, broad fluctuations in the semiconductor markets and the global economic conditions, in particular the decline of the PC market conditions, have had a more significant impact on our results of operations, than seasonality, and have made it difficult to assess the impact of seasonal factors on our business.

If we are unable to introduce or develop new and enhanced products that meet or are compatible with our customer's product requirements in a timely manner, it may harm our business, financial position and operating results.

Our success depends upon our ability to develop and introduce new and enhanced products that meet or are compatible with our customer's specifications, performance standards and other product requirements in a timely manner. The development of new and enhanced products involves highly complex processes, and at times we have experienced delays in the introduction of new products. Successful product development and introduction of new products depends on a number of factors, including the accurate product specification; timely completion of design; achievement of manufacturing yields; timely response to changes in customers' product requirements; quality and cost-effective production; and effective marketing. Since many of our products are designed for specific applications, we must frequently develop new and enhanced products jointly with our customers. In the past, we have encountered product compatibility issues with a major OEM that has negatively impacted our financial results, and although we have resolved fully such issues with the OEM, there is no guarantee that the same compatibility issues will not occur in the future with other OEMS. If we are unable to develop or acquire new products that meet or are compatible with our customer's specification and other product requirements in a timely manner, we may lose revenue or market shares with our customers, which could have a material adverse effect on our business, financial position and operating results.

We may not win sufficient designs, or our design wins may not generate sufficient revenue for us to maintain or expand our business.

We invest significant resources to compete with other power semiconductor companies to obtain winning competitive bids for our products in selection processes, known as “design wins.” Our effort to obtain design wins may detract us from or delay the completion of other important development projects, impair our relationships with existing end customers and negatively impact sales of products under development. In addition, we cannot be assured that these efforts would result in a design win, that our product would be incorporated into an end customer's initial product design, or that any such design win would lead to production orders and generate sufficient revenue. Furthermore, even after we have qualified our products with a customer and made sales, subsequent changes to our products, manufacturing processes or suppliers may require a new qualification process, which may result in delay and excess inventory. If we cannot achieve sufficient design wins in the future, or if we fail to generate production orders following design wins, our ability to grow our business and improve our financial results will be harmed.

Our success depends upon the ability of our OEM end customers to successfully sell products incorporating our products.

The consumer end markets, in particular the PC market, in which our products are used are highly competitive. Our OEM end customers may not successfully sell their products for a variety of reasons, including:

- general global and regional economic conditions;

- late introduction or lack of market acceptance of their products;
- lack of competitive pricing;
- shortage of component supplies;
- excess inventory in the sales channels into which our end customers sell their products;
- changes in the supply chain; and
- changes as a result of regulatory restrictions applicable to China-exported products.

Our success depends on the ability of our OEM end customers to sell their products incorporating our products. In addition, we have expanded our business model to include more OEMs in our direct customer base. The failure of our OEM end customers to achieve or maintain commercial success for any reason could harm our business, results of operations, and financial condition and prospects.

The operation of our Oregon fab subjects us to additional risks and the need for additional capital expenditures which may negatively impact our results of operations.

The operation of the Oregon fab requires significant fixed manufacturing cost. In order to manage the capacity of the wafer fabrication facility efficiently, we must perform a forecast of long-term market demand and general economic conditions for our products. Because market conditions may vary significantly and unexpectedly, our forecast may change significantly at any time, and we may not be able to make timely adjustments to our fabrication capacity in response to these changes. During periods of continued decline in market demand, in particular the decline of the PC market, we may not be able to absorb the excess inventory and additional costs associated with operating the facility at higher capacity, which may adversely affect our operating results. Similarly, during periods of unexpected increase in customer demand, we may not be able to ramp up production quickly to meet these demands, which may lead to the loss of significant revenue opportunities. The manufacturing processes of a fabrication facility are complex and subject to interruptions. We may experience production difficulties, including lower manufacturing yields or products that do not meet our or our customers' specifications, and problems in ramping production and installing new equipment. These difficulties could result in delivery delays, quality problems and lost revenue opportunities. Any significant quality problems could also damage our reputation with our customers and distract us from the development of new and enhanced product which may have a significant negative impact on our financial results.

In addition, semiconductor manufacturing has historically required an upgrading of process technology from time to time to remain competitive, as new and enhanced semiconductor processes are developed which permit smaller, more efficient and more powerful semiconductor devices. Accordingly, we may have to incur substantial capital expenditures and install significant production capacity at our in-house fabrication facility to support new technologies and increased production volume, which may cause delay in our ability to deliver new products or negatively impact our results of operations.

Defects and poor performance in our products could result in loss of customers, decreased revenue, unexpected expenses and loss of market share, and we may face warranty and product liability claims arising from defective products.

Our products are complex and must meet stringent quality requirements. Products as complex as ours may contain undetected errors or defects, especially when first introduced or when new versions are released. Errors, defects or poor performance can arise due to design flaws, defects in raw materials or components or manufacturing anomalies, which can affect both the quality and the yield of the product. It can also be potentially dangerous as defective power components, or improper use of our products by customers, may lead to power overloads, which could result in explosion or fire. As our products become more complex, we face higher risk of undetected defects, because our testing protocols may not be able to fully test the products under all possible operating conditions. In the past, we have experienced defects in our products and these products were returned to us and subsequently scrapped or sold at a discount. Any actual or perceived errors, defects or poor performance in our products could result in the replacement or recall of our products, shipment delays, rejection of our products, damage to our reputation, lost revenue, diversion of our engineering personnel from our product development efforts in order to address or remedy any defects and

increases in customer service and support costs, all of which could have a material adverse effect on our business and operations.

Furthermore, as our products are typically sold at prices much lower than the cost of the equipment or other devices incorporating our products, any defective, inefficient or poorly performing products, or improper use by customers of power components, may give rise to warranty and product liability claims against us that exceed any revenue or profit we receive from the affected products. Historically, we have received claims from our customers for charges such as their labor and other costs replacing defective parts, their lost profit, and/or penalty. We could incur significant costs and liabilities if we are sued

and if damages are awarded against us. There is no guarantee that our insurance policies will be available or adequate to protect against such claims. Costs or payments we may make in connection with warranty and product liability claims or product recalls may adversely affect our financial condition and results of operations.

If we do not forecast demand for our products accurately, we may experience product shortages, delays in product shipment, excess product inventory, or difficulties in planning expenses, which will adversely affect our business and financial condition.

We manufacture our products according to our estimates of customer demand. This process requires us to make numerous forecasts and assumptions relating to the demand of our end customers, channel inventory, and general market conditions. Because we sell most of our products to distributors, who in turn sell to our end customers, we have limited visibility as to end customer demand. Furthermore, we do not have long-term purchase commitments from our distributors or end customers, and our sales are generally made by purchase orders that may be cancelled, changed or deferred without notice to us or penalty. As a result, it is difficult to forecast future customer demand to plan our operations.

The utilization of our manufacturing facilities and the provisions for inventory write-downs are important factors in our profitability. If we overestimate demand for our products, or if purchase orders are canceled or shipments delayed, we may have excess inventory, which may result in adjustments to our production plans. These adjustments to our productions may affect the utilization of our own wafer fabrication and packaging facilities. If we cannot sell certain portion of the excess inventory, it will affect our provisions for inventory write-downs. Our inventory write-down provisions are subject to adjustment based on events that may not be known at the time the provisions are made, and such adjustments could be material and impact our financial results negatively.

If we underestimate demand, we may not have sufficient inventory to meet end-customer demand, and we may lose market share and damage relationships with our distributors and end customers and we may have to forego potential revenue opportunities. Obtaining additional supply in the face of product shortages may be costly or impossible, particularly in the short term, which could prevent us from fulfilling orders in a timely manner or at all.

In addition, we plan our operating expenses, including research and development expenses, hiring needs and inventory investments, base in part on our estimates of customer demand and future revenue. If customer demand or revenue for a particular period is lower than we expect, we may not be able to proportionately reduce our fixed operating expenses for that period, which would harm our operating results.

We face intense competition and may not be able to compete effectively which could reduce our revenue and market share.

The power semiconductor industry is highly competitive and fragmented. If we do not compete successfully against current or potential competitors, our market share and revenue may decline. Our main competitors are primarily headquartered in the United States, Japan, Taiwan and Europe. Our major competitors for our power discretes include Infineon Technologies AG, MagnaChip Semiconductor Corporation, ON Semiconductor Corp., STMicroelectronics N.V., Toshiba Corporation, Diodes Incorporated and Vishay Intertechnology, Inc. Our major competitors for our power ICs include Global Mixed-mode Technology Inc., Monolithic Power Systems, Inc., Richtek Technology Corp., Semtech Corporation and Texas Instruments Inc.

We expect to face competition in the future from our competitors, other manufacturers, designers of semiconductors and start-up semiconductor design companies. Many of our competitors have competitive advantages over us, including:

- significantly greater financial, technical, research and development, sales and marketing and other resources, enabling them to invest substantially more resources than us to respond to the adoption of new or emerging technologies or changes in customer requirements;
- greater brand recognition and longer operating histories;
- larger customer bases and longer, more established relationships with distributors or existing or potential end customers, which may provide them with greater reliability and information regarding future trends and requirements that may not be available to us;
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the ability to provide greater incentives to end customers through rebates, and marketing development funds or similar programs;

- more product lines, enabling them to bundle their products to offer a broader product portfolio or to integrate power management functionality into other products that we do not sell; and

- captive manufacturing facilities, providing them with guaranteed access to manufacturing facilities in times of global semiconductor shortages.

In addition, the semiconductor industry has experienced increased consolidation over the past several years that may adversely affect our competitive position. For example, On Semiconductor Corporation acquired Fairchild Semiconductor International Inc. in September 2016; Avago Technologies Limited (now Broadcom Limited ("Broadcom")) acquired Broadcom Corporation in February 2016 and LSI Corporation in May 2014; Intel acquired Altera Corporation in December 2015; and NXP Semiconductors acquired Freescale Semiconductor, Ltd. in December 2015. Consolidation among our competitors could lead to a less favorable competitive landscape, capabilities and market share, which could harm our business and results of operations.
If we are unable to compete effectively for any of the foregoing or other reasons, our business, results of operations, and financial condition and prospects will be harmed.

We depend partly on third-party semiconductor foundries to manufacture our products and implement our fabrication processes, and any failure to maintain sufficient foundry capacity and control the cost of production could significantly delay our ability to ship our products, damage our relationships with customers, reduce our sales and increase expenses.

The allocation of our wafer production between in-house facility and third-party foundries may fluctuate from time to time. We expect to continue to rely in part on third party foundries to meet our wafer requirements. Although we use several independent foundries, our primary third-party foundry is HHGrace, which manufactured 15.4%, 18.6% and 25.0% of the wafers used in our products for the fiscal years ended June 30, 2018, 2017 and 2016, respectively.

We place our purchase orders with foundries based on sales forecasts for our products. If any third-party foundry does not provide competitive pricing or is not able to meet our required capacity for any reason, we may not be able to obtain the required capacity to manufacture our products timely or efficiently. From time to time, third party suppliers may extend lead-times, limit supplies or increase prices due to capacity constraints or other factors, and we may experience a shortage of capacity on an industry-wide basis that may last for an extended period of time. There is no assurances of that we will be able to maintain sufficient capacity to meet the full demand from our customers, and failure to do so will adversely affect our results of operations. If we cannot maintain sufficient capacity or control pricing with our existing third-party foundries, we may need to increase our own manufacturing capacity, and there is no assurance that we can ramp up the production of the Oregon fab timely to meet the increased demand. If not, we may need to seek alternative foundries, which may not be available on commercially reasonable terms, or at all. In addition, the process for qualifying a new foundry is time consuming, difficult and may not be successful, particularly if we cannot integrate our proprietary process technology with the process used by the new foundry. Using a foundry with which we have no established relationship could expose us to potentially unfavorable pricing, unsatisfactory quality or insufficient capacity allocation.

In addition, even though we have been transferring more new product developments to our Oregon fab, we still rely on third-party foundries significantly to effectively implement certain of our proprietary technology and processes and also require their cooperation in developing new fabrication processes. Any failure to do so may impair our ability to introduce new products and on time delivery of wafers for our existing products. In order to maintain our profit margins and to meet our customer demand, we need to achieve acceptable production yields and timely delivery of silicon wafers. As is common in the semiconductor industry, we have experienced, and may experience from time to time, difficulties in achieving acceptable production yields and timely delivery from third-party foundry vendors. Minute impurities in a silicon wafer can cause a substantial number of wafers to be rejected or cause numerous die on a wafer to be defective. Low yields often occur during the production of new products, the migration of processes to smaller geometries or the installation and start up of new process technologies.

We face a number of other significant risks associated with outsourcing fabrication, including:

- limited control over delivery schedules, quality assurance and control and production costs;
- discretion of foundries to reduce deliveries to us on short notice, allocate capacity to other customers that may be larger or have long-term customer or preferential arrangements with foundries that we use;
- unavailability of, or potential delays in obtaining access to, key process technologies;
- limited warranties on wafers or products supplied to us;
- damage to equipment and facilities, power outages, equipment or materials shortages that could limit manufacturing yields and capacity at the foundries;
- potential unauthorized disclosure or misappropriation of intellectual property, including use of our technology by the foundries to make products for our competitors;

- financial difficulties and insolvency of foundries; and
- acquisition of foundries by third parties.

Any of the foregoing risks could delay shipment of our products, result in higher expenses and reduced revenue, damage our relationships with customers and otherwise adversely affect our business and operating results.

Our operation of two wholly-owned packaging and testing facilities are subject to risks that could adversely affect our business and financial results.

We have two wholly-owned packaging and testing facilities located in Shanghai, China that handle most of our packaging and testing requirements. The operation of high-volume packaging and testing facilities and implementation of our advanced packaging technology are complex and demand a high degree of precision and may require modification to improve yields and product performance. We have committed substantial resources to ensure that our packaging and testing facilities operate efficiently and successfully, including the acquisition of equipment and raw materials, and training and management of a large number of technical personnel and employees. Due to the fixed costs associated with operating our own packaging and testing facilities, if we are unable to utilize our in-house facilities at a desirable level of production, our gross margin and results of operations may be adversely affected. For example, a significant decline in our market share or sales orders may negatively impact our factory utilization and reduce our ability to achieve profitability.

In addition, the operation of our packaging and testing facilities is subject to a number of risks, including the following:

- unavailability of equipment, whether new or previously owned, at acceptable terms and prices;
- facility equipment failure, power outages or other disruptions;
- shortage of raw materials, including packaging substrates, copper, gold and molding compound;
- failure to maintain quality assurance and remedy defects and impurities;
- changes in the packaging requirements of customers; and
- our limited experience in operating a high-volume packaging and testing facility.

Any of the foregoing risks could adversely affect our capacity to package and test our products, which could delay shipment of our products, result in higher expenses, reduce revenue, damage our relationships with customers and otherwise adversely affect our business, results of operations, financial condition and prospects.

Our reliance on distributors to sell a substantial portion of our products subjects us to a number of risks.

We sell a substantial portion of our products to distributors, who in turn sell to our end customers. Our distributors typically offer power semiconductor products from several different companies, including our direct competitors. The distributors assume collection risk and provide logistical services to end customers, including stocking our products. Two distributors, WPG and Promate, collectively accounted for 63.5%, 62.7% and 61.0% of our revenue for the fiscal years ended June 30, 2018, 2017 and 2016, respectively. Our agreements with Promate and WPG were renewed in July 2017 and are automatically renewed for each one-year period continuously unless terminated earlier pursuant to the provisions in the agreements. We believe that our success will continue to depend upon these distributors. Our reliance on distributors subjects us to a number of risks, including:

- write-downs in inventories associated with stock rotation rights and increases in provisions for price adjustments granted to certain distributors;
- potential reduction or discontinuation of sales of our products by distributors;
- failure to devote resources necessary to sell our products at the prices, in the volumes and within the time frames that we expect;
- focusing their sales efforts on products of our competitors;
- dependence upon the continued viability and financial resources of these distributors, some of which are small organizations with limited working capital and all of which depend on general economic conditions and conditions within the semiconductor industry;
- dependence on the timeliness and accuracy of shipment forecasts and resale reports from our distributors;
- management of relationships with distributors, which can deteriorate as a result of conflicts with efforts to sell directly to our end customers; and

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- our agreements with distributors which are generally terminable by either party on short notice.

If any significant distributor becomes unable or unwilling to promote and sell our products, or if we are not able to renew our contracts with the distributors on acceptable terms, we may not be able to find a replacement distributor on reasonable terms or at all and our business could be harmed.

We have made and may continue to make strategic acquisitions of other companies, assets or businesses and these acquisitions introduce significant risks and uncertainties, including risks related to integrating the acquired assets or businesses, incurring additional debt, assuming contingent liabilities or diluting our existing shareholders.

In order to position ourselves to take advantage of growth opportunities, we have made, and may continue to make, strategic acquisitions, mergers and alliances that involve significant risks and uncertainties. Successful acquisitions and alliances in the semiconductor industry are difficult to accomplish because they require, among other things, efficient integration and aligning of product offerings and manufacturing operations and coordination of sales and marketing and research and development efforts. The difficulties of integration and alignment may be increased by the necessity of coordinating geographically separated organizations, the complexity of the technologies being integrated and aligned and the necessity of integrating personnel with disparate business backgrounds and combining different corporate cultures. Furthermore, there is no guarantee that we will be able to identify a viable target for strategic acquisition, and we may incur significant costs and resources in such effort that may not result in a successful acquisition.

In addition, we may also issue equity securities to pay for future acquisitions or alliances, which could be dilutive to existing shareholders. We may also incur debt or assume contingent liabilities in connection with acquisitions and alliances, which could impose restrictions on our business operations and harm our operating results.

If we are unable to obtain raw materials in a timely manner or if the price of raw materials increases significantly, production time and product costs could increase, which may adversely affect our business.

Our fabrication and packaging processes depend on raw materials such as silicon wafers, gold, copper, molding compound, petroleum and plastic materials and various chemicals and gases. From time to time, suppliers may extend lead times, limit supplies or increase prices due to capacity constraints or other factors. If the prices of these raw materials rise significantly, we may be unable to pass on the increased cost to our customers. Our results of operations could be adversely affected if we are unable to obtain adequate supplies of raw materials in a timely manner or at reasonable price. In addition, from time to time, we may need to reject raw materials because they do not meet our specifications or the sourcing of such materials do not comply with our conflict mineral policies, resulting in potential delays or declines in output. Furthermore, problems with our raw materials may give rise to compatibility or performance issues in our products, which could lead to an increase in customer returns or product warranty claims. Errors or defects may arise from raw materials supplied by third parties that are beyond our detection or control, which could lead to additional customer returns or product