
UNITED STATES SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

Form 10-K

(MARK ONE)

ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2019

or

TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the transition period from _____ to _____
Commission File number 0-23621

MKS INSTRUMENTS, INC.

(Exact Name of Registrant as Specified in Its Charter)

Massachusetts
*(State or other Jurisdiction of
Incorporation or Organization)*

04-2277512
*(IRS Employer
Identification No.)*

2 Tech Drive, Suite 201, Andover, Massachusetts
(Address of Principal Executive Offices)

01810
(Zip Code)

(978) 645-5500

(Registrant's Telephone Number, including area code)

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

<u>Title of each class</u>	<u>Trading Symbol(s)</u>	<u>Name of each exchange on which registered</u>
Common Stock, no par value	MKSI	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 No

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

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

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

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

Large accelerated filer Accelerated filer Non-accelerated filer Smaller reporting company Emerging growth company

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

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

Aggregate market value of the voting and non-voting common equity held by nonaffiliates of the registrant as of June 28, 2019 based on the closing price of the registrant's common stock on such date as reported by the Nasdaq Global Select Market: \$4,224,355,318.

Number of shares outstanding of the issuer's common stock, no par value, as of February 19, 2020: 54,866,512

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the definitive Proxy Statement for our 2020 Annual Meeting of Shareholders, to be filed with the Securities and Exchange Commission no later than 120 days after the close of our fiscal year ended December 31, 2019, are incorporated by reference into Part III of this Annual Report on Form 10-K.

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SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K contains “forward-looking statements” within the meaning of the Private Securities Litigation Reform Act of 1995, Section 27A of the Securities Act and Section 21E of the Securities Exchange Act of 1934 regarding the future financial performance, business prospects and growth of MKS. These statements are only predictions based on current assumptions and expectations. Any statements that are not statements of historical fact (including statements containing the words “will,” “projects,” “intends,” “believes,” “plans,” “anticipates,” “expects,” “estimates,” “forecasts,” “continues” and similar expressions) should be considered to be forward-looking statements. Actual events or results may differ materially from those in the forward-looking statements set forth herein. Among the important factors that could cause actual events to differ materially from those in the forward-looking statements are the conditions affecting the markets in which MKS operates, including the fluctuations in capital spending in the semiconductor industry and other advanced manufacturing markets, fluctuations in sales to our major customers, the ability of MKS to successfully integrate ESI’s operations and employees, unexpected costs, charges or expenses resulting from the ESI acquisition, MKS’ ability to realize anticipated synergies and cost savings from the ESI acquisition, the terms of our Term Loan Facility, competition from larger or more established companies in MKS’ markets; MKS’ ability to successfully grow ESI’s business; potential adverse reactions or changes to business relationships resulting from the ESI acquisition, the challenges, risks and costs involved with integrating the operations of the other companies we have acquired, the Company’s ability to successfully grow our business, potential fluctuations in quarterly results, dependence on new product development, rapid technological and market change, acquisition strategy, manufacturing and sourcing risks, volatility of stock price, international operations, financial risk management, and the other factors described in “Risk Factors” in Part 1, Item 1A of this Annual Report on Form 10-K. MKS is under no obligation to, and expressly disclaims any obligation to, update or alter these forward-looking statements, whether as a result of new information, future events or otherwise after the date of this report.

PART I

Item 1. *Business*

MKS Instruments, Inc. (“MKS” or the “Company”) was founded in 1961 as a Massachusetts corporation. We are a global provider of instruments, systems, subsystems and process control solutions that measure, monitor, deliver, analyze, power and control critical parameters of advanced manufacturing processes to improve process performance and productivity for our customers. Our products are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery, vacuum technology, lasers, photonics, optics, precision motion control, vibration control and laser-based manufacturing systems solutions. We also provide services relating to the maintenance and repair of our products, installation services and training. Our primary served markets include semiconductor, industrial technologies, life and health sciences, research and defense.

Where You Can Find More Information

We file reports, proxy statements and other documents with the Securities and Exchange Commission (“SEC”). Our SEC filings are available to you on the SEC’s internet site at <http://www.sec.gov>.

Our website is <http://www.mksinst.com>. We are not including the information contained in our website as part of, or incorporating it by reference into, this annual report on Form 10-K. We make available free of charge through our internet site our Annual Reports on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K and amendments to these reports filed or furnished pursuant to Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended (the “Exchange Act”), as soon as reasonably practicable after we electronically file such materials with, or furnish them to, the SEC.

Recent Events

Acquisition of Electro Scientific Industries, Inc.

On February 1, 2019, we completed our acquisition of Electro Scientific Industries, Inc. (“ESI”) pursuant to an Agreement and Plan of Merger, dated as of October 29, 2018 (the “ESI Merger”). At the effective time of the ESI Merger and pursuant to the terms and conditions of the merger agreement, each share of ESI’s common stock that was issued and outstanding immediately prior to the effective time of the ESI Merger was converted into the right to receive \$30.00 in cash, without interest and subject to deduction of any required withholding tax. We paid the former ESI stockholders aggregate consideration of approximately \$1.03 billion, excluding related transaction fees and expenses, and non-cash consideration related to the exchange of share-based awards of approximately \$31 million for a total purchase consideration of approximately \$1.06 billion. We funded the payment of the aggregate consideration with a combination of our available cash on hand and the proceeds from our 2019 Incremental Term Loan Facility, as defined and as described further in Item 7 of this Annual Report on Form 10-K.

Sale of Data Analytics Solutions Business

In April 2017, we completed the sale of our Data Analytics Solutions business for net cash proceeds \$72.5 million and recorded a pre-tax gain of \$74.9 million. This business, which had net revenues in 2016 of \$12.7 million and was included in our Vacuum & Analysis segment, was no longer a part of our long-term strategic objectives. The business did not qualify as a discontinued operation as this sale did not represent a strategic shift in our business, nor did the sale have a major effect on our operations. Therefore, the results of operations for all periods are included in our income from operations. The assets and liabilities of this business have not been reclassified or segregated in the consolidated balance sheet or consolidated statements of cash flows as the amounts were immaterial.

Reportable Segments

The Vacuum & Analysis segment provides a broad range of instruments, components and subsystems which are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery and vacuum technology.

The Light & Motion segment provides a broad range of instruments, components and subsystems which are derived from our core competencies in lasers, photonics, optics, precision motion control and vibration control.

The Equipment & Solutions segment was created in conjunction with our acquisition of ESI in February 2019. The Equipment & Solutions segment provides laser-based manufacturing systems solutions for the micro-machining industry that enable customers to optimize production. The Equipment & Solutions segment’s primary served markets include flexible and rigid printed circuit board (“PCB”) processing/fabrication, semiconductor wafer processing, and passive component manufacturing and testing. The Equipment & Solutions segment’s systems incorporate specialized laser technology and proprietary control software to efficiently process the materials and components that are an integral part of electronic devices and systems.

For further information on our segments, see Note 21 to the Notes to the Consolidated Financial Statements contained in this Annual Report on Form 10-K.

Markets and Applications

Since our inception, we have focused on satisfying the needs of our customers by establishing long-term collaborative relationships. We have a diverse base of customers and our primary served markets are manufacturers of capital equipment for semiconductor manufacturing, industrial technologies, life and health sciences, as well as research and defense.

We believe there are three secular trends benefitting MKS. First is the impact of a world that continues to be increasingly interconnected, resulting in an explosion of data transmission, data storage, and data analytics requirements, which drives continued growth for advanced memory and logic chip demand. Second is the increasing complexity of technology transitions in semiconductor manufacturing, which leads to inflections, such as extreme vertical structures and process engineering at the atomic level. These inflections provide additional growth opportunities for MKS as we believe we are uniquely positioned to deliver the broadest and deepest portfolio of solutions. Third is the accelerating need for laser-based precision manufacturing techniques, which are enabled by lasers, photonics, optics, motion, and systems solutions. We believe our long history and deep expertise in solving critical problems positions us well to address these challenges for our customers.

Semiconductor Market

A significant portion of our sales are derived from products sold to semiconductor capital equipment manufacturers and semiconductor device manufacturers. Our products are used in the major semiconductor processing steps, such as depositing thin films of material onto silicon wafer substrates, etching, cleaning, lithography, metrology and inspection.

We anticipate that the semiconductor market will continue to account for a substantial portion of our sales. While the semiconductor device manufacturing market is global, major semiconductor capital equipment manufacturers are concentrated in China, Japan, South Korea, Taiwan, and the United States.

Approximately 49%, 55% and 57% of our net revenues for the years 2019, 2018 and 2017, respectively, were from sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers.

Advanced Markets

In addition to semiconductor, our products are used in the industrial technologies, life and health sciences, as well as research and defense markets.

Industrial Technologies

Industrial technologies encompasses a wide range of diverse applications such as flexible and rigid PCB processing/fabrication, glass coating, laser marking, measurement and scribing, natural gas and oil production, environmental monitoring and electronic thin films. Electronic thin films are a primary component of numerous electronic products including flat panel displays, light emitting diodes, solar cells and data storage media. Industrial technologies manufacturers are located in developed and developing countries across the globe.

Life and Health Sciences

Our products for life and health sciences are used in a diverse array of applications, including bioimaging, medical instrument sterilization, medical device manufacturing, analytical, diagnostic and surgical instrumentation, consumable medical supply manufacturing and pharmaceutical production. Our life and health sciences customers are located globally.

Research and Defense

Our products for research and defense are sold to government, university and industrial laboratories for applications involving research and development in materials science, physical chemistry, photonics, optics and electronics materials. Our products are also sold for monitoring and defense applications including surveillance, imaging and infrastructure protection. Major equipment providers and research laboratories are concentrated in China, Europe, Japan, South Korea, Taiwan, and the United States.

Approximately 51%, 45% and 43% of our net revenues in the years 2019, 2018 and 2017, respectively, were from advanced markets.

International Markets

A significant portion of our net revenues are from sales to customers in international markets. For the years 2019, 2018 and 2017, international net revenues accounted for approximately 53%, 51% and 50% of our total net revenues, respectively. A significant portion of our international net revenues were in China, Germany, Israel, Japan and South Korea. We expect that international revenues will continue to account for a significant percentage of total net revenues for the foreseeable future, and that in particular, the proportion of our sales to Asian customers will continue to increase, due in large part to our acquisition of ESI, as approximately 80% of ESI's customers are located in Asia. Long-lived assets, located in the United States, were \$208 million and \$147 million as of December 31, 2019 and 2018, respectively, excluding goodwill, intangible assets, and long-term tax-related accounts. Long-lived assets, located outside of the United States, were \$131 million and \$77 million, as of December 31, 2019 and 2018, respectively, excluding goodwill and intangibles and long-term tax-related accounts.

Product/Service Offerings

We group our product/service offerings into three groups. These three groups are: Advanced Manufacturing Components, Advanced Manufacturing Systems and Global Service. The Advanced Manufacturing Components is comprised of product revenues from the Company's Vacuum & Analysis and Light & Motion segments. The Advanced Manufacturing Systems is comprised of product revenues from the Company's Equipment & Solutions segment. Global Service is comprised of total service revenues from all three of the Company's reportable segments.

Advanced Manufacturing Components:

Vacuum & Analysis products include:

- *Pressure and Vacuum Control Solutions Products* consist of direct and indirect pressure measurement.
- *Materials Delivery Solutions Products* include flow and valve technologies as well as integrated pressure measurement and control subsystems, which provide customers with precise control capabilities.
- *Power Delivery Products* consist of microwave, power delivery systems, radio frequency matching networks and metrology products. Our power delivery solutions are used to provide energy to various etching, stripping and deposition processes.
- *Plasma and Reactive Gas Products* consist of reactive gas products, which create reactive species. A reactive gas is used to facilitate various chemical reactions in the processing of thin films, including the deposition of films, etching and cleaning of films and surface modifications.

Light & Motion products include:

- *Laser Products* consist of lasers including ultrafast lasers and amplifiers, fiber lasers, diode-pumped solid-state lasers, high-energy pulsed lasers and tunable lasers.
- *Photonics Products* include optical components, lens assemblies and vibration isolation solutions. Our Photonics Products also includes our instruments and motion products, such as high-precision motion stages and controls, hexapods, photonics instruments for measurement and analysis, and production equipment for test and measurement customers.

Advanced Manufacturing Systems:

Equipment & Solutions products include:

Our Equipment and Solutions products consist of laser-based systems for PCB manufacturing, including flexible interconnect PCB processing systems and HDI solutions for rigid PCB manufacturing and substrate processing, as well as passive component MLCC testing.

Customers

We sell our products to thousands of customers worldwide, in a wide range of end markets. Revenues from our top ten customers accounted for approximately 33%, 41% and 43% of net revenues for the years 2019, 2018 and 2017, respectively. There were no individual customers that accounted for greater than 10% of our revenues for 2019. Applied Materials, Inc. accounted for 12% and 13% and Lam Research Corporation accounted for 11% and 12% of our net revenues for the years ended 2018 and 2017, respectively.

Sales, Marketing, Service and Support

Our worldwide sales, marketing, service and support organizations are critical to our strategy of maintaining close relationships with semiconductor capital equipment, device manufacturers and manufacturers of advanced applications. We market and sell our products and services through our global direct sales organization, an international network of independent distributors and sales representatives, our websites and product catalogs. As of December 31, 2019, we had approximately 560 sales employees worldwide. We maintain a marketing staff that identifies customer requirements, assists in product planning and specifications, and focuses on future trends in the markets we serve.

As semiconductor device manufacturers have become increasingly sensitive to the significant costs of system downtime, they have required that suppliers offer comprehensive local repair, field service and customer support. Manufacturers require close support to enable them to repair, modify, upgrade and retrofit their equipment to improve yields and adapt new materials or processes. To meet these market requirements, we provide technical support offices located near our customers' facilities. We provide repair and calibration services at internal service depots and authorized service providers located worldwide. We typically provide warranties for periods ranging from one to three years, depending upon the type of product, with the majority of our products ranging from one to two years. We typically provide warranty on our repair services for periods ranging from 90 days to up to one year, depending upon the type of repair.

Research and Development

Our products incorporate sophisticated technologies to measure, monitor, deliver, analyze, power and control complex semiconductor and advanced manufacturing processes, thereby enhancing uptime, yield and throughput for our customers. Our products have continuously advanced as we strive to meet our customers' evolving needs. We have developed, and continue to develop, new products to address industry trends, such as the shrinking of integrated circuit critical dimensions and technology inflections, and, in the flat panel display and solar markets, the transition to larger substrate sizes, which require more advanced process control technology. In addition, we have developed, and continue to develop, products that support the migration to new classes of materials, ultra-thin layers, and 3D structures that are used in small geometry manufacturing. We involve our marketing, engineering, manufacturing and sales personnel in the development of new products in order to reduce the time to market for new products. Our employees also work closely with our customers' development personnel, helping us to identify and define future technical needs on which to focus research and development efforts. We support research at academic institutions targeted at advances in materials science and semiconductor process development.

As of December 31, 2019, we had approximately 760 research and development employees located in facilities around the world. Our research and development expenses were \$164.1 million, \$135.7 million and \$132.6 million for the years 2019, 2018 and 2017, respectively. Our research and development efforts include numerous projects, none of which are individually material, and generally have a duration of 3 to 30 months, depending upon whether the product is an enhancement of existing technology or a new product. Our current initiatives include projects to enhance the performance characteristics of older products, to develop new products and to integrate various technologies into subsystems.

Manufacturing

Our manufacturing facilities are located in Austria, China, France, Germany, Israel, Italy, Mexico, Romania, Singapore, South Korea, the United Kingdom and the United States. Manufacturing activities include the assembly and testing of components and subassemblies, which are integrated into our products. We outsource some of our assembly work. We purchase a wide range of electronic, optical, mechanical and electrical components, some of which are designed to our specifications. We consider our lean manufacturing techniques and responsiveness to customers' significantly fluctuating product demands to be a competitive advantage. As of December 31, 2019, we had approximately 3,400 manufacturing-related employees.

Backlog

At December 31, 2019, our backlog of unfilled orders for all products and services was \$500 million, compared to \$400 million at December 31, 2018. The increase in backlog of \$100 million in 2019 compared to 2018 is attributed to our growth in the semiconductor market during the second half of 2019 and from our Equipment & Solutions segment. As of December 31, 2019, approximately \$480 million of our consolidated backlog was scheduled to be shipped on or before December 31, 2020. In general, we schedule production of our products based upon our customers' delivery requirements. Our lead times are very short, as a large portion of our orders are received and shipped within 90 days. While backlog is calculated on the basis of firm orders, orders may be subject to cancellation or delay, in many cases, by the customer with limited or no penalty. Our backlog at any particular date, therefore, is not necessarily indicative of actual sales which may be generated for any succeeding period. Historically, our backlog levels have fluctuated based upon the ordering patterns of our customers and changes in our manufacturing capacity.

Competition

The market for our products is cyclical and highly competitive. Principal competitive factors include:

- product quality, performance and price;
- historical customer relationships;
- breadth of product line;
- ease of use;
- manufacturing capabilities and responsiveness; and
- customer service and support.

Although we believe that we compete favorably with respect to these factors, we can make no assurances that we will continue to do so.

We encounter substantial competition in most of our product lines, although no single competitor competes with us across all product lines. Certain of our competitors may have greater financial and other resources than we do. In some cases, competitors are smaller than we are, but are well established in specific product niches.

For example, Advanced Energy Industries, Inc. offers products that compete with our power delivery and reactive gas generator products. Hitachi Ltd. and Horiba Ltd. products compete with our mass flow controllers. Inficon, Inc. offers products that compete with our vacuum measurement and gas analysis products and our vacuum gauging products. Brooks Instrument and VAT, Inc. offer products that compete with our vacuum components. Sigma Koki Co., Ltd. offers products that compete with our optics and photonics products. Coherent, Inc. offers products that compete with our lasers and photonics instruments. Qioptiq offers products that compete with our laser and optics products. IPG Photonics, Inc. offers products that compete with our laser products. Jenoptik AG offers products that compete with our laser, optics, and photonics products. PI miCos GmbH offers products that compete with our photonics products. Thorlabs, Inc. offers products that compete with our optics, lasers and photonics products. Trumpf Group, Lumentum Holdings Inc., Edgwave GmbH and Amplitude Systemes SA offer products that compete with our laser products. Our laser systems primarily compete with laser systems provided by Via Mechanics, Ltd., EO Technics Co., Ltd., LPKF Laser & Electronics AG, Mitsubishi Electric Corporation, and Han's Laser Technology Industry Group Co., Ltd. Our component test products primarily compete with Humo Laboratory Ltd., as well as component manufacturers that develop systems for internal use.

Patents and Other Intellectual Property Rights

We rely on a combination of patent, copyright, trademark and trade secret laws and license agreements to establish and protect our proprietary rights. As of December 31, 2019, we owned 724 U.S. patents and 1,501 foreign patents that expire at various dates through 2039. As of December 31, 2019, we had 107 pending U.S. patent applications. Foreign counterparts of certain U.S. applications have been filed or may be filed at the appropriate time.

We require each of our employees, including our executive officers, to enter into standard agreements pursuant to which the employee agrees to keep confidential all of our proprietary information and to assign to us all inventions while they are employed by us.

Employees

As of December 31, 2019, we employed approximately 5,500 persons. We believe our ongoing success depends upon our continued ability to attract and retain highly skilled employees. Outside of the United States, there are certain countries where our employees are represented by works councils or trade unions, as is common practice or required by law. We believe our employee relations are good.

Item 1A. Risk Factors

The following describes certain risks we face in our business. Additional risks that we do not yet know of or that we currently believe are immaterial may also impair our business. If any of the events or circumstances described in the following risks actually occurs, our business, financial condition or operating results would suffer, and the trading price of our common stock could decline. In assessing these risks, investors should also refer to the other information contained or incorporated by reference in this report and our other filings with the Securities and Exchange Commission.

Our business depends significantly on capital spending in the semiconductor and consumer electronics industries, which are characterized by periodic fluctuations that may cause a reduction in demand for our products.

Our business depends upon the capital expenditures of semiconductor device manufacturers, which in turn depends upon the demand for semiconductors. Approximately 49%, 55% and 57% of our net revenues for the years 2019, 2018 and 2017, respectively, were from sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers. We anticipate that sales to these customers will continue to account for a substantial portion of our net revenues. Our industrial technologies market also experiences cyclical fluctuations, resulting largely from the ebb and flow of demand for consumer electronics, particularly mobile phones. While

this market is not as significant to us as the semiconductor market, the cyclical nature of this market can also have a significant impact on our business, financial condition and operating results, and we experience similar risks associated with rapid changes in demand from this market.

The semiconductor and consumer electronics industries are characterized by rapid technological change, frequent product introductions, changing customer requirements and evolving industry standards. Because our customers face uncertainties regarding the growth and requirements of these industries, their products and components may not achieve, or continue to achieve, anticipated levels of market acceptance or demand. If our semiconductor market customers or the consumer electronics manufacturers that purchase from our industrial technologies market customers are unable to deliver products that gain market acceptance, it is likely that these customers will not purchase our products or will purchase smaller quantities of our products. We often invest substantial resources in developing our products in advance of significant sales of these products to such customers. Any failure of our customers' products to gain market acceptance, or a failure of these markets to sustain current sales levels or to grow would have a significant negative effect on our business, financial condition and operating results.

The semiconductor and consumer electronics industries have also historically experienced cyclical variations in product supply and demand. These sometimes sudden and severe cycles can result from many factors, including overall consumer and industrial spending and demand for electronic products that drive manufacturer production, as well as the manufacturer's capacity utilization, timing of new product introductions and demand for customers' products, inventory levels relative to demand and access to affordable capital. The timing, severity and duration of these market cycles are difficult to predict, and we may not be able to respond effectively to these cycles. For example, our sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers sequentially increased by 4% in 2018 and 52% in 2017, but sequentially decreased 19% in 2019 after a moderation in capital spending in the second half of 2018 and the first half of 2019. However, capital spending increased in the second half of 2019. While the timing of a full market recovery remains uncertain, we are seeing improvement in market conditions.

During downturns in the semiconductor and consumer electronics industries, periods of overcapacity have resulted in rapid and significantly reduced demand for our products, which may result in lower gross margins due to reduced absorption of manufacturing overhead, as our ability to rapidly and effectively reduce our cost structure in response to such downturns is limited by the fixed nature of many of our expenses in the near term. Further, our ability to reduce our long-term expenses is constrained by our need to continue investment in next-generation product technology and to support and service our products. In addition, due to the relatively long manufacturing lead times for some of the products we sell to these industries, we may incur expenditures or purchase raw materials or components for products we are unable to sell. As a result, downturns in these industries may materially harm our business, financial condition and operating results. Conversely, when upturns in these industries occur, we may have difficulty rapidly and effectively increasing our manufacturing capacity to meet sudden increases in customer demand. If we fail to do so, we may lose business to our competitors and our relationships with our customers may be harmed. In addition, many semiconductor and consumer electronics manufacturers have operations and customers in Asia, a region that in past years has experienced serious economic problems including currency devaluations, debt defaults, lack of liquidity and recessions.

The terms of our Term Loan Facility and ABL Facility impose significant financial obligations and risks upon us, limit our ability to take certain actions, and could discourage a change in control.

The total principal balance of our Term Loan Facility, as defined and as described further in Item 7 of this Annual Report on Form 10-K, at December 31, 2019 was \$892 million. Our ABL Facility, as defined and as described further in Item 7 of this Annual Report on Form 10-K, provides us with a senior secured asset-based revolving credit facility of up to \$100 million, subject to a borrowing base limitation. The total principal balance of our ABL Facility at December 31, 2019 was \$0.

A significant portion of amounts outstanding under the credit facilities bear interest at variable interest rates. Although we hedge some exposure, if interest rates increase, variable rate debt will create higher debt service requirements, which would adversely affect our cash flows. In addition, our credit ratings could affect the cost and availability of future borrowings and, accordingly, our cost of capital. Our ratings of our indebtedness reflect each nationally recognized statistical rating organization's opinion of our financial strength, operating performance and ability to meet our debt obligations. We cannot make any assurances that we will achieve a particular rating or maintain a particular rating in the future. Moreover, we may be required to raise substantial additional financing to fund working capital, capital expenditures, acquisitions or other general corporate requirements. Our ability to obtain additional financing or refinancing will depend on, among other factors, our financial position and performance, as well as prevailing market conditions and other factors beyond our control. We cannot make any assurances that we will be able to obtain additional financing or refinancing on terms acceptable to us or at all.

Each of our Term Loan Facility and ABL Facility, each as amended, uses London Interbank Offered Rate ("LIBOR") as a reference rate, such that the interest due pursuant to such loans may be calculated using LIBOR (subject to a stated minimum value). On July 27, 2017, the United Kingdom's Financial Conduct Authority, which regulates LIBOR, announced that it intends to phase out LIBOR by the end of 2021. LIBOR may become unavailable before that date. It is unclear if at that time LIBOR will cease to exist or if new methods of calculating LIBOR will be established, such that it continues to exist after 2021. If the method for calculation of LIBOR changes, if LIBOR is no longer available or if lenders have increased costs due to changes in LIBOR, we may have to modify our credit facilities, or interest under each credit facility will be calculated using the base rate (calculated by reference to the higher of the federal funds effective rate plus 50 basis points or the prime rate, subject to a stated minimum value). The Alternative Reference Rates Committee selected the Secured Overnight Financing Rate ("SOFR"), a new index calculated by reference to short-term repurchase agreements backed by Treasury securities, as its preferred replacement for U.S. dollar LIBOR. We expect to reach agreement with our lenders on an amendment to our Term Loan Facility and ABL Facility to use SOFR in lieu of LIBOR, prior to the phase-out of LIBOR. We do not expect a significant change to the effective interest rate on our borrowing as a result of any replacement reference rate. Whether or not SOFR attains market acceptance as a LIBOR replacement tool remains unknown. As such, the future of LIBOR and the potential alternatives to LIBOR at this time is uncertain. In the event we are unable to reach agreement on a replacement reference rate, the term loans outstanding under our Term Loan Facility and any revolving loans borrowed under our ABL Facility from time to time using LIBOR as a reference rate will convert to the base rate, which could result in higher interest rates on these term loans and any such revolving loans.

Our Term Loan Facility and ABL Facility contain several negative covenants that, among other things and subject to certain exceptions, restrict our ability and/or our subsidiaries' ability to:

- incur additional indebtedness;
- pay certain dividends on our capital stock or redeem, repurchase or retire certain capital stock or certain other indebtedness;
- make certain investments, loans and acquisitions;
- engage in certain transactions with our affiliates;
- sell assets, including capital stock of our subsidiaries;
- materially alter the business we conduct;
- consolidate or merge;
- incur liens; and
- engage in sale-leaseback transactions.

These restrictions on our ability to engage in or benefit from these actions limit our flexibility in planning for, or reacting to, changes in and opportunities for our business, such as limiting our ability to engage in mergers and acquisitions. This could place us at a competitive disadvantage. If the matters described in our other risk factors result in a material adverse effect on our business, financial condition or operating results, we may be unable to comply with the terms of our credit facilities or experience an event of default.

Our Term Loan Facility and ABL Facility contain customary events of default, including:

- failure to make required payments;
- failure to comply with certain agreements or covenants;
- materially breaching any representation or warranty made or deemed made in connection with the respective credit facility;
- failure to pay, or cause acceleration of, certain other indebtedness;
- certain events of bankruptcy and insolvency;
- failure to pay certain judgments; and
- a change in control of us.

The amount of cash available to us for repayment of amounts owed under these credit facilities will depend on our usage of our existing cash balances and our operating performance and ability to generate cash flow from operations in future periods, which will be subject to financial, business and other factors affecting our operations, many of which are beyond our control. We cannot provide any assurances that we will generate sufficient cash flow from operations to service our debt obligations. Any failure to repay these obligations as they become due would result in an event of default under the credit facilities.

If an event of default occurs, the lenders may end their obligation to make loans to us under the credit facilities and may declare any outstanding indebtedness under these credit facilities immediately due and payable. In such case, we would need to obtain additional financing or significantly deplete our available cash, or both, to repay this indebtedness. Any additional financing may not be available on reasonable terms or at all, and significant depletion of our available cash would harm our ability to fund our operations or execute our broader corporate objectives. If we were unable to repay outstanding indebtedness following an event of default, then in addition to other available rights and remedies, the lenders could initiate foreclosure proceedings on substantially all of our assets. Any such foreclosure proceedings or other rights and remedies successfully implemented by the lenders in an event of default would have a material adverse effect on our business, financial condition and operating results.

Further, because a change in control of us constitutes an event of default under these credit facilities, this would likely be a deterrent to a potential acquirer, as any potential acquisition would trigger an event of default, unless the lenders agreed to waive such event of default. We cannot guarantee that any such waiver would be obtained.

The COVID-19 coronavirus outbreak could impact our international operations.

In December 2019, a novel strain of coronavirus, COVID-19, originated in Wuhan, China, and has rapidly spread across China and into other parts of Asia, as well as to North America and Europe and other global regions. As a result, many countries have suspended travel to and from China and imposed quarantines on affected individuals. The commercial activities of our customers and suppliers in China and our manufacturing facilities in Wuxi and Shenzhen, China, have been restricted due to government-mandated closures, and many employees have been or remain in quarantine and have been delayed in returning to work at our facilities once they have re-opened. This is a highly dynamic situation, and the extent to which the Coronavirus may impact our

results is uncertain, and depends on the length and severity of this viral outbreak and the responsive governmental actions. However, if the outbreak continues to spread and lasts for an extended period of time, it would likely have a material adverse effect on our business, financial condition and operating results.

Our quarterly operating results have fluctuated, and are likely to continue to vary significantly, which may result in volatility in the market price of our common stock.

A substantial portion of our shipments occurs shortly after an order is received, and therefore we generally operate with a relatively low level of backlog. As a result, a decrease in demand for our products from one or more customers could occur with limited advance notice and could have a significant adverse effect on our operating results in any particular period. Further, we often recognize a significant portion of the revenue of certain of our business lines in the last month of each fiscal quarter, due in part to the tendency of some customers to wait until late in a quarter to commit to purchase these products as a result of capital expenditure approvals and budgeting constraints occurring at the end of a quarter, or the hope of obtaining more favorable pricing from a competitor seeking the business. Thus, variations in timing of sales can cause significant fluctuations in our quarterly sales, gross margin and profitability. Orders expected to ship in one period could shift to another period due to changes in the timing of our customers' purchase decisions, rescheduled delivery dates requested by our customers, manufacturing capacity constraints or logistics delays. Our orders are generally subject to rescheduling without penalty or cancellation without penalty other than reimbursement for certain labor and material costs. Our operating results for a particular quarter or year may be adversely affected if our customers, particularly our largest customers, cancel or reschedule orders, or if we cannot fill orders in time due to capacity constraints or unexpected delays in manufacturing, testing, shipping, delivery or product acceptance. Also, we base our manufacturing plans on our forecasted product mix. If the actual product mix varies significantly from our forecast, we may not be able to fill some orders, which would result in delays in the shipment of our products and could shift sales to a subsequent period. All of these risks have a particularly high impact on our Equipment & Solutions Division, which derives substantial revenue from a few significant customers and the sale of a relatively small quantity of products. A significant percentage of our expenses are fixed and based in part on expectations of future net revenues. Our inability to adjust spending quickly enough to compensate for any shortfall would magnify the adverse impact of a shortfall in net revenues on our operating results.

Customers of our high-value, more complex products often require substantial time to qualify our products and make purchase decisions. In addition, some of our sales to defense and security customers are under major defense programs that involve lengthy competitive bidding and qualification processes. These customers often perform, or require us to perform, extensive configuration, testing and evaluation of our products before committing to purchasing them, which can require a significant upfront investment in time and resources. The sales cycle for these products from initial contact through shipment varies significantly, is difficult to predict and can last more than a year. If we fail to anticipate the likelihood, costs, or timing associated with sales of these products, or the cancellation or rescheduling of orders for these products, our business and operating results would be harmed.

Our worldwide sales to customers in the research and defense markets rely to a large extent on government funding for research and defense-related programs. Any decline in government funding as a result of reduced budgets in connection with fiscal austerity measures, revised budget priorities or other causes would likely result in reduced sales of our products that are purchased either directly or indirectly with government funding, which would have an adverse impact on our operating results. Concerns regarding the global availability of credit may also make it more difficult for our customers to raise capital, whether debt or equity, to finance their projects and purchases of capital equipment, which would adversely affect sales of our products and therefore harm our business and operating results.

Factors that could cause fluctuations in our financial results include:

- a worldwide economic slowdown or disruption in the global financial markets;
- fluctuations in our customers' capital spending, industry cyclicality (particularly in the semiconductor and consumer electronics industries), market seasonality (particularly in the research and defense and consumer electronics industries), levels of government funding available to our customers (particularly in the life and health sciences and research and defense markets) and other economic conditions within the markets we serve;
- the timing of the receipt of orders within a given period and the level of orders from major customers;
- demand for our products and the products sold by our customers;
- shipment and delivery delays;
- disruption in sources of supply;
- production capacity constraints;
- government regulatory and trade restrictions in the countries we manufacture and sell our products;
- specific features requested by customers;
- the timing and level of cancellations and delays of orders in backlog for our products;
- natural disasters or other events beyond our control (such as earthquakes, floods or storms, regional economic downturns, pandemics, social unrest, political instability, terrorism, or acts of war);
- the timing of product shipments and revenue recognition within a given quarter;
- variations in the mix of products we sell;
- changes in our pricing practices or in the pricing practices of our competitors or suppliers;
- our timing in introducing new products;
- engineering and development investments relating to new product introductions, and significant changes to our manufacturing and outsourcing operations;
- market acceptance of any new or enhanced versions of our products;
- timing of new product introductions by our competitors;
- timing and level of inventory obsolescence, scrap and warranty expenses;
- the availability, quality and cost of components and raw materials we use to manufacture our products;
- changes in our effective tax rates;
- changes in our capital structure, including cash, marketable securities and debt balances, and changes in interest rates;
- changes in bad debt expense based on the collectability of our accounts receivable;
- timing, type, and size of acquisitions and divestitures, and related expenses and charges;
- fluctuations in currency exchange rates;
- our expense levels;
- impairment of goodwill and amortization of intangible assets; and
- fees, expenses and settlement costs or judgments against us relating to litigation or regulatory compliance.

As a result of the factors discussed above, among others, it is likely that we may in the future experience quarterly or annual fluctuations in our operating results, and that, in one or more future quarters, our operating results may fall below the expectations of public market analysts or investors. In any such event, the price of our common stock could fluctuate or decline significantly. Consequently, we believe that quarter-to-quarter and year-to-year comparisons of our operating results, or any other similar period-to-period comparisons, may not be reliable indicators of our future performance.

The loss of net revenues from any one of our major customers would likely have a material adverse effect on us.

Our top ten customers accounted for approximately 33%, 41% and 43% of our net revenues for the years 2019, 2018 and 2017, respectively. No single customer accounted for more than 10% of our net revenues in 2019. One customer, Applied Materials, Inc., accounted for approximately 12% and 13% of our net revenues for the years 2018 and 2017, respectively, and another customer, Lam Research Corporation, accounted for 11% and 12% of our net revenues for the years 2018 and 2017, respectively. In any one reporting period, a single customer or several customers may contribute even a larger percentage of our consolidated net revenues. Further, our recently-acquired Equipment & Solutions Division also depends on a few significant customers for a large portion of its revenue in any given quarter. The loss of a major customer or any reduction in orders by these customers, including reductions due to market or competitive conditions, would likely have a material adverse effect on our business, financial condition and operating results. None of our significant customers has entered into an agreement with us requiring it to purchase any minimum quantity of our products.

Attempts to lessen the adverse effect of any loss or reduction of net revenues through the rapid addition of new customers would be difficult because a relatively small number of companies dominate the semiconductor and consumer electronics industries. Further, prospective customers typically require lengthy qualification periods prior to placing volume orders with a new supplier. Our future success will continue to depend upon:

- our ability to maintain relationships with existing key customers;
- our ability to attract new customers and satisfy any required qualification periods;
- our ability to introduce new products in a timely manner for existing and new customers; and
- the successes of our OEM customers in creating demand for their capital equipment products that incorporate our products.
- our ability to gain significant customers in new, emerging segments of our markets

We face significant risks from doing business internationally.

Our business is subject to risks inherent in conducting business globally. International revenues account for a significant portion of total net revenues, with a substantial portion of such sales to customers in Asia (especially China, South Korea, Japan, Israel, and Taiwan) and Europe (especially Germany). We expect that international revenues will continue to account for a significant percentage of total net revenues for the foreseeable future, and that in particular, the proportion of our sales to Asian customers will continue to increase. Additionally, we have substantial international manufacturing, sales and administrative operations, with significant facilities and employee populations in Europe and Asia, and a substantial portion of our manufacturing in China, Israel, Mexico and Singapore. Our international operations expose us to various risks, which include:

- adverse changes or instability in the political or economic conditions in countries or regions where we manufacture or sell our products, for example, the uncertainty associated with the exit of the United Kingdom from the European Union (“EU”);
- challenges of administering our diverse business and product lines globally;

- the actions of government regulatory authorities, including embargoes, executive orders, import and export restrictions, tariffs, currency controls, trade restrictions and trade barriers (including retaliatory actions), license requirements, environmental and other regulatory requirements and other rules and regulations applicable to the manufacture, import and export of our products, all of which are complicated and potentially conflicting, often require significant investments in cost, time and resources for compliance, and may impose strict and severe penalties for noncompliance;
- greater risk of violations of applicable U.S. and international anti-corruption and trade laws by our employees, sales representatives, distributors or other agents;
- longer accounts receivable collection periods and longer payment cycles;
- overlapping, differing or more burdensome tax structures and laws;
- the potential that certain tax benefits may be revoked or reclaimed;
- adverse currency exchange rate fluctuations;
- reduced or inconsistent protection of intellectual property;
- shipping and other logistics complications;
- the imposition of restrictions on currency conversion or the transfer of funds;
- compliance costs and withholding taxes associated with the repatriation of our overseas earnings;
- increased risk of exposure to significant health concerns (such as the recent COVID-19 coronavirus, Sudden Acute Respiratory Syndrome, Avian Influenza, the H7N9, Ebola or Zika viruses), which could disrupt our sales, manufacturing and logistical activities, as well as the activities of our suppliers and our customers;
- the expropriation of private enterprises;
- more complex and burdensome labor laws and practices in countries where we have employees;
- cultural and management style differences;
- preference for locally-produced products;
- changes in labor conditions and difficulties in staffing and managing foreign operations, including, but not limited to, the formation of labor unions;
- difficulties in staffing and managing each of our individual international operations; and
- increased risk of exposure to civil unrest, terrorism and military activities.

If we experience any of the risks associated with international business, our business, financial condition and operating results could be significantly harmed.

We have significant facilities and operations and a considerable number of employees in Israel. A number of our products are manufactured in facilities located in Israel. The Middle East remains a volatile region, and the future of peace efforts between Israel and neighboring countries remains extremely uncertain. Any armed conflicts or significant political instability in the region is likely to negatively affect business conditions and could significantly disrupt our operations in Israel, which would negatively impact our business. Further, many of our employees in Israel are subject to being called for active military duty under emergency circumstances. If a military conflict or war arises, these individuals could be required to serve in the military for extended periods of time, and our operations in Israel could be disrupted by the absence of one or more key employees or a significant number of other employees for a significant period of time. Any such disruption could adversely affect our business.

The United States government has taken actions against certain of our customers, particularly in Asia, including indictments for various criminal charges, and in some cases, restrictions on doing business with these customers. For example, we have had to suspend outstanding orders from one such customer, and have been negatively impacted by the cancellation of orders from customers who are providers to such customer. These actions by the United States government have caused us, and may in the future cause us, to lose the anticipated revenue from these product sales, the amount of which could be significant. In addition, these or other customers could elect to purchase products from unaffected non-U.S. competitors, even when trade restrictions are not in place, jeopardizing our future long-term relationship with them. Further, compliance with regulatory restrictions may cause us to breach contractual obligations, which could result in costs, penalties and litigation.

Additionally, potential customers in certain countries, particularly in Asia, have a strong preference for technology and products developed by suppliers based in their home countries. The recent trade disputes between the United States government and other governments in Asia and elsewhere have further reinforced and broadened this preference, as these customers and some of our existing customers seek to avoid the uncertainty related to these trade disputes. While we have attempted to mitigate this issue by establishing a significant local presence in many of these countries, companies like us that are based outside of these countries remain at a disadvantage.

If significant tariffs or other trade restrictions on our products or components that are imported from or exported to China continue or are increased, our business, financial condition and operating results may be materially harmed.

Trade tensions between the U.S. and China escalated throughout 2018 and 2019, with successive rounds of U.S. tariffs on Chinese goods followed by retaliatory tariffs imposed by the Chinese government on certain products made in the U.S. and shipped to China. These tariffs currently affect some of our products made in China and some of the components that we or our suppliers source from China, and some of our products and components we export to China. The U.S. and China tariffs have negatively impacted our business, financial condition and operating results. We continue to explore our options to reduce the impact of these tariffs on our business, including but not limited to, seeking alternative sources of supply, modifying other business practices, raising our prices, and shifting production outside of China.

In May 2019, the U.S. Department of Commerce's Bureau of Industry and Security ("BIS") added Chinese-based Huawei Technologies Co., Ltd. and 68 of its affiliates onto the BIS Entity List, thereby prohibiting the sale of U.S. goods to Huawei, without a license from BIS. In August 2019, BIS added another 46 non-U.S. affiliates of Huawei to the Entity List. Accordingly, we have had to suspend and may lose our outstanding orders from Huawei, and we have been negatively impacted by the cancellation of orders from customers who are providers to Huawei. In addition, China's Ministry of Commerce announced in May 2019 that China will introduce an "unreliable entity list" under which non-Chinese entities that cut-off suppliers to Chinese companies may be subject to government action.

The geopolitical and economic uncertainty between the U.S. and China caused by the tariffs and trade bans have caused, and may continue to cause, decreased demand for our products, directly and indirectly, which could materially harm our business, financial condition and operating results. This trade uncertainty has caused, and may continue to cause, customers to delay or cancel orders as they limit expenditures that could be affected by future actions and evaluate ways to mitigate their own tariff and cost exposure by sourcing from locally-based suppliers or suppliers based in other countries. Such delays and cancellations could have a material impact on our business, financial condition and operating results.

It is possible that additional restrictions on trade will be imposed, and that existing tariffs will be increased on imports of our products or the components used in our products, or that our business will be impacted by additional retaliatory tariffs or restrictions imposed and/or increased by China or other countries in response to existing or future tariffs, causing us to potentially lose additional sales and customers, incur increased costs and lower margins, seek alternative suppliers, raise prices or make changes to our operations, any of which could materially harm our business, financial condition and operating results.

As part of our business strategy, we have entered into and may enter into or seek to enter into business combinations and acquisitions that may be difficult to identify and complete, challenging and costly to integrate, disruptive to our business and our management, and/or dilutive to stockholder value.

Since our inception, we have acquired other companies and businesses, and as a part of our business strategy, we may enter into additional business combinations and acquisitions. The acquisitions of Newport in April 2016 and ESI in February 2019 significantly increased our size, including with respect to net revenues, product offerings, number of employees and facilities. Our ability to successfully identify suitable acquisition targets, complete acquisitions on acceptable terms, and efficiently and effectively integrate our acquired businesses into our organization is critical to our growth. We may not be able to identify target companies that meet our strategic objectives or successfully negotiate and complete acquisitions with companies we have identified on acceptable terms. Further, we may incur significant expense in pursuing acquisitions that cannot be completed, or are significantly delayed, due to regulatory or other restrictions. Additionally, our credit facilities only permit us to make acquisitions under certain circumstances, and also restrict our ability to incur additional indebtedness in certain circumstances. Further, the process of integrating acquired companies into our operations requires significant resources and is time consuming, expensive and disruptive to our business. We may not realize the benefits we anticipate from these acquisitions because of the following significant challenges:

- the difficulty of integrating the operations, technology and personnel of the acquired companies;
- the potential disruption of our ongoing business and distraction of management;
- possible internal control weaknesses of the acquired companies;
- significant expenses related to the acquisitions, including any resulting shareholder litigation;
- the assumption of unknown or contingent liabilities associated with acquired businesses;
- the potential to incur or record significant cash or non-cash charges or write-down the carrying value of intangible assets and goodwill obtained in the acquisition, which could adversely impact our cash flow or lower our earnings in the period or periods for which we incur such charges or write-down such assets;
- potentially incompatible cultural differences between the two companies;
- incorporating the acquired company's technology and products into our current and future product lines, and successfully generating market demand for these expanded product lines;
- potential additional geographic dispersion of operations;
- the difficulty in achieving anticipated synergies and efficiencies;
- the difficulty in leveraging the acquired company and our combined technologies and capabilities across our product lines and customer base;
- potential sales disruptions as a result of integrating the acquired company's sales channels with our sales channels; and
- our ability to retain key customers, suppliers and employees of an acquired company.

We may also be placed at a competitive disadvantage by selling products in markets and geographies that are new to us. In addition, if we are not successful in completing acquisitions that we may pursue in the future, we may be required to re-evaluate our growth strategy. We may incur substantial expenses and devote significant management time and resources in seeking to complete proposed acquisitions that may not generate the expected financial results that we planned to achieve.

In particular, we continue to experience some significant risks associated with our ESI acquisition, including our ability to retain key personnel and to realize the anticipated growth in net revenues from the acquired business, as well as the potential to incur or record significant cash or non-cash charges or write-down the carrying value of intangible assets and goodwill obtained in the ESI acquisition, which could adversely impact our cash flow or lower our earnings in the period or periods for which we incur such charges or write-down such assets.

Further, some very significant customers of our laser and motion products compete with our Equipment & Solutions Division. While our Equipment & Solutions Division is separate from our Light & Motion Division that supplies these laser and motion products, and we have implemented internal measures intended to segregate competitively sensitive information that we receive from these customers from our Equipment & Solutions Division, these customers may nonetheless choose to source their laser and motion products from alternate suppliers, which would result in a potentially significant loss of revenue for our laser and motion business.

In addition, with future acquisitions, we could use substantial portions of our available cash as all or a portion of the purchase price. We could also issue additional securities as consideration for these acquisitions, which could cause significant stockholder dilution, or obtain additional debt financing, which would increase our costs and reduce our future cash flow, without achieving the desired accretion to our business. For example, in 2019, we used approximately \$400 million of our available cash and obtained approximately \$650 million of additional debt financing in order to acquire ESI. Further, our prior acquisitions and any future acquisitions may not ultimately help us achieve our strategic goals and may pose other risks to us.

As a result of our previous acquisitions, we have several different decentralized operating and accounting systems. We will need to continue to modify our accounting policies, internal controls, procedures and compliance programs to provide consistency across all of our operations. In order to increase efficiency and operating effectiveness and improve corporate visibility into our decentralized operations, we continue to review opportunities to integrate Enterprise Resource Planning (“ERP”) systems where practical. Any future implementations may risk potential disruption of our operations during the conversion periods and the implementations could require significantly more management time and higher implementation costs than currently estimated.

Many of the markets and industries that we serve are highly competitive, are subject to rapid technological change, and have narrow design windows, and if we fail to introduce new and innovative products or improve our existing products, or if the adoption or applications we serve is not successful, our business, financial condition and operating results will be harmed.

Many of our markets are characterized by rapid technological advances, evolving industry standards, shifting customer needs, new product introductions and enhancements, and the periodic introduction of disruptive technology that displaces current technology due to a combination of price, performance and reliability. For example, our Equipment & Solutions Division is largely dependent upon the mobile phone market (which we include within our industrial technologies market), which is subject to rapid technological changes. As a result, many of the products in our markets can become outdated quickly and without warning. We depend, to a significant extent, upon our ability to enhance our existing products, to anticipate and address the demands of the marketplace for new and improved and disruptive technologies, either through internal development or by acquisitions, and to be price competitive. If we or our competitors introduce new or enhanced products, it may cause our customers to defer or cancel orders for our existing products. If we or our competitors introduce disruptive technology that displaces current technology, existing product platforms or lines of business from which we generate significant net revenues may be rendered obsolete. Further, if our customers or the industries we serve shift to technologies that do not utilize our platform of products, our business, financial condition and operating results would be harmed.

Many of our sophisticated and complex products are difficult to design and manufacture, and we may experience delays in introducing new products or enhancements to our existing products. If we do not introduce our new products or enhancements into the marketplace in a timely fashion, our customers may choose to purchase our competitors’ products. Our success depends on our products being designed into new generations of equipment. Certain of our markets, such as the semiconductor capital equipment market and the mobile phone market, experience cyclicality and unevenness in capital spending, so if we fail to introduce new products in a timely manner we may miss market upturns, or may fail to have our products or subsystems designed into our customers’ products. New products designed by capital equipment manufacturers typically have a lifespan of five to fifteen years. We must develop products that are technologically advanced in a timely manner so that they are

positioned to be chosen for use in each successive generation of capital equipment. We may not be successful in acquiring, developing, manufacturing or marketing new products and technologies on a timely or cost-effective basis. If we fail to adequately introduce new, competitive products and technologies on a timely basis, our business, financial condition and operating results will be harmed.

In addition, we must make a significant capital investment to develop products for our customers well before our products are introduced and before we can be sure that we will recover our capital investment through sales to the customers in significant volume. If our products fail to meet our customers' technical or cost requirements, they may be replaced by a competitive product or alternative technology solution, and we may be unable to recover our development costs.

Further, our competitive success in our markets often depends upon factors outside of our control. For example, in some cases, semiconductor device manufacturers may direct semiconductor capital equipment manufacturers to use a specified supplier's product in their equipment. Accordingly, for such products, our success will depend in part on our ability to have semiconductor device manufacturers specify that our products be used at their semiconductor fabrication facilities. In addition, we may encounter difficulties in changing established relationships of competitors that already have a large installed base of products within such semiconductor fabrication facilities.

We are constantly investing in products for emerging applications, and we expect to generate increasingly significant net revenue levels from sales of products for these applications. These applications are evolving, and the extent to which they achieve widespread adoption or significant growth is uncertain. Many factors may affect the viability of widespread adoption or growth of these applications, including their cost-effectiveness, performance and reliability compared to alternatives. If these applications or our products for these applications are not widely adopted or fail to grow as we project, we will not generate the growth in net revenues that we anticipate from sales of our products for these emerging applications, and our operating results could be harmed.

Manufacturing interruptions or delays could affect our ability to meet customer demand and lead to higher costs, while the failure to estimate customer demand accurately could result in excess or obsolete inventory.

Our business depends on the timely supply of products and services that meet the rapidly changing technical and volume requirements of our customers, which depends in part on the timely delivery of parts, components and subassemblies from suppliers, including contract manufacturers. Cyclical industry conditions and the volatility of demand for manufacturing equipment increase capital, technical, operational and other risks for us and for companies throughout our supply chain. We may also experience significant interruptions of our manufacturing operations, delays in our ability to deliver products or services, increased costs or customer order cancellations as a result of:

- volatility in the availability and cost of materials, including rare earth elements;
- information technology or infrastructure failures; and
- natural disasters or other events beyond our control (such as earthquakes at our facilities in California and Portland, Oregon, floods or storms, regional economic downturns, pandemics such as the recent COVID-19 virus, social unrest, political instability, terrorism, or acts of war), particularly where we or our suppliers, subcontractors and contract manufacturers conduct manufacturing.

In addition, if we need to rapidly increase our business and manufacturing capacity to meet increases in demand or expedited shipment schedules, this may exacerbate any interruptions in our manufacturing operations and supply chain and the associated effect on our working capital. Moreover, if actual demand for our products is different than expected, we may purchase more/fewer parts than necessary or incur costs for canceling, postponing or expediting delivery of parts. If we purchase inventory in anticipation of customer demand that does not materialize, or if our customers reduce or delay orders, we may incur excess inventory charges. Any or all of these factors could materially and adversely affect our business, financial condition and operating results.

Our dependence on sole and limited source suppliers and international suppliers could affect our ability to manufacture products and systems.

We rely on sole and limited source suppliers and international suppliers for some of our components and subassemblies that are critical to the manufacturing of our products due to unique component designs as well as specialized quality and performance requirements needed to manufacture our products. This reliance involves several risks, including the following:

- the potential inability to obtain an adequate supply of required components;
- quality and reliability problems with components, which in turn adversely affects our products' quality and reliability;
- prohibitively higher component prices due to the imposition of tariffs;
- supply chain disruptions resulting from the relocation of our low-cost and sole and single source suppliers to less-developed countries, such as the movement of some suppliers from China to the Philippines or Vietnam;
- reduced control over pricing and timing of delivery of components; and
- the potential inability of our suppliers to develop technologically advanced products to support our growth and development of new products.

We believe we could obtain and qualify alternative sources for most sole and limited source and international supplier parts; however, the transition time to alternative sources may be long. Seeking alternative sources for these parts could also require us to redesign our products, resulting in increased costs and likely shipping delays and the potential need to requalify products with our customers, particularly those who have "copy exact" requirements. In such an event, any inability to redesign our products could result in further costs and shipping delays. These increased costs would decrease our profit margins if we could not pass the costs to our customers. Further, shipping delays could damage our relationships with current and potential customers and have a material adverse effect on our business and operating results.

In addition, we obtain some of the critical capital equipment we use to manufacture certain of our products from sole or limited sources due to the unique nature of the equipment. In some cases, this equipment can only be serviced by the manufacturer or a very limited number of service providers due to the complex and specialized nature of the equipment. If service and/or spare parts for this equipment become unavailable, this equipment could be rendered inoperable, which could cause delays in the production of our products, and could require us to procure alternate equipment, if available, which would likely involve long lead times and significant additional cost, and could harm our operating results.

We offer products for multiple markets and must face the challenges of supporting the distinct needs of each of the markets we serve.

We offer products for a number of very diverse markets. Because we operate in multiple markets, we must work constantly to understand the needs, standards and technical requirements of many different applications within these markets, and must devote significant resources to developing different products for these markets. Product development is costly and time consuming. We must anticipate trends in our customers' industries and develop products before our customers' products are commercialized. If we do not anticipate our customers' needs and future activities, we may invest substantial resources in developing products that do not achieve broad market acceptance. Our growth prospects rely in part on successful entry into new segments, which depends on our displacing competitors who are more familiar with these markets and better known to customers. In many cases, we are attempting to enter or expand our presence in these new segments with newly-introduced products that are not yet proven in the industry. Our decision to continue to offer products to a given market or to penetrate new markets is based in part on our judgment of the size, growth rate, profitability and other factors

that contribute to the attractiveness of a particular market. If our product offerings in any particular market are not competitive, our analyses of a market are incorrect or our sales and marketing approach for a market is ineffective, we may not achieve anticipated growth rates in this market, and our business, financial condition and operating results would be harmed.

Further, serving diverse markets requires an understanding of different sales cycles and customer types, and the development and maintenance of a complex global sales team and sales channels to support the markets' differing needs. It also requires dynamic operations that can support both complex, customized product builds as well as quick turn-around for commercial off-the-shelf sales. If we fail to provide the sales and operational support for our diverse markets, our business, financial condition and operating results would be harmed.

Key personnel may be difficult to attract and retain.

Our ability to maintain and grow our business is directly related to the service of our employees in each area of our business. Our future performance will be directly tied to our ability to hire, train, motivate and retain qualified personnel, including highly skilled technical, financial, managerial, and sales and marketing personnel. Competition for personnel in the technology marketplace is intense, particularly in certain geographies where we are located, including the Boston Area, the San Francisco Bay Area, Orange County, California, and China; we cannot be certain that we will be successful in attracting and retaining such personnel. In addition, many of our product manufacturing processes and product service require deep technical expertise, and these positions can be particularly challenging to fill. We have from time to time in the past experienced attrition in certain key positions, and we expect to continue to experience this attrition in the future. A significant portion of our employee population is in a demographic nearing or at retirement age, and we may have difficulty attracting a sufficient number of younger employees with the necessary skills to replace employees who retire. If we are unable to hire sufficient numbers of employees with the experience and skills we need or to retain and motivate our existing employees, our business and operating results would be harmed.

A material amount of our assets represents goodwill and intangible assets, and our net income would be reduced if our goodwill or intangible assets become impaired.

As of December 31, 2019, our goodwill and intangible assets, net, represented approximately \$1,058.5 million, or 31% of our total assets. Goodwill is generated in our acquisitions when the cost of an acquisition exceeds the fair value of the net tangible and identifiable intangible assets we acquire. As a result of the ESI acquisition, we added approximately \$474 million of additional goodwill and intangible assets. Goodwill is subject to an impairment analysis at least annually based on the fair value of the reporting unit. Intangible assets relate primarily to the developed technologies, customer relationships and patents and trademarks acquired by us as part of our acquisitions of other companies and are subject to an impairment analysis whenever events or changes in circumstances exist that indicate that the carrying value of the intangible asset might not be recoverable. We will continue to monitor and evaluate the carrying value of goodwill and intangible assets. If market and economic conditions or business performance deteriorate, the likelihood that we would record an impairment charge would increase, which impairment charge could materially and adversely affect our operating results.

We operate in highly competitive industries.

The markets for our products are intensely competitive, and we believe that competition from both new and existing competitors will increase in the future. Principal competitive factors include:

- maintaining historical customer relationships and obtaining new customers;
- continued technological advancement;
- product quality, performance and price;
- breadth of product line;

- manufacturing capabilities; and
- customer service and support.

Although we believe that we compete favorably with respect to these factors, we may not be able to continue to do so. We encounter substantial competition in most of our product lines. Certain of our competitors may enjoy greater name recognition and have greater financial, technical, marketing and other resources than we have, and some may have lower material costs than ours due to their control over sources of components and raw materials. In some cases, competitors are smaller than we are, but well established in specific product niches. We may encounter difficulties in changing established relationships of competitors with a large installed base of products. In addition, our competitors can be expected to continue to improve the design and performance of their products. Competitors may develop products that offer performance or technological features superior to those of our products. If our competitors develop superior products, we may lose existing customers and market share. Further, technological advances in our served markets may cause one or more of our portfolio of products to be displaced over time. We also face competition in some of our markets from our existing and potential customers who have developed or may develop products that are competitive to ours, or who engage subcontract manufacturers or system integrators to manufacture competitive products on their behalf. Some of our largest customers have recently increased their internal development efforts of sophisticated high-value products that compete with our products. If we are unable to develop products that are significantly superior to these internally-developed products in performance, price or both, our products would likely be replaced by these internally-developed products.

We have also experienced and continue to experience pricing pressure from both competitors and customers in the sale of our products. New entrants to our markets have offered aggressive price and payment terms in an attempt to gain market share. Some competitors, particularly in China, also develop low-cost competitive products. Pricing pressures typically have become even more intense during cyclical downturns in our markets, such as the semiconductor capital equipment market, when competitors seek to maintain or increase market share, reduce inventory or introduce more technologically advanced or lower-cost products. In addition, we may agree to pricing concessions or extended payment terms with our customers in connection with expanding into new markets or gaining volume orders, or to improve our customer cost of ownership in highly competitive applications. Our business, financial condition, gross margins or operating results may be materially and adversely affected by competitive pressure and price-based competition.

Our failure to successfully manage our offshore manufacturing locations or the transition of certain of our products to other manufacturing locations and/or to contract manufacturers would harm our business, financial condition and operating results.

As part of our continuous cost-reduction efforts, we continue to relocate the manufacture of certain of our existing product lines and subassemblies to, and initiate the manufacture of certain new products in, our facilities in China, Israel, Singapore and Romania, as well as to our significant subcontracted operations in Mexico and selected contract manufacturers in Asia. In the future, we may expand the level of manufacturing, administrative and certain other operations that we perform offshore to take advantage of cost efficiencies available to us in those countries. However, we may not achieve the significant cost savings or other benefits that we would anticipate from moving manufacturing and other operations to these countries, and costs may increase in these countries as development and manufacturing expertise increase and labor, material, shipping and facility-related costs rise, as we have seen in our manufacturing locations in China. If these costs increase to the extent that we no longer realize suitable gross margins from our products manufactured in these countries, we may need to relocate the manufacture of these products to other lower-cost regions. Additionally, if we are unable to successfully manage the relocation, initiation or oversight of the manufacture of these products, our business, financial condition and operating results would be harmed.

In particular, transferring product lines to other manufacturing locations and/or to our contract manufacturers' facilities often requires us to transplant complex manufacturing equipment and processes across a large geographical distance and to train a completely new workforce concerning the use of this equipment and

these processes. In addition, certain of our customers may require the requalification of products supplied to them in connection with the relocation of manufacturing operations. If we are unable to manage this transfer and training smoothly and comprehensively, or if we are unable to complete the requalification of products in a timely manner, we could suffer manufacturing and supply chain delays, excessive product defects, harm to our operating results and our reputation with our customers, and loss of customers. Further, the utilization of overseas manufacturing locations and contract manufacturers may require additional customs tariffs or may require export licenses, which may be difficult or costly to obtain. We also may not realize the cost savings that we currently anticipate from locating operations in Mexico, China, Israel, Romania and Singapore. For example, we are experiencing rising material, labor, shipping and facility-related costs in China and new or increased tariffs on our products manufactured in China.

Additionally, qualifying contract manufacturers and commencing volume production are expensive and time-consuming activities, and there is no guarantee we will continue to do so successfully. Further, our reliance on contract manufacturers reduces our control over the assembly process, quality assurance, production costs and material and component supply for our products. If we fail to manage our relationship with our contract manufacturers, or if any of the contract manufacturers experience financial difficulty, or delays, disruptions, capacity constraints or quality control problems in their operations, our ability to ship products to our customers could be impaired and our competitive position and reputation could be harmed. Further, if we or our contract manufacturers are unable to negotiate with suppliers for reduced component costs, our operating results could be harmed.

In addition, our contract manufacturers may terminate our agreements with them upon prior notice to us or immediately for reasons such as if we become insolvent, or if we fail to perform a material obligation under the agreements. If we are required to change contract manufacturers or assume internal manufacturing operations for any reason, including the termination of one of our contract manufacturing contracts, we will likely suffer manufacturing and shipping delays, lost sales, increased costs and damage to our customer relationships, any of which would harm our business, financial condition and operating results.

Our products could contain defects, which would increase our costs and seriously harm our business, operating results, financial condition and customer relationships.

Many of our products are inherently complex in design and, in some cases, require extensive customization and/or ongoing regular maintenance. Further, the manufacture of these products often involves a highly complex and precise process and the utilization of specially qualified components that conform to stringent specifications. Several of our products require highly skilled labor. As a result of the technical complexity of these products, design defects, skilled labor turnover, changes in our or our suppliers' manufacturing processes or the inadvertent use of defective or nonconforming materials by us or our suppliers could adversely affect our manufacturing yields and product reliability. This could in turn harm our business, operating results, financial condition and customer relationships.

We provide warranties for our products, and we accrue allowances for estimated warranty costs at the time we recognize revenue for the sale of the products. The determination of such allowances requires us to make estimates of product return rates and expected costs to repair or replace the products under warranty. We establish warranty reserves based on historical warranty costs for our products. If actual return rates or repair and replacement costs differ significantly from our estimates, our operating results would be negatively impacted. In particular, our Equipment & Solutions Division's products are extremely complex, and have historically had much higher warranty costs as a percentage of net revenues than our other products.

Our customers may discover defects in our products after the products have been fully deployed and operated under peak stress conditions. In addition, some of our products are combined with products from other suppliers, which may contain defects. Furthermore, some of our customers use our products in ways other than their intended purpose. As a result, should problems occur, it may be difficult to identify the source of the problem. If we are unable to identify and fix defects or other problems, we could experience, among other things:

- loss of customers;

- increased costs of product returns and warranty expenses;
- increased costs required to analyze and mitigate the defects or problems;
- damage to our reputation;
- failure to attract new customers or achieve market acceptance;
- diversion of development and engineering resources; and/or
- legal action by our customers.

The occurrence of any one or more of the foregoing factors could seriously harm our business, financial condition and operating results.

We are exposed to various risks related to legal proceedings, including product liability claims, intellectual property infringement claims and contractual claims, which if successful, could have a material adverse effect on our business, financial condition and operating results.

From time to time, we may be involved in legal proceedings or claims regarding product performance, product liability, patent infringement, intellectual property rights, antitrust, environmental regulations, securities, contracts, unfair competition, misappropriation of trade secrets, employment, workplace safety, and other matters.

For example, some of our products, such as certain ultrafast lasers, are used in medical and scientific research applications where malfunctions could result in serious injury. In addition, certain of our products may be hazardous if not operated properly or if defective. We are exposed to significant risks for product liability claims if death, personal injury or property damage results from the use of our products. We may experience material product liability losses in the future. We currently maintain insurance for certain product liability claims. However, our insurance coverage may not continue to be available on terms that we accept, if at all. This insurance coverage also may not adequately cover liabilities that we incur. Further, if our products are defective, we may be required to recall or redesign these products. A successful claim against us that exceeds our insurance coverage level or that is not covered by insurance, or any product recall, could have a material adverse effect on our business, financial condition and operating results.

In addition, we are currently involved in securities class action litigation in connection with the acquisitions of Newport and previously were involved in a securities class action litigation in connection with the acquisition of ESI. In each case, the plaintiffs have alleged, among other things, that the then-current directors of each such acquired company breached their fiduciary duties to their respective shareholders by agreeing to sell such company through an inadequate and unfair process, leading to inadequate and unfair consideration, by agreeing to unfair deal protection devices, and by omitting material information from the proxy statement.

Regardless of the outcome, securities class action litigation such as this can be time-consuming, result in significant expense to the Company and divert attention and resources of our management and other key employees. Costs and expenses, or an unfavorable outcome in such cases, could exceed applicable insurance coverage, if any. Any such unfavorable outcome could have a material adverse effect on our business, financial condition, operating results and cash flows.

With respect to our intellectual property, we have from time to time received claims from third parties alleging that we are infringing certain trademarks, patents or other intellectual property rights held by them. Such infringement claims have in the past and may in the future result in litigation. Any such litigation could be protracted and costly, and we could become subject to damages for infringement, or to an injunction preventing us from selling one or more of our products or using one or more of our trademarks. Such claims could also result in the necessity of obtaining a license relating to one or more of our products or current or future

technologies, which may not be available on commercially reasonable terms or at all. Any intellectual property litigation and the failure to obtain necessary licenses or other rights or develop substitute technology may divert management's attention from other matters and could have a material adverse effect on our business, financial condition and operating results. In addition, the terms of some of our customer contracts typically require us to indemnify the customer in the event of any claim of infringement brought by a third party based on our products. Any claims of this kind may have a material adverse effect on our business, financial condition or operating results.

Although our standard commercial documentation sets forth the terms and conditions that we intend to apply to commercial transactions with our business partners, counterparties to such transactions may not explicitly agree to our terms and conditions. In situations where we engage in business with a third party without an explicit written agreement regarding the applicable terms and conditions, or where the commercial documentation applicable to the transaction is subject to varying interpretations, we may have disputes with those third parties regarding the applicable terms and conditions of our transaction with them. These disputes could result in deterioration of our commercial relationship with those parties, costly and time-consuming litigation, or additional concessions or obligations being offered by us to resolve these disputes, or could impact our net revenue or cost recognition. Any of these outcomes could materially and adversely affect our business, financial condition and operating results.

In addition, from time to time in the normal course of business we indemnify parties with whom we enter into contractual relationships, including customers, suppliers and lessors, with respect to certain matters. We have agreed, under certain conditions, to hold these parties harmless against specified losses, such as those arising from a breach of representations or covenants, negligence or willful misconduct, other third-party claims that our products infringe the intellectual property rights of these other third parties, or other claims made against certain parties. We may be compelled to enter into or accrue for probable settlements of alleged indemnification obligations, or we may be subject to potential liability arising from our customers' involvements in legal disputes. In addition, notwithstanding the provisions related to limitations on our liability that we seek to include in our business agreements, the counterparties to such agreements may dispute our interpretation or application of such provisions, and a court of law may not interpret or apply such provisions in our favor, any of which could result in an obligation for us to pay significant additional damages and engage in costly legal proceedings. It is difficult to determine the maximum potential amount of liability under any indemnification obligations, whether or not asserted, due to the unique facts and circumstances that are likely to be involved in any particular claim. Our business, financial condition and operating results in a reported fiscal period could be materially and adversely affected if we expend significant amounts in defending or settling any asserted claims, regardless of their merit or outcomes.

Legal proceedings and claims, whether with or without merit, and associated internal investigations, may be time-consuming and expensive to prosecute, defend or conduct; divert management's attention and other of our resources; inhibit our ability to sell our products; result in adverse judgments for damages, injunctive relief, penalties and fines; and negatively affect our business. We can make no assurances regarding the outcome of current or future legal proceedings, claims or investigations.

We are subject to international trade compliance regulations, and violations of those regulations could result in fines or trade restrictions, which could have a material adverse effect on us.

We are subject to trade compliance laws in both the United States and other jurisdictions where we operate. For example, exports of our products and technology developed or manufactured in the U.S. are subject to export controls imposed by the U.S. Government and administered by the U.S. Departments of Commerce, State and Treasury. Export regulations govern exports of our products and technology developed or manufactured in other countries, including, for example, Austria, France, Germany, Israel, Romania and Singapore, and China. In certain instances, these regulations may require obtaining licenses from the administering agency prior to exporting products or technology to international locations or foreign nationals, including foreign nationals

employed by us in the United States and abroad. For products and technology subject to the U.S. Export Administration Regulations administered by the U.S. Department of Commerce's Bureau of Industry and Security, the requirement for a license is dependent on the type and end use of the product and technology, the final destination and the identity and nationality of the end user. Virtually all exports from the United States of defense articles subject to the International Traffic in Arms Regulations, administered by the Department of State's Directorate of Defense Trade Controls, require a license. The Israeli Ministry of Economy and the Defense Export Control Agency of the Israeli Ministry of Defense administer similar export regulations and license requirements, which apply to many of our products and technology developed or manufactured in Israel. In addition, the Romanian Ministry of Foreign Affairs and the Department for Export Controls administer similar export regulations and license requirements, which apply to many of our products and technology developed or manufactured in Romania. Obtaining export licenses can be difficult and time-consuming, and we may not be successful in obtaining them. Failure to obtain export licenses to enable product and technology exports could reduce our net revenues, harm our relationships with our customers and could adversely affect our business, financial condition and operating results. Compliance with export regulations may also subject us to additional fees and costs. The absence of comparable export restrictions on competitors in other countries may adversely affect our competitive position. In addition, if we or our international representatives or distributors fail to comply with any of these export regulations, we or they could be subject to civil and criminal, monetary and non-monetary penalties, disruptions to our business, restrictions on our ability to export products and technology, costly consent decrees and damage to our reputation, and our business and operating results could be significantly harmed. While we have implemented policies and procedures to comply with these laws, we cannot be certain that our employees, contractors, suppliers or agents will not violate such laws or our policies.

Unfavorable currency exchange rate fluctuations may lead to lower operating margins or may cause us to raise or reduce prices, which could result in reduced sales.

A significant portion of our net revenues are from customers in international markets. For the years 2019, 2018 and 2017, international net revenues accounted for approximately 53%, 51% and 50% of our total net revenues, respectively. Currency exchange rate fluctuations could have an adverse effect on our net revenues and operating results and we could experience losses with respect to our hedging activities. Unfavorable currency fluctuations could require us to increase or decrease prices to foreign customers, which could result in lower net revenues from such customers. Alternatively, if we do not adjust the prices for our products in response to unfavorable currency fluctuations, our operating results would be adversely affected by declining net revenues or profit margins for our products in international markets when the sales are translated into U.S. dollars. Such exchange rate fluctuations could also increase the costs and expenses of our non-U.S. operations when translated into U.S. dollars or require us to modify our current business practices. In addition, most sales made by our foreign subsidiaries are denominated in the currency of the country in which these products are sold and the currency they receive in payment for such sales could be less valuable at the time of receipt as a result of exchange rate fluctuations. We enter into forward foreign exchange contracts to reduce a portion of our currency exposure arising from intercompany sales of inventory as well as intercompany accounts receivable and intercompany loans. However, we cannot be certain that our efforts will be adequate to protect us against significant currency fluctuations or that such efforts will not expose us to additional exchange rate risks.

Changes in tax rates or tax regulation or the termination of tax incentives could affect our operating results.

As a global company, we are subject to taxation in the United States and various other countries. Significant judgment is required to determine and estimate worldwide tax liabilities. Our future annual and quarterly effective tax rates could be affected by numerous factors, including changes in the applicable tax laws; composition of pre-tax income in countries with differing tax rates; and/or valuation of our deferred tax assets and liabilities.

The enactment of the Tax Cuts and Jobs Act (the "Act") in December 2017 significantly affected U.S. tax law by changing how the U.S. imposes tax on multinational corporations. The U.S. Department of Treasury has broad authority under the Act to issue regulations and interpretive guidance. No proposed or final regulations have been issued for certain significant provisions of the Act, and other provisions may require corrective action by Congress.

In addition, some of the proposed and final regulations that have been issued have been challenged in court. We have applied available guidance to estimate our tax obligations, but new guidance issued by the U.S. Treasury Department may cause us to adjust our tax estimates in future periods. The ultimate impact of this Act is based upon our understanding and interpretation of the regulatory guidance that has been issued regarding the Act.

In addition, we are subject to regular examination by the United States Internal Revenue Service and state, local and foreign tax authorities. We regularly assess the likelihood of favorable or unfavorable outcomes resulting from these examinations to determine the adequacy of our provision for income taxes. Although we believe our tax estimates are reasonable, we can make no assurances that any final determination will not be materially different from the treatment reflected in our historical income tax provisions and accruals, which could materially and adversely affect our financial condition and operating results.

In certain foreign jurisdictions, we qualify for tax incentives and tax holidays based on our ability to meet, on a continuing basis, various tests relating to our employment levels, research and development expenditures and other qualification requirements in a particular foreign jurisdiction. While we intend to operate in such a manner to maintain and maximize our tax incentives, we can make no assurances that we have so qualified or that we will so qualify for any particular year or jurisdiction. If we fail to qualify or remain qualified for certain foreign tax incentives and tax holidays, the tax incentives we previously received may be terminated and/or retroactively revoked requiring repayment of past tax benefits, and we would be subject to an increase in our effective tax rate which would adversely impact our financial results.

We are exposed to risks related to cybersecurity threats and incidents and subject to restrictions of and changes in laws and regulations governing data privacy and data protection that could have a material adverse effect on our business.

We rely on various information technology networks and systems, some of which are managed by third parties, to process, transmit and store electronic information and to carry out and support a variety of business activities, including human resources, manufacturing, research and development, supply chain management, sales and accounting. This data includes confidential information, transactional information and intellectual property belonging to us, our customers and our business partners, as well as personally-identifiable information of individuals. We have experienced, and expect to continue to be subject to, cybersecurity threats and incidents ranging from employee error or misuse to individual attempts to gain unauthorized access to information systems to sophisticated and targeted measures known as advanced persistent threats, none of which have materially affected our financial condition or operating results to date. While we devote significant resources to network security, data encryption and other measures to protect our systems and information from unauthorized access or misuse, a failure in or a breach of our operational or security systems or infrastructure, or those of our suppliers and other business partners, including as a result of cyber-attacks, could disrupt our business; result in the disclosure, misuse, corruption or loss of confidential information, including intellectual property and other critical data of ours, our customers and other business partners; damage our reputation; cause data privacy issues; decrease the value of our investment in research, development and engineering; cause losses; result in litigation with third parties; and increase our cybersecurity protection and remediation costs.

We are also subject to numerous data privacy laws and regulations around the world that apply to the processing, collection, transmission, storage and use of personally identifiable information, including the California Consumer Privacy Act and the General Data Protection Regulation, which imposes robust EU data protection requirements and provides for significant penalties for noncompliance. The EU regulations also established a prohibition on the transfer of personal information from the EU to other countries whose laws do not protect personal data to an adequate level of privacy or security. While we have utilized certain permitted approaches for transferring personal information from the EU to the United States, these approaches may be reviewed and invalidated by the EU courts or regulatory bodies and we may be required to ascertain an alternative legal basis for such transfers. In addition, certain countries and states have and will continue to modify or adopt more stringent data protection standards.

While we continue to assess and address the implications of existing and new domestic and foreign regulations relating to data privacy, the evolving regulatory landscape presents a number of legal and operational challenges, and our efforts to comply with these regulations may be unsuccessful. We may also face audits or investigations by one or more government agencies relating to our compliance with these regulations that could result in the imposition of penalties or fines, significant expenses in facilitating and responding to the investigations, and overall reputational harm or negative publicity. The costs of compliance with, and other burdens imposed by, these laws, regulations and policies that are applicable to us including, restrictions on marketing activities, could have a material adverse effect on our business, financial condition and operating results.

We outsource a number of services to third-party service providers, which decreases our control over the performance of these functions. Disruptions or delays at our third-party service providers could adversely impact our operations.

We outsource a number of services, including our information technology systems management and certain accounting functions, to domestic and overseas third-party service providers. While outsourcing arrangements may lower our cost of operations, they also reduce our direct control over the services rendered. This diminished control may have an adverse effect on the quality or quantity of products delivered or services rendered, on our ability to quickly respond to changing market conditions, or on our ability to ensure compliance with all applicable domestic and foreign laws and regulations. In addition, many of these outsourced service providers, including certain hosted software applications that we use for confidential data storage, employ cloud computing technology for such storage. These providers' of cloud computing systems may be susceptible to "cyber incidents," such as intentional cyber-attacks aimed at theft of sensitive data or inadvertent cyber-security compromises, which are outside of our control. If we do not effectively develop and manage our outsourcing strategies, if required export and other governmental approvals are not timely obtained, if our third-party service providers do not perform as anticipated, or do not adequately protect our data from cyber-related security breaches, or if there are delays or difficulties in enhancing business processes, we may experience operational difficulties (such as limitations on our ability to pay suppliers in a timely manner), increased costs, manufacturing or service interruptions or delays, loss of intellectual property rights or other sensitive data, quality and compliance issues, and challenges in managing our product inventory or recording and reporting financial and management information, any of which could materially and adversely affect our business, financial condition and operating results.

Our proprietary technology is important to the continued success of our business. Our failure to protect this proprietary technology may significantly impair our competitive position.

Our success and ability to compete depend in large part upon protecting our proprietary technology. We rely on a combination of patent, trademark and trade secret protection and other agreements, such as nondisclosure agreements, to protect our proprietary rights. The steps we have taken may not be sufficient to prevent the misappropriation of our intellectual property, particularly in countries outside the United States, where the laws may not protect our proprietary rights as fully as in the United States. For example, the patent prosecution and enforcement systems within China, where we have a significant customer base and manufacturing presence, and where we have recently transferred several important laser product lines, are less robust than these systems in other international jurisdictions and as a result, we may be limited in our ability to enforce our intellectual property rights there. We would also likely be at a disadvantage in any enforcement proceeding in China as a foreign entity seeking protection against a Chinese company. Patent and trademark laws and trade secret protection may not be adequate to deter third party infringement or misappropriation of our patents, trademarks, trade secrets and similar proprietary rights. In addition, patents issued to us may be challenged, invalidated or circumvented. Our rights granted under those patents may not provide competitive advantages to us, and the claims under our patent applications may not be allowed. The loss or expiration of any of our key patents could lead to a significant loss of sales of certain of our products and could materially affect our future operating results. We have in the past and may in the future be subject to or may initiate interference proceedings in the United States Patent and Trademark Office, or similar international agencies, which can demand significant

financial and management resources. The process of seeking patent protection can be time consuming and expensive and patents may not be issued from currently pending or future applications. Moreover, our existing patents or any new patents that may be issued may not be sufficient in scope or strength to provide meaningful protection or any commercial advantage to us. We may initiate claims or litigation against third parties for infringement of our proprietary rights in order to determine the scope and validity of our proprietary rights or the proprietary rights of our competitors, which claims could result in costly litigation, the diversion of our technical and management personnel and the assertion of counterclaims by the defendants, including counterclaims asserting invalidity of our patents. We will take such actions where we believe that they are of sufficient strategic or economic importance to us to justify the cost.

The market price of our common stock has fluctuated and may continue to fluctuate for reasons over which we have no control.

The stock market has from time to time experienced, and is likely to continue to experience, extreme price and volume fluctuations. Prices of securities of technology companies have been especially volatile and have often fluctuated for reasons that are unrelated to the operating performance of the companies. Historically, the market price of shares of our common stock has fluctuated greatly and could continue to fluctuate due to a variety of factors. In the past, companies that have experienced volatility in the market price of their stock have been the objects of securities class action litigation. If we become the subject of such securities class action litigation, it could result in substantial costs and a diversion of our management's attention and resources.

We may not pay dividends on our common stock.

Holders of our common stock are only entitled to receive dividends when and if they are declared by our Board of Directors. Our credit facilities restrict our ability to pay dividends on our capital stock under certain circumstances. Although we have declared cash dividends on our common stock since 2011, and occasionally increased the dividends from prior quarters, we are not required to do so, and we may reduce or eliminate our cash dividend in the future. This could adversely affect the market price of our common stock.

We are subject to environmental regulations. If we fail to comply with these regulations, our business could be harmed.

Our operations are subject to various federal, state, local and international regulations relating to the protection of the environment, including those governing discharges of pollutants into the air and water, the management and disposal of hazardous substances and waste and the cleanup of contaminated sites. In the United States, we are subject to the federal regulation and control of the Environmental Protection Agency ("EPA"), and we are subject to comparable authorities in other countries. Some of our operations require environmental permits and controls to prevent and reduce air and water pollution, and these permits are subject to modification, renewal and revocation by issuing authorities. Future developments, administrative actions or liabilities relating to environmental matters could have a material adverse effect on our business, operating results or financial condition.

Although we believe that our safety procedures for using, handling, storing and disposing of such materials comply with the standards required by applicable state, federal and international laws and regulations, we cannot completely eliminate the risk of accidental contamination or injury from these materials. We have been, and may in the future be, subject to claims by employees or third parties alleging such contamination or injury, and could be liable for damages, which liability could exceed the amount of our liability insurance coverage (if any) and the resources of our business.

Certain portions of the soil at the former facility of our Spectra-Physics lasers business, located in Mountain View, California, and certain portions of the aquifer surrounding the facility, through which contaminated groundwater flows, are part of an EPA-designated Superfund site and are subject to a cleanup and abatement order from the California Regional Water Quality Control Board. Spectra-Physics, which we acquired as part of

the Newport acquisition in April 2016 and which had been acquired by Newport in 2004, along with other entities with facilities located near the Mountain View, California facility, were identified as responsible parties with respect to this Superfund site, due to releases of hazardous substances during the 1960s, 1970s and 1980s. Spectra-Physics and the other responsible parties entered into cost-sharing agreements covering the costs of remediating the off-site groundwater impact. The site is mature, and investigations, monitoring and remediation efforts by the responsible parties have been ongoing for approximately 30 years.

We have certain ongoing costs related to investigation, monitoring and remediation of the site that have not been material to us as a whole in the recent past. However, while we benefitted from the indemnification of certain costs by a third party in the past, that indemnification is now in a transition period, and we will become subject to a greater portion of future costs of remediation going forward. Our ultimate costs of remediation and other potential liabilities are difficult to predict. In the event that the EPA and the California Regional Water Quality Control Board determine that the site cleanup requires additional measures to ensure that it meets current standards for environmental contamination, or if they enhance any of the applicable required standards, we will likely become subject to additional remediation obligations in the future. In addition to our investigation, monitoring and remediation obligations, we may be liable for property damage or personal injury claims relating to this site. While we are not aware of any material claims at this time, such claims could be made against us in the future. If significant costs or other liability relating to this site arise in the future, our business, financial condition and operating results would be adversely affected.

The environmental regulations that we are subject to include a variety of federal, state, local and international environmental regulations that restrict the use and disposal of materials used in the manufacture of our products or require design changes or recycling of our products. If we fail to comply with any present or future regulations, we could be subject to future liabilities, the suspension of manufacturing or a prohibition on the sale of products we manufacture. In addition, such regulations could restrict our ability to equip our facilities or could require us to acquire costly equipment, or to incur other significant expenses to comply with environmental regulations, including expenses associated with the recall of any non-compliant product and the management of historical waste.

For example, the EU has enacted the Restriction on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Directive, which regulates the use of certain hazardous substances in certain products, and the Waste Electrical and Electronic Equipment Directive, which requires the collection, reuse and recycling of waste from certain products. Compliance with such laws requires significant resources. These regulations may require us to redesign our products or source alternative components to ensure compliance with applicable requirements, for example by mandating the use of different types of materials in certain components. Any such redesign or alternative sourcing may increase the cost of our products, adversely impact the performance of our products, add greater testing lead-times for product introductions, or in some cases limit the markets for certain products. Further, such environmental laws are frequently amended, which increases the cost and complexity of compliance. For example, such amendments have in the past, and may in the future, result in certain of our products falling in the scope of the directive, even if they were initially exempt. In addition, certain of our customers, particularly original equipment manufacturer customers whose end products may be subject to these directives, may require that the products we supply to them comply with these directives, even if not mandated by law. Because certain directives, for example, those issued from the EU are implemented in individual member states, compliance is particularly challenging. Our failure to comply with any of such regulatory requirements or contractual obligations could result in our being directly or indirectly liable for costs, fines or penalties and third-party claims, and could jeopardize our ability to conduct business in certain countries.

Some provisions of our restated articles of organization, as amended, our amended and restated by-laws and Massachusetts law could discourage potential acquisition proposals and could delay or prevent a change in control.

Anti-takeover provisions could diminish the opportunities for stockholders to participate in tender offers, including tender offers at a price above the then current market price of our common stock. Such provisions may also inhibit increases in the market price of our common stock that could result from takeover attempts. For

example, while we have no present plans to issue any preferred stock, our Board of Directors, without further stockholder approval, may issue preferred stock that could have the effect of delaying, deterring or preventing a change in control of us. The issuance of preferred stock could adversely affect the voting power of the holders of our common stock, including the loss of voting control to others. In addition, our amended and restated by-laws provide for a classified Board of Directors consisting of three classes. Our classified board could also have the effect of delaying, deterring or preventing a change in control of our Company.

Item 1B. Unresolved Staff Comments

None.

Item 2. Properties

The following table provides information concerning MKS' principal and certain other owned and leased facilities as of December 31, 2019:

Country	City	Sq. Ft.	Activity	Reportable Segment	Lease Expires
CHINA	Shenzhen	302,000	Manufacturing	Vacuum & Analysis	August 31, 2025
FRANCE	(1)	183,000	Manufacturing, Research and Development	Light & Motion	Owned
ISRAEL	Jerusalem	118,000	Manufacturing, Sales, Research and Development	Light & Motion	(2)
MEXICO	Nogales	174,700	Manufacturing, Service	Vacuum & Analysis and Light & Motion	(3)
UNITED STATES	Andover, MA	158,000	Corporate Headquarters, Manufacturing, Research and Development	Vacuum & Analysis	(4)
	Irvine, CA	254,900	Manufacturing, Research and Development	Light & Motion	(5)
	Rochester, NY	156,000	Manufacturing, Sales, Customer Support, Service, Research and Development	Vacuum & Analysis	Owned
	Santa Clara, CA	139,500	Manufacturing, Customer Support, Research and Development	Light & Motion	March 31, 2021
	Wilmington, MA	118,000	Manufacturing, Customer Support, Service, Research and Development	Vacuum & Analysis	Owned
	Portland, OR	197,017	Manufacturing, Office, and Warehouse	Equipment & Solutions	(6)

- (1) MKS owns two facilities, one in Beaune-la-Rolande with 57,000 square feet and one in Brigueuil with 126,000 square feet.
- (2) MKS owns one facility with 70,000 square feet and leases two other facilities with 38,000 square feet and 10,000 square feet, both with a lease expiration date of December 31, 2020.
- (3) MKS Vacuum & Analysis leases a facility with 124,200 square feet with a lease expiration date of September 1, 2023 and also leases another facility for Light & Motion with 50,500 square feet with a lease expiration date of July 31, 2028.
- (4) MKS owns one facility with 82,000 square feet and leases another facility with 76,000 square feet with a lease expiration date of November 30, 2026.
- (5) MKS leases a facility with 212,300 square feet with a lease expiration date of February 28, 2022, of which 20,000 square feet is vacant. MKS leases another facility with 42,600 square feet with a lease expiration date of February 28, 2022, which is currently vacant.
- (6) MKS sold three separate buildings, in 2019, as part of sale and leaseback transactions and will lease back the buildings over varying terms into 2021. One building lease has an expiration of May 31, 2020 and the other two building leases have an expiration of May 31, 2021.

In addition to the significant facilities listed above, MKS also provides manufacturing, worldwide sales, customer support and services from various other leased and owned facilities throughout the world not listed in the table above. See "Business—Sales, Marketing, Service and Support." We believe that our current facilities are suitable and adequate to meet our needs.

Item 3. Legal Proceedings

Newport Litigation

In 2016, two putative class actions lawsuit captioned Dixon Chung v. Newport Corp., et al., Case No. A-16-733154-C, and Hubert C. Pincon v. Newport Corp., et al., Case No. A-16-734039-B, were filed in the District Court, Clark County, Nevada on behalf of a putative class of stockholders of Newport Corporation ("Newport") for claims related to the merger agreement ("Newport Merger Agreement") between the Company, Newport, and a wholly-owned subsidiary of the Company ("Merger Sub"). The lawsuits named as defendants the

Company, Newport, Merger Sub, and certain then current and former members of Newport's board of directors. Both complaints alleged that Newport directors breached their fiduciary duties to Newport's stockholders by agreeing to sell Newport through an inadequate and unfair process, which led to inadequate and unfair consideration, by agreeing to unfair deal protection devices and by omitting material information from the proxy statement. The complaints also alleged that the Company, Newport and Merger Sub aided and abetted the directors' alleged breaches of their fiduciary duties. The Court consolidated the actions, and plaintiffs later filed an amended complaint captioned *In re Newport Corporation Shareholder Litigation*, Case No. A-16-733154-B, in the District Court, Clark County, Nevada, on behalf of a putative class of Newport's stockholders for claims related to the Newport Merger Agreement. The amended complaint alleged that members of Newport's board of directors breached their fiduciary duties to Newport's stockholders and that the Company, Newport and Merger Sub had aided and abetted these breaches and sought monetary damages, including pre- and post-judgment interest. In June 2017, the Court granted defendants' motion to dismiss and dismissed the amended complaint against all defendants but granted plaintiffs leave to amend.

On July 27, 2017, plaintiffs filed a second amended complaint containing substantially similar allegations but naming only Newport's former directors as defendants. On August 8, 2017, the Court dismissed the Company and Newport from the action. The second amended complaint seeks monetary damages, including pre- and post-judgment interest. The Court granted a motion for class certification on September 27, 2018, appointing Mr. Pincon and Locals 302 and 612 of the International Union of Operating Engineers—Employers Construction Industry Retirement Trust as class representatives. On June 11, 2018, plaintiff Dixon Chung was voluntarily dismissed from the litigation. On August 9, 2019, plaintiffs filed a motion for leave to file a third amended complaint, which was denied on October 10, 2019. On August 23, 2019, defendants filed a motion for summary judgment. On January 23, 2020, the court entered its findings of fact, conclusions of law, and order granting defendants' motion for summary judgment. On February 18, 2020, plaintiffs filed a notice of appeal from the court's order granting defendants' motion for summary judgment, as well as from the court's prior orders granting defendants' motion for a bench trial and denying plaintiffs' motion for leave to file an amended complaint.

The Company is subject to various legal proceedings and claims, which have arisen in the ordinary course of business. In the opinion of management, the ultimate disposition of these matters will not have a material adverse effect on our results of operations, financial condition or cash flows.

Item 4. *Mine Safety Disclosures*

Not applicable.

PART II

Item 5. Market for the Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities

Common Stock

Our common stock is traded on the Nasdaq Global Select Market under the symbol MKSI.

On February 19, 2020, we had 83 stockholders of record.

Dividend Policy and Cash Dividends

Holders of our common stock are entitled to receive dividends when and if they are declared by our Board of Directors. During 2019, our Board of Directors declared a cash dividend of \$0.20 per share during each quarter of 2019, which totaled \$43.5 million or \$0.80 per share. During 2018, our Board of Directors declared a cash dividend of \$0.18 per share during the first quarter of 2018 and \$0.20 per share for the second, third and fourth quarters of 2018, which totaled \$42.4 million or \$0.78 per share.

On February 10, 2020, our Board of Directors declared a quarterly cash dividend of \$0.20 per share to be paid on March 6, 2020 to shareholders of record as of February 24, 2020.

Future dividend declarations, if any, as well as the record and payment dates for such dividends, are subject to the final determination of our Board of Directors. The Board of Directors intends to declare and pay cash dividends on our common stock based on our financial conditions and results of operations of the Company, although it has no obligation to do so. Our credit facilities contain covenants that restrict our ability to grant cash dividends in certain circumstances.

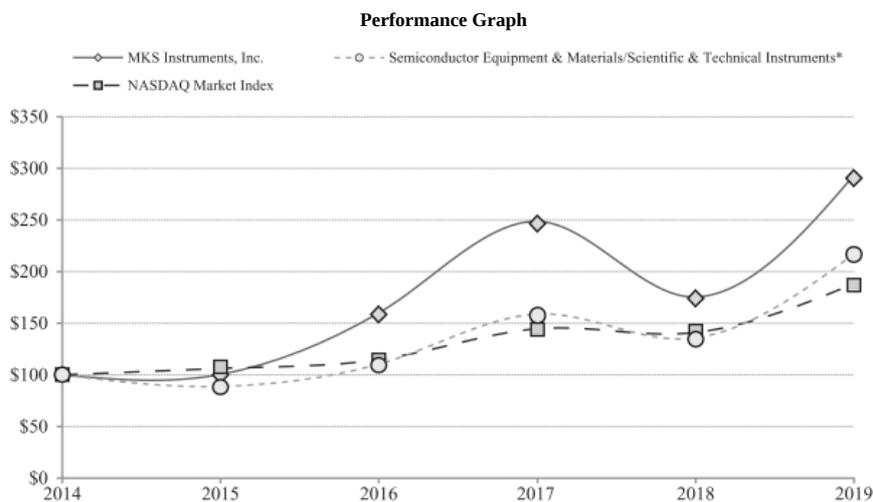
Share Repurchase Program

On July 25, 2011, our Board of Directors approved, and on July 27, 2011, we publicly announced, a share repurchase program for the repurchase of up to an aggregate of \$200 million of our outstanding common stock from time to time in open market purchases, privately negotiated transactions or through other appropriate means. The timing and quantity of any shares repurchased depends upon a variety of factors, including business conditions, stock market conditions and business development activities, including, but not limited to, merger and acquisition opportunities. These repurchases may be commenced, suspended or discontinued at any time without prior notice.

During 2019, the Company did not repurchase any shares of common stock. During 2018, the Company repurchased approximately 818,000 shares of its common stock for \$75.0 million, or an average price of \$91.67 per share. We have repurchased approximately 2,588,000 shares of common stock for approximately \$127.0 million pursuant to the program since its adoption.

Comparative Stock Performance

The following graph compares the cumulative total shareholder return (assuming reinvestment of dividends) from investing \$100 on December 31, 2014, and plotted at the last trading day of each of the fiscal years ended December 31, 2015, 2016, 2017, 2018 and 2019 in each of MKS' common stock; a peer group index which represents a combination of all companies comprising the Morningstar Semiconductor Equipment & Materials Industry Group Index and Morningstar Scientific & Technical Instruments Industry Group Index, published by Zacks Investment Research, Inc., with these indices weighted equally; and the Nasdaq Market Index. The stock price performance on the graph below is not necessarily indicative of future price performance. Our common stock is listed on the Nasdaq Global Select Market under the ticker symbol MKSI.



	2014	2015	2016	2017	2018	2019
MKS Instruments, Inc.	\$ 100.00	\$ 100.24	\$ 168.06	\$ 269.74	\$ 185.96	\$ 319.70
Nasdaq Market Index	\$ 100.00	\$ 106.96	\$ 116.45	\$ 150.96	\$ 146.67	\$ 200.49
Morningstar Semiconductor Equipment & Materials/Scientific & Technical Instruments*	\$ 100.00	\$ 87.08	\$ 111.78	\$ 167.05	\$ 140.53	\$ 233.18

* Semiconductor Equipment & Materials and Scientific & Technical Instruments indices weighted equally.

Item 6. Selected Financial Data
Selected Consolidated Financial Data

	2019	2018	2017	2016	2015
	(in thousands, except per share data)				
Statement of Operations Data(1)					
Net revenues	\$ 1,899,773	\$ 2,075,108	\$ 1,915,977	\$ 1,295,342	\$ 813,524
Gross profit(2)	\$ 830,431	\$ 979,476	\$ 891,451	\$ 565,619	\$ 362,872
Income from operations(3)	\$ 219,851	\$ 494,059	\$ 406,634	\$ 157,267	\$ 156,612
Net income(4)	\$ 140,386	\$ 392,896	\$ 339,132	\$ 104,809	\$ 122,297
Basic net income per share	\$ 2.57	\$ 7.22	\$ 6.26	\$ 1.96	\$ 2.30
Diluted net income per share	\$ 2.55	\$ 7.14	\$ 6.16	\$ 1.94	\$ 2.28
Cash dividends paid per common share	\$ 0.80	\$ 0.78	\$ 0.71	\$ 0.68	\$ 0.68
Balance Sheet Data(1)					
Cash and cash equivalents, including restricted cash	\$ 414,572	\$ 644,345	\$ 333,887	\$ 233,910	\$ 227,574
Short-term investments	\$ 109,417	\$ 73,826	\$ 209,434	\$ 189,463	\$ 430,663
Working capital	\$ 1,115,866	\$ 1,200,819	\$ 946,431	\$ 761,469	\$ 848,527
Total assets	\$ 3,416,320	\$ 2,614,246	\$ 2,414,018	\$ 2,212,242	\$ 1,273,347
Short-term debt(5)	\$ 12,099	\$ 3,986	\$ 2,972	\$ 10,993	\$ —
Long-term debt, net(5)	\$ 871,667	\$ 343,842	\$ 389,993	\$ 601,229	\$ —
Other liabilities(6)	\$ 203,628	\$ 133,932	\$ 145,296	\$ 131,921	\$ 21,482
Stockholders' equity	\$ 2,023,344	\$ 1,873,187	\$ 1,588,907	\$ 1,241,792	\$ 1,160,881

- (1) The Statement of Operations Data and the Balance Sheet Data for 2019, 2018, 2017 and 2016 include statement of operations data and assets and liabilities acquired as a result of the acquisition of Newport Corporation ("Newport") in April 2016 (the "Newport Merger"). In addition, the Statement of Operations Data and the Balance Sheet Data for 2019 include statement of operations data and assets and liabilities acquired as a result of the acquisition of Electro Scientific Industries, Inc. ("ESI") in February 2019 (the "ESI Merger").
- (2) Gross profit for 2019 includes a \$7.6 million charge for the amortization of inventory step-up to fair value related to the ESI Merger. Gross profit for 2016 includes a \$15.1 million charge for the amortization of the inventory step-up to fair value related to the Newport Merger.
- (3) Income from operations for 2019 includes \$7.6 million of amortization of inventory step-up to fair value, \$37.3 million of acquisition and integration costs primarily related to our acquisition of ESI, \$6.6 million of fees and expenses related to our Term Loan Facility, as defined and described further in Item 7 of this Annual Report on Form 10-K, \$7.0 million of restructuring and other costs and \$4.7 million of asset impairment charges. These charges are offset by a \$6.8 million gain on sale of a long-lived asset. Income from operations for 2018 includes \$3.6 million of restructuring charges and \$3.1 million of acquisition and integration costs, which is primarily comprised of acquisition costs related to the ESI Merger. Income from operations for 2017 includes \$6.7 million of an asset impairment charge, primarily related to the write-off of goodwill and intangible assets in conjunction with the consolidation of two manufacturing plants, \$5.3 million of acquisition and integration costs from the Newport Merger and \$3.9 million of restructuring charges. Income from operations for 2016 includes a \$15.1 million charge for the amortization of the inventory step-up to fair value, \$27.3 million of acquisition and integration costs from the Newport Merger and \$5.0 million of an asset impairment charge. Income from operations for 2015 includes \$2.1 million of restructuring charges.
- (4) Net income for 2019 includes charges, net of tax, of \$32.9 million of acquisition and integration costs, \$5.8 million of amortization of inventory step-up to fair value, \$5.1 million of fees and expenses related to

our Term Loan Facility related to the ESI Merger, \$3.9 million of amortization of debt issuance costs, \$5.1 million of restructuring and other costs, \$4.7 million of asset impairment charges and \$5.4 million of tax cost on the inter-company sale of an asset. These charges are offset by a \$5.2 million gain on sale of long-lived assets and \$2.2 million of windfall tax benefit on the vesting of stock-based compensation. Net income for 2018 includes an \$8.3 million windfall tax benefit on the vesting of stock-based compensation and \$5.0 million of accrued taxes on MKS subsidiary distributions. Net income for 2017 includes charges, net of tax, of \$6.7 million of an asset impairment charge, \$3.4 million of acquisition and integration costs and \$3.7 million of restructuring charges. Net income for 2017 also includes a gain, net of tax of \$72.0 million related to the sale of a business, a \$28.7 million transition tax on accumulated foreign earnings, a \$14.0 million tax accrual on a distribution to a subsidiary, a \$24.5 million deferred tax adjustment, which also includes the reversal of a tax accrual on an intercompany dividend related to the 2017 Tax Cut and Jobs Act, a \$11.1 million windfall tax benefit on the vesting of stock-based compensation and an adjustment, net of tax of \$5.9 million of amortization of debt issuance costs relating to our Term Loan Facility used to partially finance the Newport Merger. Net income for 2016 includes charges, net of tax, of \$9.8 million of amortization of inventory step-up to fair value, \$19.0 million of acquisition and integration costs, \$5.0 million of asset impairment charges and a \$2.0 million withholding tax on dividends. These charges are offset by a tax benefit of \$5.0 million for a legal entity restructuring. Net income for 2015 includes charges, net of tax, of \$1.4 million of restructuring costs and also includes \$7.7 million in tax credits for reserve releases related to the settlement of tax audits.

- (5) Short-term and long-term debt, net, includes \$9.0 million and \$871.7 million, respectively, in 2019, long-term debt, net includes \$343.8 million in 2018, \$389.3 million in 2017 and short-term and long-term debt, net includes \$6.3 million and \$600.7 million, respectively, in 2016, related to our Term Loan Facility.
- (6) Other liabilities include non-current deferred taxes, non-current accrued compensation and non-current lease liability.

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations

The Management's Discussion and Analysis of Financial Condition and Results of Operations, or MD&A, describes principal factors affecting the results of our operations, financial condition and liquidity, as well as our critical accounting policies and estimates that require significant judgment and thus have the most significant potential impact on our Consolidated Financial Statements. This section provides an analysis of our financial results for the year ended December 31, 2019 compared to the year ended December 31, 2018. For the discussion and analysis covering the year ended December 31, 2018 compared to the year ended December 31, 2017, please refer to Item 7, "Management's Discussion and Analysis of Financial Condition and Results of Operations" in our Annual Report on Form 10-K for the year ended December 31, 2018, as filed with the SEC on February 26, 2019.

Overview

We are a global provider of instruments, systems, subsystems and process control solutions that measure, monitor, deliver, analyze, power and control critical parameters of advanced manufacturing processes to improve process performance and productivity for our customers. Our products are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery, vacuum technology, lasers, photonics, optics, precision motion control, vibration control and laser-based manufacturing systems solutions. We also provide services relating to the maintenance and repair of our products, installation services and training. Our primary served markets include semiconductor, industrial technologies, life and health sciences, research and defense.

Recent Events

Acquisition of Electro Scientific Industries, Inc.

On February 1, 2019, we completed our acquisition of Electro Scientific Industries, Inc. ("ESI") pursuant to an Agreement and Plan of Merger, dated as of October 29, 2018 (the "ESI Merger"). At the effective time of the ESI Merger and pursuant to the terms and conditions of the merger agreement, each share of ESI's common stock that was issued and outstanding immediately prior to the effective time of the ESI Merger was converted into the right to receive \$30.00 in cash, without interest and subject to deduction of any required withholding tax. We paid the former ESI stockholders aggregate consideration of approximately \$1.033 billion, excluding related transaction fees and expenses, and non-cash consideration related to the exchange of share-based awards of approximately \$31 million for a total purchase consideration of approximately \$1.063 billion. We funded the payment of the aggregate consideration with a combination of our available cash on hand and the proceeds from our 2019 Incremental Term Loan Facility, as defined and as described further below.

Segments and Markets

The Vacuum & Analysis segment provides a broad range of instruments, components and subsystems which are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery, and vacuum technology.

The Light & Motion segment provides a broad range of instruments, components and subsystems which are derived from our core competencies in lasers, photonics, optics, precision motion control and vibration control.

The Equipment & Solutions segment was created in conjunction with the ESI Merger. The Equipment & Solutions segment provides laser-based manufacturing systems solutions for the micro-machining industry that enable customers to optimize production. The primary served markets for the Equipment & Solutions segment

include flexible and rigid printed circuit board (“PCB”) processing/fabrication, semiconductor wafer processing and passive component manufacturing and testing. The Equipment & Solutions segment’s systems incorporate specialized laser technology and proprietary control software to efficiently process the materials and components that are an integral part of electronic devices and systems.

We have a diverse base of customers. Approximately 51% and 45% of our net revenues, for the years 2019 and 2018, respectively, were from sales to customers in our advanced markets. These include, but are not limited to, industrial technologies, life and health sciences, and research and defense.

Approximately 49% and 55% of our net revenues, for the years 2019 and 2018, respectively, were from sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers.

We expect the relative split in our net revenues between sales to customers in our advanced markets and sales to customers in our semiconductor capital equipment manufacturer and semiconductor device manufacturer markets will be relatively consistent for the foreseeable future, excluding the impact of any future acquisitions.

Net revenues from customers in our advanced markets increased by \$40 million, or 4%, in 2019, compared to 2018, primarily due to an increase of \$151 million from our Equipment & Solutions segment as a result of the ESI Merger. The increase was offset by a decrease of \$37 million in our Vacuum & Analysis segment and a decrease of \$74 million in our Light & Motion segment, primarily in our industrial technologies market.

Net revenues from semiconductor capital equipment manufacture and semiconductor device manufacture customers decreased by \$215 million, or 19%, in 2019, compared to 2018. The decrease was primarily due to a volume decrease in net semiconductor revenues of \$233 million and \$14 million in the Vacuum & Analysis and Light & Motion segments, respectively, offset by an increase of \$32 million from our Equipment & Solutions segment as a result of the ESI Merger.

The semiconductor capital equipment industry experienced a moderation in capital spending in the second half of 2018 and the first half of 2019. However, the semiconductor capital equipment industry has seen an increase in capital spending in the second half of 2019. We noted a corresponding effect on our semiconductor revenue over the same period. While the timing of a full market recovery remains uncertain, we have seen an improvement in market conditions. The semiconductor capital equipment industry is subject to rapid demand shifts, which are difficult to predict, and we cannot be certain as to the timing or extent of future demand or any future weakness in the semiconductor capital equipment industry.

A significant portion of our net revenues is from sales to customers in international markets. International net revenues accounted for approximately 53% and 51% of our total net revenues, in 2019 and 2018, respectively. A significant portion of our international net revenues was from China, South Korea, Germany and Japan. We expect international net revenues will continue to represent a significant percentage of our total net revenues. Long-lived assets located in the United States were \$208 million and \$147 million, in 2019 and 2018, respectively, excluding goodwill, intangible assets, and long-term tax-related accounts. Long-lived assets located outside of the United States were \$131 million and \$77 million, in 2019 and 2018, respectively, excluding goodwill and intangibles, and long-term tax-related accounts.

Critical Accounting Policies and Estimates

The MD&A discusses our consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States. The preparation of these financial statements requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. On an on-going basis, we evaluate our estimates and judgments, including those related to revenue recognition, allowance for doubtful accounts, pension plan

valuations, inventory, warranty costs, stock-based compensation expense, intangible assets, goodwill and other long-lived assets, in-process research and development and income taxes. We base our estimates and judgments on historical experience and on various other factors that are believed to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions.

We believe the following critical accounting policies affect the most significant judgments, assumptions and estimates we use in preparing our consolidated financial statements:

Revenue Recognition and Allowance for Doubtful Accounts . We adopted Accounting Standards Codification (“ASC”) 606 (“ASC 606”) on January 1, 2018 using the modified retrospective method for all contracts not completed as of the date of adoption. The reported results for the twelve months ended December 31, 2019 and 2018 reflect the application of ASC 606 guidance while the reported results for 2017 was prepared under the guidance of ASC 605, Revenue Recognition.

We recorded a net increase to opening retained earnings of \$1.7 million as of January 1, 2018 due to the cumulative impact of adopting ASC 606, with the impact primarily related to its service business and certain custom products.

The adoption of ASC 606 represents a change in accounting principle that will more closely align revenue recognition with the delivery of our goods or services. To achieve this core principle, we apply the following five steps when recording revenue:

- Identify the contract with a customer
- Identify the performance obligations in the contract
- Determine the transaction price
- Allocate the transaction price to performance obligations in the contract
- Recognize revenue when or as the Company satisfies a performance obligation

Revenue under ASC 606 is recognized when or as obligations under the terms of a contract with our customer has been satisfied and control has transferred to the customer. The majority of our performance obligations, and associated revenue, are transferred to customers at a point in time, generally upon shipment of a product to the customer or receipt of the product by the customer and without significant judgments. Installation services are not significant and are usually completed in a short period of time (normally less than two weeks) and therefore, recorded at a point in time when the installation services are completed, rather than over time as they are not material. Extended warranty, service contracts, and repair services, which are transferred to the customer over time, are recorded as revenue as the services are performed. For repair services, we make an accrual at each quarter end based upon historical repair times within our product groups to record revenue based upon the estimated number of days completed to date, which is consistent with ratable recognition. Customized products with no alternative future use to us, and that have an enforceable right to payment for performance completed to date, are also recorded over time. We consider this to be a faithful depiction of the transfer to the customer of revenue over time as the work is performed or service is delivered, ratably over time.

Revenue is measured as the amount of consideration we expect to receive in exchange for transferring goods or providing services. Performance obligations promised in a contract are identified based on the products or services that will be transferred to the customer that are both capable of being distinct, whereby the customer can benefit from the product or service either on its own or together with other resources that are readily available from third parties or from us, and are distinct in the context of the contract, whereby the transfer of the product or service is separately identifiable from other promises in the contract. Sales, value add, and other taxes we collect

concurrent with revenue-producing activities are excluded from revenue. Our normal payment terms are 30 to 60 days but vary by the type and location of our customers and the products or services offered. The time between invoicing and when payment is due is not significant. For certain products and services and customer types, we require payment before the products or services are delivered to, or performed for, the customer. None of our contracts as of December 31, 2019 contained a significant financing component.

We periodically enter into contracts with our customers in which a customer may purchase a combination of goods and or services, such as products with installation services or extended warranty obligations. These contracts include multiple promises that we evaluate to determine if the promises are separate performance obligations. Once we determine the performance obligations, we then determine the transaction price, which includes estimating the amount of variable consideration to be included in the transaction price, if any. To the extent the transaction price includes variable consideration, we estimate the amount of variable consideration that should be included in the transaction price utilizing either the expected value method or the most likely amount method depending on the method we expect to better predict the amount of consideration to which it will be entitled. There are no constraints on the variable consideration recorded. We then allocate the transaction price to each performance obligation in the contract based on a relative stand-alone selling price charged separately to customers or using an expected cost plus margin method. The corresponding revenues are recognized when or as the related performance obligations are satisfied, which are noted above. The impact of variable consideration has been immaterial.

We sometimes sell separately-priced service contracts and extended warranty contracts related to certain of our products, especially our laser products. The separately priced contracts generally range from 12 to 60 months. We normally receive payment at the inception of the contract and recognize revenue over the term of the agreement in proportion to the costs expected to be incurred in satisfying the obligations under the contract.

We monitor and track the amount of product returns, provide for sales return allowances and reduce revenue at the time of shipment for the estimated amount of such future returns, based on historical experience. While product returns have historically been within our expectations and the provisions established, there is no assurance that we will continue to experience the same return rates that we have in the past. Any significant increase in product return rates could have a material adverse impact on our operating results for the period or periods in which such returns materialize.

While we maintain a credit approval process, significant judgments are made by management in connection with assessing our customers' ability to pay at the time of shipment. Despite this assessment, from time to time, our customers are unable to meet their payment obligations. We continuously monitor our customers' credit worthiness, and use our judgment in establishing a provision for estimated credit losses based upon our historical experience and any specific customer collection issues that we have identified. While such credit losses have historically been within our expectations and the provisions established, there is no assurance that we will continue to experience the same credit loss rates that we have in the past. A significant change in the liquidity or financial position of our customers could have a material adverse impact on the collectability of accounts receivable and our future operating results.

Inventory . We value our inventory at the lower of cost (first-in, first-out method) or market. We regularly review inventory quantities on hand and record a provision to write-down excess and obsolete inventory to its estimated net realizable value, if less than cost, based primarily on our estimated forecast of product demand. Once our inventory value is written-down and a new cost basis has been established, the inventory value is not increased due to demand increases. Demand for our products can fluctuate significantly. A significant increase in the demand for our products could result in a short-term increase in the cost of inventory purchases as a result of supply shortages or a decrease in the cost of inventory purchases as a result of volume discounts, while a significant decrease in demand could result in an increase in the charges for excess inventory quantities on hand. In addition, our industry is subject to technological change, new product development and product technological

obsolescence that could result in an increase in the amount of obsolete inventory quantities on hand. Therefore, any significant unanticipated changes in demand or technological developments could have a significant impact on the value of our inventory and our reported operating results.

Warranty Costs. We provide for the estimated costs to fulfill customer warranty obligations upon the recognition of the related revenue. We provide warranty coverage for our products for periods ranging from 12 to 36 months, with the majority of our products for periods ranging from 12 to 24 months. Short-term accrued warranty obligations, which expire within one year, are included in other current liabilities and long-term accrued warranty obligations are included in other liabilities in the consolidated balance sheets. We estimate the anticipated costs of repairing our products under such warranties based on the historical costs of the repairs and any known specific product issues. The assumptions we use to estimate warranty accruals are re-evaluated periodically in light of actual experience and, when appropriate, the accruals are adjusted. Our determination of the appropriate level of warranty accrual is based upon estimates. Should product failure rates differ from our estimates, actual costs could vary significantly from our expectations. Defective products will be either repaired or replaced, generally at our option, upon meeting certain criteria.

Pension Plans. Several of our non-U.S. subsidiaries have defined benefit pension plans covering substantially all full-time employees of those subsidiaries. Some of the plans are unfunded, as permitted under the plans and applicable laws. For financial reporting purposes, the calculation of net periodic pension costs is based upon a number of actuarial assumptions, including a discount rate for plan obligations, an assumed rate of return on pension plan assets and an assumed rate of compensation increase for employees covered by the plan. All of these assumptions are based upon our judgment, considering all known trends and uncertainties. Actual results that differ from these assumptions would impact future expense recognition and the cash funding requirements of our pension plans.

Stock-Based Compensation Expense. We record compensation expense for all stock-based compensation awards to employees and directors based upon the estimated fair market value of the underlying instrument. Accordingly, stock-based compensation cost is measured at the grant date, based upon the fair value of the award.

We typically issue restricted stock units (“RSUs”) as stock-based compensation. We also provide employees the opportunity to purchase shares through an Employee Stock Purchase Plan (“ESPP”). For RSUs, the fair value is the stock price on the date of grant. We estimate the fair value of stock appreciation rights and shares issued under our ESPP using the Black-Scholes pricing model, which is affected by our stock price as well as assumptions regarding a number of complex and subjective variables. These variables include our expected stock price volatility over the term of the awards, expected life, risk free interest rate and expected dividends. Management determined that blended volatility, a combination of historical and implied volatility, is more reflective of market conditions and a better indicator of expected volatility than historical or implied volatility alone.

Certain RSUs involve stock to be issued upon the achievement of performance conditions (“performance shares”) under our stock incentive plans. Such performance shares become available, subject to time-based vesting conditions if, and to the extent that, financial or operational performance criteria for the applicable period are achieved. Accordingly, the number of performance shares earned will vary based on the level of achievement of financial or operational performance objectives for the applicable period. Until such time that our performance can ultimately be determined, each quarter we estimate the number of performance shares to be earned based on an evaluation of the probability of achieving the performance objectives. Such estimates are revised, if necessary, in subsequent periods when the underlying factors change our evaluation of the probability of achieving the performance objectives. Accordingly, share-based compensation expense associated with performance shares may differ significantly from the amount recorded in the current period.

As part of our acquisitions of Newport Corporation (“Newport”) in 2016 (the “Newport Merger”) and the ESI Merger in 2019, we assumed all stock appreciation rights (“SARs”) granted under any Newport equity plan or ESI equity plan, whether vested or unvested, that were outstanding immediately prior to the effective time of the Newport Merger and the ESI Merger. For SARs, the converted number of shares, fair value, vesting schedule and expiration dates are all based on the original grant date information. The stock-based compensation expense reflects the remaining fair value for all unvested SARs as of the acquisition dates, recognized over the remaining time to vest.

The assumptions used in calculating the fair value of share-based compensation awards represents management’s best estimates, but these estimates involve inherent uncertainties and the application of management’s judgment. As a result, if factors change and we use different assumptions, our stock-based compensation expense could be materially different in the future.

Intangible Assets, Goodwill and Other Long-Lived Assets . As a result of our acquisitions, we have identified intangible assets and generated significant goodwill. Definite-lived intangible assets are valued based on estimates of future cash flows and amortized over their estimated useful life. Determining fair value requires the exercise of significant judgment, including assumptions about appropriate discount rates as well as forecasted revenue growth rates and gross profit and operating margins.

Goodwill and indefinite-lived intangible assets are subject to annual impairment testing as well as testing upon the occurrence of any event that indicates a potential impairment. Intangible assets and other long-lived assets are also subject to an impairment test if there is an indicator of impairment. If our expectations of future results and cash flows are significantly diminished, intangible assets and goodwill may be impaired and the resulting charge to operations may be material. When we determine that the carrying value of intangibles or other long-lived assets may not be recoverable based upon the existence of one or more indicators of impairment, we use the projected undiscounted cash flow method to determine whether an impairment exists, and then measure the impairment using discounted cash flows. To measure impairment for goodwill, we compare the fair value of our reporting units by measuring discounted cash flows to the book value of the reporting units. Goodwill would be impaired if the resulting implied fair value was less than the recorded book value of the goodwill.

The estimation of useful lives and expected cash flows require us to make significant judgments regarding future periods that are subject to some factors outside of our control. Changes in these estimates can result in significant revisions to the carrying value of these assets and may result in material charges to the results of operations.

We have elected to perform our annual goodwill impairment test as of October 31 of each year, or more often if events or circumstances indicate that there may be impairment. Goodwill is the amount by which the cost of acquired net assets exceeded the fair value of those net assets on the date of acquisition. We allocate goodwill to reporting units at the time of acquisition or when there is a change in the reporting structure and base that allocation on which reporting units will benefit from the acquired assets and liabilities. Reporting units are defined as operating segments or one level below an operating segment, referred to as a component. The estimated fair value of our reporting units was based on discounted cash flow models derived from internal earnings and internal and external market forecasts. Determining fair value requires the exercise of significant judgment, including assumptions about appropriate discount and perpetual growth rates, as well as forecasted revenue growth rates and gross profit and operating margins. Discount rates are based on a weighted average cost of capital (“WACC”), which represents the average rate a business must pay its providers of debt and equity. The WACC used to test goodwill is derived from a group of comparable companies. Assumptions in estimating future cash flows are subject to a high degree of judgment and complexity. We make every effort to forecast these future cash flows as accurately as possible with the information available at the time the forecast is developed.

In performing our annual goodwill impairment test, we are permitted to first assess qualitative factors to determine whether it is more likely than not that the fair value of our reporting unit is less than its carrying

amount, including goodwill. In performing the qualitative assessment, we consider certain events and circumstances specific to the reporting unit and to the entity as a whole, such as macroeconomic conditions, industry and market considerations, overall financial performance and cost factors when evaluating whether it is more likely than not that the fair value of the reporting unit is less than its carrying amount. We are also permitted to bypass the qualitative assessment and proceed directly to the quantitative test. If we choose to undertake the qualitative assessment and we conclude that it is more likely than not that the fair value of the reporting unit is less than its carrying amount, we would then proceed to the quantitative impairment test. In the quantitative assessment, we compare the fair value of the reporting unit to its carrying amount, which includes goodwill. If the fair value exceeds the carrying value, no impairment loss exists. If the fair value is less than the carrying amount, a goodwill impairment loss is measured and recorded.

On July 1, 2018, we reassigned goodwill to certain reporting units within the Light & Motion reportable segment resulting from a reorganization of the composition of reporting units. The goodwill was reassigned to the reporting units affected using the relative fair value approach. In conjunction with this goodwill reassignment, we performed an interim quantitative impairment test as of July 1, 2018 for all of our reporting units and concluded that the fair values of each reporting unit exceeded their respective carrying values.

As of October 31, 2019, we performed our annual impairment assessment of goodwill using a quantitative assessment for our Equipment & Solutions reporting unit, which comprises our Equipment & Solutions reportable segment, and a qualitative assessment for all of our other reporting units and determined that it is more likely than not that the fair values of the reporting units exceed their carrying amount. We will continue to monitor and evaluate the carrying value of goodwill. If market and economic conditions or business performance deteriorate, this could increase the likelihood of us recording an impairment charge. However, we believe it is not reasonably likely that an impairment will occur at any of its reporting units over the next twelve months.

Income Taxes. We evaluate the realizability of our net deferred tax assets and assess the need for a valuation allowance on a quarterly basis. The future benefit to be derived from our deferred tax assets is dependent upon our ability to generate sufficient future taxable income in each jurisdiction of the right type to realize the assets. We record a valuation allowance to reduce our net deferred tax assets to the amount that is expected to be realized. To the extent we establish a valuation allowance an expense is recorded within the provision for income taxes line in the consolidated statements of operations and comprehensive income.

Accounting for income taxes requires a two-step approach to recognize and measure uncertain tax positions. The first step is to evaluate the tax position for recognition by determining if, based on the technical merits, it is more likely than not that the position will be sustained upon audit, including resolutions of related appeals or litigation processes, if any. The second step is to measure the tax benefit as the largest amount that is more than 50% likely of being realized upon ultimate settlement. We re-evaluate these uncertain tax positions on a quarterly basis. This evaluation is based on factors including, but not limited to, changes in facts or circumstances, changes in tax law, effectively settled issues under audit and new audit activity. Any change in these factors could result in the recognition of a tax benefit or an additional charge to the tax provision.

On December 22, 2017, the Tax Cuts and Jobs Act (the "Act") was enacted. Some of the more significant changes from the Act that impact us include the reduction of the U.S. federal corporate income tax rate from 35.0% to 21.0% as of January 1, 2018, the implementation of a new scheme for the taxation of our controlled foreign corporations and the imposition of a transition tax on deemed repatriated cumulative earnings of foreign subsidiaries.

Results of Operations

The following table sets forth, for the periods indicated, the percentage of total net revenues of certain line items included in our consolidated statements of operations and comprehensive income data:

	Years Ended December 31.	
	2019	2018
Net revenues:		
Product	84.8%	88.4%
Service	15.2	11.6
Total net revenues	100.0%	100.0%
Cost of revenues:		
Product	48.1	46.7
Service	8.2	6.1
Total cost of revenues	56.3	52.8
Gross profit	43.7%	47.2%
Research and development	8.6	6.5
Selling, general and administrative	17.4	14.4
Acquisition and integration costs	2.0	0.1
Restructuring and other	0.4	0.3
Fees and expenses related to repricing of Term Loan Facility	0.3	—
Amortization of intangible assets	3.5	2.1
Gain on the sale of long-lived assets	(0.3)	—
Asset impairment	0.2	—
Income from operations	11.6%	23.8%
Interest income	0.3	0.3
Interest expense	2.3	0.8
Other expense, net	0.2	0.1
Income from operations before income taxes	9.4%	23.2%
Provision for income taxes	2.0	4.3
Net income	7.4%	18.9%

Year Ended December 31, 2019 compared to 2018

Net Revenues

(Dollars in millions)	Years Ended December 31.	
	2019	2018
Product	\$ 1,611.3	\$ 1,835.2
Service	288.5	239.9
Total net revenues	\$ 1,899.8	\$ 2,075.1

Product revenues decreased \$223.9 million in 2019, compared to 2018. The decrease was attributed to a decrease in net product revenues, primarily due to lower volume, from our semiconductor customers of \$209.5 million and a decrease in net product revenues from customer in our advanced markets of \$14.4 million. The decrease in product revenue from our semiconductor customers for the MKS business, excluding the impact of the ESI Merger (the “legacy MKS business”), during 2019, was \$241.7 million compared to 2018, offset by an increase in product revenues from our semiconductor customers of \$32.2 million from the Equipment & Solutions segment, as a result of the ESI Merger. The decrease in product revenues from customers in our

advanced markets for the legacy MKS business in 2019, was \$110.6 million, mainly due to decreases in the industrial technologies market which we believe has been negatively impacted by general trade tensions, increasing tariffs, other trade restrictions and a softening in consumer electronics demand. The decrease was offset by an increase in product revenues from customers in our advanced markets of \$96.3 million from the Equipment & Solutions segment as a result of the ESI Merger.

Service revenues consisted mainly of fees for services related to the maintenance and repair of our products, sales of spare parts, and installation and training. Service revenues increased \$48.6 million in 2019, compared to 2018. The increase was primarily attributed to an increase in service revenues from customers in our advanced markets of \$55.2 million from the Equipment & Solutions segment as a result of the ESI Merger.

Total international net revenues, including product and service, were \$1.0 billion in 2019 compared to \$1.1 billion for 2018. The decrease in 2019 was primarily due to decreases in net revenues in Japan and South Korea, partially offset by an increase in net revenues from China.

The following table sets forth our net revenues by reportable segment:

Net Revenues

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Vacuum & Analysis	\$ 990.5	\$ 1,260.9
Light & Motion	725.6	814.2
Equipment & Solutions	183.7	—
Total net revenues	<u>\$ 1,899.8</u>	<u>\$ 2,075.1</u>

Net revenues for our Vacuum & Analysis segment decreased \$270.4 million in 2019, compared to 2018, due primarily to volume decreases of \$233.1 million from our semiconductor customers and \$37.3 million from our advanced market customers, primarily from customers in our process and industrial technologies market.

Net revenues for our Light & Motion segment decreased \$88.6 million in 2019, compared to 2018, due to decreases of \$14.3 million from our semiconductor customers and \$74.3 million from our advanced market customers, primarily from volume decreases from customers in our process and industrial technologies market.

The following table sets forth gross profit as a percentage of net revenues by product and service:

Gross Profit

(As a percentage of net revenues)	Years Ended December 31,		% Points Change
	2019	2018	
Product	43.3%	47.2%	(3.9)%
Service	46.0%	47.3%	(1.3)%
Total gross profit percentage	<u>43.7%</u>	<u>47.2%</u>	<u>(3.5)%</u>

Gross profit as a percentage of net product revenues decreased by 3.9 percentage points in 2019, compared to 2018, primarily due to lower factory utilization and lower revenue volumes, partially offset by favorable product mix.

Gross profit as a percentage of net service revenues decreased by 1.3 percentage points in 2019, compared to 2018, primarily due to unfavorable product mix and higher material costs, partially offset by higher utilization of service technicians.

The following table sets forth gross profit as a percentage of net revenues by reportable segment:

Gross Profit

(As a percentage of net revenues)	Years Ended December 31,		% Points Change
	2019	2018	
Vacuum & Analysis	43.0%	45.8%	(2.8)%
Light & Motion	46.1	49.3	(3.2)
Equipment & Solutions	36.8	—	—
Total net revenues	43.7%	47.2%	(3.5)%

Gross profit as a percentage of net revenues for our Vacuum & Analysis segment decreased by 2.8 percentage points in 2019, compared to 2018, primarily due to lower factory utilization and lower revenue volumes, partially offset by favorable product mix.

Gross profit as a percentage of net revenues for our Light & Motion segment decreased by 3.2 percentage points in 2019, compared to 2018, primarily due to lower factory utilization, lower revenue volumes and unfavorable product mix.

Gross profit as a percentage of net revenues for our Equipment & Solutions includes the inventory step-up adjustment to fair value from purchase accounting of \$7.6 million related to the ESI Merger. Excluding this adjustment, the gross margin for 2019 would have been 41.0%.

Research and Development

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Research and development expenses	\$ 164.1	\$ 135.7

Research and development expenses increased \$28.4 million in 2019, compared to 2018, due to an increase of \$26.8 million from the ESI Merger, primarily due to increases of \$16.8 million in compensation-related expense, \$3.5 million in project materials, \$3.4 million in depreciation expense and \$1.7 million in occupancy costs and an increase of \$1.6 million from the legacy MKS business, primarily due to increases of \$2.8 million in project materials and \$0.6 million in professional fees, offset by a \$2.1 million decrease in compensation-related expense.

Our research and development is primarily focused on developing and improving our instruments, components, subsystems and process control solutions to improve process performance and productivity.

We have thousands of products and our research and development efforts primarily consist of a large number of projects related to these products, none of which is individually material to us. Current projects typically have durations of 3 to 30 months depending upon whether the product is an enhancement of existing technology or a new product. Our current initiatives include projects to enhance the performance characteristics of older products, to develop new products and to integrate various technologies into subsystems. These projects support in large part, the transition in the semiconductor industry to smaller integrated circuit geometries and in the flat panel display and solar markets to larger substrate sizes, which require more advanced process control

technology. Research and development expenses consist primarily of salaries and related expenses for personnel engaged in research and development, fees paid to consultants, material costs for prototypes and other expenses related to the design, development, testing and enhancement of our products.

We believe that the continued investment in research and development and ongoing development of new products are essential to the expansion of our markets. We expect to continue to make significant investment in research and development activities. We are subject to risks from products not being developed in a timely manner, as well as from rapidly changing customer requirements and competitive threats from other companies and technologies. Our success primarily depends on our products being designed into new generations of equipment for the semiconductor industry and advanced technology markets. We develop products that are technologically advanced so that they are positioned to be chosen for use in each successive generation of semiconductor capital equipment. If our products are not chosen to be designed into our customers' products, our net revenues may be reduced during the lifespan of those products.

Selling, General and Administrative

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Selling, general and administrative expenses	\$ 330.3	\$ 298.1

Selling, general and administrative expenses increased \$32.2 million during 2019, compared to 2018, due to an increase of \$38.7 million from the ESI Merger, primarily due to \$24.0 million in compensation-related expense, \$4.1 million of depreciation expense, \$2.2 million of travel and entertainment expense and \$2.3 million of consulting and professional fees offset by a decrease of \$6.5 million from the legacy MKS business, primarily due to a decrease of \$8.5 million in compensation-related expense, offset by an increase of \$1.4 million in occupancy costs.

Acquisition and Integration Costs

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Acquisition and integration costs	\$ 37.3	\$ 3.1

Acquisition and integration costs incurred during 2019 and 2018 related primarily to the ESI Merger. In 2019, these costs consisted primarily of compensation costs for certain executives from ESI who had change in control provisions in their respective ESI employment agreements that were accounted for as dual-trigger arrangements and other stock vesting accelerations, as well as consulting and professional fees associated with the ESI Merger. In 2018, these costs consisted primarily of consulting and professional fees associated with the ESI Merger offset by \$1.1 million severance accrual reversal related to the Newport Merger.

Restructuring and other

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Restructuring and other	\$ 7.0	\$ 4.6

In 2019, we recorded \$7.0 million of restructuring and other charges which primarily consisted of severance costs related to an organization-wide reduction in workforce, the consolidation of service functions in Asia, the movement of certain products to lower costs regions and costs incurred from the pending closure of a facility in Europe. In addition, we recorded a charge for a legal settlement from a contractual obligation we assumed as part of the Newport Merger.

In 2018, we recorded \$4.6 million of restructuring and other charges which primarily consisted of severance costs related to transferring a portion of our shared services functions to a third party, as well as the consolidation of certain shared service functions in Asia. We also recorded environmental costs related to an Environmental Protection Agency-designated Superfund site, which we acquired as part of the Newport Merger.

Fees and Expenses Related to Repricing of Term Loan Facility

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Fees and expenses related to repricing of Term Loan Facility	\$ 6.6	\$ 0.4

In 2019, we recorded fees and expenses related to Amendment No. 6 to our Term Loan Credit Agreement, as defined and as described further below, which included the fifth repricing of our Term Loan Facility, as defined and as described further below, and a consolidation of the two existing tranches into one tranche with a maturity date in February 2026. We also recorded fees and expenses related to Amendment No. 5 to our Term Loan Credit Agreement.

In 2018, we recorded fees and expenses related to previous repricings of our Term Loan Facility.

Amortization of Intangible Assets

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Amortization of intangible assets	\$ 67.4	\$ 43.5

Amortization of intangible assets increased by \$23.9 million in 2019, compared to 2018, due to intangible assets acquired in the ESI Merger.

Gain on Sale of Long-Lived Assets

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Gain on sale of long-lived assets	\$ (6.8)	\$ —

We recorded a net gain on the sale of two properties in Boulder, Colorado and three properties in Portland, Oregon.

Asset Impairment

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Asset impairment	\$ 4.7	\$ —

In 2019, we recorded \$4.7 million of impairment charges related to a minority interest investment in a private company.

Interest Expense, Net

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Interest expense, net	\$ 38.7	\$ 11.2

Interest expense, net, increased by \$27.5 million in 2019, compared to 2018, primarily due to interest expense related to Amendment No. 5, as described below.

Other Expense, Net

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Other expense, net	\$ 3.3	\$ 1.9

Other expense, net for 2019 and 2018 primarily related to changes in foreign exchange rates.

Provision for Income Taxes

(Dollars in millions)	Years Ended December 31,	
	2019	2018
Provision for income taxes	\$ 37.5	\$ 88.1

Our effective tax rates for the years 2019 and 2018 were 21.1% and 18.3%, respectively. Our 2019 effective tax rate was higher than the U.S. statutory tax rate due to the global intangible low taxed income inclusion, non-deductible executive compensation and gain on intercompany sale of assets, offset by the deduction for foreign derived intangible income, the geographic mix of income earned by our international subsidiaries being taxed at rates lower than the U.S. statutory tax rate and the impact of various tax credits.

The effective tax rate in 2018 and related income tax expense was impacted by the Act. The effective tax rate for the period ending December 31, 2018 was lower than the U.S. statutory rate due to the geographic mix of income earned by our international subsidiaries being taxed at rates lower than the U.S. statutory tax rate, windfall benefits of stock compensation and the deduction for foreign derived intangible income, offset by state income taxes.

As of December 31, 2019, the total gross unrecognized tax benefits, which excludes interest and penalties, was \$43.5 million. As of December 31, 2018, the total gross unrecognized tax benefits, which excludes interest and penalties, was \$32.7 million. The net increase was primarily attributable to the addition of historical gross unrecognized tax benefits for ESI as a result of the ESI Merger during the quarter ended March 31, 2019.

We accrue interest and, if applicable, penalties for any uncertain tax positions. Interest and penalties are classified as a component of income tax expense. As of December 31, 2019 and 2018, we accrued interest on unrecognized tax benefits of approximately \$0.5 million and \$0.6 million, respectively.

Over the next 12 months it is reasonably possible that we may recognize approximately \$1.5 million of previously net unrecognized tax benefits, excluding interest and penalties, related to various U.S. federal, state and foreign tax positions primarily due to the expiration of statutes of limitations.

We are subject to examination by U.S. federal, state and foreign tax authorities. The U.S. Internal Revenue Service (the "IRS") commenced an examination of our U.S. federal income tax filings for tax years 2015 and 2016 during the quarter ended September 30, 2017. This audit was effectively settled during the quarter ended March 31, 2018, and the impact was not material. Also, during the quarter ended March 31, 2018, we received notification from the IRS of its intent to audit our subsidiary, Newport, for the tax year 2015. This audit commenced during the quarter ended June 30, 2018 and was effectively settled during the quarter ended June 30, 2019 with a no change result. The U.S. statute of limitations remains open for tax years 2016 through the present. The statute of limitations for our tax filings in other jurisdictions varies between fiscal years 2014 through present. We also have certain federal credit carry-forwards and state tax loss and credit carry-forwards that are open to examination for tax years 2000 through the present.

In 2019, we recorded a net benefit to income tax expense of \$1.7 million, excluding interest and penalties, due to reserve releases related to the expiration of certain statutes of limitations for previously open tax years and the effective settlement of an IRS audit. In 2018, we recorded a net benefit to income tax expense of \$1.6 million, excluding interest and penalties, due to reserve releases related to the expiration of certain statutes of limitations for previously open tax years and the effective settlement of an IRS audit.

The United Kingdom (“UK”) completed its withdrawal from the EU on January 31, 2020. There will be a transition period, set to expire on December 31, 2020, within which the UK will continue to obey EU laws and European courts. We are currently monitoring the developments during this transition period and the possible impact to our overall tax assets, tax liabilities and effective tax rate.

Our future effective tax rate depends on various factors, including further interpretations and guidance from U.S. federal and state governments on the impact of proposed regulations issued by the IRS, as well as the geographic composition of our pre-tax income and changes in income tax reserves for unrecognized tax benefits. We monitor these factors and timely adjust our estimates of the effective tax rate accordingly. We expect the geographic mix of pre-tax income will continue to have a favorable impact on our effective tax rate, however the geographic mix of pre-tax income can change based on multiple factors resulting in changes to the effective tax rate in future periods. While we believe we have adequately provided for all tax positions, amounts asserted by taxing authorities could materially differ from our accrued positions as a result of uncertain and complex application of tax law and regulations. Additionally, the recognition and measurement of certain tax benefits include estimates and judgment by management. Accordingly, we could record additional provisions or benefits for U.S. federal, state, and foreign tax matters in future periods as new information becomes available.

Liquidity and Capital Resources

Cash, cash equivalents and short-term marketable investments totaled \$524.0 million at December 31, 2019, a decrease of \$194.2 million compared to \$718.2 million at December 31, 2018. The primary driver in our current and anticipated future cash flows is and will continue to be cash generated from operations, consisting primarily of our net income, excluding non-cash changes and changes in operating assets and liabilities. In periods when our sales are growing, higher sales to customers will result in increased trade receivables, and inventories will generally increase as we build products for future sales. This may result in lower cash generated from operations. Conversely, in periods when our sales are declining, our trade accounts receivable and inventory balances will generally decrease, resulting in increased cash from operations.

Net cash provided by operating activities was \$244.5 million for 2019 and resulted from net income of \$140.4 million, which included non-cash net charges of \$192.5 million, offset by an increase in working capital of \$88.4 million. The increase in working capital consisted primarily of an increase in inventories of \$29.3 million, a decrease in accounts payable of \$24.1 million, a decrease in income taxes payable of \$12.4 million, an increase in other current and non-current assets of \$9.8 million, a decrease in other current and non-current liabilities of \$8.4 million and a decrease in current and non-current compensation of \$4.2 million.

Net cash provided by operating activities was \$413.8 million for 2018 and resulted from net income of \$392.9 million, which included non-cash net charges of \$118.9 million, offset by an increase in working capital of \$98.0 million. The increase in working capital consisted primarily of an increase in inventories of \$73.8 million, a decrease in income taxes payable of \$11.4 million, a decrease in accrued compensation of \$8.7 million and a decrease in other current and non-current liabilities of \$4.0 million.

Net cash used in investing activities was \$947.2 million for 2019 and was due to the payment of a portion of the purchase price for the ESI Merger of \$988.6 million, net of cash acquired, and purchases of property, plant and equipment of \$63.9 million, offset by net sales and maturities of short-term investments of \$63.2 million and proceeds from the sale of long-lived assets of \$42.1 million. Net cash provided by investing activities was \$72.8 million for 2018, due to net sales and maturities of short-term investments of \$135.7 million, offset by the purchases of property, plant and equipment of \$62.9 million.

Net cash provided by financing activities was \$476.2 million for 2019 and was from net proceeds of \$530.7 million, mainly from our 2019 Incremental Term Loan Facility, as defined and as described further below, used to finance the ESI Merger, offset by dividend payments made to common stockholders of \$43.5 million and net payments related to tax payments for employee stock awards of \$11.0 million. Net cash used in financing activities was \$178.0 million for 2018 and primarily resulted from the repurchase of common stock of \$75.0 million, partial repayment of our Term Loan Facility of \$50.0 million, dividend payments made to common stockholders of \$42.4 million and net payments related to tax payments for employee stock awards of \$11.1 million.

On July 25, 2011, our Board of Directors approved a share repurchase program for the repurchase of up to an aggregate of \$200 million of our common stock from time to time in open market purchases, privately negotiated transactions or through other appropriate means. The timing and quantity of any shares repurchased depends upon a variety of factors, including business conditions, stock market conditions and business development activities, including, but not limited to, merger and acquisition opportunities. These repurchases may be commenced, suspended or discontinued at any time without prior notice. During 2019, we did not repurchase any shares of our common stock. During 2018, we repurchased approximately 818,000 shares of our common stock for \$75.0 million, or an average price of \$91.67 per share.

For the year ended December 31, 2019, we paid cash dividends of \$43.5 million in the aggregate or \$0.80 per share. For the year ended December 31, 2018, we paid cash dividends of \$42.4 million in the aggregate, or \$0.78 per share. Future dividend declarations, if any, as well as the record and payment dates for such dividends, are subject to the final determination of our Board of Directors. Holders of our common stock are entitled to receive dividends when and if they are declared by our Board of Directors. In addition, under the terms of our Term Loan Facility and our ABL Facility, as defined and described further below, we may be restricted from paying dividends under certain circumstances.

On February 10, 2020, our Board of Directors declared a quarterly cash dividend of \$0.20 per share to be paid on March 6, 2020 to shareholders of record as of February 24, 2020.

Senior Secured Term Loan Credit Facility

In connection with the completion of the Newport Merger in April 2016, we entered into a term loan credit agreement (the "Term Loan Credit Agreement") with Barclays Bank PLC, as administrative agent and collateral agent, and the lenders from time to time party thereto (the "Lenders"), that provided a senior secured term loan credit facility in the original principal amount of \$780.0 million (the "2016 Term Loan Facility"), subject to increase at our option and subject to receipt of lender commitments in accordance with the Term Loan Credit Agreement (the 2016 Term Loan Facility, together with the 2019 Incremental Term Loan Facility and 2019 Term Loan Refinancing Facility (each as defined below), the "Term Loan Facility"). Prior to the effectiveness of Amendment No. 6 (as defined below), the 2016 Term Loan Facility had a maturity date of April 29, 2023. As of December 31, 2019, borrowings under the Term Loan Facility bear interest per annum at one of the following rates selected by us: (a) a base rate determined by reference to the highest of (1) the federal funds effective rate plus 0.50%, (2) the "prime rate" quoted in *The Wall Street Journal*, (3) a London Interbank Offer Rate ("LIBOR") rate determined by reference to the costs of funds for U.S. dollar deposits for an interest period of one month adjusted for certain additional costs, plus 1.00%, and (4) a floor of 1.75%, plus, in each case, an applicable margin; or (b) a LIBOR rate determined by reference to the costs of funds for U.S. dollar deposits for the interest period relevant to such borrowing adjusted for certain additional costs, subject to a LIBOR rate floor of 0.0%, plus an applicable margin. We have elected the interest rate as described in clause (b) of the foregoing sentence. The Term Loan Credit Agreement provides that, unless an alternate rate of interest is agreed, all loans will be determined by reference to the base rate if the LIBOR rate cannot be ascertained, if regulators impose material restrictions on the authority of a lender to make LIBOR rate loans, or for other reasons. The 2016 Term Loan Facility was issued with original issue discount of 1.00% of the principal amount thereof.

We subsequently entered into four separate repricing amendments to the 2016 Term Loan Facility, which decreased the applicable margin for LIBOR borrowings from 4.0% to 1.75%, with a LIBOR rate floor of 0.75%. As a consequence of the pricing of the 2019 Incremental Term Loan Facility (defined below), the applicable margin for the 2016 Term Loan Facility was increased to 2.00% (from 1.75%) with respect to LIBOR borrowings and 1.00% (from 0.75%) with respect to base rate borrowings.

On September 30, 2016, we entered into an interest rate swap agreement, which has a maturity date of September 30, 2020, to fix the rate on \$335.0 million of the then-outstanding balance of the 2016 Term Loan Facility. The rate was fixed at 1.198% per annum plus the applicable credit spread, which was 1.75% at December 31, 2019. At December 31, 2019, the notional amount of this transaction was \$250.0 million and it had a fair value asset of \$0.8 million.

We incurred \$28.7 million of deferred finance fees, original issue discount and repricing fees related to the term loans under the 2016 Term Loan Facility, which are included in long-term debt in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

On February 1, 2019, in connection with the completion of the ESI Merger, we entered into an amendment (“Amendment No. 5”) to the Term Loan Credit Agreement. Amendment No. 5 provided an additional tranche B-5 term loan commitment in the original principal amount of \$650.0 million (the “2019 Incremental Term Loan Facility”), all of which was drawn down in connection with the closing of the ESI Merger. Pursuant to Amendment No. 5, we also effectuated certain amendments to the Term Loan Credit Agreement which make certain of the negative covenants and other provisions less restrictive. Prior to the effectiveness of Amendment No. 6 (as defined below), the 2019 Incremental Term Loan Facility had a maturity date of February 1, 2026 and bore interest at a rate per annum equal to, at our option, a base rate or LIBOR rate (as described above) plus, in each case, an applicable margin equal to 1.25% with respect to base rate borrowings and 2.25% with respect to LIBOR borrowings. The 2019 Incremental Term Loan Facility was issued with original issue discount of 1.00% of the principal amount thereof.

On April 3, 2019, we entered into an interest rate swap agreement, which has a maturity date of March 31, 2023, to fix the rate on \$300.0 million of the then-outstanding balance of the 2019 Incremental Term Loan Facility. The rate was fixed at 2.309% per annum plus the applicable credit spread, which was 1.75% at December 31, 2019. At December 31, 2019, the notional amount of this transaction was \$300.0 million and it had a fair value liability of \$6.5 million.

We incurred \$11.4 million of deferred finance fees and original issue discount fees related to the term loans under the 2019 Incremental Term Loan Facility, which are included in long-term debt in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

On September 27, 2019, we entered into an amendment (“Amendment No. 6”) to the Term Loan Credit Agreement. Amendment No. 6 refinanced all existing loans outstanding under the 2016 Term Loan Facility and 2019 Incremental Term Loan Facility (“Existing Term Loans”) for a tranche B-6 term loan commitment in the original principal amount of \$896.8 million (“2019 Term Loan Refinancing Facility”). Each lender of the Existing Term Loans that elected to participate in the 2019 Term Loan Refinancing Facility was deemed to have exchanged the aggregate outstanding principal amount of its Existing Term Loans for an equal aggregate principal amount of tranche B-6 term loans under the 2019 Term Loan Refinancing Facility. On the effective date of Amendment No. 6 and immediately prior to the exchanges described above, we made a voluntary prepayment of \$50.0 million, which was applied to the Existing Term Loans on a pro rata basis.

We incurred \$2.2 million of original issue discount fees related to the term loans under the 2019 Term Loan Refinancing Facility, which are included in long-term debt in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

As of December 31, 2019, the remaining balance of deferred finance fees and original issue discount of the Term Loan Facility was \$11.8 million. A portion of the deferred finance fees and original issue discount have been accelerated in connection with the various debt prepayments and extinguishments during 2016, 2017, 2018 and 2019.

The 2019 Term Loan Refinancing Facility matures on February 2, 2026, and bears interest at a rate per annum equal to, at our option, a base rate or LIBOR rate (as described above) plus, in each case, an applicable margin equal to 0.75% with respect to base rate borrowings and 1.75% with respect to LIBOR borrowings. The 2019 Term Loan Refinancing Facility was issued with original issue discount of 0.25% of the principal amount thereof.

We are required to make scheduled quarterly payments each equal to 0.25% of the original principal amount of the 2019 Term Loan Refinancing Facility with the balance due on February 2, 2026. If, on or prior to the date that is six months after the closing date of Amendment No. 6, we prepay any loans under the 2019 Term Loan Refinancing Facility in connection with a repricing transaction, we must pay a prepayment premium of 1.00% of the aggregate principal amount of the loans so prepaid.

As of December 31, 2019, after total principal prepayments of \$525.0 million and regularly scheduled principal payments of \$12.6 million, the total outstanding principal balance of the Term Loan Facility was \$892.4 million and the interest rate was 3.45%.

On January 24, 2020, we made an additional principal prepayment of \$50.0 million, reducing the outstanding principal balance of the Term Loan Facility to \$842.4 million.

Under the Term Loan Credit Agreement, we are required to prepay outstanding term loans, subject to certain exceptions, with portions of our annual excess cash flow as well as with the net cash proceeds of certain of our asset sales, certain casualty and condemnation events and the incurrence or issuance of certain debt. Due to our prepayments of term loan debt of \$100 million during 2019, we were not required to make a prepayment of excess cash flow for the period ended December 31, 2019.

All obligations under the Term Loan Facility are guaranteed by certain of our domestic subsidiaries, and are collateralized by substantially all of our assets and the assets of such subsidiaries, subject to certain exceptions and exclusions.

The Term Loan Credit Agreement contains customary representations and warranties, affirmative and negative covenants and provisions relating to events of default. If an event of default occurs, the lenders under the Term Loan Facility will be entitled to take various actions, including the acceleration of amounts due under the Term Loan Facility and all actions generally permitted to be taken by a secured creditor. At December 31, 2019, we were in compliance with all covenants under the Term Loan Credit Agreement.

Senior Secured Asset-Based Revolving Credit Facility

On February 1, 2019, in connection with the completion of the ESI Merger, we entered into an asset-based revolving credit agreement with Barclays Bank PLC, as administrative agent and collateral agent, the other borrowers from time to time party thereto, and the lenders and letters of credit issuers from time to time party thereto (the "ABL Credit Agreement"), that provides a senior secured asset-based revolving credit facility of up to \$100.0 million, subject to a borrowing base limitation (the "ABL Facility"). On April 26, 2019, we entered into a First Amendment to the ABL Credit Agreement which amended the borrowing base calculation for eligible

inventory prior to an initial field examination and appraisal requirements. The borrowing base for the ABL Facility at any time equals the sum of: (a) 85% of certain eligible accounts; plus (b) prior to certain notice and field examination and appraisal requirements, the lesser of (i) 20% of net book value of eligible inventory in the United States and (ii) 30% of the borrowing base, and after the satisfaction of such requirements, the lesser of (i) the lesser of (A) 65% of the lower of cost or market value of certain eligible inventory and (B) 85% of the net orderly liquidation value of certain eligible inventory and (ii) 30% of the borrowing base; minus (c) reserves established by the administrative agent, in each case, subject to additional limitations and examination requirements for eligible accounts and eligible inventory acquired in an acquisition after February 1, 2019. The ABL Facility includes borrowing capacity in the form of letters of credit up to \$25.0 million.

Borrowings under the ABL Facility bear interest at a rate per annum equal to, at our option, any of the following, plus, in each case, an applicable margin: (a) a base rate determined by reference to the highest of (1) the federal funds effective rate plus 0.50%, (2) the “prime rate” quoted in *The Wall Street Journal*, (3) a LIBOR rate determined by reference to the costs of funds for U.S. dollar deposits for an interest period of one month adjusted for certain additional costs, plus 1.00% and (4) a floor of 0.00%; and (b) a LIBOR rate determined by reference to the costs of funds for U.S. dollar deposits for the interest period relevant to such borrowing adjusted for certain additional costs, with a floor of 0.00%. The initial applicable margin for borrowings under the ABL Facility is 0.50% with respect to base rate borrowings and 1.50% with respect to LIBOR borrowings. Commencing with the completion of the first fiscal quarter ending after the closing of the ABL Facility, the applicable margin for borrowings thereunder is subject to upward or downward adjustment each fiscal quarter, based on the average historical excess availability during the preceding quarter.

In addition to paying interest on any outstanding principal under the ABL Facility, we are required to pay a commitment fee in respect of the unused commitments thereunder equal to 0.25% per annum. We must also pay customary letter of credit fees and agency fees.

We incurred \$0.8 million of costs in connection with the ABL Facility, which were capitalized and included in other assets in the accompanying consolidated balance sheet and are being amortized to interest expense over the contractual term of five years of the ABL Facility. As a result of a prior senior secured asset-based revolving credit facility being terminated concurrently with our entry into the ABL Facility, we wrote off \$0.2 million of previously capitalized debt issuance costs.

If at any time the aggregate amount of outstanding loans, protective advances, unreimbursed letter of credit drawings and undrawn letters of credit under the ABL Facility exceeds the lesser of (a) the commitment amount and (b) the borrowing base, we are required to repay outstanding loans and/or cash collateralize letters of credit, with no reduction of the commitment amount. During any period that the amount available under the ABL Facility is less than the greater of (i) \$8.5 million and (ii) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base for three consecutive business days, until the time when excess availability has been at least the greater of (i) \$8.5 million and (ii) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base, in each case, for 30 consecutive calendar days (a “Cash Dominion Period”), or during the continuance of an event of default, we are required to repay outstanding loans and/or cash collateralize letters of credit with the cash that it is required to deposit daily in a collection account maintained with the administrative agent under the ABL Facility. During a Cash Dominion Period, we may make borrowings under the ABL Facility subject to the satisfaction of customary funding conditions.

There is no scheduled amortization under the ABL Facility. The principal amount outstanding under the ABL Facility is due and payable in full on the fifth anniversary of the closing date.

All obligations under the ABL Facility are guaranteed by certain of our domestic subsidiaries, and are collateralized by substantially all of our assets and the assets of such subsidiaries, subject to certain exceptions and exclusions.

From the time when we have excess availability less than the greater of (a) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base and (b) \$8.5 million, until the time when we have excess availability equal to or greater than the greater of (a) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base and (b) \$8.5 million for 30 consecutive days, or during the continuance of an event of default, the ABL Credit Agreement requires us to maintain a Fixed Charge Coverage Ratio (as defined in the ABL Credit Agreement) tested on the last day of each fiscal quarter of at least 1.0 to 1.0.

The ABL Credit Agreement also contains customary representations and warranties, affirmative covenants and provisions relating to events of default. If an event of default occurs, the lenders under the ABL Facility will be entitled to take various actions, including the acceleration of amounts due under the ABL Facility and all actions permitted to be taken by a secured creditor. We have not borrowed against this ABL Facility to date.

Lines of Credit and Short-Term Borrowing Arrangements

One of our Japanese subsidiaries has lines of credit and short-term borrowing arrangements with two financial institutions which arrangements generally expire and are renewed at three-month intervals. The lines of credit provided for aggregate borrowings as of December 31, 2019, of up to an equivalent of \$21.1 million U.S. dollars. One of the borrowing arrangements has an interest rate based on the Tokyo Interbank Offer Rate at the time of borrowing and the other has an interest rate based on the Japanese Short-Term Prime Lending Rate. There were no borrowings outstanding under these arrangements at December 31, 2019 and 2018, respectively.

We assumed various revolving lines of credit and a financing facility with the completion of the Newport Merger. These revolving lines of credit and financing facility have no expiration date and provide for aggregate borrowings as of December 31, 2019 of up to an equivalent of \$11.5 million U.S. dollars. These lines of credit have a base interest rate of 1.25% plus a Japanese Yen overnight LIBOR rate. Total borrowings outstanding under these arrangements were \$3.1 million and \$3.4 million at December 31, 2019 and 2018.

We have provided financial guarantees for certain unsecured borrowings and have standby letters of credit, some of which do not have fixed expiration dates. At December 31, 2019, our maximum exposure as a result of these financial guarantees and standby letters of credit was approximately \$5.1 million.

Sale of Long-Lived Assets

In August of 2019, we sold two of our buildings in Boulder, Colorado and three of our buildings in Portland, Oregon. Total net cash proceeds received for these two transactions was \$41.2 million and we recognized a net gain on the sale of these long-lived assets of \$6.8 million.

Our total cash and cash equivalents and short-term marketable investments at December 31, 2019 consisted of \$263.2 million held in the United States and \$260.8 million held by our foreign subsidiaries. We believe that our current cash and investments position and available borrowing capacity, together with the cash anticipated to be generated from our operations, will be sufficient to satisfy our estimated working capital, planned capital expenditure requirements, and any future cash dividends declared by our Board of Directors or share repurchases through at least the next 12 months and the foreseeable future.

Contractual Obligations

In connection with the ESI Merger, which closed in February 2019, in addition to the entry into Amendment No. 5 to our Term Loan Credit Agreement described above, we assumed certain contractual lease obligations and purchase obligations in 2019.

Future contractual obligations as of December 31, 2019 are as follows:

Contractual Obligations (In thousands)	Payment Due By Period					
	Total	Less than 1 Year	1-3 years	3-5 years	After 5 years	Other
Operating lease obligations	\$ 65,391	\$ 20,227	\$ 21,374	\$ 12,917	\$ 10,873	\$ —
Purchase obligations(1)	302,270	258,137	30,737	10,615	2,781	—
Pension obligations	38,651	1,133	2,519	3,020	31,979	—
Debt	895,576	12,099	18,031	17,937	847,509	—
Other long-term liabilities reflected on the Balance Sheet under U.S. GAAP(2)	120,669	—	7,147	433	77,907	35,182
Total	<u>\$ 1,422,557</u>	<u>\$ 291,596</u>	<u>\$ 79,808</u>	<u>\$ 44,922</u>	<u>\$ 971,049</u>	<u>\$ 35,182</u>

- (1) As of December 31, 2019, we have entered into purchase commitments for certain inventory components and other equipment and services used in our normal operations. The majority of these purchase commitments covered by these arrangements are for periods less than a year and aggregate to approximately \$258.1 million.
- (2) The majority of this balance relates to deferred tax liabilities.

Derivatives

We enter into derivative instruments for risk management purposes only, including derivatives designated as hedging instruments and those utilized as economic hedges. We operate internationally, and in the normal course of business, are exposed to fluctuations in interest rates and foreign exchange rates. These fluctuations can increase the costs of financing, investing and operating the business. We have used derivative instruments, such as forward exchange contracts and an interest rate hedge to manage certain foreign currency and interest rate exposures.

By nature, all financial instruments involve market and credit risks. We enter into derivative instruments with major investment grade financial institutions and no collateral is required. We have policies to monitor the credit risk of these counterparties. While there can be no assurance, we do not anticipate any material non-performance by any of these counterparties.

We hedge a portion of our forecasted foreign currency denominated intercompany sales of inventory, over a maximum period of eighteen months, using forward foreign exchange contracts accounted for as cash-flow hedges related to Japanese, South Korean, British, Euro and Taiwanese currencies. To the extent these derivatives are effective in offsetting the variability of the hedged cash flows, and otherwise meet the hedge accounting criteria, changes in the derivatives' fair value are not included in current earnings but are included in accumulated other comprehensive income in stockholders' equity. These changes in fair value will subsequently be reclassified into earnings, as applicable, when the forecasted transaction occurs. To the extent that a previously designated hedging transaction is no longer an effective hedge, any ineffectiveness measured in the hedging relationship is recorded currently in earnings in the period it occurs. The cash flows resulting from forward exchange contracts are classified in the consolidated statements of cash flows as part of cash flows from operating activities. We do not enter into derivative instruments for trading or speculative purposes.

We also enter into forward exchange contracts to hedge certain balance sheet amounts. To the extent the hedge accounting criteria is not met, the related foreign currency forward contracts are considered as economic hedges and changes in the fair value of these contracts are recorded immediately in earnings in the period in which they occur. These include hedges that are used to reduce exchange rate risks arising from the change in fair value of certain foreign currency-denominated assets and liabilities (i.e., payables, receivables) and other economic hedges where the hedge accounting criteria were not met.

We had forward exchange contracts with notional amounts totaling \$154.7 million outstanding at December 31, 2019 of which \$51.7 million were outstanding to exchange South Korean Won to U.S. dollars and \$45.9 million were outstanding to exchange Japanese Yen to U.S. dollars. We had forward exchange contracts with notional amounts totaling \$159.4 million outstanding at December 31, 2018 of which \$59.1 million were outstanding to exchange South Korean Won to U.S. dollars and \$43.8 million were outstanding to exchange Japanese Yen to U.S. dollars.

As of December 31, 2019, the unrealized loss that will be reclassified from accumulated other comprehensive income to earnings over the next twelve months is immaterial. Gains and losses on forward exchange contracts that qualify for hedge accounting are classified in cost of products in 2019 and 2018 and totaled a gain (loss) of \$5.7 and \$(3.4) million, respectively. There were no ineffective portions of the derivatives recorded in 2019 and 2018.

We hedge certain intercompany accounts receivable and intercompany loans with forward exchange contracts. Typically, as these derivatives hedge existing amounts that are denominated in foreign currencies, the derivatives do not qualify for hedge accounting. Realized and unrealized gains and losses on forward exchange contracts that do not qualify for hedge accounting are recognized currently in earnings. The net foreign exchange losses on these derivatives were immaterial in each of 2019 and 2018. Foreign currency gains or losses are classified in other expense, net. The cash flows resulting from forward exchange contracts are classified in our consolidated statements of cash flows as part of cash flows from operating activities. We do not hold or issue derivative financial instruments for trading purposes.

We have also entered into interest rate swap agreements related to our Term Loan Facility. See details above under “Senior Secured Term Loan Credit Facility.”

Off-Balance Sheet Arrangements

We do not have any financial partnerships with unconsolidated entities, such as entities often referred to as structured finance, special purpose entities or variable interest entities, which are often established for the purpose of facilitating off-balance sheet arrangements or for other contractually narrow or limited purposes. Accordingly, we have no off-balance sheet arrangements that have or are reasonably expected to have a current or future effect on our financial condition, changes in financial condition, revenues or expenses, results of operations, liquidity, capital expenditures or capital resources that are material to investors.

Recently Issued Accounting Pronouncements

In December 2019, the Financial Accounting Standards Board (“FASB”) issued Accounting Standards Update (“ASU”) 2019-12, “Income Taxes (Topic 740).” This standard simplifies the accounting for income taxes by removing certain exceptions to the general principles in Topic 740. The amendments also improve consistent application and simplify U.S. GAAP for other areas of Topic 740 by clarifying and amending existing guidance. This standard is effective for annual periods beginning after December 15, 2021, including interim periods within those fiscal years beginning after December 15, 2022. We evaluated the requirements of this ASU and the impact of pending adoption on our consolidated financial statements. We do not expect that the impact of these changes will be material to our consolidated financial statements when adopted.

In August 2018, the FASB issued ASU 2018-15, “Intangibles-Goodwill and Other-Internal-Use Software (Subtopic 350-40): Customer’s Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement that is a Service Contract.” This standard aligns the requirements for capitalizing implementation costs incurred in a hosting arrangement that is a service contract with the requirements for capitalizing implementation costs incurred to develop or obtain internal-use software (and hosting arrangements that include an internal-use software license). The accounting for the service element of a hosting arrangement that is a service contract is not affected by the amendments to this update. This standard is effective for annual periods

beginning after December 15, 2019, including interim periods within those fiscal years. We are currently evaluating the requirements of this ASU and the impact of pending adoption on our consolidated financial statements.

In June 2016, the FASB issued ASU 2016-13, "Financial Instruments—Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments." This standard introduced the expected credit losses methodology for the measurement of credit losses on financial assets that are not measured at fair value through net income and replaces today's "incurred loss" model with an "expected credit loss" model that requires consideration of a broader range of information to estimate expected credit losses over the lifetime of the asset. There have been several consequential subsequent amendments to this standard. This standard is effective for annual periods beginning after December 15, 2019, including interim periods within those fiscal years. We do not expect adoption of this ASU to have a material impact on our consolidated financial statements.

Item 7A. Quantitative and Qualitative Disclosures about Market Risk

Market Risk and Sensitivity Analysis

Our primary exposures to market risks include fluctuations in interest rates on our Term Loan Facility, as defined and as described further in Item 7 of this Annual Report on Form 10-K, and investment portfolio, as well as fluctuations in foreign currency exchange rates.

Foreign Exchange Rate Risk

We mainly enter into forward exchange contracts to reduce currency exposure arising from intercompany sales of inventory. We also enter into forward exchange contracts to reduce foreign exchange risks arising from the change in fair value of certain foreign currency denominated assets and liabilities.

We had forward exchange contracts with notional amounts totaling \$154.7 million outstanding and a net fair value liability of \$0.2 million at December 31, 2019. We had forward exchange contracts with notional amounts totaling \$159.4 million outstanding and a net fair value asset totaling \$1.3 million at December 31, 2018. The potential fair value loss for a hypothetical 10% adverse change in the currency exchange rate on our forward exchange contracts at December 31, 2019 and 2018 would be immaterial.

Interest Rate Risk

We hold our cash, cash equivalents and short-term investments for working capital purposes. Some of the securities we invest in are subject to market risk. This means that a change in prevailing interest rates may cause the principal amount of such investments to fluctuate. To minimize this risk, we maintain our portfolio of cash, cash equivalents and short-term investments in a variety of securities including money market funds and government debt securities. Due to the short-term nature of these instruments, we believe that we do not have any material exposure to changes in the fair value of our investment portfolio as a result of changes in interest rates. Declines in interest rates, however, would reduce future interest income. The effect of a hypothetical 10% increase or decrease in overall interest rates would not have had a material impact on our operating results or the total fair value of the portfolio.

We are exposed to market risks related to fluctuations in interest rates related to our Term Loan Facility. As of December 31, 2019, we owed \$892.4 million with \$250.0 million at a fixed interest rate of 1.198%, plus the applicable credit spread which was 1.75% at December 31, 2019, \$300.0 million at a fixed interest rate of 2.309%, plus the applicable credit spread which was 1.75% at December 31, 2019, and \$342.4 million at a variable interest rate of 1.75% plus LIBOR. We performed a sensitivity analysis on the outstanding portion of our debt obligations as of December 31, 2019. Should the current average interest rate increase or decrease by 10%, the resulting annual increase or decrease to interest expense would be approximately \$1.2 million as of December 31, 2019.

From time to time, we have outstanding lines of credit and short-term borrowings with variable interest rates, primarily denominated in Japanese Yen. As of December 31, 2019, \$3.1 million was outstanding under these arrangements. These lines of credit have a base interest rate of 1.25% plus a Japanese Yen overnight LIBOR rate. A 10% change in interest rates would not have had a material impact on our operating results.

Item 8. Financial Statements and Supplementary Data

Report of Independent Registered Public Accounting Firm

To the Board of Directors and Stockholders of MKS Instruments, Inc.

Opinions on the Financial Statements and Internal Control over Financial Reporting

We have audited the accompanying consolidated balance sheets of MKS Instruments, Inc. and its subsidiaries (the “Company”) as of December 31, 2019 and 2018, and the related consolidated statements of operations and comprehensive income, of stockholders’ equity and of cash flows for each of the three years in the period ended December 31, 2019, including the related notes and schedule of valuation and qualifying accounts for each of the three years in the period ended December 31, 2019 as listed in the index appearing under Item 15(a)(2) (collectively referred to as the “consolidated financial statements”). We also have audited the Company’s internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control – Integrated Framework* (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO).

In our opinion, the consolidated financial statements referred to above present fairly, in all material respects, the financial position of the Company as of December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019 in conformity with accounting principles generally accepted in the United States of America. Also in our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control – Integrated Framework* (2013) issued by the COSO.

Changes in Accounting Principles

As discussed in Note 3 to the consolidated financial statements, the Company changed the manner in which it accounts for leasing arrangements in 2019 and the manner in which it accounts for revenue from contracts with customers in 2018.

Basis for Opinions

The Company’s management is responsible for these consolidated financial statements, for maintaining effective internal control over financial reporting, and for its assessment of the effectiveness of internal control over financial reporting, included in Management’s Report on Internal Control over Financial Reporting appearing under Item 9A. Our responsibility is to express opinions on the Company’s consolidated financial statements and on the Company’s internal control over financial reporting based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audits to obtain reasonable assurance about whether the consolidated financial statements are free of material misstatement, whether due to error or fraud, and whether effective internal control over financial reporting was maintained in all material respects.

Our audits of the consolidated financial statements included performing procedures to assess the risks of material misstatement of the consolidated financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the consolidated financial statements. Our audits also included evaluating the

accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the consolidated financial statements. Our audit of internal control over financial reporting included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, and testing and evaluating the design and operating effectiveness of internal control based on the assessed risk. Our audits also included performing such other procedures as we considered necessary in the circumstances. We believe that our audits provide a reasonable basis for our opinions.

As described in Management's Report on Internal Control over Financial Reporting, management has excluded Electro Scientific Industries, Inc. from its assessment of internal control over financial reporting as of December 31, 2019, because it was acquired by the Company in a purchase business combination during 2019. We have also excluded Electro Scientific Industries, Inc. from our audit of internal control over financial reporting. Electro Scientific Industries, Inc. is a wholly-owned subsidiary whose total assets and total revenues excluded from management's assessment and our audit of internal control over financial reporting represent 29% and 10%, respectively, of the related consolidated financial statement amounts as of and for the year ended December 31, 2019.

Definition and Limitations of Internal Control over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (i) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Critical Audit Matters

The critical audit matters communicated below are matters arising from the current period audit of the consolidated financial statements that were communicated or required to be communicated to the audit committee and that (i) relate to accounts or disclosures that are material to the consolidated financial statements and (ii) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the consolidated financial statements, taken as a whole, and we are not, by communicating the critical audit matters below, providing separate opinions on the critical audit matters or on the accounts or disclosures to which they relate.

Acquisition of Electro Scientific Industries, Inc. ("ESI") – Valuation of Laser Completed Technology Intangible Asset

As described in Note 12 to the consolidated financial statements, the Company completed its acquisition of Electro Scientific Industries, Inc. ("ESI") for a purchase price of \$1,019.2 million, net of cash and cash equivalents acquired. As part of the purchase price allocation, management recorded \$255.7 million for the fair value of the acquired laser completed technology intangible asset, which was determined using the income approach. In performing the valuation for the intangible asset, the key underlying judgments and assumptions used included the discount rate as well as forecasted revenue growth rates and gross profit and operating margins.

The principal considerations for our determination that performing procedures relating to the valuation of the laser completed technology intangible asset is a critical audit matter are there was significant judgment by management when estimating the fair value of the acquired laser completed technology intangible asset, which in turn led to a high degree of auditor judgment, subjectivity, and effort in performing procedures and evaluating audit evidence relating to management's estimates and assumptions with respect to the discount rate and forecasted revenue growth rates and gross profit and operating margins. In addition, the audit effort involved the use of professionals with specialized skill and knowledge to assist in performing procedures over the discount rate and evaluating the audit evidence obtained.

Addressing the matter involved performing procedures and evaluating audit evidence in connection with forming our overall opinion on the consolidated financial statements. These procedures included testing the effectiveness of controls relating to the acquisition accounting, including controls over management's valuation of the acquired laser completed technology and assumptions related to the discount rate and forecasted revenue growth rates and gross profit and operating margins. These procedures also included, among others, (i) reading the purchase agreement, (ii) evaluating the methods and significant assumptions used by management in developing the fair value for the laser completed technology intangible asset, including the discount rate and forecasted revenue growth rates and gross profit and operating margins, and (iii) testing the completeness, accuracy and relevance of the underlying data used in the valuation. Evaluating whether the discount rate and forecasted revenue growth rates and gross profit and operating margins were reasonable involved considering the past performance of the acquired entity and industry data. Professionals with specialized skill and knowledge were used to assist in the evaluation of management's valuation model and certain significant assumptions, including the discount rate.

Goodwill – Quantitative Impairment Assessment – Equipment & Solutions Reporting Unit

As described in Notes 3, 12, 13, and 21 to the consolidated financial statements, the Company's consolidated goodwill balance was \$1,058.5 million as of December 31, 2019, and the goodwill balance for the Equipment & Solutions reportable segment was \$473.3 million as of December 31, 2019, which constitutes the goodwill of the Equipment & Solutions reporting unit. Management assesses goodwill for impairment on an annual basis as of October 31 or more frequently when events and circumstances occur indicating that the recorded goodwill may be impaired. In the quantitative assessment, management compares the fair value of the reporting unit to its carrying amount, which includes goodwill. If the fair value exceeds the carrying value, no impairment loss exists. If the fair value is less than the carrying amount, a goodwill impairment loss is measured and recorded. The estimated fair value of the Company's reporting units are based on discounted cash flow models. Determining fair value requires the exercise of significant judgment, including judgments about discount and terminal growth rates, as well as forecasted revenue growth rates and gross profit and operating margins.

The principal considerations for our determination that performing procedures relating to the quantitative goodwill impairment assessment of the Equipment & Solutions reporting unit is a critical audit matter are there was significant judgment by management when determining the fair value measurement of the reporting unit, which in turn led to a high degree of auditor judgment, subjectivity, and effort in performing procedures and evaluating audit evidence relating to the significant assumptions used in the discounted cash flow model, including the discount rate and forecasted revenue growth rates and gross profit and operating margins. In addition, the audit effort involved the use of professionals with specialized skill and knowledge to assist in the evaluation of management's valuation model and certain significant assumptions, including the discount rate.

Addressing the matter involved performing procedures and evaluating audit evidence in connection with forming our overall opinion on the consolidated financial statements. These procedures included testing the effectiveness of controls relating to management's goodwill impairment assessment, including controls over the significant assumptions used in the valuation of the Equipment & Solutions reporting unit related to the discount rate and forecasted revenue growth rates and gross profit and operating margins. These procedures also included, among others, (i) testing management's process for developing the fair value estimate; (ii) evaluating the

appropriateness of the discounted cash flow model; (iii) testing the completeness and accuracy of underlying data used in the model; and (iv) evaluating the significant assumptions used by management, including the discount rate and forecasted revenue growth rates and gross profit and operating margins. Evaluating management's assumptions related to the discount rate and forecasted revenue growth rates and gross profit and operating margins involved evaluating whether the assumptions used by management were reasonable considering the current and past performance of the reporting unit, external market and industry data, and whether these assumptions were consistent with evidence obtained in other areas of the audit. Professionals with specialized skill and knowledge were used to assist in the evaluation of the Company's discounted cash flow model and certain significant assumptions, including the discount rate.

/s/ PricewaterhouseCoopers LLP
Boston, Massachusetts
February 28, 2020

We have served as the Company's auditor since 1981.

MKS Instruments, Inc.
Consolidated Balance Sheets

	December 31,	
	2019	2018
(in thousands, except share data)		
ASSETS		
Current assets:		
Cash and cash equivalents	\$ 414,572	\$ 644,345
Short-term investments	109,417	73,826
Trade accounts receivable, net of allowance for doubtful accounts of \$1,783 and \$5,243 at December 31, 2019 and 2018, respectively	341,064	295,454
Inventories	462,146	384,689
Other current assets	106,348	65,790
Total current assets	<u>1,433,547</u>	<u>1,464,104</u>
Property, plant and equipment, net	241,871	194,367
Right-of-use asset	64,497	—
Goodwill	1,058,454	586,996
Intangible assets, net	564,630	319,807
Long-term investments	5,854	10,290
Other assets	47,467	38,682
Total assets	<u>\$ 3,416,320</u>	<u>\$ 2,614,246</u>
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Short-term debt	\$ 12,099	\$ 3,986
Accounts payable	88,397	83,825
Accrued compensation	100,851	82,350
Income taxes payable	15,448	16,358
Lease liability	20,632	—
Deferred revenue and customer advances	21,494	14,246
Other current liabilities	58,760	62,520
Total current liabilities	<u>317,681</u>	<u>263,285</u>
Long-term debt, net	871,667	343,842
Non-current deferred taxes	72,428	48,223
Non-current accrued compensation	43,930	55,598
Non-current lease liability	44,759	—
Other non-current liabilities	42,511	30,111
Total liabilities	<u>1,392,976</u>	<u>741,059</u>
Commitments and contingencies (Note 23)		
Stockholders' equity:		
Preferred stock, \$0.01 par value, 2,000,000 shares authorized; none issued and outstanding	—	—
Common stock, no par value, 200,000,000 shares authorized; 54,596,183 and 54,039,554 shares issued and outstanding at December 31, 2019 and 2018, respectively	113	113
Additional paid-in capital	864,305	793,932
Retained earnings	1,181,216	1,084,797
Accumulated other comprehensive loss	(22,290)	(5,655)
Total stockholders' equity	<u>2,023,344</u>	<u>1,873,187</u>
Total liabilities and stockholders' equity	<u>\$ 3,416,320</u>	<u>\$ 2,614,246</u>

The accompanying notes are an integral part of the consolidated financial statements.

MKS Instruments, Inc.
Consolidated Statements of Operations and Comprehensive Income

	Years Ended December 31,		
	2019	2018	2017
	(in thousands, except per share data)		
Net Revenues:			
Products	\$ 1,611,297	\$ 1,835,202	\$ 1,701,301
Services	288,476	239,906	214,676
Total net revenues	1,899,773	2,075,108	1,915,977
Cost of revenues:			
Products	913,482	969,288	906,369
Services	155,860	126,344	118,157
Total cost of revenues (exclusive of amortization shown separately below)	1,069,342	1,095,632	1,024,526
Gross profit	830,431	979,476	891,451
Research and development	164,061	135,720	132,555
Selling, general and administrative	330,346	298,118	290,056
Acquisition and integration costs	37,262	3,113	5,332
Restructuring and other	6,983	4,567	3,920
Fees and expenses related to repricing of Term Loan Facility	6,637	378	492
Amortization of intangible assets	67,402	43,521	45,743
Gain on sale of long-lived assets	(6,773)	—	—
Asset impairment	4,662	—	6,719
Income from operations	219,851	494,059	406,634
Interest income	5,453	5,775	3,021
Interest expense	44,135	16,942	30,990
Gain on sale of business	—	—	74,856
Other expense, net	3,333	1,942	5,896
Income before income taxes	177,836	480,950	447,625
Provision for income taxes	37,450	88,054	108,493
Net income	\$ 140,386	\$ 392,896	\$ 339,132
Other comprehensive income, net of tax:			
Changes in value of financial instruments designated as cash flow hedges	\$ (10,013)	\$ 4,942	\$ (4,568)
Foreign currency translation adjustments	(6,111)	(14,161)	37,172
Unrecognized pension (loss) gain	(536)	149	323
Unrealized gain (loss) on investments	25	(37)	1,072
Total comprehensive income	\$ 123,751	\$ 383,789	\$ 373,131
Net income per share:			
Basic	\$ 2.57	\$ 7.22	\$ 6.26
Diluted	\$ 2.55	\$ 7.14	\$ 6.16
Weighted average common shares outstanding:			
Basic	54,711	54,406	54,137
Diluted	55,111	54,992	55,074

The accompanying notes are an integral part of the consolidated financial statements.

MKS Instruments, Inc.
Consolidated Statements of Stockholders' Equity

(in thousands, except share data)	Common Stock		Additional Paid-In Capital	Retained Earnings	Accumulated Other Comprehensive Income/(Loss)	Total Stockholders' Equity
	Shares	Amount				
Balance at December 31, 2016	53,672,861	\$ 113	\$777,482	\$ 494,744	\$ (30,547)	\$ 1,241,792
Net issuance under stock-based plans	682,674		(12,216)			(12,216)
Stock-based compensation			24,378			24,378
Cash dividend (\$0.71 per common share)				(38,178)		(38,178)
Comprehensive income (net of tax):						
Net income				339,132		339,132
Other comprehensive gain					33,999	33,999
Balance at December 31, 2017	54,355,535	\$ 113	\$789,644	\$ 795,698	\$ 3,452	\$ 1,588,907
Net issuance under stock-based plans	502,150		(11,104)			(11,104)
Stock-based compensation			27,262			27,262
Stock repurchase	(818,131)		(11,870)	(63,130)		(75,000)
Cash dividend (\$0.78 per common share)				(42,405)		(42,405)
Accounting Standards Codification Topic 606 adjustment				1,738		1,738
Comprehensive income (net of tax):						
Net income				392,896		392,896
Other comprehensive loss					(9,107)	(9,107)
Balance at December 31, 2018	54,039,554	\$ 113	\$793,932	\$ 1,084,797	\$ (5,655)	\$ 1,873,187
Net issuance under stock-based plans	556,629		(11,010)			(11,010)
Settlement of share-based compensation awards(1)			30,630			30,630
Stock-based compensation			50,318			50,318
Cash dividend (\$0.80 per common share)				(43,528)		(43,528)
Stock dividends accrued			435	(435)		—
Other				(4)		(4)
Comprehensive income (net of tax):						
Net income				140,386		140,386
Other comprehensive loss					(16,635)	(16,635)
Balance at December 31, 2019	54,596,183	\$ 113	\$864,305	\$ 1,181,216	\$ (22,290)	\$ 2,023,344

(1) Represents the vested but unissued portion of Electro Scientific Industries, Inc. ("ESI") share-based compensation awards as of the acquisition date of February 1, 2019 as described further in Note 12.

The accompanying notes are an integral part of the consolidated financial statements.

MKS Instruments, Inc.
Consolidated Statements of Cash Flows
(in thousands)

	Years Ended December 31,		
	2019	2018	2017
Cash flows from operating activities:			
Net income	\$ 140,386	\$ 392,896	\$ 339,132
Adjustments to reconcile net income to net cash provided by operating activities:			
Depreciation and amortization	110,034	79,853	82,556
Amortization of inventory step-up adjustment to fair value	7,624	—	—
Amortization of debt issuance cost and original issue discount	7,074	4,718	10,699
Stock-based compensation	49,194	27,262	24,378
Provision for excess and obsolete inventory	24,734	22,324	20,213
Provision for doubtful accounts	(728)	1,435	825
Deferred income taxes	(4,215)	(19,388)	(4,831)
Gain on sale of long-lived asset	(6,773)	—	—
Gain on sale of business	—	—	(74,856)
Asset impairment	4,662	—	6,719
Other	870	2,649	824
Changes in operating assets and liabilities, net of business acquired:			
Trade accounts receivable	(93)	(546)	(44,077)
Inventories	(29,289)	(73,779)	(72,471)
Income taxes payable	(12,374)	(11,430)	12,805
Other current and non-current assets	(9,830)	(1,639)	(8,631)
Current and non-current accrued compensation	(4,191)	(8,649)	32,502
Other current and non-current liabilities	(8,424)	(3,948)	18,030
Accounts payable	(24,152)	2,023	11,405
Net cash provided by operating activities	244,509	413,781	355,222
Cash flows (used in) provided by investing activities:			
Acquisition of business, net of cash acquired	(988,599)	—	—
Net proceeds from sale of business	—	—	72,509
Purchases of investments	(246,315)	(253,598)	(229,557)
Maturities of investments	142,571	181,749	157,342
Sales of investments	166,915	207,542	53,564
Proceeds from sale of assets	42,079	—	—
Purchases of property, plant and equipment	(63,904)	(62,941)	(31,287)
Other	—	—	66
Net cash (used in) provided by investing activities	(947,253)	72,752	22,637
Cash flows provided by (used in) financing activities:			
Net proceeds from short and long-term borrowings	642,207	67,669	28,551
Payments of short-term borrowings	(5,375)	(67,163)	(29,711)
Payments of long-term borrowings	(106,116)	(50,003)	(228,141)
Repurchases of common stock	—	(75,000)	—
Net payments related to employee stock awards	(11,010)	(11,104)	(12,216)
Dividend payments	(43,528)	(42,405)	(38,178)
Net cash provided by (used in) financing activities	476,178	(178,006)	(279,695)
Effect of exchange rate changes on cash and cash equivalents	(3,207)	1,931	1,813
(Decrease) increase in cash and cash equivalents	(229,773)	310,458	99,977
Cash and cash equivalents at beginning of period	644,345	333,887	233,910
Cash and cash equivalents at end of period	\$ 414,572	\$ 644,345	\$ 333,887
Supplemental disclosure of cash flow information:			
Cash paid during the period for:			
Interest	\$ 39,899	\$ 14,593	\$ 20,467
Income taxes	\$ 35,512	\$ 91,765	\$ 104,691

The accompanying notes are an integral part of the consolidated financial statements.

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS
(in thousands, except share and per share data)

1) Business Description

MKS Instruments, Inc. (“MKS” or the “Company”) was founded in 1961 and is a global provider of instruments, systems, subsystems and process control solutions that measure, monitor, deliver, analyze, power and control critical parameters of advanced manufacturing processes to improve process performance and productivity for our customers. The Company’s products are derived from its core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery, vacuum technology, lasers, photonics, optics, precision motion control, vibration control and laser-based manufacturing systems solutions. The Company also provides services relating to the maintenance and repair of its products, installation services and training. The Company’s primary served markets include semiconductor, industrial technologies, life and health sciences, research and defense. The Company groups its product/service offerings into three groups. These three groups are: Advanced Manufacturing Components, Advanced Manufacturing Systems and Global Service.

Effective February 1, 2019, in conjunction with the Company’s acquisition of ESI as described further in Note 12, we created a third reportable segment known as the Equipment & Solutions segment in addition to its two then-existing reportable segments: the Vacuum & Analysis segment and the Light & Motion segment.

2) Basis of Presentation

The consolidated financial statements include the accounts of MKS Instruments, Inc. and its wholly owned subsidiaries. All intercompany accounts and transactions have been eliminated in consolidation.

The consolidated financial statements have been prepared in accordance with accounting principles generally accepted in the United States of America (“U.S. GAAP”). The preparation of these financial statements requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. On an on-going basis, management evaluates its estimates and judgments, including those related to revenue recognition and allowance for doubtful accounts, inventory valuation, warranty costs, stock-based compensation, intangible assets, goodwill, other long-lived assets, in process research and development and other acquisition expenses and income taxes. Management bases its estimates and judgments on historical experience and on various other factors that are believed to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions.

3) Summary of Significant Accounting Policies

Leases

The Company adopted Accounting Standards Update (“ASU”) 2016-02 “Leases” on January 1, 2019 and used the effective date as its date of initial application. As such, the Company did not adjust prior period amounts. The Company also elected to adopt the package of practical expedients upon transition, which permits companies to not reassess lease identification, classification, and initial direct costs for leases that commenced prior to the effective date. The Company implemented internal controls and a lease accounting information system to enable preparation on adoption. Upon adoption, the Company recorded a cumulative effect of initially applying this new standard, resulting in the addition of \$71,042 of right-of-use assets and \$20,192 and \$54,147 of

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

short-term and long-term lease liabilities, respectively. The right-of-use asset is net of the deferred rent liability, prepaid rent and a net favorable lease asset which were re-classified to the right-of-use asset upon adoption of the standard.

The Company has various operating leases for real estate and non-real estate items. The non-real estate leases are mainly comprised of automobiles but also include copiers, printers and other lower-valued items. The Company does not have any finance leases.

The Company has existing leases that include variable lease and non-lease components that are not included in the right-of-use asset and lease liability and are reflected as expenses in the periods incurred. Such payments primarily include common area maintenance charges and increases in rent payments that are driven by factors such as future changes in an index (e.g., the Consumer Price Index).

The Company has lease arrangements with lease and non-lease components, has elected to account for the lease and non-lease components as a single lease component, and has allocated all of the contract consideration to the lease component only. The Company has existing net leases in which the non-lease components (e.g. common area maintenance, maintenance, consumables, etc.) are paid separately from rent based on actual costs incurred. Therefore, non-lease components are not included in the right-of-use asset and lease liability and are reflected as expenses in the periods incurred.

Revenue from Contracts with Customers

The Company adopted Accounting Standards Codification (“ASC”) 606 (“ASC 606”) on January 1, 2018 using the modified retrospective method for all contracts not completed as of the date of adoption. The reported results for the twelve months ended December 31, 2019 and 2018 reflect the application of ASC 606 guidance while the reported results for 2017 were prepared under the guidance of ASC 605, Revenue Recognition.

The Company recorded a net increase to opening retained earnings of \$1,738 as of January 1, 2018 due to the cumulative impact of adopting ASC 606, with the impact primarily related to its service business and certain custom products. The impact to revenue for the year ended December 31, 2018 as a result of applying ASC 606 was immaterial.

The adoption of ASC 606 represents a change in accounting principle that will more closely align revenue recognition with the delivery of the Company’s goods or services and will provide financial statement readers with enhanced disclosures. To achieve this core principle, the Company applies the following steps:

- Identify the contract with a customer
- Identify the performance obligations in the contract
- Determine the transaction price
- Allocate the transaction price to performance obligations in the contract
- Recognize revenue when or as the Company satisfies a performance obligation

Revenue under ASC 606 is recognized when or as obligations under the terms of a contract with the Company’s customer has been satisfied and control has transferred to the customer. The majority of the Company’s performance obligations, and associated revenue, are transferred to customers at a point in time, generally upon shipment of a product to the customer or receipt of the product by the customer and without

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

significant judgments. Installation services are not significant and are usually completed in a short period of time (normally less than two weeks) and therefore, recorded at a point in time when the installation services are completed, rather than over time as they are not material. Extended warranty, service contracts, and repair services, which are transferred to the customer over time, are recorded as revenue as the services are performed. For repair services, the Company makes an accrual at quarter end based upon historical repair times within its product groups to record revenue based upon the estimated number of days completed to date, which is consistent with ratable recognition. Customized products with no alternative future use to the Company, and that have an enforceable right to payment for performance completed to date, are also recorded over time. The Company considers this to be a faithful depiction of the transfer to the customer of revenue over time as the work is performed or service is delivered, ratably over time.

Revenue is measured as the amount of consideration the Company expects to receive in exchange for transferring goods or providing services. Performance obligations promised in a contract are identified based on the products or services that will be transferred to the customer that are both capable of being distinct, whereby the customer can benefit from the product or service either on its own or together with other resources that are readily available from third parties or from the Company, and are distinct in the context of the contract, whereby the transfer of the product or service is separately identifiable from other promises in the contract. Sales, value add, and other taxes the Company collects concurrent with revenue-producing activities are excluded from revenue. The Company's normal payment terms are 30 to 60 days but vary by the type and location of its customers and the products or services offered. The time between invoicing and when payment is due is not significant. For certain products and services and customer types, the Company requires payment before the products or services are delivered to, or performed for, the customer.

Contracts with Multiple Performance Obligations

The Company periodically enters into contracts with its customers in which a customer may purchase a combination of goods and or services, such as products with installation services or extended warranty obligations. These contracts include multiple promises that the Company evaluates to determine if the promises are separate performance obligations. Once the Company determines the performance obligations, the Company then determines the transaction price, which includes estimating the amount of variable consideration to be included in the transaction price, if any. To the extent the transaction price includes variable consideration, the Company estimates the amount of variable consideration that should be included in the transaction price utilizing either the expected value method or the most likely amount method depending on the method the Company expects to better predict the amount of consideration to which it will be entitled. There are no constraints on the variable consideration recorded. The Company then allocates the transaction price to each performance obligation in the contract based on a relative stand-alone selling price charged separately to customers or using an expected cost plus margin method. The corresponding revenues are recognized when or as the related performance obligations are satisfied, which are noted above. The impact of variable consideration was immaterial during 2019 and 2018.

Deferred Revenues

The Company's standard assurance warranty period is normally 12 to 24 months. The Company sells separately-priced service contracts and extended warranty contracts related to certain of its products, especially its laser products. The separately priced contracts generally range from 12 to 60 months. The Company normally receives payment at the inception of the contract and recognizes revenue over the term of the agreement in proportion to the costs expected to be incurred in satisfying the obligations under the contract. The Company has elected to use the practical expedient related to disclosing the remaining performance obligations as of December 31, 2019 and 2018, as the majority have a duration of less than one year.

MKS INSTRUMENTS, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

Costs to Obtain and Fulfill a Contract

Under ASC 606, the Company expenses sales commissions when incurred because the amortization period would have been one year or less. These costs are recorded within selling, general and administration expenses. The Company has elected to recognize the costs for freight and shipping when control over products has transferred to the customer as an expense in cost of sales.

Product revenue, excluding revenue from certain custom products, is recorded at a point in time, while the majority of service revenue and revenue from certain custom products is recorded over time.

Accounts Receivable Allowances

Accounts receivable allowances include sales returns and bad debt allowances. The Company monitors and tracks the amount of product returns and reduces revenue at the time of shipment for the estimated amount of such future returns, based on historical experience. The Company makes estimates evaluating its allowance for doubtful accounts. The Company continuously monitors collections and payments from its customers and maintains a provision for estimated credit losses based upon its historical experience and any specific customer collection issues that it has identified.

Research and Development

Research and development costs are expensed as incurred and consist mainly of compensation-related expenses and project materials. The Company's research and development efforts include numerous projects, which generally have a duration of 3 to 30 months. Acquired in-process research and development ("IPR&D") expenses, which are capitalized at fair value as an intangible asset until the related project is completed, are then amortized over the estimated useful life of the product. The Company monitors projects and, if they are abandoned, the Company immediately writes them off.

Advertising Costs

Advertising costs are expensed as incurred and were immaterial in 2019, 2018 and 2017.

Stock-Based Compensation

The accounting for share-based compensation expense requires the measurement and recognition of compensation expense for all share-based payment awards made to employees and directors based on estimated fair values. For restricted stock units ("RSUs"), the fair value is measured on the date of grant and expensed normally over a three-year period. The Company also provides employees the opportunity to purchase shares through an employee stock purchase plan. For shares issued under its employee stock purchase plan, the Company has estimated the fair value on the date of grant using the Black-Scholes pricing model, which is affected by the Company's stock price as well as assumptions regarding a number of complex and subjective variables. These variables include the Company's expected stock price volatility over the term of the awards, expected life, risk-free interest rate and expected dividends. The Company is also required to estimate forfeitures at the time of grant and revise those estimates in subsequent periods if actual forfeitures differ from those estimates.

Management determined that blended volatility, a combination of historical and implied volatility, is more reflective of market conditions and a better indicator of expected volatility than historical or implied volatility

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

alone. The assumptions used in calculating the fair value of share-based payment awards represent management's best estimates, but these estimates involve inherent uncertainties and the application of management judgment. As a result, if factors change and the Company uses different assumptions, stock-based compensation expense could be materially different in the future.

Accumulated Other Comprehensive Income

For foreign subsidiaries where the functional currency is the local currency, assets and liabilities are translated into U.S. dollars at the current exchange rate on the balance sheet date. Revenue and expenses are translated at average rates of exchange prevailing during the year. Translation adjustments resulting from this process are recorded to Accumulated Other Comprehensive Income ("OCI"). Unrealized gains and losses on securities classified as available-for-sale and unrecognized pension gains and losses are included in OCI in consolidated stockholders' equity. For derivative instruments designated as cash-flow hedges, the effective portion of the derivative's gain (loss) is initially reported as a component of OCI and is subsequently recognized in earnings when the hedged exposure is recognized in earnings.

Net Income Per Share

Basic net income per share is based on the weighted average number of common shares outstanding and diluted net income per share is based on the weighted average number of common shares outstanding and all potential dilutive common equivalent shares outstanding. The dilutive effect of RSUs and SARs are determined under the treasury stock method using the average market price for the period. Common equivalent shares are included in the per share calculations when the effect of their inclusion would be dilutive.

Cash and Cash Equivalents and Investments

All highly liquid investments with a maturity date of three months or less at the date of purchase are considered to be cash equivalents. The appropriate classification of investments in securities is determined at the time of purchase. Debt securities that the Company does not have the intent and ability to hold to maturity are classified as "available-for-sale" and are carried at fair value.

The Company classifies investments with maturity dates greater than twelve months in short-term investments rather than long-term investments. This method classifies these securities as current based on the nature of the securities and the availability for use in current operations. The Company believes this method is preferable because it is more reflective of the Company's assessment of its overall liquidity position.

The Company reviews its investment portfolio on a quarterly basis to identify and evaluate individual investments that have indications of possible impairment. The factors considered in determining whether a loss is other-than-temporary include: the length of time and extent to which fair market value has been below the cost basis, the financial condition and near-term prospects of the issuer, credit quality, and the Company's ability to hold the investment for a period of time sufficient to allow for any anticipated recovery in fair value.

In 2019, the Company determined that the fair value of an investment in a minority interest of a private company had significantly declined in value and therefore, recorded an impairment charge of \$4,662 for the remainder of its investment.

MKS INSTRUMENTS, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

Concentrations of Credit Risk

The Company's significant concentrations of credit risk consist principally of cash and cash equivalents, investments, forward exchange contracts and trade accounts receivable. The Company maintains cash and cash equivalents with financial institutions including some banks with which it had borrowings. The Company maintains investments primarily in U.S. Treasury and government agency securities and corporate debt securities. The Company enters into forward currency contracts with high credit-quality financial institutions in order to minimize credit risk exposure. The Company's largest customers are primarily concentrated in the semiconductor industry, and a limited number of these customers account for a significant portion of the Company's revenues. The Company regularly monitors the creditworthiness of its customers and believes it has adequately provided for potential credit loss exposures. Credit is extended for all customers based primarily on financial condition, and collateral is not required.

During the years 2019, 2018 and 2017, approximately 49%, 55% and 57% of the Company's net revenues, respectively, were from sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers. There were no customers that represented 10% or more of the Company's accounts receivable balance as of December 31, 2019 and 2018.

Inventories

Inventories are stated at the lower of cost or market, cost being determined using a standard costing system which approximates cost based on a first-in, first-out method. The Company regularly reviews inventory quantities on hand and records a provision to write-down excess and obsolete inventory to its estimated net realizable value, if less than cost, based primarily on its estimated forecast of product demand.

Property, Plant and Equipment

Property, plant and equipment are stated at cost. Expenditures for major renewals and betterments that extend the useful lives of property, plant and equipment are capitalized. Expenditures for maintenance and repairs are charged to expense as incurred. When assets are sold or otherwise disposed of, the cost and related accumulated depreciation are eliminated from the accounts and any resulting gain or loss is recognized in earnings.

Depreciation is provided on the straight-line method over the estimated useful lives of ten to fifty years for buildings and three to eighteen years for machinery and equipment, furniture and fixtures and office equipment, which includes enterprise resource planning software. Leasehold improvements are amortized over the shorter of the lease term or the estimated useful life of the leased asset.

Acquisition Accounting

The fair value of the consideration exchanged in an acquisition is allocated to tangible assets and identifiable intangible assets acquired and liabilities assumed at acquisition date fair value. Goodwill is measured as the excess of the consideration transferred over the net fair value of identifiable assets acquired and liabilities assumed. The accounting for an acquisition involves a considerable amount of judgement and estimation. Cost, income, market or a combination of approaches may be used to establish the fair value of consideration exchanged, assets acquired, and liabilities assumed, depending on the nature of those items. The valuation approach is determined in accordance with generally accepted valuation methods. Key areas of estimation and judgment may include the selection of valuation approaches, cost of capital, market characteristics, cost structure, impacts of synergies, and estimates of terminal value, among other factors.

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While the Company uses best estimates and assumptions as part of the purchase price allocation process to estimate the value of assets acquired and liabilities assumed, estimates are inherently uncertain and subject to refinement. During the measurement period, which may be up to one year from the acquisition date, the Company may record adjustments to the assets acquired and liabilities assumed, with a corresponding offset to goodwill, to the extent that adjustments are identified to the preliminary purchase price allocation. Upon conclusion of the measurement period, or final determination of the value of the assets acquired and liabilities assumed, whichever comes first, any subsequent adjustments are recorded to results of operations.

Intangible Assets

Intangible assets resulting from the acquisitions of businesses are estimated by management based on the fair value of assets acquired. These include acquired customer lists, technology, patents, trade names, covenants not to compete and IPR&D. Intangible assets are amortized from one to eighteen years on a straight-line basis which represents the estimated periods of benefit and the expected pattern of consumption.

Goodwill

Goodwill is the amount by which the cost of acquired net assets exceeded the fair value of those net assets on the date of acquisition. The Company allocates goodwill to reporting units at the time of acquisition or when there is a change in the reporting structure and bases that allocation on which reporting units will benefit from the acquired assets and liabilities. Reporting units are defined as operating segments or one level below an operating segment, referred to as a component. The Company assesses goodwill for impairment on an annual basis as of October 31 or more frequently when events and circumstances occur indicating that the recorded goodwill may be impaired.

The estimated fair value of the Company's reporting units are based on discounted cash flow models derived from internal earnings and internal and external market forecasts. Determining fair value requires the exercise of significant judgment, including judgments about appropriate discount and terminal growth rates, as well as forecasted revenue growth rates and gross profit and operating margins. Discount rates are based on a weighted average cost of capital ("WACC"), which represents the average rate a business must pay its providers of debt and equity. The WACC used to test goodwill is derived from a group of comparable companies. Assumptions in estimating future cash flows are subject to a high degree of judgment and complexity. The Company makes every effort to forecast these future cash flows as accurately as possible with the information available at the time the forecast is developed.

In performing the Company's annual goodwill impairment test, the Company is permitted to first assess qualitative factors to determine whether it is more likely than not that the fair value of our reporting unit is less than its carrying amount, including goodwill. In performing the qualitative assessment, the Company considers certain events and circumstances specific to the reporting unit and to the entity as a whole, such as macroeconomic conditions, industry and market considerations, overall financial performance and cost factors when evaluating whether it is more likely than not that the fair value of the reporting unit is less than its carrying amount. The Company is also permitted to bypass the qualitative assessment and proceed directly to the quantitative test. If the Company chooses to undertake the qualitative assessment and concludes that it is more likely than not that the fair value of the reporting unit is less than its carrying amount, the Company would then proceed to the quantitative impairment test. In the quantitative assessment, the Company compares the fair value of the reporting unit to its carrying amount, which includes goodwill. If the fair value exceeds the carrying value, no impairment loss exists. If the fair value is less than the carrying amount, a goodwill impairment loss is measured and recorded.

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Effective July 1, 2018, the Company reassigned goodwill to certain reporting units within the Light & Motion reportable segment resulting from a reorganization of the composition of reporting units. The goodwill was reassigned to the reporting units affected using the relative fair value approach. In conjunction with this goodwill reassignment, the Company performed an interim quantitative impairment test as of July 1, 2018 for all of its reporting units and concluded that the fair values of each reporting unit exceeded their respective carrying values.

Effective January 1, 2019, the Company reassigned goodwill to certain reporting units within the Light & Motion reportable segment resulting from a reorganization of the composition of reporting units. The goodwill was reassigned to the reporting units affected using the relative fair value approach. The Company also concluded that the fair value of each reporting unit exceeded its respective carrying value.

As of October 31, 2019, the Company performed its annual impairment assessment of goodwill by performing a quantitative impairment analysis of its Equipment & Solutions reporting unit and a qualitative analysis for all other reporting units and determined that it is more likely than not that the fair values of the reporting units exceed their carrying amount.

Impairment of Long-Lived Assets

The Company evaluates the recoverability of its long-lived assets whenever events and changes in circumstances indicate that the carrying amount of an asset may not be fully recoverable. This periodic review may result in an adjustment of estimated depreciable lives or asset impairment. When indicators of impairment are present, the carrying values of the asset are evaluated in relation to their operating performance and future undiscounted cash flows of the underlying business. If the future undiscounted cash flows are less than their carrying value, impairment exists. The impairment is measured as the difference between the carrying value and the fair value of the underlying asset. Fair values are based on estimates of market prices and assumptions concerning the amount and timing of estimated future cash flows and assumed discount rates, reflecting varying degrees of perceived risk.

Foreign Exchange

The functional currency of the majority of the Company's foreign subsidiaries is the applicable local currency. For those subsidiaries, assets and liabilities are translated to U.S. dollars at year-end exchange rates. Income and expense accounts are translated at the average exchange rates prevailing during the year. The resulting translation adjustments are included in accumulated other comprehensive income (loss) in consolidated stockholders' equity. Foreign exchange transaction gains and losses are classified in other income/expense in the statement of operations.

Net foreign exchange (gain) loss resulting from re-measurement were \$(31), \$2,497 and \$6,132 for the years ended December 31, 2019, 2018 and 2017, respectively, and are included in other expense (income). These amounts do not reflect the corresponding gain (loss) from foreign exchange contracts. See Note 9 "Derivatives" regarding foreign exchange contracts.

Employee Benefit Plans

The majority of the Company's employees participate in defined contribution plans (401(k) plans) whereby the Company matches a certain percentage of salary based upon the amount of each participant's annual contribution and their total compensation.

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The Company also has defined benefit retirement plans at certain of its foreign subsidiaries. The Company accounts for these plans based on the provisions of ASC Topic 715, "Compensation-Retirement Benefits." Some of the key assumptions used to calculate the pension expense and projected benefit obligation include the discount rate, rate of forecasted salary increases, the expected long-term rate of return on plan assets and the mortality lives of participants. The obligation for these claims and the related periodic costs are measured using actuarial techniques and assumptions. Actuarial gains and losses are deferred and amortized over future periods.

Income Taxes

The Company records income taxes using the asset and liability method. Deferred income tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective income tax bases, and also for operating loss and tax credit carry-forwards. On a quarterly basis, the Company evaluates both the positive and negative evidence that affects the realizability of net deferred tax assets and assesses the need for a valuation allowance. The future benefit to be derived from its deferred tax assets is dependent upon its ability to generate sufficient future taxable income in each jurisdiction of the right type to realize the assets. The Company records a valuation allowance to reduce its net deferred tax assets to the amount that is expected to be realized. To the extent the Company establishes a valuation allowance an expense will be recorded as a component of the provision for income taxes on the statement of operations.

Accounting for income taxes requires a two-step approach to recognize and measure uncertain tax positions. The first step is to evaluate the tax position for recognition by determining if, based on the technical merits, it is more likely than not that the position will be sustained upon audit, including resolutions of related appeals or litigation processes, if any. The second step is to measure the tax benefit as the largest amount that is more than 50% likely of being realized upon ultimate settlement. The Company re-evaluates these uncertain tax positions on a quarterly basis. This evaluation is based on factors including, but not limited to, changes in facts or circumstances, changes in tax law, effectively settled issues under audit and new audit activity. Any change in these factors could result in the recognition of a tax benefit or an additional charge to the tax provision.

Income tax effects resulting from changes in tax are generally accounted for by the Company in the period in which the law is enacted and the effects are recorded as a component of provision for income taxes from continuing operations. On December 22, 2017, the Securities and Exchange Commission Staff issued Staff Accounting Bulletin No. 118 ("SAB 118") to provide guidance for reporting entities' ability to timely complete the accounting for certain income tax effects of the Act and allowed a measurement period up to one year from the enactment date of the "Act". The Company obtained, prepared and analyzed the information needed to complete the accounting requirements under ASC Topic 740 and as a result, in accordance with SAB 118, the Company finalized and recorded the effects of the Act during the quarter ended December 31, 2018.

4) Recently Issued Accounting Pronouncements

In December 2019, the Financial Accounting Standards Board ("FASB") issued ASU 2019-12, "Income Taxes (Topic 740)." This standard simplifies the accounting for income taxes by removing certain exceptions to the general principles in Topic 740. The amendments also improve consistent application and simplify U.S. GAAP for other areas of Topic 740 by clarifying and amending existing guidance. This standard is effective for annual periods beginning after December 15, 2021, including interim periods within those fiscal years beginning after December 15, 2022. The Company evaluated the requirements of this ASU and the impact of pending adoption on the Company's consolidated financial statements. The Company does not expect that the impact of these changes will be material to the Company's consolidated financial statements.

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In October 2018, the FASB issued ASU 2018-16, “Derivatives and Hedging (Topic 815).” This standard permits the use of the Overnight Index Swap Rate (“OIS”) based on the Secured Overnight Financing Rate as a U.S. benchmark interest rate for hedge accounting purposes under Topic 815 in addition to the interest rates on direct treasury obligations of the U.S. government, the London Interbank Offered Rate (“LIBOR”) swap rate, the OIS rate based on the Federal Funds Effective Rate and the Securities Industry and Financial Markets Association Municipal Swap Rate. This standard is effective for annual periods beginning after December 15, 2018, including interim periods within those fiscal years. The Company adopted this ASU during the first quarter of 2019 and the adoption of this ASU did not have a material impact on the Company’s consolidated financial statements.

In August 2018, the FASB issued ASU 2018-15, “Intangibles-Goodwill and Other-Internal-Use Software (Subtopic 350-40): Customer’s Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement that is a Service Contract.” This standard aligns the requirements for capitalizing implementation costs incurred in a hosting arrangement that is a service contract with the requirements for capitalizing implementation costs incurred to develop or obtain internal-use software (and hosting arrangements that include an internal-use software license). The accounting for the service element of a hosting arrangement that is a service contract is not affected by the amendments to this update. This standard is effective for annual periods beginning after December 15, 2019, including interim periods within those fiscal years. The Company is currently evaluating the requirements of this ASU and the impact of pending adoption on the Company’s consolidated financial statements.

In August 2017, the FASB issued ASU 2017-12, “Derivatives and Hedging (Topic 815).” This standard better aligns an entity’s risk management activities and financial reporting for hedging relationships through changes to both the designation and measurement guidance for qualifying hedging relationships and the presentation of hedge results. The provisions of this ASU are effective for annual periods beginning after December 15, 2018, including interim periods within those fiscal years. The Company adopted this ASU during the first quarter of 2019 and the adoption of this ASU did not have a material impact on the Company’s consolidated financial statements.

In February 2016, the FASB issued ASU 2016-02, “Leases”. This standard requires the recognition of lease assets and liabilities for all leases, with certain exceptions, on the balance sheet. This ASU is effective for annual periods beginning after December 15, 2018, including interim periods within those fiscal years. The Company adopted ASU 2016-02 on January 1, 2019, and used the effective date as its date of initial application. As such, the Company did not adjust prior period amounts. The Company also elected to adopt the package of practical expedients upon transition, which permits companies to not reassess lease identification, classification, and initial direct costs for leases that commenced prior to the effective date. The Company implemented internal controls and a lease accounting information system to enable preparation on adoption. Upon adoption, the Company recorded a cumulative effect of initially applying this new standard, resulting in the addition of \$71,042 of right-of-use assets and \$20,192 and \$54,147 of short-term and long-term lease liabilities, respectively. The right-of-use asset is net of the deferred rent liability, prepaid rent and a net favorable lease asset which were re-classified to the right-of-use asset upon adoption of the standard. For additional information on the required disclosures related to the impact of adopting this standard, see Note 5 to the Consolidated Financial Statements.

In June 2016, the FASB issued ASU 2016-13, “Financial Instruments-Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments.” This standard introduced the expected credit losses methodology for the measurement of credit losses on financial assets that are not measured at fair value through net income and replaces today’s “incurred loss” model with an “expected credit loss” model that requires

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consideration of a broader range of information to estimate expected credit losses over the lifetime of the asset. There have been several consequential subsequent amendments to this standard. This standard is effective for annual periods beginning after December 15, 2019, including interim periods within those fiscal years. The Company does not expect adoption of this ASU to have a material impact on its consolidated financial statements.

5) Leases

A right-of-use asset of \$64,497, short-term lease liability of \$20,632 and long-term lease liability of \$44,759 were reflected on the balance sheet as of December 31, 2019.

The elements of lease expense were as follows:

	<u>Twelve Months Ended December 31, 2019</u>
Lease cost:	
Operating lease(1)	\$ 23,176
Leases with a term less than 12 months	4,305
Total lease cost	<u>\$ 27,481</u>

(1) Operating lease cost includes an immaterial amount of variable expenses and sublease rental income.

The weighted average discount rate and the weighted average remaining lease term were 3.8% and 4.9 years, respectively, for the period ended December 31, 2019. Operating cash flows used for operating leases for the twelve months ended December 31, 2019 was \$23,356.

In 2019, the Company sold two buildings in Boulder, Colorado, and three buildings in Portland, Oregon, as part of sale and leaseback transactions, and will lease back the buildings over varying terms into 2021. Total net cash proceeds received for these two transactions were \$41,179 and the Company recognized a net gain on the sale of these long-lived assets of \$6,773.

Future lease payments under non-cancelable leases as of December 31, 2019 are detailed as follows:

<u>Year Ending December 31,</u>	<u>Amount</u>
2020	\$22,299
2021	14,862
2022	9,006
2023	7,563
2024	6,660
Thereafter	11,387
Total lease payments	<u>71,777</u>
Less: imputed interest	6,386
Total operating lease liabilities	<u>\$65,391</u>

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Amounts presented above do not include payments relating to immaterial leases excluded from the balance sheet as part of transition elections adopted upon implementation of ASU 2016-02, as well as operating leases with terms of less than twelve months. Additionally, we have excluded approximately \$126,400 of lease payments (undiscounted basis) that have not yet commenced. These leases commence in 2020 with lease terms expected between 20 and 21 years.

Minimum lease payments under operating leases as of December 31, 2018, prior to adoption of ASU 2016-02 were as follows:

<u>Year Ending December 31,</u>	<u>Amount</u>
2019	\$20,106
2020	17,142
2021	10,325
2022	5,573
2023	4,410
Thereafter	8,739
Total minimum lease payments	<u>\$66,295</u>

6) Revenue from Contracts with Customers

Contract assets as of December 31, 2019 and 2018 were \$3,527 and \$3,624, respectively, and included in other current assets.

A rollforward of the Company's deferred revenue and customer advances is as follows:

	<u>Years Ended December 31,</u>	
	<u>2019</u>	<u>2018</u>
Beginning balance, January 1(1)	\$ 17,474	\$ 27,800
Deferred revenue and customer advances assumed in ESI Merger	4,629	—
Additions to deferred revenue and customer advances	77,727	73,171
Amount of deferred revenue and customer advances recognized in income	(75,046)	(83,497)
Ending balance, December 31(2)	<u>\$ 24,784</u>	<u>\$ 17,474</u>

- (1) Beginning deferred revenue and customer advances as of January 1, 2019 included \$8,134 of current deferred revenue, \$3,228 of long-term deferred revenue and \$6,112 of current customer advances.
- (2) Ending deferred revenue and customer advances as of December 31, 2019 included \$12,441 of current deferred revenue, \$3,290 of long-term deferred revenue and \$9,053 of current customer advances.

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Disaggregation of Revenue

The following table summarizes revenue from contracts with customers:

	<u>Year Ended December 31, 2019</u>			<u>Total</u>
	<u>Vacuum & Analysis</u>	<u>Light & Motion</u>	<u>Equipment & Solutions</u>	
Net revenues:				
Products	\$819,078	\$663,730	\$ 128,489	\$1,611,297
Services	171,445	61,840	55,191	288,476
Total net revenues	<u>\$990,523</u>	<u>\$725,570</u>	<u>\$ 183,680</u>	<u>\$1,899,773</u>
	<u>Year Ended December 31, 2018</u>			<u>Total</u>
	<u>Vacuum & Analysis</u>	<u>Light & Motion</u>	<u>Equipment & Solutions</u>	
Net revenues:				
Products	\$1,080,343	\$754,859	\$ —	\$1,835,202
Services	180,519	59,387	—	239,906
Total net revenues	<u>\$1,260,862</u>	<u>\$814,246</u>	<u>\$ —</u>	<u>\$2,075,108</u>
	<u>Year Ended December 31, 2017</u>			<u>Total</u>
	<u>Vacuum & Analysis</u>	<u>Light & Motion</u>	<u>Equipment & Solutions</u>	
Net revenues:				
Products	\$1,047,639	\$653,662	\$ —	\$1,701,301
Services	159,818	54,858	—	214,676
Total net revenues	<u>\$1,207,457</u>	<u>\$708,520</u>	<u>\$ —</u>	<u>\$1,915,977</u>

Refer to Note 21 for revenue by reportable segment, geography and groupings of similar products.

7) Investments

Investments classified as short-term consist of the following:

	<u>Years Ended December 31,</u>	
	<u>2019</u>	<u>2018</u>
Available-for-sale investments:		
Time deposits and certificates of deposit	\$ 13,045	\$ 102
Bankers' acceptance drafts	4,043	989
Asset-backed securities	—	9,113
Commercial paper	61,205	19,359
Corporate obligations	—	9,352
U.S. treasury obligations	5,000	13,298
U.S. agency obligations	26,124	21,613
	<u>\$ 109,417</u>	<u>\$ 73,826</u>

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Investments classified as long-term consist of the following:

	Years Ended December 31,	
	2019	2018
Available-for-sale investments:		
Group insurance contracts	\$ 5,854	\$ 5,890
Cost method investments:		
Minority interest in a private company(1)	—	4,400
	<u>\$ 5,854</u>	<u>\$ 10,290</u>

- (1) During 2019, the Company recognized \$4,700 of impairment charges, which included an impairment of \$4,400 of a long-term cost method investment in a private company.

The following table shows the gross unrealized gains and (losses) aggregated by investment category for available-for-sale investments:

<u>As of December 31, 2019:</u>	<u>Cost</u>	<u>Gross Unrealized Gains</u>	<u>Gross Unrealized (Losses)</u>	<u>Estimated Fair Value</u>
Short-term investments:				
Available-for-sale investments:				
Time deposits and certificates of deposit	\$ 13,045	\$ —	\$ —	\$ 13,045
Bankers' acceptance drafts	4,043	—	—	4,043
Commercial paper	61,498	—	(293)	61,205
U.S. treasury obligations	4,999	1	—	5,000
U.S. agency obligations	26,123	2	(1)	26,124
	<u>\$109,708</u>	<u>\$ 3</u>	<u>\$ (294)</u>	<u>\$109,417</u>

<u>As of December 31, 2019:</u>	<u>Cost</u>	<u>Gross Unrealized Gains</u>	<u>Gross Unrealized (Losses)</u>	<u>Estimated Fair Value</u>
Long-term investments:				
Available-for-sale investments:				
Group insurance contracts	<u>\$5,261</u>	<u>\$ 593</u>	<u>\$ —</u>	<u>\$ 5,854</u>

<u>As of December 31, 2018:</u>	<u>Cost</u>	<u>Gross Unrealized Gains</u>	<u>Gross Unrealized (Losses)</u>	<u>Estimated Fair Value</u>
Short-term investments:				
Available-for-sale investments:				
Time deposits and certificates of deposit	\$ 102	\$ —	\$ —	\$ 102
Bankers' acceptance drafts	989	—	—	989
Asset-backed securities	9,121	1	(9)	9,113
Commercial paper	19,504	—	(145)	19,359
Corporate obligations	9,367	—	(15)	9,352
U.S. treasury obligations	13,294	4	—	13,298
U.S. agency obligations	21,617	2	(6)	21,613
	<u>\$73,994</u>	<u>\$ 7</u>	<u>\$ (175)</u>	<u>\$ 73,826</u>

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<u>As of December 31, 2018:</u>	<u>Cost</u>	<u>Gross Unrealized Gains</u>	<u>Gross Unrealized (Losses)</u>	<u>Estimated Fair Value</u>
Long-term investments:				
Available-for-sale investments:				
Group insurance contracts	\$5,546	\$ 344	\$ —	\$ 5,890

The tables above, which show the gross unrealized gains and (losses) aggregated by investment category for available-for-sale investments as of December 31, 2019 and 2018, reflect the inclusion within short-term investments of investments with contractual maturities greater than one year from the date of purchase. Management has the ability, if necessary, to liquidate any of its investments in order to meet the Company's liquidity needs in the next 12 months. Accordingly, those investments with contractual maturities greater than one year from the date of purchase are classified as short-term on the accompanying balance sheets.

Interest income is accrued as earned. Dividend income is recognized as income on the date the security trades "ex-dividend." The cost of marketable securities sold is determined by the specific identification method and realized gains or losses are reflected in income and were not material in 2019, 2018 and 2017.

8) Fair Value Measurements

In accordance with the provisions of fair value accounting, a fair value measurement assumes that the transaction to sell an asset or transfer a liability occurs in the principal market for the asset or liability or, in the absence of a principal market, the most advantageous market for the asset or liability and defines fair value based upon an exit price model.

The fair value measurement guidance establishes a fair value hierarchy which requires an entity to maximize the use of observable inputs and minimize the use of unobservable inputs when measuring fair value. The guidance describes three levels of inputs that may be used to measure fair value:

- Level 1 Quoted prices in active markets for identical assets or liabilities as of the reporting date. Active markets are those in which transactions for the asset or liability occur in sufficient frequency and volume to provide pricing information on an ongoing basis.
- Level 2 Observable inputs other than Level 1 prices, such as quoted prices for similar assets or liabilities; quoted prices in markets that are not active; or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the assets or liabilities. Level 2 assets and liabilities include debt securities with quoted prices that are traded less frequently than exchange-traded instruments or securities or derivative contracts that are valued using a pricing model with inputs that are observable in the market or can be derived principally from or corroborated by observable market data.
- Level 3 Unobservable inputs that are supported by little or no market activity and that are significant to the fair value of the assets or liabilities. Level 3 assets and liabilities include financial instruments whose value is determined using pricing models, discounted cash flow methodologies, or similar techniques, as well as instruments for which the determination of fair value requires significant management judgment or estimation.

In certain cases, the inputs used to measure fair value may fall into different levels of the fair value hierarchy. In such cases, the Company categorizes such assets and liabilities based on the lowest level input that

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is significant to the fair value measurement in its entirety. The Company's assessment of the significance of a particular input to the fair value measurement in its entirety requires judgment and considers factors specific to the asset.

Assets and liabilities of the Company measured at fair value on a recurring basis as of December 31, 2019, are summarized as follows:

Description	December 31, 2019	Fair Value Measurements at Reporting Date Using		
		Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Assets:				
Cash equivalents:				
Money market funds	\$ 288	\$ 288	\$ —	\$ —
Time deposits and certificates of deposit	2,190	—	2,190	—
Commercial paper	42,559	—	42,559	—
U.S. treasury obligations	2,700	—	2,700	—
U.S. agency obligations	17,071	—	17,071	—
Restricted cash – money market funds	333	333	—	—
Available-for-sale securities:				
Time deposits and certificates of deposit	13,045	—	13,045	—
Bankers' acceptance drafts	4,043	—	4,043	—
Commercial paper	61,205	—	61,205	—
U.S. treasury obligations	5,000	—	5,000	—
U.S. agency obligations	26,124	—	26,124	—
Group insurance contracts	5,854	—	5,854	—
Derivatives – currency forward contracts	1,074	—	1,074	—
Derivatives – interest rate hedge - current	843	—	843	—
Funds in investments and other assets:				
Israeli pension assets	16,713	—	16,713	—
Deferred compensation plan assets:				
Mutual funds and exchange traded funds	2,002	—	2,002	—
Money market securities	485	—	485	—
Total assets	\$ 201,529	\$ 621	\$ 200,908	\$ —
Liabilities:				
Derivatives – currency forward contracts	\$ 259	\$ —	\$ 259	\$ —
Derivatives – interest rate hedge – non-current	6,510	—	6,510	—
Total liabilities	\$ 6,769	\$ —	\$ 6,769	\$ —
Reported as follows:				
Assets:				
Cash and cash equivalents, including restricted cash(1)	\$ 65,141	\$ 621	\$ 64,520	\$ —
Short-term investments	109,417	—	109,417	—
Other current assets	1,917	—	1,917	—
Total current assets	\$ 176,475	\$ 621	\$ 175,854	\$ —
Long-term investments	\$ 5,854	\$ —	\$ 5,854	\$ —
Other assets	19,200	—	19,200	—
Total long-term assets	\$ 25,054	\$ —	\$ 25,054	\$ —
Liabilities:				
Other current liabilities	\$ 259	\$ —	\$ 259	\$ —
Other liabilities	\$ 6,510	\$ —	\$ 6,510	\$ —

(1) The cash and cash equivalent amounts presented in the table above does not include cash of \$349,431 as of December 31, 2019.

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Assets and liabilities of the Company measured at fair value on a recurring basis as of December 31, 2018, are summarized as follows:

Description	December 31, 2018	Fair Value Measurements at Reporting Date Using		
		Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Assets:				
Cash equivalents:				
Money market funds	\$ 180,340	\$ 180,340	\$ —	\$ —
Time deposits and certificates of deposit	850	—	850	—
Commercial paper	2,687	—	2,687	—
U.S. agency obligations	3,418	—	3,418	—
Restricted cash – money market funds	110	110	—	—
Available-for-sale securities:				
Time deposits and certificates of deposit	102	—	102	—
Bankers' acceptance drafts	989	—	989	—
Asset-backed securities	9,113	—	9,113	—
Commercial paper	19,359	—	19,359	—
Corporate obligations	9,352	—	9,352	—
U.S. treasury obligations	13,298	—	13,298	—
U.S. agency obligations	21,613	—	21,613	—
Group insurance contracts	5,890	—	5,890	—
Derivatives – currency forward contracts	2,485	—	2,485	—
Funds in investments and other assets:				
Israeli pension assets	14,408	—	14,408	—
Derivatives – interest rate hedge – non-current	6,083	—	6,083	—
Total assets	\$ 290,097	\$ 180,450	\$ 109,647	\$ —
Liabilities:				
Derivatives – currency forward contracts	\$ 1,168	\$ —	\$ 1,168	\$ —
Reported as follows:				
Assets:				
Cash and cash equivalents, including restricted cash(1)	\$ 187,405	\$ 180,450	\$ 6,955	\$ —
Short-term investments	73,826	—	73,826	—
Other current assets	2,485	—	2,485	—
Total current assets	\$ 263,716	\$ 180,450	\$ 83,266	\$ —
Long-term investments(2)	\$ 5,890	\$ —	\$ 5,890	\$ —
Other assets	20,491	—	20,491	—
Total long-term assets	\$ 26,381	\$ —	\$ 26,381	\$ —
Liabilities:				
Other current liabilities	\$ 1,168	\$ —	\$ 1,168	\$ —

- (1) The cash and cash equivalent amounts presented in the table above do not include cash of \$456,940 as of December 31, 2018.
- (2) The long-term investments presented in the table above do not include our minority interest investment in a private company, which is accounted for under the cost method.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

Money Market Funds

Money market funds are cash and cash equivalents and are classified within Level 1 of the fair value hierarchy.

Available-For-Sale Investments

As of December 31, 2019, available-for-sale investments consisted of time deposits and drafts denominated in the Euro currency, certificates of deposit, bankers' acceptance drafts, commercial paper, U.S. treasury obligations, U.S. agency obligations and group insurance contracts.

The Company measures its debt and equity investments at fair value. The Company's available-for-sale investments are classified within Level 2 of the fair value hierarchy.

Israeli Pension Assets

Israeli pension assets represent investments in mutual funds, government securities and other time deposits. These investments are set aside for the retirement benefit of the employees at the Company's Israeli subsidiaries. These funds are classified within Level 2 of the fair value hierarchy.

Derivatives

As a result of the Company's global operating activities, the Company is exposed to market risks from changes in foreign currency exchange rates and variable interest rates, which may adversely affect its operating results and financial position. When deemed appropriate, the Company minimizes its risks from foreign currency exchange rate and interest rate fluctuations through the use of derivative financial instruments. The principal market in which the Company executes its foreign currency contracts and interest rate swaps is the institutional market in an over-the-counter environment with a relatively high level of price transparency. The market participants usually are large commercial banks. The forward foreign currency exchange contracts and interest rate hedge are valued using broker quotations, or market transactions and are classified within Level 2 of the fair value hierarchy.

9) Derivatives

The Company enters into derivative instruments for risk management purposes only, including derivatives designated as hedging instruments and those utilized as economic hedges. The Company operates internationally and, in the normal course of business, is exposed to fluctuations in interest rates and foreign exchange rates. These fluctuations can increase the costs of financing, investing and operating the business. The Company has used derivative instruments, such as forward foreign currency exchange contracts, to manage certain foreign currency exposure, and interest rate swaps to manage interest rate exposure.

By nature, all financial instruments involve market and credit risks. The Company enters into derivative instruments with major investment grade financial institutions, for which no collateral is required. The Company has policies to monitor the credit risk of these counterparties. While there can be no assurance, the Company does not anticipate any material non-performance by any of these counterparties.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
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Interest Rate Swap Agreements

On September 30, 2016, the Company entered into an interest rate swap agreement to fix the rate on approximately 50% of its then-outstanding balance under the 2016 Term Loan Facility, as described further in Note 15. This hedge fixes the interest rate paid on the hedged debt at 1.198% per annum plus the applicable credit spread, which was 1.75% as of December 31, 2019, through September 30, 2020. At December 31, 2019, the notional amount of this transaction was \$250,000 and it had a fair value asset of \$843. At December 31, 2018, the notional amount of this transaction was \$290,000 and had a fair value asset of \$6,083.

On April 3, 2019, the Company entered into an interest rate swap agreement, which has a maturity date of March 31, 2023, to fix the rate on \$300,000 of the then-outstanding balance of the 2019 Incremental Term Loan Facility, as described further in Note 15. The rate was fixed at 2.309% per annum plus the applicable credit spread, which was 1.75% at December 31, 2019. At December 31, 2019, the notional amount of this transaction was \$300,000 and had a fair value liability of \$6,510.

The interest rate swaps are recorded at fair value on the balance sheet and changes in the fair value are recognized in OCI. To the extent that these arrangements are no longer an effective hedge, any ineffectiveness measured in the hedging relationships is recorded currently in earnings in the period it occurs.

Foreign Exchange Contracts

The Company hedges a portion of its forecasted foreign currency-denominated intercompany sales of inventory, over a maximum period of eighteen months, using forward foreign exchange contracts accounted for as cash-flow hedges related to Japanese, South Korean, British, Euro and Taiwanese currencies. To the extent these derivatives are effective in off-setting the variability of the hedged cash flows, and otherwise meet the hedge accounting criteria, changes in the derivatives' fair value are not included in current earnings but are included in OCI in stockholders' equity. These changes in fair value will subsequently be reclassified into earnings, as applicable, when the forecasted transaction occurs. To the extent that a previously designated hedging transaction is no longer an effective hedge, any ineffectiveness measured in the hedging relationship is recorded currently in earnings in the period it occurs. The cash flows resulting from forward exchange contracts are classified in the consolidated statements of cash flows as part of cash flows from operating activities. The Company does not enter into derivative instruments for trading or speculative purposes.

As of December 31, 2019 and 2018, the Company had outstanding forward foreign exchange contracts with gross notional values of \$154,674 and \$159,394, respectively. The following tables provide a summary of the primary net hedging positions and corresponding fair values held as of December 31, 2019 and December 31, 2018:

Currency Hedged (Buy/Sell)	December 31, 2019	
	Gross Notional Value	Fair Value (1)
U.S. Dollar/Japanese Yen	\$ 45,899	\$ 43
U.S. Dollar/South Korean Won	51,733	167
U.S. Dollar/Euro	15,670	221
U.S. Dollar/U.K. Pound Sterling	8,279	(166)
U.S. Dollar/Taiwan Dollar	33,093	(450)
Total	<u>\$ 154,674</u>	<u>\$ (185)</u>

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

Currency Hedged (Buy/Sell)	December 31, 2018	
	Gross Notional Value	Fair Value (1)
U.S. Dollar/Japanese Yen	\$ 43,770	\$ (478)
U.S. Dollar/South Korean Won	59,149	570
U.S. Dollar/Euro	23,515	688
U.S. Dollar/U.K. Pound Sterling	11,827	323
U.S. Dollar/Taiwan Dollar	21,133	214
Total	\$ 159,394	\$ 1,317

- (1) Represents the (payable) receivable amount included in the consolidated balance sheet.

The following table provides a summary of the fair value amounts of the Company's derivative instruments:

Derivatives Designated as Hedging Instruments	Years Ended December 31,	
	2019	2018
Derivative asset:		
Forward exchange contracts(1)	\$ 1,074	\$ 2,485
Foreign currency interest rate hedge(2)	843	6,083
Derivative liability:		
Forward exchange contracts(1)	(1,259)	(1,168)
Foreign currency interest rate hedge(2)	(6,510)	—
Total net derivative (liability) asset designated as hedging instruments	\$ (5,852)	\$ 7,400

- (1) The derivative asset of \$1,074 and derivative liability of \$1,259 related to the forward foreign exchange contracts are classified in other current assets and other current liabilities in the consolidated balance sheet as of December 31, 2019. The derivative asset of \$2,485 and derivative liability of \$1,168 related to the forward foreign exchange contracts are classified in other current assets and other current liabilities in the consolidated balance sheet as of December 31, 2018. These forward foreign exchange contracts are subject to a master netting agreement with one financial institution. However, the Company has elected to record these contracts on a gross basis in the balance sheet.
- (2) The foreign currency interest rate hedge asset of \$843 is classified in other current assets in the consolidated balance sheet as of December 31, 2019. The foreign currency interest rate hedge liability of \$6,510 is classified in other non-current liabilities in the consolidated balance sheet as of December 31, 2019. The foreign currency rate hedge asset of \$6,083 is classified in other assets in the consolidated balance sheet as of December 31, 2018.

The net amount of existing gains as of December 31, 2019 that is expected to be reclassified from OCI into earnings within the next 12 months is immaterial.

The following table provides a summary of the (losses) gains on derivatives designated as cash flow hedging instruments:

Derivatives Designated as Cash Flow Hedging Instruments	Years Ended December 31,		
	2019	2018	2017
Forward exchange contracts:			
Net (loss) gain recognized in OCI, net of tax(1)	\$ (10,013)	\$ 4,942	\$ (4,568)
Net gain (loss) reclassified from OCI into income(2)	\$ 5,658	\$ (3,367)	\$ (2,685)

- (1) Net change in the fair value of the effective portion classified in OCI.
- (2) Effective portion classified in cost of products.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

The following table provides a summary of losses on derivatives not designated as cash flow hedging instruments:

<u>Derivatives Not Designated as Hedging Instruments</u>	<u>Years Ended December 31,</u>		
	<u>2019</u>	<u>2018</u>	<u>2017</u>
Forward exchange contracts:			
Net (loss) gain recognized in income(1)	\$ (1,314)	\$ 105	\$ (3,416)

- (1) The Company enters into forward foreign exchange contracts to hedge against changes in the balance sheet for certain subsidiaries to mitigate the risk associated with certain foreign currency transactions in the ordinary course of business. These derivatives are not designated as cash flow hedging instruments and gains or losses from these derivatives are recorded immediately in other expense, net in 2019, 2018 and 2017.

10) Inventories

Inventories consist of the following:

	<u>Years Ended December 31,</u>	
	<u>2019</u>	<u>2018</u>
Raw material	\$ 288,771	\$ 235,593
Work-in-process	79,367	61,908
Finished goods	94,008	87,188
	<u>\$ 462,146</u>	<u>\$ 384,689</u>

Inventory-related excess and obsolete charges of \$24,734, \$22,324 and \$20,213 were recorded in cost of products in the years ended December 31, 2019, 2018 and 2017, respectively.

11) Property, Plant and Equipment

Property, plant and equipment consist of the following:

	<u>Years Ended December 31,</u>	
	<u>2019</u>	<u>2018</u>
Land	\$ 11,926	\$ 11,448
Buildings	113,303	104,023
Machinery and equipment	396,193	330,821
Furniture and fixtures, office equipment and software	186,651	149,145
Leasehold improvements	80,389	66,569
Construction in progress	46,926	44,823
	<u>835,388</u>	<u>706,829</u>
Less: accumulated depreciation	593,517	512,462
	<u>\$ 241,871</u>	<u>\$ 194,367</u>

Depreciation of property, plant and equipment totaled \$42,632, \$36,332 and \$36,813 for the years ended 2019, 2018 and 2017, respectively.

MKS INSTRUMENTS, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

12) Acquisitions and Dispositions

Electro Scientific Industries, Inc.

On February 1, 2019, the Company completed its acquisition of Electro Scientific Industries, Inc. (“ESI”) pursuant to an Agreement and Plan of Merger, dated as of October 29, 2018 (the “Merger Agreement”), by and among the Company, EAS Equipment, Inc., formerly a Delaware corporation and a wholly-owned subsidiary of the Company, and ESI (the “ESI Merger”). At the effective time of the ESI Merger and pursuant to the terms and conditions of the Merger Agreement, each share of ESI’s common stock that was issued and outstanding immediately prior to the effective time of the ESI Merger was converted into the right to receive \$30.00 in cash, without interest and subject to deduction of any required withholding tax.

The aggregate consideration was \$1,032,671, which excludes related transaction fees and expenses, and non-cash consideration related to the exchange of share-based awards of \$30,630, for a total purchase consideration of \$1,063,301. The Company funded the payment of the aggregate consideration with a combination of the Company’s available cash on hand and the proceeds from the Company’s 2019 Incremental Term Loan Facility, as defined and as described further in Note 15.

ESI provides laser-based manufacturing systems solutions for the micro-machining industry that enable customers to optimize production. Its market is composed primarily of flexible and rigid PCB processing/fabrication, semiconductor wafer processing and passive component manufacturing and testing. ESI solutions incorporate specialized laser technology and proprietary control software to efficiently process the materials and components that are an integral part of electronic devices and systems.

The purchase price of ESI consisted of the following:

Cash paid for outstanding shares(1)	\$1,032,671
Settlement of share-based compensation awards(2)	30,630
Total purchase price	<u>1,063,301</u>
Less: cash and cash equivalents acquired	<u>(44,072)</u>
Total purchase price, net of cash and cash equivalents acquired	<u>\$1,019,229</u>

- (1) Represents cash paid of \$30.00 per share for approximately 34,422,361 shares of ESI common stock, without interest and subject to a deduction for any required withholding tax.
- (2) Represents the vested but unissued portion of ESI share-based compensation awards as of the acquisition date of February 1, 2019.

Under the acquisition method of accounting, the total estimated acquisition consideration is allocated to the acquired tangible and intangible assets and assumed liabilities of ESI based on their fair values as of the acquisition date. Any excess of the acquisition consideration over the fair value of assets acquired and liabilities assumed is allocated to goodwill. The Company expects that none of such goodwill and intangible assets will be deductible for tax purposes.

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

The following table summarizes the allocation of the purchase price to the fair values assigned to assets acquired and liabilities assumed at the date of the ESI Merger:

Current assets (excluding inventory)	\$ 208,009
Inventory	81,696
Intangible assets	316,200
Goodwill	473,951
Property, plant and equipment	65,489
Long-term assets	9,633
Total assets acquired	<u>1,154,978</u>
Current liabilities	51,479
Non-current deferred taxes	33,039
Other long-term liabilities	7,159
Total liabilities assumed	<u>91,677</u>
Fair value of assets acquired, and liabilities assumed	<u>1,063,301</u>
Less: Cash and cash equivalents acquired	<u>(44,072)</u>
Total purchase price, net of cash and cash equivalents acquired	<u>\$1,019,229</u>

The fair value write-up of acquired finished goods inventory was \$7,624, the amount of which will be expensed over the period during which the acquired inventory is sold. For the year ended December 31, 2019, the Company recorded \$7,624 of incremental cost of sales charges associated with the fair value write-up of inventory acquired in the ESI Merger.

The fair value write-up of acquired property, plant and equipment of \$39,267 will be amortized over the estimated useful life of the applicable assets, excluding the fair value write-up in the value of land. Property, plant and equipment is valued at its value-in-use, unless there was a known plan to dispose of the asset.

The acquired intangible assets are being amortized on a straight-line basis, which approximates the economic use of the asset.

The following table reflects the allocation of the acquired intangible assets and related estimate of useful lives:

Completed technology - Laser	\$255,700	12 years
Completed technology -Non-Laser	18,300	10 years
Trademarks and trade names	14,400	7 years
Customer relationships	25,400	10 years
Backlog	2,400	1 year
	<u>\$316,200</u>	

While the Company uses its best estimates and assumptions as part of the purchase price allocation process to value the assets acquired and liabilities assumed on the acquisition date, its estimates and assumptions are subject to refinement. The net fair value of the acquired intangibles was determined using the income approach. In performing these valuations, the key underlying judgments and assumptions used included the appropriate

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

discount rates as well as forecasted revenue growth rates and gross profit and operating margins. Fair value estimates are based on a complex series of judgments about future events and uncertainties and rely heavily on estimates and assumptions. The judgments used to determine the estimated fair value assigned to each class of assets acquired and liabilities assumed, as well as asset lives, can materially impact the Company's results of operations. The finalization of the purchase accounting assessment will result in a change in the valuation of assets acquired and liabilities assumed and may have a material impact on the Company's results of operations and financial position. As a result, during the measurement period, which may be up to one year from the acquisition date, the Company records adjustments to the assets acquired and liabilities assumed with a corresponding offset to goodwill to reflect additional information received about facts and circumstances which existed at the date of acquisition. The Company records adjustments to the assets acquired and liabilities assumed subsequent to the purchase price allocation period in the Company's operating results in the period in which the adjustments are determined. The size and breadth of the ESI Merger will necessitate the use of this measurement period to adequately analyze and assess a number of the factors used in establishing the fair value of certain tangible and intangible assets acquired and liabilities assumed as of the acquisition date and the related tax impacts of any changes made. The Company believes that the measurement period is complete at December 31, 2019.

The Company believes the amount of goodwill relative to identifiable intangible assets relates to several factors, including broadening its position in key industrial end markets to complementary solutions, and leveraging component and systems expertise to provide robust solutions to meet customer evolving technology needs.

The results of this acquisition were included in the Company's consolidated statement of operations beginning on February 1, 2019. ESI constitutes the Company's Equipment & Solutions reportable segment (see Note 21).

Certain executives from ESI had severance provisions in their respective ESI employment agreements. The agreements included terms that were accounted for as dual-trigger arrangements. Through the Company's acquisition accounting, the expense relating to these benefits was recognized in the combined entity's financial statements. The Company recorded costs of \$2,701 and \$14,023 in acquisition and integration costs as compensation expense and stock-based compensation expense, respectively, for the year ended December 31, 2019 associated with these severance provisions. The restricted stock units and stock appreciation rights that were eligible for accelerated vesting if the executive exercised his or her rights but were not issued as of each reporting period-end, were excluded from the computation of basic earnings per share and included in the computation of diluted earnings per share for such reporting period.

The Company's consolidated net revenue and earnings for the year ended December 31, 2019 include the following amounts of revenue and earnings of ESI since the acquisition date:

	<u>Year Ended</u> <u>December 31,</u> <u>2019</u>
Total net revenues	\$ 183,680
Net loss	\$ (33,446)
Net loss per share:	
Basic	\$ (0.61)
Diluted	\$ (0.61)

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

Pro Forma Results

The following unaudited pro forma financial information presents the combined results of operations of the Company as if the ESI Merger had occurred on January 1, 2018. The unaudited pro forma financial information is not necessarily indicative of what the Company's condensed consolidated results of operations actually would have been had the acquisition occurred at the beginning of each year. In addition, the unaudited pro forma financial information does not attempt to project the future results of operations of the combined Company.

	Years Ended December 31,	
	2019	2018
Total net revenues	\$ 1,914,561	\$ 2,445,711
Net income	\$ 171,537	\$ 424,778
Net income per share:		
Basic	\$ 3.14	\$ 7.81
Diluted	\$ 3.11	\$ 7.72

The unaudited pro forma financial information above gives effect primarily to the following:

- (1) Incremental amortization and depreciation expense related to the estimated fair value of identifiable intangible assets and property, plant and equipment from the purchase price allocation.
- (2) Revenue and cost of goods sold adjustments as a result of the reduction in deferred revenue and the cost related to their estimated fair value.
- (3) Incremental interest expense related to the Company's 2019 Incremental Term Loan Facility, as defined in Note 15.
- (4) The exclusion of acquisition costs and inventory step-up amortization for the year ended December 31, 2019 and the addition of these items to the year ended December 31, 2018.
- (5) The estimated tax impact of the above adjustments.

Sale of Data Analytics Solutions

In April 2017, the Company completed the sale of its Data Analytics Solutions business for total proceeds of \$72,509, net of cash sold and recorded a gain of \$74,856. This business, which had revenues in 2016 of \$12,700 and was included in the Vacuum & Analysis segment, was no longer a part of the Company's long-term strategic objectives.

The business did not qualify as a discontinued operation as this sale did not represent a strategic shift in the Company's business, nor did the sale have a major effect on the Company's operations. Therefore, the results of operations for all periods are included in the Company's income from operations. The assets and liabilities of this business have not been reclassified or segregated in the consolidated balance sheet or consolidated statements of cash flows as the amounts were immaterial.

13) Goodwill and Intangible Assets**Goodwill**

The Company's methodology for allocating the purchase price relating to purchase acquisitions is determined through established and generally accepted valuation techniques. Goodwill is measured as the excess

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NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
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of the cost of the acquisition over the sum of the amounts assigned to tangible and identifiable intangible assets acquired less liabilities assumed. The Company assigns assets acquired (including goodwill) and liabilities assumed to one or more reporting units as of the date of acquisition. Typically acquisitions relate to a single reporting unit and thus do not require the allocation of goodwill to multiple reporting units. If the products obtained in an acquisition are assigned to multiple reporting units, the goodwill is distributed to the respective reporting units as part of the purchase price allocation process.

Goodwill and purchased intangible assets with indefinite useful lives are not amortized but are reviewed for impairment annually during the fourth quarter of each fiscal year and whenever events or changes in circumstances indicate that the carrying value of an asset may not be recoverable. The process of evaluating the potential impairment of goodwill and intangible assets requires significant judgment. The Company regularly monitors current business conditions and other factors including, but not limited to, adverse industry or economic trends, restructuring actions and lower projections of profitability that may impact future operating results.

Effective July 1, 2018, the Company reassigned goodwill to certain reporting units within the Light & Motion reportable segment resulting from a reorganization of the composition of reporting units. The goodwill was reassigned to the reporting units affected using the relative fair value approach. In conjunction with this goodwill reassignment, the Company performed an interim quantitative impairment test as of July 1, 2018 for all of its reporting units and concluded that the fair values of each reporting unit exceeded their respective carrying values.

Effective January 1, 2019, the Company reassigned goodwill to certain reporting units within the Light & Motion reportable segment resulting from a reorganization of the composition of goodwill reporting units. The goodwill was reassigned to the reporting units affected using the relative fair value approach. The Company also concluded that the fair value of each reporting unit exceeded its respective carrying value.

The changes in the carrying amount of goodwill and accumulated impairment losses were as follows:

	2019			2018		
	Gross Carrying Amount	Accumulated Impairment Loss	Net	Gross Carrying Amount	Accumulated Impairment Loss	Net
Beginning balance at January 1	\$ 731,272	\$ (144,276)	\$ 586,996	\$ 735,323	\$ (144,276)	\$ 591,047
Acquired goodwill(1)	473,951	—	473,951	—	—	—
Foreign currency translation	(2,493)	—	(2,493)	(4,051)	—	(4,051)
Ending balance at December 31	<u>\$ 1,202,730</u>	<u>\$ (144,276)</u>	<u>\$ 1,058,454</u>	<u>\$ 731,272</u>	<u>\$ (144,276)</u>	<u>\$ 586,996</u>

(1) During the twelve months ended December 31, 2019, the Company recorded \$473,951 of goodwill related to the ESI Merger.

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Intangible Assets

Components of the Company's acquired intangible assets are comprised of the following:

<u>As of December 31, 2019</u>	<u>Gross</u>	<u>Accumulated Impairment Charges</u>	<u>Accumulated Amortization</u>	<u>Foreign Currency Translation</u>	<u>Net</u>
Completed technology(1)	\$ 446,431	\$ (105)	\$ (178,310)	\$ (208)	\$267,808
Customer relationships(1)	308,144	(1,406)	(84,167)	(1,361)	221,210
Patents, trademarks, trade names and other	120,895	—	(45,505)	222	75,612
	<u>\$ 875,470</u>	<u>\$ (1,511)</u>	<u>\$ (307,982)</u>	<u>\$ (1,347)</u>	<u>\$564,630</u>

- (1) During the twelve months ended December 31, 2019, the Company recorded \$316,200 of separately identified intangible assets related to the ESI Merger, of which \$274,000 was completed technology, \$25,400 was customer relationships and \$16,800 was trademarks, trade names and backlog. Separately, on January 1, 2019, the Company reclassified \$6,428 of gross favorable lease assets and \$3,445 of related accumulated amortization from patents, trademarks, trade names and other to the right-of-use asset line in the balance sheet.

<u>As of December 31, 2018</u>	<u>Gross</u>	<u>Accumulated Impairment Charges</u>	<u>Accumulated Amortization</u>	<u>Foreign Currency Translation</u>	<u>Net</u>
Completed technology	\$ 172,431	\$ (105)	\$ (137,283)	\$ (73)	\$ 34,970
Customer relationships	282,744	(1,406)	(63,788)	(269)	217,281
Patents, trademarks, trade names and other	110,523	—	(42,954)	(13)	67,556
	<u>\$565,698</u>	<u>\$ (1,511)</u>	<u>\$ (244,025)</u>	<u>\$ (355)</u>	<u>\$319,807</u>

Aggregate amortization expense related to acquired intangible assets for the years 2019, 2018 and 2017 was \$67,402, \$43,521 and \$45,743, respectively. The amortization expense in 2019, 2018 and 2017 is net of \$0, \$885 and \$811, respectively, of amortization income from unfavorable lease commitments. Aggregate net amortization expense related to acquired intangible assets for future years is:

<u>Year</u>	<u>Amount</u>
2020	\$ 55,808
2021	47,720
2022	45,254
2023	44,902
2024	43,985
Thereafter	\$271,061

The Company excluded \$55,900 of indefinite-lived trademarks and tradenames that were not subject to amortization from the table above.

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14) Product Warranties

The Company provides for the estimated costs to fulfill customer warranty obligations upon the recognition of the related revenue. While the Company engages in extensive product quality programs and processes, including actively monitoring and evaluating the quality of its component suppliers, the Company’s warranty obligation is affected by shipment volume, product failure rates, utilization levels, material usage and supplier warranties on parts delivered to the Company. Should actual product failure rates, utilization levels, material usage, or supplier warranties on parts differ from the Company’s estimates, revisions to the estimated warranty liability would be required.

Product warranty activities were as follows:

	Years Ended December 31,	
	2019	2018
Beginning balance	\$ 10,399	\$ 10,104
Assumed product warranty liability from ESI Merger	7,177	—
Provision for product warranties	17,397	15,987
Direct and other charges to warranty liability	(20,100)	(15,692)
Ending balance(1)	\$ 14,873	\$ 10,399

- (1) Short-term product warranty of \$12,085 and long-term product warranty of \$2,788, each as of December 31, 2019, are included within other current liabilities and other non-current liabilities, respectively, within the accompanying consolidated balance sheet. Short-term product warranty of \$9,986 and long-term product warranty of \$413 as of December 31, 2018, are included within other current liabilities and other non-current liabilities, respectively, within the accompanying consolidated balance sheet.

15) Debt

Senior Secured Term Loan Credit Facility

In connection with the completion of the acquisition of Newport Corporation (“Newport”) in 2016 (the “Newport Merger”), the Company entered into a term loan credit agreement (the “Term Loan Credit Agreement”) with Barclays Bank PLC, as administrative agent and collateral agent, and the lenders from time to time party thereto (the “Lenders”), that provided a senior secured term loan credit facility in the original principal amount of \$780,000 (the “2016 Term Loan Facility”), subject to increase at the Company’s option and subject to receipt of lender commitments in accordance with the Term Loan Credit Agreement (the 2016 Term Loan Facility, together with the 2019 Incremental Term Loan Facility and 2019 Term Loan Refinancing Facility (each as defined below), the “Term Loan Facility”). Prior to the effectiveness of Amendment No. 6 (as defined below), the 2016 Term Loan Facility had a maturity date of April 29, 2023. As of December 31, 2019, borrowings under the Term Loan Facility bear interest per annum at one of the following rates selected by the Company: (a) a base rate determined by reference to the highest of (1) the federal funds effective rate plus 0.50%, (2) the “prime rate” quoted in *The Wall Street Journal*, (3) a London Interbank Offer Rate (“LIBOR”) rate determined by reference to the costs of funds for U.S. dollar deposits for an interest period of one month adjusted for certain additional costs, plus 1.00%, and (4) a floor of 1.75%, plus, in each case, an applicable margin; or (b) a LIBOR rate determined by reference to the costs of funds for U.S. dollar deposits for the interest period relevant to such borrowing adjusted for certain additional costs, subject to a LIBOR rate floor of 0.0%, plus an applicable margin. The Company has elected the interest rate as described in clause (b) of the foregoing sentence. The Term Loan Credit Agreement provides that, unless an alternate rate of interest is agreed, all loans will be determined by reference to the base

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rate if the LIBOR rate cannot be ascertained, if regulators impose material restrictions on the authority of a lender to make LIBOR rate loans, or for other reasons. The 2016 Term Loan Facility was issued with original issue discount of 1.00% of the principal amount thereof.

The Company subsequently entered into four separate repricing amendments to the 2016 Term Loan Facility, which decreased the applicable margin for LIBOR borrowings from 4.0% to 1.75%, with a LIBOR rate floor of 0.75%. As a consequence of the pricing of the 2019 Incremental Term Loan Facility (defined below), the applicable margin for the 2016 Term Loan Facility was increased to 2.00% (from 1.75%) with respect to LIBOR borrowings and 1.00% (from 0.75%) with respect to base rate borrowings.

On September 30, 2016, the Company entered into an interest rate swap agreement, which has a maturity date of September 30, 2020, to fix the rate on \$335,000 of the then-outstanding balance of the 2016 Term Loan Facility. The rate was fixed at 1.198% per annum plus the applicable credit spread, which was 1.75% at December 31, 2019. At December 31, 2019, the notional amount of this transaction was \$250,000 and it had a fair value asset of \$843.

The Company incurred \$28,747 of deferred finance fees, original issue discount and repricing fees related to the term loans under the 2016 Term Loan Facility, which are included in long-term debt in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

On February 1, 2019, in connection with the completion of the ESI Merger, the Company entered into an amendment (“Amendment No. 5”) to the Term Loan Credit Agreement. Amendment No. 5 provided an additional tranche B-5 term loan commitment in the original principal amount of \$650,000 (the “2019 Incremental Term Loan Facility”), all of which was drawn down in connection with the closing of the ESI Merger. Pursuant to Amendment No. 5, the Company also effectuated certain amendments to the Term Loan Credit Agreement which make certain of the negative covenants and other provisions less restrictive. Prior to the effectiveness of Amendment No. 6 (as defined below), the 2019 Incremental Term Loan Facility had a maturity date of February 1, 2026 and bore interest at a rate per annum equal to, at the Company’s option, a base rate or LIBOR rate (as described above) plus, in each case, an applicable margin equal to 1.25% with respect to base rate borrowings and 2.25% with respect to LIBOR borrowings. The 2019 Incremental Term Loan Facility was issued with original issue discount of 1.00% of the principal amount thereof.

On April 3, 2019, the Company entered into an interest rate swap agreement, which has a maturity date of March 31, 2023, to fix the rate on \$300,000 of the then-outstanding balance of the 2019 Incremental Term Loan Facility. The rate was fixed at 2.309% per annum plus the applicable credit spread, which was 1.75% at December 31, 2019. At December 31, 2019, the notional amount of this transaction was \$300,000 and it had a fair value liability of \$6,510.

The Company incurred \$11,362 of deferred finance fees and original issue discount fees related to the term loans under the 2019 Incremental Term Loan Facility, which are included in long-term debt in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

On September 27, 2019, the Company entered into an amendment (“Amendment No. 6”) to the Term Loan Credit Agreement. Amendment No. 6 refinanced all existing loans outstanding under the 2016 Term Loan Facility and 2019 Incremental Term Loan Facility (“Existing Term Loans”) for a tranche B-6 term loan

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commitment in the original principal amount of \$896,839 ("2019 Term Loan Refinancing Facility"). Each lender of the Existing Term Loans that elected to participate in the 2019 Term Loan Refinancing Facility was deemed to have exchanged the aggregate outstanding principal amount of its Existing Term Loans for an equal aggregate principal amount of tranche B-6 term loans under the 2019 Term Loan Refinancing Facility. On the effective date of Amendment No. 6 and immediately prior to the exchanges described above, the Company made a voluntary prepayment of \$50,000, which was applied to the Existing Term Loans on a pro rata basis.

The Company incurred \$2,242 of original issue discount fees related to the term loans under the 2019 Term Loan Refinancing Facility, which are included in long-term debt in the accompanying consolidated balance sheets and are being amortized to interest expense over the estimated life of the term loans using the effective interest method.

As of December 31, 2019, the remaining balance of deferred finance fees and original issue discount of the Term Loan Facility was \$11,810. A portion of the deferred finance fees and original issue discount have been accelerated in connection with the various debt prepayments and extinguishments during 2016, 2017, 2018 and 2019.

The 2019 Term Loan Refinancing Facility matures on February 2, 2026, and bears interest at a rate per annum equal to, at the Company's option, a base rate or LIBOR rate (as described above) plus, in each case, an applicable margin equal to 0.75% with respect to base rate borrowings and 1.75% with respect to LIBOR borrowings. The 2019 Term Loan Refinancing Facility was issued with original issue discount of 0.25% of the principal amount thereof.

The Company is required to make scheduled quarterly payments each equal to 0.25% of the original principal amount of the 2019 Term Loan Refinancing Facility with the balance due on February 2, 2026. If, on or prior to the date that is six months after the closing date of Amendment No. 6, the Company prepays any loans under the 2019 Term Loan Refinancing Facility in connection with a repricing transaction, the Company must pay a prepayment premium of 1.00% of the aggregate principal amount of the loans so prepaid.

As of December 31, 2019, after total principal prepayments of \$525,000 and regularly scheduled principal payments of \$12,646, the total outstanding principal balance of the Term Loan Facility was \$892,354 and the interest rate was 3.45%.

Under the Term Loan Credit Agreement, the Company is required to prepay outstanding term loans, subject to certain exceptions, with portions of its annual excess cash flow as well as with the net cash proceeds of certain of its asset sales, certain casualty and condemnation events and the incurrence or issuance of certain debt. As a result of prepayments of term loan debt of \$100,000 during 2019, the Company was not required to make a prepayment of excess cash flow for the period ended December 31, 2019.

All obligations under the Term Loan Facility are guaranteed by certain of the Company's domestic subsidiaries and are collateralized by substantially all of the Company's assets and the assets of such subsidiaries, subject to certain exceptions and exclusions.

The Term Loan Credit Agreement contains customary representations and warranties, affirmative and negative covenants and provisions relating to events of default. If an event of default occurs, the lenders under the Term Loan Facility will be entitled to take various actions, including the acceleration of amounts due under the Term Loan Facility and all actions generally permitted to be taken by a secured creditor. At December 31, 2019, the Company was in compliance with all covenants under the Term Loan Credit Agreement.

MKS INSTRUMENTS, INC.**NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)**
(in thousands, except share and per share data)Senior Secured Asset-Based Revolving Credit Facility

On February 1, 2019, in connection with the completion of the ESI Merger, the Company entered into an asset-based revolving credit agreement with Barclays Bank PLC, as administrative agent and collateral agent, the other borrowers from time to time party thereto, and the lenders and letters of credit issuers from time to time party thereto (the “ABL Credit Agreement”), that provides a senior secured asset-based revolving credit facility of up to \$100,000, subject to a borrowing base limitation (the “ABL Facility”). On April 26, 2019, the Company entered into a First Amendment to the ABL Credit Agreement which amended the borrowing base calculation for eligible inventory prior to an initial field examination and appraisal requirements. The borrowing base for the ABL Facility at any time equals the sum of: (a) 85% of certain eligible accounts; plus (b) prior to certain notice and field examination and appraisal requirements, the lesser of (i) 20% of net book value of eligible inventory in the United States and (ii) 30% of the borrowing base, and after the satisfaction of such requirements, the lesser of (i) the lesser of (A) 65% of the lower of cost or market value of certain eligible inventory and (B) 85% of the net orderly liquidation value of certain eligible inventory and (ii) 30% of the borrowing base; minus (c) reserves established by the administrative agent, in each case, subject to additional limitations and examination requirements for eligible accounts and eligible inventory acquired in an acquisition after February 1, 2019. The ABL Facility includes borrowing capacity in the form of letters of credit up to \$25,000.

Borrowings under the ABL Facility bear interest at a rate per annum equal to, at the Company’s option, any of the following, plus, in each case, an applicable margin: (a) a base rate determined by reference to the highest of (1) the federal funds effective rate plus 0.50%, (2) the “prime rate” quoted in *The Wall Street Journal*, (3) a LIBOR rate determined by reference to the costs of funds for U.S. dollar deposits for an interest period of one month adjusted for certain additional costs, plus 1.00% and (4) a floor of 0.00%; and (b) a LIBOR rate determined by reference to the costs of funds for U.S. dollar deposits for the interest period relevant to such borrowing adjusted for certain additional costs, with a floor of 0.00%. The initial applicable margin for borrowings under the ABL Facility is 0.50% with respect to base rate borrowings and 1.50% with respect to LIBOR borrowings. Commencing with the completion of the first fiscal quarter ending after the closing of the ABL Facility, the applicable margin for borrowings thereunder is subject to upward or downward adjustment each fiscal quarter, based on the average historical excess availability during the preceding quarter.

In addition to paying interest on any outstanding principal under the ABL Facility, the Company is required to pay a commitment fee in respect of the unutilized commitments thereunder equal to 0.25% per annum. The Company must also pay customary letter of credit fees and agency fees.

The Company incurred \$785 of costs in connection with the ABL Facility, which were capitalized and included in other assets in the accompanying consolidated balance sheet and are being amortized to interest expense over the contractual term of five years of the ABL Facility. As a result of a prior asset-based revolving credit facility being terminated concurrently with our entry into the ABL Facility, the Company wrote off \$216 of previously capitalized debt issuance costs.

If at any time the aggregate amount of outstanding loans, protective advances, unreimbursed letter of credit drawings and undrawn letters of credit under the ABL Facility exceeds the lesser of (a) the commitment amount and (b) the borrowing base, we are required to repay outstanding loans and/or cash collateralize letters of credit, with no reduction of the commitment amount. During any period that the amount available under the ABL Facility is less than the greater of (i) \$8,500 and (ii) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base for three consecutive business days, until the time when excess availability has been at least the greater of (i) \$8,500 and (ii) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base, in each case, for 30 consecutive calendar days (a “Cash Dominion Period”), or during the continuance of an

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event of default, the Company is required to repay outstanding loans and/or cash collateralize letters of credit with the cash that it is required to deposit daily in a collection account maintained with the administrative agent under the ABL Facility. During a Cash Dominion Period, the Company may make borrowings under the ABL Facility subject to the satisfaction of customary funding conditions.

There is no scheduled amortization under the ABL Facility. The principal amount outstanding under the ABL Facility is due and payable in full on the fifth anniversary of the closing date.

All obligations under the ABL Facility are guaranteed by certain of our domestic subsidiaries and are collateralized by substantially all of the Company's assets and the assets of such subsidiaries, subject to certain exceptions and exclusions.

From the time when the Company has excess availability less than the greater of (a) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base and (b) \$8,500, until the time when the Company has excess availability equal to or greater than the greater of (a) 10.0% of the lesser of (1) the commitment amount and (2) the borrowing base and (b) \$8,500 for 30 consecutive days, or during the continuance of an event of default, the ABL Credit Agreement requires the Company to maintain a Fixed Charge Coverage Ratio (as defined in the ABL Credit Agreement) tested on the last day of each fiscal quarter of at least 1.0 to 1.0.

The ABL Credit Agreement also contains customary representations and warranties, affirmative covenants and provisions relating to events of default. If an event of default occurs, the lenders under the ABL Facility will be entitled to take various actions, including the acceleration of amounts due under the ABL Facility and all actions permitted to be taken by a secured creditor. The Company has not borrowed against this ABL Facility to date.

Lines of Credit and Short-Term Borrowing Arrangements

One of the Company's Japanese subsidiaries has lines of credit and short-term borrowing arrangements with two financial institutions, which arrangements generally expire and are renewed at three-month intervals. The lines of credit provided for aggregate borrowings as of December 31, 2019 of up to an equivalent of \$21,126 U.S. dollars. One of the borrowing arrangements has an interest rate based on the Tokyo Interbank Offer Rate at the time of borrowing and the other has an interest rate based on the Japanese Short-Term Prime Lending Rate. There were no borrowings outstanding under these arrangements at December 31, 2019 and 2018.

The Company assumed various revolving lines of credit and a financing facility with the completion of the Newport Merger. These revolving lines of credit and financing facility have no expiration date and provided for aggregate borrowings as of December 31, 2019 of up to an equivalent of \$11,482 U.S. dollars. These lines of credit have a base interest rate of 1.25% plus a Japanese Yen overnight LIBOR rate. Total borrowings outstanding under these arrangements were \$3,131 and \$3,389 at December 31, 2019 and 2018.

	<u>December 31, 2019</u>	<u>December 31, 2018</u>
Short-term debt:		
Japanese lines of credit	\$ 2,558	\$ 2,724
Japanese receivables financing facility	573	665
Other debt	—	597
Term Loan Facility	8,968	—
	<u>\$ 12,099</u>	<u>\$ 3,986</u>

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	<u>December 31, 2019</u>	<u>December 31, 2018</u>
Long-term debt:		
Other debt	\$ 94	\$ 86
Term Loan Facility, net(1)	871,573	343,756
	<u>\$ 871,667</u>	<u>\$ 343,842</u>

- (1) Net of deferred financing fees, original issuance discount and re-pricing fee in the aggregate of \$11,810 and \$4,708 as of December 31, 2019 and 2018, respectively.

The Company recognized interest expense of \$44,135, \$16,942 and \$30,990 for the twelve months ended December 31, 2019, 2018 and 2017, respectively.

Contractual maturities of the Company's debt obligations as of December 31, 2019 are as follows:

<u>Year</u>	<u>Amount</u>
2020	\$ 12,099
2021	9,062
2022	8,968
2023	8,968
2024	8,968
Thereafter	847,511

16) Income Taxes

The Tax Cuts and Jobs Act ("the Act"), which was enacted on December 22, 2017, reduced the U.S. federal corporate tax rate from 35% to 21% effective January 1, 2018, required companies to pay a one-time transition tax on earnings of certain foreign subsidiaries that were previously tax deferred and created new taxes on certain foreign sourced earnings. The Company applied SAB 118 when accounting for the enactment effects of the Act. During the quarter ended December 31, 2018, the Company completed and recorded the impacts of the Act based on its understanding and interpretation of the regulatory guidance issued.

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A reconciliation of the Company's effective tax rate to the U.S. federal statutory rate is as follows:

	Years Ended December 31,		
	2019	2018	2017
U.S. Federal income tax statutory rate	21.0%	21.0%	35.0%
Federal tax credits	(2.9)	(0.7)	(0.7)
State income taxes, net of federal benefit	2.3	1.3	1.0
Effect of foreign operations taxed at various rates	(4.4)	(1.3)	(12.1)
Qualified production activity tax benefit	—	—	(1.4)
Executive compensation	5.8	—	—
Gain on intercompany sale of assets	2.9	—	—
Benefit of a capital loss	(1.2)	—	—
Foreign derived intangible income deduction	(3.8)	(2.1)	—
Global intangible low taxed income, net of foreign tax credits	2.6	0.4	—
Transition tax, net of foreign tax credits	—	(0.1)	6.4
Revaluation of deferred income taxes	(1.4)	(0.3)	(5.0)
Revaluation of prepaid taxes	—	1.6	—
Stock-based compensation	(0.3)	(1.3)	(2.5)
Deferred tax asset valuation allowance	0.1	—	(0.1)
Release of income tax reserves (including interest)	(0.8)	(0.4)	(0.4)
Foreign dividends, net of foreign tax credits	0.6	(1.0)	3.3
Other	0.6	1.2	0.7
	<u>21.1%</u>	<u>18.3%</u>	<u>24.2%</u>

The effective tax rate for 2019 includes a correction of an out of period error with respect to deferred tax assets related to limitations on the deduction of executive compensation in the amount of \$5,023. This correction, which should have been recorded during the three months ended September 30, 2018, increased the Company's effective tax rate for the year ended December 31, 2019 by approximately 2.8%.

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The components of income from operations before income taxes and the related provision for income taxes consist of the following:

	Years Ended December 31,		
	2019	2018	2017
Income before income taxes:			
United States	\$ 2,279	\$287,309	\$224,979
Foreign	175,557	193,641	222,646
	<u>\$ 177,836</u>	<u>\$480,950</u>	<u>\$447,625</u>
Current taxes:			
United States	\$ 6,790	\$ 41,428	\$ 77,023
State	2,068	8,094	6,149
Foreign	32,807	57,920	30,152
	<u>41,665</u>	<u>107,442</u>	<u>113,324</u>
Deferred taxes:			
United States	(1,743)	(2,533)	(16,250)
State and Foreign	(2,472)	(16,855)	11,419
	<u>(4,215)</u>	<u>(19,388)</u>	<u>(4,831)</u>
Provision for income taxes	<u>\$ 37,450</u>	<u>\$ 88,054</u>	<u>\$108,493</u>

The significant components of the deferred tax assets and deferred tax liabilities are as follows:

	Years Ended December 31,	
	2019	2018
Deferred tax assets:		
Carry-forward losses and credits	\$ 59,189	\$ 23,675
Inventory and warranty reserves	29,661	17,945
Accrued expenses and other reserves	12,607	10,260
Stock-based compensation	8,580	5,351
Executive supplemental retirement benefits	1,556	5,972
Lease liability	15,284	—
Unrealized net loss	2,741	—
Other	2,347	2,396
Total deferred tax assets	<u>\$ 131,965</u>	<u>\$ 65,599</u>
Deferred tax liabilities:		
Acquired intangible assets and goodwill	\$ (128,144)	\$ (74,120)
Depreciation and amortization	(14,072)	(8,332)
Loan costs	(2,317)	(1,108)
Right-of-use asset	(14,415)	—
Foreign withholding taxes	(5,008)	(3,176)
Unrealized net gain	—	(1,952)
Total deferred tax liabilities	<u>(163,956)</u>	<u>(88,688)</u>
Valuation allowance	(27,360)	(17,936)
Net deferred tax liabilities	<u>\$ (59,351)</u>	<u>\$ (41,025)</u>

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Due to the reduction in U.S. federal statutory tax rate from the enactment of the Act, the Company recorded a provisional adjustment reducing its net deferred tax liabilities by \$22,345 as of December 31, 2017. This provisional adjustment was finalized during the year ended December 31, 2018 and an additional tax provision of \$2,614 was recorded.

As of December 31, 2019, the Company had federal, state and foreign gross research and other tax credit carry-forwards of \$64,983. Included in the total carry-forward are \$14,230 of credits that can be carried forward indefinitely and the remaining credits expire at various dates through 2037. The Company also had federal, state and foreign gross net operating loss and capital loss carry-forwards of \$98,280. Included in the total carry-forward are \$57,588 of losses that can be carried forward indefinitely while the remaining losses expire at various dates through 2037.

Although the Company believes that its tax positions are consistent with applicable U.S. federal, state and international laws, it maintains certain tax reserves as of December 31, 2019 in the event its tax positions were to be challenged by the applicable tax authority and additional tax assessed upon audit.

A reconciliation of the beginning and ending amount of gross unrecognized tax benefits is as follows:

	Years Ended December 31,		
	2019	2018	2017
Balance at beginning of year	\$ 32,684	\$27,345	\$25,465
Increases for prior years	9,324	934	640
Increases for the current year	3,219	6,091	4,340
Reductions related to expiration of statutes of limitations and audit settlements	(1,734)	(1,686)	(3,100)
Balance at end of year	<u>\$ 43,493</u>	<u>\$32,684</u>	<u>\$27,345</u>

As of December 31, 2019, the total gross unrecognized tax benefits, which excludes interest and penalties, was \$43,493. As of December 31, 2018, the total gross unrecognized tax benefits, which excludes interest and penalties, was \$32,684. The net increase was primarily attributable to the addition of historical gross unrecognized tax benefits for ESI as a result of the ESI Merger during the quarter ended March 31, 2019.

The Company accrues interest and, if applicable, penalties for any uncertain tax positions. Interest and penalties are classified as a component of income tax expense. As of December 31, 2019, 2018 and 2017, the Company had accrued interest on unrecognized tax benefits of approximately \$527, \$568 and \$327, respectively.

Over the next 12 months it is reasonably possible that the Company may recognize \$1,463 of previously net unrecognized tax benefits, excluding interest and penalties, related to various U.S. federal, state and foreign tax positions primarily due to the expiration of statutes of limitations.

The Company and its subsidiaries are subject to examination by U.S. federal, state and foreign tax authorities. The U.S. Internal Revenue Service commenced an examination of the Company's U.S. federal income tax filings for tax years 2015 and 2016 during the quarter ended September 30, 2017. This audit was effectively settled during the quarter ended March 31, 2018, and the impact was not material. Also, during the quarter ended March 31, 2018, the Company received notification from the U.S. Internal Revenue Service of their intent to audit its U.S. subsidiary, Newport, for the tax year 2015. This audit commenced during the quarter

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ended June 30, 2018 and was effectively settled during the quarter ended June 30, 2019, with a no change result. The U.S. statute of limitations remains open for tax years 2016 through the present. The statute of limitations for the Company's tax filings in other jurisdictions varies between fiscal years 2014 through present. The Company has certain federal credit carry-forwards and state tax loss and credit carry-forwards that are open to examination for tax years 2000 through the present.

On a quarterly basis, the Company evaluates both positive and negative evidence that affects the realizability of net deferred tax assets and assesses the need for a valuation allowance. The future benefit to be derived from its deferred tax assets is dependent upon its ability to generate sufficient future taxable income to realize the assets.

During 2019, the Company increased its valuation allowance by \$9,424. This increase was primarily attributable to the addition of historical valuation allowances for ESI and its subsidiaries which were included as a result of the ESI Merger during the quarter ended March 31, 2019. During 2018, the Company increased its valuation allowance by \$4,307, primarily related to certain tax credit and net operating loss carry-forward amounts. During 2017, the Company increased its valuation allowance by \$1,102, primarily related to certain state tax credits.

No provision has been made for deferred taxes related to remaining historical outside basis differences in certain of the Company's non-US subsidiaries. The Company continues to assert indefinite reinvestment in these outside basis differences generated on or before December 31, 2019. Determination of the amount of unrecognized deferred tax liability on outside basis differences is not practicable because the amount of such liability, if any, is dependent upon circumstances existing and tax planning choices available when a transaction using outside basis occurs.

Certain of the Company's subsidiaries have obtained tax rate reductions or tax holidays under incentive programs offered under government programs. A Singapore subsidiary of ESI obtained a tax holiday in Singapore. The benefits of the holiday were approximately \$2.2 million (\$0.04 per share) in 2019. The tax holiday in Singapore is expected to expire at the end of June 2021.

17) Stock-Based Compensation

Employee Stock Purchase Plans

The 2014 ESPP Plan was adopted by the Board of Directors on February 10, 2014 and approved by the Company's stockholders on May 5, 2014. The 2014 ESPP Plan authorizes the issuance of up to an aggregate of 2,500,000 shares of common stock to participating employees. Offerings under the 2014 ESPP Plan commence on June 1 and December 1 and terminate, respectively, on November 30 and May 31. Historically, under the 2014 ESPP Plan, eligible employees could purchase shares of common stock through payroll deductions of up to 10% of their compensation or up to an annual maximum amount of \$21,250. The price at which an employee's purchase option was exercised for each offering period was the lower of (1) 85% of the closing price of the common stock on the Nasdaq Global Select Market on the day that each offering commences, or (2) 85% of the closing price on the day that the offering terminated. On January 31, 2017, the Compensation Committee of the Board of Directors approved an increase in the exercise price to the lower of (1) 90% of the closing price on the common stock on the Nasdaq Global Select Market on the day that each offering commences, or (2) 90% of the closing price on the day that the offering terminates. The increase in the exercise price became effective for the offering commencing on June 1, 2017. As a result of this change, the annual maximum payroll deduction was increased from \$21,250 to \$22,500. During 2019, 2018, and 2017, the Company issued 126,407, 105,672, and

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105,506 shares, respectively, of common stock to employees who participated in the 2014 ESPP Plan at exercise prices of \$64.31 and \$63.78 per share in 2019, \$84.11 and \$70.61 per share in 2018, and \$46.37 and \$74.12 per share in 2017. As of December 31, 2019, there were 1,800,324 shares reserved for future issuance under the 2014 ESPP Plan.

Equity Incentive Plans

The Company grants restricted stock units (“RSUs”) to employees and directors under the 2014 Stock Incentive Plan (the “2014 Plan”). The 2014 Plan is administered by the Compensation Committee of the Company’s Board of Directors. The 2014 Plan is intended to attract and retain employees and directors, and to provide an incentive for these individuals to assist the Company to achieve long-range performance goals and to enable these individuals to participate in the long-term growth of the Company.

The 2014 Plan was adopted by the Board of Directors on February 10, 2014 and was approved by the Company’s stockholders on May 5, 2014. Up to 18,000,000 shares of common stock (subject to adjustment in the event of stock splits and other similar events) may be issued pursuant to awards granted under the 2014 Plan. The Company may grant options, RSUs, restricted stock, stock appreciation rights (“SARs”) and other stock-based awards to employees, officers, directors, consultants and advisors under the 2014 Plan. Any full-value awards granted under the 2014 Plan will be counted against the shares reserved for issuance under the 2014 Plan as 2.4 shares for each share of common stock subject to such award and any award granted under the 2014 Plan that is not a full-value award (including, without limitation, any option or SAR) will be counted against the shares reserved for issuance under the plan as one share for each one share of common stock subject to such award. “Full-value award” means any RSU, or other stock-based award with a per share price or per unit purchase price lower than 100% of fair market value on the date of grant. To the extent a share that was subject to an award that counted as one share is returned to the 2014 Plan, each applicable share reserve will be credited with one share. To the extent that a share that was subject to an award that counts as 2.4 shares is returned to the 2014 Plan, each applicable share reserve will be credited with 2.4 shares. As of December 31, 2019, there were 13,268,546 shares reserved for future issuance under the 2014 Plan.

Time-based RSUs granted to employees in 2019, 2018 and 2017 generally vest 33% per year beginning on the first anniversary of the date of grant. Performance-based RSUs granted to the Company’s executive officers in 2019, 2018 and 2017 were based on the Company’s achievement of non-GAAP cash flows from operations for the relevant year, defined as GAAP net income plus depreciation, amortization and non-cash stock-based compensation and excluding any charges or income not related to the operating performance of the Company, set at varying revenue levels. The final number of performance-based RSUs that vest vary based on the level of performance achieved from 0% to 150% of the underlying target shares. The performance-based RSUs earned will vest 33% per year beginning on the first anniversary of the date of grant. RSUs granted to certain employees who meet certain retirement eligibility requirements will vest in full upon each such employee’s retirement and are expensed immediately. RSUs granted to directors generally vest at the earliest of (1) one day prior to the next annual meeting, (2) 13 months from date of grant, or (3) the effective date of a change in control of the Company.

In connection with the completion of the Newport Merger, the Company assumed:

- all RSUs granted under any Newport equity plan that were outstanding immediately prior to the effective time of the Newport Merger, and as to which shares of Newport common stock were not fully distributed in connection with the closing of the Newport Merger (the “Newport RSUs”), and
- all SARs granted under any Newport equity plan, whether vested or unvested, that were outstanding immediately prior to the effective time of the Newport Merger (the “Newport SARs”).

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As of the effective time of the Newport Merger, based on a formula provided in the Newport Merger Agreement, (a) the Newport RSUs were converted automatically into RSUs with respect to 360,674 shares of the Company's common stock (the "Newport Assumed RSUs"), and (b) the Newport SARs were converted automatically into SARs with respect to 899,851 shares of the Company's common stock (the "Newport Assumed SARs").

Included in the total number of Newport Assumed RSUs were 36,599 RSUs for outside directors that were part of the Newport Deferred Compensation Plan (the "Newport DC Plan"), from which 5,515 shares were released in May 2017, 5,561 shares were released in May 2018 and 967 shares were released in May 2019. As of December 31, 2019, 5,794 Company RSUs remained outstanding under the Newport DC Plan, and an additional 57 shares of the Company's common stock were added to the Newport DC Plan due to reinvested dividends. As of December 31, 2018, 6,694 Company RSUs remained outstanding under the Newport DC Plan, and an additional 66 shares of the Company's common stock were added to the Newport DC Plan due to reinvested dividends. As of December 31, 2017, 12,134 Company RSUs remained outstanding under the Newport DC Plan, and an additional 122 shares of the Company's common stock were added to the Newport DC Plan due to reinvested dividends. These Newport Assumed RSUs will not become issued shares until their respective release dates.

The shares of the Company's common stock that are subject to the Newport Assumed SARs and the Newport Assumed RSUs are issuable pursuant to the Company's 2014 Plan.

The 1,260,525 shares of the Company's common stock that are issuable pursuant to the Newport Assumed RSUs and the Newport Assumed SARs under the 2014 Plan were registered under the Securities Act of 1933, as amended ("Securities Act"), on a registration statement on Form S-8. These shares are in addition to the 18,000,000 shares of the Company's common stock reserved for issuance under the 2014 Plan and previously registered under the Securities Act on a registration statement on Form S-8.

In connection with the completion of the ESI Merger, the Company assumed:

- all RSUs that vest based solely on the satisfaction of service conditions, granted under any ESI equity plan, arrangement or agreement ("ESI Plan") that were outstanding immediately prior to the effective time of the ESI Merger, and as to which shares of ESI common stock were not fully distributed in connection with the closing of the ESI Merger ("ESI Time-Based RSUs"),
- all RSUs that were granted subject to vesting based on both the achievement of performance goals and the satisfaction of service conditions granted under any ESI Plan that were outstanding immediately prior to the effective time of the ESI Merger ("ESI Performance-Based RSUs and collectively with the ESI Time-Based RSUs, the "ESI RSUs"), and
- all SARs granted under any ESI Plan, whether vested or unvested, that were outstanding immediately prior to the effective time of the ESI Merger and held by an individual who was a service provider of ESI as of the date on which the effective time of the ESI Merger occurred (the "ESI SARs").

As of the effective time of the ESI Merger, based on a formula in the ESI Merger Agreement, (a) such ESI RSUs were converted automatically into RSUs with respect to 736,133 shares of the Company's common stock (the "ESI Assumed RSUs"), and (b) such ESI SARs were converted automatically into SARs with respect to 12,787 shares of the Company's common stock (the "ESI Assumed SARs").

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Included in the total number of ESI Assumed RSUs are 326,283 shares of the Company's common stock for employees and outside directors that are part of the ESI Deferred Compensation plan (the "ESI DC Plan"). These shares will not become issued shares until their respective release dates. As of December 31, 2019, 327,328 Company RSUs remained outstanding under the ESI DC Plan, and an additional 3,086 shares of the Company's common stock were added to the ESI DC Plan due to reinvested dividends.

The 748,920 shares of the Company's common stock that are issuable pursuant to the ESI Assumed RSUs and the ESI Assumed SARs under the 2014 Plan were registered under the Securities Act on a registration statement on Form S-8. These shares are in addition to the 18,000,000 shares of the Company's common stock reserved for issuance under the 2014 Plan and the 1,260,525 shares of the Company's common stock that were issuable in connection with the Newport Merger, all of which shares were previously registered under the Securities Act on a registration statement on Form S-8.

The following table presents the activity for RSUs under the Plans:

	Year Ended December 31, 2019	
	RSUs	Weighted Average Grant Date Fair Value
RSUs — beginning of period	647,394	\$ 74.04
Assumed from ESI Merger	736,133	\$ 84.10
Accrued dividend shares	5,222	\$ 85.67
Granted	434,970	\$ 87.11
Vested	(577,688)	\$ 70.27
Forfeited or expired	(143,498)	\$ 89.55
RSUs — end of period	<u>1,102,533</u>	<u>\$ 85.93</u>

The following table presents the activity for SARs under the Plans:

	Year Ended December 31, 2019	
	Outstanding and Exercisable SARs	Weighted Average Base Value
SARs — beginning of period	177,538	\$ 28.52
Assumed from ESI Merger	12,787	\$ 17.38
Exercised	(77,473)	\$ 26.29
Forfeited or expired	(3,998)	\$ 23.00
SARs Outstanding — end of period	<u>108,854</u>	<u>\$ 29.05</u>

At December 31, 2019, the Company's outstanding and exercisable SARs, the weighted-average base value, the weighted average remaining contractual life and the aggregate intrinsic value thereof, were as follows:

	Number of Shares	Weighted Average Base Value	Weighted Average Remaining Contractual Life (years)	Aggregate Intrinsic Value
SARs outstanding and exercisable	108,854	\$ 29.05	1.6	\$ 8,813

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The Company settles employee RSU vesting and SARs exercises with newly issued shares of the Company's common stock.

Stock-Based Compensation Expense

The Company recognized the full impact of its share-based payment plans in the consolidated statements of operations and comprehensive income for the years 2019, 2018 and 2017. As of December 31, 2019, the Company capitalized \$1,595 of such cost on its consolidated balance sheet. As of December 31, 2018, and 2017, the Company capitalized \$471 of such cost on its consolidated balance sheet. The following table reflects the effect of recording stock-based compensation for the years 2019, 2018 and 2017:

	Years Ended December 31,		
	2019	2018	2017
Stock-based compensation expense by type of award:			
RSUs	\$47,005	\$24,883	\$ 22,428
SARs	73	98	529
Employee stock purchase plan	2,116	2,281	1,421
Total stock-based compensation	\$49,194	27,262	24,378
Windfall tax effect on stock-based compensation	(2,244)	(8,277)	(11,071)
Net effect on net income	<u>\$46,950</u>	<u>\$18,985</u>	<u>\$ 13,307</u>
Effect on net earnings per share:			
Basic	\$ 0.86	\$ 0.35	\$ 0.25
Diluted	<u>\$ 0.85</u>	<u>\$ 0.35</u>	<u>\$ 0.24</u>

The pre-tax effect within the consolidated statements of operations and comprehensive income of recording stock-based compensation for the years 2019, 2018 and 2017 was as follows:

	Years Ended December 31,		
	2019	2018	2017
Cost of revenues	\$ 2,789	\$ 3,516	\$ 3,894
Research and development expense	3,847	2,750	2,816
Selling, general and administrative expense	20,457	20,996	17,668
Acquisition and integration related expense	21,728	—	—
Restructuring related expense	373	—	—
Total pre-tax stock-based compensation expense	<u>\$49,194</u>	<u>\$27,262</u>	<u>\$24,378</u>

Valuation Assumptions

The Company determines the fair value of RSUs based on the closing market price of the Company's common stock on the date of the award and estimates the fair value of stock appreciation rights and employee stock purchase plan rights using the Black-Scholes valuation model. Such values are recognized as expense on a straight-line basis for time-based awards and using the accelerated graded vesting method for performance-based awards, both over the requisite service periods, net of estimated forfeitures except for retirement eligible employees in which the Company expenses the fair value of the grant in the period in which the grant was

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awarded. The estimation of stock-based awards that will ultimately vest requires significant judgment. The Company considers many factors when estimating expected forfeitures, including types of awards and historical experience. Actual results, and future changes in estimates, may differ substantially from the Company's current estimates.

The weighted average fair value per share of employee stock purchase plan rights granted in 2019, 2018 and 2017 was \$16.04, \$21.74, and \$13.14, respectively. The fair value of the employees' purchase plan rights was estimated using the Black-Scholes option-pricing model with the following weighted average assumptions:

	Years Ended December 31,		
	2019	2018	2017
Employee stock purchase plan rights:			
Expected life (years)	0.5	0.5	0.5
Risk-free interest rate	2.4%	1.8%	0.8%
Expected volatility	38.7%	38.6%	26.5%
Expected annual dividends per share	\$0.80	\$0.76	\$0.69

Expected volatilities for 2019, 2018 and 2017 are based on a combination of implied and historical volatilities of the Company's common stock; the expected life represents the weighted average period of time that options granted are expected to be outstanding giving consideration to vesting schedules and the Company's historical exercise patterns; and the risk-free interest rate is based on the U.S. Treasury yield curve in effect at the time of grant for periods corresponding with the expected life of the option.

The total intrinsic value of SARs exercised and the total fair value of RSUs vested during 2019, 2018 and 2017 was approximately \$68,123, \$61,626 and \$60,302, respectively. As of December 31, 2019, the unrecognized compensation cost related to RSUs and SARs was approximately \$26,137 and will be recognized over an estimated weighted average amortization period of 1.0 year.

18) Stockholders' EquityStock Repurchase Program

On July 25, 2011, the Company's Board of Directors approved a share repurchase program for the repurchase of up to an aggregate of \$200,000 of its outstanding common stock from time to time in open market purchases, privately negotiated transactions or through other appropriate means. The timing and quantity of any shares repurchased will depend upon a variety of factors, including business conditions, stock market conditions and business development activities, including, but not limited to, merger and acquisition opportunities. These repurchases may be commenced, suspended or discontinued at any time without prior notice.

During 2019, there were no repurchases of common stock. During 2018, the Company repurchased approximately 818,000 shares of its common stock for \$75,000 at an average price of \$91.67 per share. During 2017, there were no repurchases of common stock.

The Company has repurchased approximately 2,588,000 shares of common stock for approximately \$127,000 pursuant to the program since its adoption.

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Cash Dividends

Holders of the Company's common stock are entitled to receive dividends when they are declared by the Company's Board of Directors. In addition, the Company accrues dividend equivalents on the RSUs the Company assumed in the ESI Merger described in Note 17 above when dividends are declared by the Company's Board of Directors. The Company's Board of Directors declared a cash dividend of \$0.20 per share during each quarter of 2019, which totaled \$43,528 or \$0.80 per share. The Company's Board of Directors declared a cash dividend of \$0.18 per share during the first quarter of 2018 and \$0.20 per share during each of the second, third and fourth quarters of 2018, which totaled \$42,405 or \$0.78 per share.

Future dividend declarations, if any, as well as the record and payment dates for such dividends, are subject to the final determination of the Company's Board of Directors.

On February 10, 2020, the Company's Board of Directors declared a quarterly cash dividend of \$0.20 per share to be paid on March 6, 2020 to Stockholders of record as of February 24, 2020.

19) Employee Benefit Plans

The Company has a 401(k) profit-sharing plan for U.S. employees meeting certain requirements in which eligible employees may contribute between 1% and 50% of their annual compensation to this plan, and, with respect to employees who are age 50 and older, certain specified additional amounts, limited by an annual maximum amount determined by the Internal Revenue Service. The Company, at its discretion, makes certain matching contributions to these plans based on participating employees' annual contribution to the plans and their total compensation. The Company's contributions were \$6,944, \$6,093 and \$5,651 for 2019, 2018 and 2017, respectively.

The Company maintains a bonus plan which provides cash awards to key employees, at the discretion of the compensation committee of the Board of Directors, based upon the Company's operating results. In addition, the Company's foreign locations also have various bonus plans based upon local operating results and employee performance. The total bonus expense was \$32,172, \$38,254 and \$46,783 for 2019, 2018 and 2017, respectively.

The Company provides supplemental retirement benefits for a number of former retired executives. The total cost of these benefits was \$3,211, \$4,609 and \$3,478 for 2019, 2018 and 2017, respectively. The current accumulated benefit obligation was \$21,341 and was included in other current liabilities and the non-current accumulated benefit obligation was \$2,471 and was included in other non-current liabilities at December 31, 2019. The accumulated benefit obligation was \$20,644 at December 31, 2018 and was included in other long-term liabilities.

The Company also assumed a deferred compensation plan from each of the Newport Merger and the ESI Merger. Participants in the Newport deferred compensation plan were not permitted to make any new elections beginning with 2018 compensation. Participants in the ESI deferred compensation plan were not permitted to make any new elections beginning with 2020 compensation.

Defined Benefit Pension Plans

As a result of the Newport Merger, the Company assumed all assets and liabilities of Newport's defined benefit pension plans, which cover substantially all of its full-time employees in France, Germany, Israel and Japan. In addition, there are certain pension assets and liabilities relating to former employees in the United Kingdom. The German plan is unfunded, as permitted under the plan and applicable laws.

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As a result of the ESI merger, the Company assumed all assets and liabilities of ESI's defined benefit pension plans, which cover substantially all of its full time employees in Taiwan, Korea and Japan.

For financial reporting purposes, the calculation of net periodic pension costs was based upon a number of actuarial assumptions including a discount rate for plan obligations, an assumed rate of return on pension plan assets and an assumed rate of compensation increase for employees covered by the plan. All of these assumptions were based upon management's judgment, considering all known trends and uncertainties. Actual results that differ from these assumptions would impact future expense recognition and the cash funding requirements of the Company's pension plans.

The net periodic benefit costs for the plans included the following components:

	Year Ended December 31,	
	2019	2018
Service cost	\$ 828	\$ 657
Interest cost on projected benefit obligations	471	433
Expected return on plan assets	(111)	(115)
Amortization of actuarial net loss	136	127
	<u>\$ 1,324</u>	<u>\$ 1,102</u>

The changes in projected benefit obligations and plan assets, as well as the ending balance sheet amounts for the Company's defined benefit plans, were as follows:

	Year Ended December 31,	
	2019	2018
Change in projected benefit obligations:		
Projected benefit obligations, beginning of year	\$ 24,885	\$ 25,736
Assumed in ESI Merger	3,522	—
Service cost	828	657
Interest cost	471	433
Actuarial loss (gain)	2,057	(98)
Benefits paid	(1,469)	(895)
Currency translation adjustments	(242)	(948)
Projected benefit obligations, end of year	<u>\$ 30,052</u>	<u>\$ 24,885</u>
Change in plan assets:		
Fair value of plan assets, beginning of year	\$ 7,822	\$ 8,152
Assumed in ESI Merger	1,272	—
Company contributions	1,846	324
Gain (loss) on plan assets	591	(56)
Benefits paid	(569)	(369)
Currency translation adjustments	131	(229)
Fair value of plan assets, end of year	<u>11,093</u>	<u>7,822</u>
Net underfunded status	<u>\$ (18,959)</u>	<u>\$ (17,063)</u>

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As of December 31, 2019, the estimated benefit payments for the Company's defined benefit plans for the next 10 years were as follows:

	Estimated benefit payments
2020	\$ 1,133
2021	1,302
2022	1,217
2023	1,537
2024	1,483
2025-2029	8,646
	<u>\$ 15,318</u>

The Company expects to contribute \$2,086 to the plans during 2020.

The weighted-average rates used to determine the net periodic benefit costs were as follows:

	December 31, 2019	December 31, 2018
Discount rate	1.4%	1.9%
Rate of increase in salary levels	2.2%	2.1%
Expected long-term rate of return on assets	2.1%	1.9%

In determining the expected long-term rate of return on plan assets, the Company considers the relative weighting of plan assets, the historical performance of total plan assets and individual asset classes, and economic and other indicators of future performance.

Plan assets were held in the following categories as a percentage of total plan assets:

	Year Ended December 31, 2019		Year Ended December 31, 2018	
	Amount	Percentage	Amount	Percentage
Cash	\$ 430	4%	\$ 193	2%
Debt securities	8,023	72	4,855	62
Equity securities	1,519	14	1,342	17
Other	1,121	10	1,432	19
	<u>\$ 11,093</u>	<u>100%</u>	<u>\$ 7,822</u>	<u>100%</u>

In general, the Company's asset management objectives include maintaining an adequate level of diversification to reduce interest rate and market risk while providing adequate liquidity to meet immediate and future benefit payment requirements.

The Company's Israeli plans account for the deferred vested benefits using the shut-down method of accounting, which resulted in assets of \$16,713 and vested benefit obligations of \$19,692 as of December 31, 2019 and assets of \$14,409 and vested benefit obligations of \$17,552 as of December 31, 2018. Under the shut-down method, the liability is calculated as if it were payable as of the balance sheet date, on an undiscounted basis.

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Other Pension-Related Assets

As of December 31, 2019 and 2018, the Company had assets with an aggregate market value of \$5,854 and \$5,890, respectively, for its German pension plans. These assets are invested in group insurance contracts through the insurance companies administering these plans, in accordance with applicable pension laws. The Germany contracts have a guaranteed minimum rate of return ranging from 2.25% to 4.25%, depending on the contract. Because the assets were not separate legal assets of the pension plan, they were not included in the Company's plan assets shown above. However, the Company has designated such assets to pay pension benefits. Such assets are included in other assets in the accompanying consolidated balance sheet.

20) Net Income Per Share

The following is a reconciliation of basic to diluted net income per share:

	Years Ended December 31,		
	2019	2018	2017
Numerator:			
Net income	\$ 140,386	\$ 392,896	\$ 339,132
Denominator:			
Shares used in net income per common share — basic	54,711,000	54,406,000	54,137,000
Effect of dilutive securities	400,000	586,000	937,000
Shares used in net income per common share — diluted	55,111,000	54,992,000	55,074,000
Net income per common share:			
Basic	\$ 2.57	\$ 7.22	\$ 6.26
Diluted	\$ 2.55	\$ 7.14	\$ 6.16

Basic earnings per share ("EPS") is computed by dividing income available to common stockholders by the weighted-average number of common shares outstanding during the period. The computation of diluted EPS is similar to the computation of basic EPS except that the denominator is increased to include the number of additional common shares that would have been outstanding (using the treasury stock method) if securities containing potentially dilutive common shares (RSUs and SARs) had been converted to such common shares, and if such assumed conversion is dilutive.

In 2019, 2018 and 2017, the potential dilutive effect of 65,664, 79,500 and 404 weighted average shares, respectively, of RSUs, were excluded from the computation of diluted weighted-average shares outstanding, as the shares would have had an anti-dilutive effect on EPS, and would thus need to be excluded from the computation of diluted weighted-average shares.

21) Business Segment, Geographic Area, Product Information and Significant Customer Information

The Company is a global provider of instruments, systems, subsystems and process control solutions that measure, monitor, deliver, analyze, power and control critical parameters of advanced manufacturing processes to improve process performance and productivity for its customers. The Company's products are derived from its core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery, vacuum technology, lasers, photonics, optics, precision motion control, vibration control and laser-based

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manufacturing systems solutions. The Company also provides services relating to the maintenance and repair of its products, installation services and training. The Company's primary served markets include semiconductor, industrial technologies, life and health sciences, research and defense.

The Company's Chief Operating Decision Maker ("CODM") utilizes financial information to make decisions about allocating resources and assessing performance for the entire Company, which is used in the decision making process to assess performance. Effective February 1, 2019, in conjunction with its acquisition of ESI, the Company created a third reportable segment known as the Equipment & Solutions segment in addition to its two then-existing reportable segments: the Vacuum & Analysis segment and the Light & Motion segment.

The Vacuum & Analysis segment provides a broad range of instruments, components and subsystems which are derived from the Company's core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, electronic control technology, reactive gas generation and delivery, power generation and delivery and vacuum technology.

The Light & Motion segment provides a broad range of instruments, components and subsystems which are derived from the Company's core competencies in lasers, photonics, optics, precision motion control and vibration control.

The Equipment & Solutions segment provides laser-based manufacturing systems solutions for the micro-machining industry that enable customers to optimize production. The Equipment & Solutions segment's primary served markets include flexible and rigid PCB processing/fabrication, semiconductor wafer processing, and passive component manufacturing and testing. The Equipment & Solutions segment's systems incorporate specialized laser technology and proprietary control software to efficiently process the materials and components that are an integral part of electronic devices and systems.

The Company derives its segment results directly from the manner in which results are reported in its management reporting system. The accounting policies that the Company uses to derive reportable segment results are substantially the same as those used for external reporting purposes. The Company does not disclose external or intersegment revenues separately by reportable segment as this information is not presented to the CODM for decision making purposes.

The following table sets forth net revenues by reportable segment:

	Years Ended December 31,		
	2019	2018	2017
Vacuum & Analysis	\$ 990,523	\$ 1,260,862	\$ 1,207,457
Light & Motion	725,570	814,246	708,520
Equipment & Solutions	183,680	—	—
	<u>\$ 1,899,773</u>	<u>\$ 2,075,108</u>	<u>\$ 1,915,977</u>

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The following table sets forth a reconciliation of segment gross profit to consolidated net income:

	Years Ended December 31,		
	2019	2018	2017
Gross profit by reportable segment:			
Vacuum & Analysis	\$426,464	\$577,552	\$551,078
Light & Motion	336,764	401,924	340,373
Equipment & Solutions	67,203	—	—
Total gross profit by reportable segment	<u>830,431</u>	<u>979,476</u>	<u>891,451</u>
Operating expenses:			
Research and development	164,061	135,720	132,555
Selling, general and administrative	330,346	298,118	290,056
Acquisition and integration costs	37,262	3,113	5,332
Restructuring and other	6,983	4,567	3,920
Fees and expenses related to repricing of Term Loan Facility	6,637	378	492
Amortization of intangible assets	67,402	43,521	45,743
Gain on sale of long-lived assets	(6,773)	—	—
Asset impairment	4,662	—	6,719
Income from operations	<u>219,851</u>	<u>494,059</u>	<u>406,634</u>
Interest income	5,453	5,775	3,021
Interest expense	44,135	16,942	30,990
Gain on sale of business	—	—	74,856
Other expense, net	3,333	1,942	5,896
Income before income taxes	<u>177,836</u>	<u>480,950</u>	<u>447,625</u>
Provision for income taxes	37,450	88,054	108,493
Net income	<u>\$140,386</u>	<u>\$392,896</u>	<u>\$339,132</u>

The following table set forth capital expenditures by reportable segment for the years ended December 31, 2019, 2018 and 2017:

	Vacuum & Analysis	Light & Motion	Equipment & Solutions	Total
December 31, 2019:				
Capital expenditures	<u>\$ 34,130</u>	<u>\$ 23,045</u>	<u>\$ 6,729</u>	<u>\$63,904</u>
December 31, 2018:				
Capital expenditures	<u>\$ 40,144</u>	<u>\$ 22,797</u>	<u>\$ —</u>	<u>\$62,941</u>
December 31, 2017:				
Capital expenditures	<u>\$ 17,111</u>	<u>\$ 14,176</u>	<u>\$ —</u>	<u>\$31,287</u>

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The following table sets forth depreciation and amortization by reportable segment for the years ended December 31, 2019, 2018 and 2017:

	Vacuum & Analysis	Light & Motion	Equipment & Solutions	Total
December 31, 2019:				
Depreciation and amortization	\$ 16,826	\$53,857	\$ 39,351	\$110,034
December 31, 2018:				
Depreciation and amortization	\$ 20,808	\$59,045	\$ —	\$ 79,853
December 31, 2017:				
Depreciation and amortization	\$ 20,297	\$62,259	\$ —	\$ 82,556

Total income tax expense is not presented by reportable segment because the necessary information is not available or used by the CODM.

The following table sets forth segment assets by reportable segment:

	Vacuum & Analysis	Light & Motion	Equipment & Solutions	Corporate, Eliminations and Other	Total
December 31, 2019:					
Segment assets:					
Accounts receivable	\$185,889	\$147,150	\$ 40,125	\$ (32,100)	\$341,064
Inventory	224,815	163,768	73,458	105	462,146
Total segment assets	<u>\$410,704</u>	<u>\$310,918</u>	<u>\$ 113,583</u>	<u>\$ (31,995)</u>	<u>\$803,210</u>
December 31, 2018:					
Segment assets:					
Accounts receivable	\$171,604	\$140,658	\$ —	\$ (16,808)	\$295,454
Inventory	222,965	161,658	—	66	384,689
Total segment assets	<u>\$394,569</u>	<u>\$302,316</u>	<u>\$ —</u>	<u>\$ (16,742)</u>	<u>\$680,143</u>

MKS INSTRUMENTS, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

The following is a reconciliation of segment assets to consolidated total assets:

	Years Ended December 31,	
	2019	2018
Total segment assets	\$ 803,210	\$ 680,143
Cash and cash equivalents and short-term investments	523,989	718,171
Other current assets	106,348	65,790
Property, plant and equipment, net	241,871	194,367
Right-of-use asset	64,497	—
Goodwill and intangible assets, net	1,623,084	906,803
Other assets and long-term assets	53,321	48,972
Consolidated total assets	<u>\$3,416,320</u>	<u>\$2,614,246</u>

Geographic

Information about the Company's operations in different geographic regions is presented in the tables below. Net revenues to unaffiliated customers are based on the location in which the sale originated. Transfers between geographic areas are at tax transfer prices and have been eliminated from consolidated net revenues.

Net revenues:	Years Ended December 31,		
	2019	2018	2017
United States	\$ 888,370	\$1,022,660	\$ 955,284
China	178,618	127,681	97,072
South Korea	167,651	203,567	212,763
Japan	143,081	193,264	167,318
Germany	150,584	159,508	122,339
Other	371,469	368,428	361,201
	<u>\$1,899,773</u>	<u>\$2,075,108</u>	<u>\$1,915,977</u>

Long-lived assets:(1)	Years Ended December 31,	
	2019	2018
United States	\$ 208,323	\$ 146,687
Europe	41,433	26,794
Asia	89,567	50,572
	<u>\$ 339,323</u>	<u>\$ 224,053</u>

(1) Long-lived assets include property, plant and equipment, net, right-of-use assets, and certain other assets, and exclude goodwill, intangible assets and long-term tax-related accounts.

MKS INSTRUMENTS, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

Goodwill associated with each of our reportable segments is as follows:

	<u>Years Ended December 31,</u>	
	<u>2019</u>	<u>2018</u>
Reportable segment:		
Vacuum & Analysis	\$ 196,717	\$197,126
Light & Motion	388,463	389,870
Equipment & Solutions	473,274	—
Total goodwill	<u>\$1,058,454</u>	<u>\$586,996</u>

Worldwide Product Information

Worldwide net revenue for each group of products is as follows:

	<u>Years Ended December 31,</u>		
	<u>2019</u>	<u>2018</u>	<u>2017</u>
Advanced Manufacturing Components	\$1,482,808	\$1,835,202	\$1,701,301
Global Service	288,476	239,906	214,676
Advanced Manufacturing Systems	128,489	—	—
	<u>\$1,899,773</u>	<u>\$2,075,108</u>	<u>\$1,915,977</u>

Advanced manufacturing components are comprised of product revenues from the Company's Vacuum & Analysis and Light & Motion segments. Global service is comprised of total service revenues for all three of the Company's reportable segments. Advanced manufacturing systems is comprised of product revenues for the Company's Equipment & Solutions segment.

Major Customers

No individual customers accounted for greater than 10% of the Company's net revenues for 2019. Applied Materials, Inc. accounted for 12% and 13% and Lam Research Corporation accounted for 11% and 12% of the Company's net revenues for the years ended 2018 and 2017, respectively.

22) Restructuring and Other

Restructuring

During 2019, the Company recorded restructuring charges of \$5,532, primarily related to costs incurred from the pending closure of a facility in Europe and also to severance costs related to an organization-wide reduction in workforce, the consolidation of service functions in Asia and the movement of certain products to lower costs regions.

During 2018, the Company recorded restructuring charges of \$3,567, primarily related to severance costs related to a worldwide reduction in workforce including severance costs related to transferring a portion of the Company's shared accounting functions in the United States to a third party, as well as the consolidation of certain shared accounting functions in Asia.

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

The activity related to the Company's restructuring accrual is shown below:

	<u>2019</u>	<u>2018</u>
Balance at January 1	\$ 2,632	\$ 3,244
Charged to expense	5,532	3,567
Payments and adjustments	<u>(4,428)</u>	<u>(4,179)</u>
Balance at December 31	<u>\$ 3,736</u>	<u>\$ 2,632</u>

Other

During 2019, the Company recorded a charge of \$1,451 related to a legal settlement from a contractual obligation assumed as part of the Newport Merger.

During 2018, the Company recorded a charge of \$1,000 for environmental costs related to a U.S. Environmental Protection Agency-designated Superfund site, as part of the Newport Merger.

23) Commitments and Contingencies

In 2016, two putative class actions lawsuit captioned Dixon Chung v. Newport Corp., et al., Case No. A-16-733154-C, and Hubert C. Pincon v. Newport Corp., et al., Case No. A-16-734039-B, were filed in the District Court, Clark County, Nevada on behalf of a putative class of stockholders of Newport for claims related to the merger agreement ("Newport Merger Agreement") between the Company, Newport, and a wholly-owned subsidiary of the Company ("Merger Sub"). The lawsuits named as defendants the Company, Newport, Merger Sub, and certain then current and former members of Newport's board of directors. Both complaints alleged that Newport directors breached their fiduciary duties to Newport's stockholders by agreeing to sell Newport through an inadequate and unfair process, which led to inadequate and unfair consideration, by agreeing to unfair deal protection devices and by omitting material information from the proxy statement. The complaints also alleged that the Company, Newport and Merger Sub aided and abetted the directors' alleged breaches of their fiduciary duties. The Court consolidated the actions, and plaintiffs later filed an amended complaint captioned In re Newport Corporation Shareholder Litigation, Case No. A-16-733154-B, in the District Court, Clark County, Nevada, on behalf of a putative class of Newport's stockholders for claims related to the Newport Merger Agreement. The amended complaint alleged Newport's former board of directors breached their fiduciary duties to Newport's stockholders and that the Company, Newport and Merger Sub had aided and abetted these breaches and sought monetary damages, including pre- and post-judgment interest. In June 2017, the Court granted defendants' motion to dismiss and dismissed the amended complaint against all defendants but granted plaintiffs leave to amend.

On July 27, 2017, plaintiffs filed a second amended complaint containing substantially similar allegations but naming only Newport's former directors as defendants. On August 8, 2017, the Court dismissed the Company and Newport from the action. The second amended complaint seeks monetary damages, including pre- and post-judgment interest. The Court granted a motion for class certification on September 27, 2018, appointing Mr. Pincon and Locals 302 and 612 of the International Union of Operating Engineers—Employers Construction Industry Retirement Trust as class representatives. On June 11, 2018, plaintiff Dixon Chung was voluntarily dismissed from the litigation. On August 9, 2019, plaintiffs filed a motion for leave to file a third amended complaint, which was denied on October 10, 2019. On August 23, 2019, defendants filed a motion for summary judgment. On January 23, 2020, the court entered its findings of fact, conclusions of law,

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS — (continued)
(in thousands, except share and per share data)

and order granting defendants' motion for summary judgment. On February 18, 2020, plaintiffs filed a notice of appeal from the court's order granting defendants' motion for summary judgment, as well as from the court's prior orders granting defendants' motion for a bench trial and denying plaintiffs' motion for leave to file an amended complaint.

The Company is subject to various legal proceedings and claims, which have arisen in the ordinary course of business. In the opinion of management, the ultimate disposition of these matters will not have a material adverse effect on our results of operations, financial condition or cash flows.

The Company leases certain of its facilities and machinery and equipment under operating leases expiring in various years through 2184. Refer to Note 5 for schedule of future lease payments under non-cancelable leases as of December 31, 2019.

As of December 31, 2019, the Company has entered into purchase commitments for certain inventory components and other equipment and services used in its normal operations. The majority of these purchase commitments covered by these arrangements are for periods of less than one year and aggregate to approximately \$258,137.

To the extent permitted by Massachusetts law, the Company's Restated Articles of Organization, as amended, require the Company to indemnify any of its current or former officers or directors or any person who has served or is serving in any capacity with respect to any of the Company's employee benefit plans. The Company believes that the estimated exposure for these indemnification obligations is currently not material. Accordingly, the Company has no material liabilities recorded for these requirements as of December 31, 2019.

The Company also enters into agreements in the ordinary course of business which include indemnification provisions. Pursuant to these agreements, the Company indemnifies, holds harmless and agrees to reimburse the indemnified party, generally its customers, for losses suffered or incurred by the indemnified party in connection with certain patent or other intellectual property infringement claims, and, in some instances, other claims, by any third party with respect to the Company's products. The term of these indemnification obligations is generally perpetual after execution of the agreement. The maximum potential amount of future payments the Company could be required to make under these indemnification agreements is, in some instances, not contractually limited. The Company has never incurred costs to defend lawsuits or settle claims related to these indemnification obligations. As a result, the Company believes the estimated fair value of these obligations is minimal. Accordingly, the Company has no liabilities recorded for these obligations as of December 31, 2019.

As part of past acquisitions and divestitures of businesses or assets, the Company has provided a variety of indemnifications to the sellers and purchasers for certain events or occurrences that took place prior to the date of the acquisition or divestiture. Typically, certain of the indemnifications expire after a defined period of time following the transaction, but certain indemnifications may survive indefinitely. The maximum potential amount of future payments the Company could be required to make for such obligations is undeterminable at this time. Other than obligations recorded as liabilities at the time of the acquisitions, historically the Company has not made significant payments for these indemnifications. Accordingly, no material liabilities have been recorded for these obligations.

In conjunction with certain asset sales, the Company may provide routine indemnifications whose terms range in duration and often are not explicitly defined. Where appropriate, an obligation for such indemnification is recorded as a liability. Because the amounts of liability under these types of indemnifications are not explicitly stated, the overall maximum amount of the obligation under such indemnifications cannot be reasonably estimated. Other than obligations recorded as liabilities at the time of the asset sale, historically the Company has not made significant payments for these indemnifications.

MKS Instruments, Inc.
Supplemental Financial Data

	Quarter Ended			
	March 31	June 30	Sept. 30	Dec. 31
(Table in thousands, except per share data)				
(Unaudited)				
2019				
Statement of Operations Data				
Net revenues	\$463,561	\$474,110	\$462,451	\$499,651
Gross profit	198,118	211,027	205,004	216,282
Income from operations	23,066	63,902	66,820	66,063
Net income	\$ 12,455	\$ 37,739	\$ 47,428	\$ 42,764
Net income per share:				
Basic	\$ 0.23	\$ 0.69	\$ 0.86	\$ 0.78
Diluted	\$ 0.23	\$ 0.69	\$ 0.86	\$ 0.77
Cash dividends paid per common share	\$ 0.20	\$ 0.20	\$ 0.20	\$ 0.20
2018				
Statement of Operations Data				
Net revenues	\$554,275	\$573,140	\$487,152	\$460,541
Gross profit	262,855	274,877	231,860	209,884
Income from operations	131,639	151,291	117,045	94,084
Net income	\$105,121	\$122,862	\$ 93,277	\$ 71,636
Net income per share:				
Basic	\$ 1.93	\$ 2.25	\$ 1.71	\$ 1.33
Diluted	\$ 1.90	\$ 2.22	\$ 1.70	\$ 1.32
Cash dividends paid per common share	\$ 0.18	\$ 0.20	\$ 0.20	\$ 0.20

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure

None.

Item 9A. Controls and Procedures

Evaluation of Disclosure Controls and Procedures

Our management, with the participation of our Chief Executive Officer and Chief Financial Officer, evaluated the effectiveness of our disclosure controls and procedures as of December 31, 2019. The term “disclosure controls and procedures,” as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, as amended (the “Exchange Act”), means controls and other procedures of an issuer that are designed to ensure that information required to be disclosed by the issuer in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the SEC’s rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by an issuer in the reports that it files or submits under the Exchange Act is accumulated and communicated to the issuer’s management, including its principal executive and principal financial officers, or persons performing similar functions as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based on the evaluation of our disclosure controls and procedures as of December 31, 2019, our Chief Executive Officer and Chief Financial Officer concluded that, as of such date, our disclosure controls and procedures were effective at the reasonable assurance level to ensure that information required to be disclosed by us in reports that we file or submit under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in Securities and Exchange Commission rules and forms and is accumulated and communicated to our management, including our Chief Executive Officer and Chief Financial Officer as appropriate to allow timely decisions regarding required disclosure.

Management’s Report on Internal Control over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting. Internal control over financial reporting is defined in Rules 13a-15(f) and 15d-15(f) promulgated under the Exchange Act as a process designed by, or under the supervision of our Chief Executive Officer and Chief Financial Officer or persons performing similar functions and effected by our Board of Directors, management and other personnel, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles and includes those policies and procedures that:

- Pertain to the maintenance of records that in reasonable detail accurately and fairly reflect the transactions and dispositions of the assets of the Company;
- Provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that our receipts and expenditures of the Company are being made only in accordance with authorization of our management and directors of the Company; and
- Provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use or disposition of our assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Under the supervision and with the participation of our management including our Chief Executive Officer and Chief Financial Officer, we conducted an assessment of the effectiveness of our internal control over financial reporting as of December 31, 2019. In making this assessment, we used the criteria set forth in the *Internal Control-Integrated Framework* (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission. Based on our assessment, our management concluded that, as of December 31, 2019, our internal control over financial reporting was effective.

We excluded ESI from our assessment of internal control over financial reporting as of December 31, 2019 because we acquired it in 2019. ESI's total assets and total revenues represent approximately 29% and 10%, respectively, of the Company's total assets and total revenues, as of and for the year ended December 31, 2019.

Our internal controls over financial reporting as of December 31, 2019 have been audited by PricewaterhouseCoopers LLP, an independent registered public accounting firm, as stated in its attestation report which appears in Item 8 of this Annual Report on Form 10-K.

Changes in Internal Control over Financial Reporting

There was no change in our internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act) during our fourth fiscal quarter that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Item 9B. Other Information

None.

PART III

Item 10. *Directors, Executive Officers and Corporate Governance*

The information required by this item will be set forth under the captions “Proposal One — Election of Directors,” “Directors,” “Corporate Governance,” “Executive Officers,” “Corporate Governance — Code of Ethics” and “Corporate Governance — Board of Directors Meetings and Committees of the Board of Directors — Audit Committee” in our definitive proxy statement for the 2020 Annual Meeting of Stockholders, to be filed with the Securities and Exchange Commission no later than 120 days after the end of our fiscal year, and is incorporated herein by reference.

We are also required under Item 405 of Regulation S-K to provide information concerning delinquent filers of reports under Section 16 of the Securities and Exchange Act of 1934, as amended. This information will be set forth under the caption “Delinquent Section 16(a) Reports,” if applicable, in our definitive proxy statement for the 2020 Annual Meeting of Stockholders, to be filed with the Securities and Exchange Commission no later than 120 days after the end of our fiscal year, and is incorporated herein by reference.

Item 11. *Executive Compensation*

The information required by this item will be set forth under the captions “Executive Officers,” “Executive Compensation — Compensation Discussion and Analysis,” “Corporate Governance — Board of Director Meetings and Committees of the Board of Directors – Compensation Committee — Compensation Committee Interlocks and Insider Participation,” “Compensation Committee Report” and “Director Compensation” in our definitive proxy statement for the 2020 Annual Meeting of Stockholders, to be filed with the Securities and Exchange Commission no later than 120 days after the end of our fiscal year, and is incorporated herein by reference.

Item 12. *Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters*

The information required by Item 403 of Regulation S-K will be set forth under the caption “Security Ownership of Certain Beneficial Owners and Management” in our definitive proxy statement for the 2020 Annual Meeting of Stockholders, to be filed with the Securities and Exchange Commission no later than 120 days after the end of our fiscal year, and is incorporated herein by reference.

The information required by Item 201(d) of Regulation S-K will be set forth under the caption “Equity Compensation Plan Information” in our definitive proxy statement for the 2020 Annual Meeting of Stockholders, to be filed with the Securities and Exchange Commission no later than 120 days after the end of our fiscal year, and is incorporated herein by reference.

Item 13. *Certain Relationships and Related Transactions and Director Independence*

The information required by this item will be set forth under the captions “Corporate Governance — Board Independence” and “Corporate Governance — Transactions with Related Persons” in our definitive proxy statement for the 2020 Annual Meeting of Stockholders, to be filed with the Securities and Exchange Commission no later than 120 days after the end of our fiscal year, and is incorporated herein by reference.

Item 14. *Principal Accountant Fees and Services*

The information required by this item will be set forth under the caption “Audit and Financial Accounting Oversight — Principal Accountant Fees and Services” in our definitive proxy statement for the 2020 Annual Meeting of Stockholders, to be filed with the Securities and Exchange Commission no later than 120 days after the end of our fiscal year, and is incorporated herein by reference.

PART IV

Item 15. *Exhibits and Financial Statement Schedules*

(a) The following documents are filed as a part of this Report:

1. *Financial Statements*. The following Consolidated Financial Statements are included under Item 8 of this Annual Report on Form 10-K.

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Consolidated Statements of Operations and Comprehensive Income for the years ended December 31, 2019, 2018 and 2017	66
Consolidated Statements of Stockholders' Equity for the years ended December 31, 2019, 2018 and 2017	67
Consolidated Statements of Cash Flows for the years ended December 31, 2019, 2018 and 2017	68
Notes to Consolidated Financial Statements	69

2. *Financial Statement Schedules*. The following consolidated financial statement schedule is included in this Annual Report on Form 10-K:

Schedule II — Valuation and Qualifying Accounts

Schedules other than those listed above have been omitted since they are either not required or information is otherwise included.

3. *Exhibits*. The following exhibits are filed as part of this Annual Report on Form 10-K.

<u>Exhibit No.</u>	<u>Title</u>
+2.1(1)	Agreement and Plan of Merger, by and among the Registrant, Merger Sub and Electro Scientific Industries, Inc., dated October 29, 2018
+3.1(2)	Restated Articles of Organization of the Registrant
+3.2(3)	Articles of Amendment to Restated Articles of Organization, as filed with the Secretary of State of Massachusetts on May 18, 2001
+3.3(4)	Articles of Amendment to Restated Articles of Organization, as filed with the Secretary of State of Massachusetts on May 16, 2002
+3.4(5)	Amended and Restated By-Laws of the Registrant
4.1	Specimen certificate representing the Common Stock
4.2	Description of Capital Stock Registered Under Section 12 of the Exchange Act
+10.1(6)	Term Loan Credit Agreement, dated April 29, 2016, by and among the Registrant, Barclays Bank PLC, as administrative agent and collateral agent, and the lenders from time to time party thereto
+10.2(7)	Amendment No. 1 to Term Loan Credit Agreement, dated as of June 9, 2016, by and among the Registrant, the other loan parties party thereto, Barclays Bank PLC, as administrative agent and collateral agent, and each participating lender party thereto
+10.3(8)	Amendment No. 2 to Term Loan Credit Agreement, dated as of December 14, 2016, by and among the Registrant, the other loan parties party thereto, Barclays Bank PLC, as administrative agent and collateral agent, and each participating lender party thereto

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<u>Exhibit No.</u>	<u>Title</u>
+10.4(9)	<u>Amendment No. 3 to Term Loan Credit Agreement, dated as of July 6, 2017, by and among the Registrant, the other loan parties party thereto, Barclays Bank PLC, as administrative agent and collateral agent, and each participating lender party thereto</u>
+10.5(10)	<u>Amendment No. 4 to Term Loan Credit Agreement, dated as of April 11, 2018, by and among the Registrant, the other loan parties party thereto, Barclays Bank PLC, as administrative agent and collateral agent, and each participating lender party thereto</u>
+10.6(11)	<u>Amendment No. 5 to Term Loan Credit Agreement and Amendment to Term Loan Guaranty and Term Loan Security Agreement, dated as of February 1, 2019, by and among the Registrant, the other loan parties party thereto, Barclays Bank PLC, as administrative agent and collateral agent, and each participating lender party thereto</u>
+10.7(12)	<u>Amendment No. 6 to Term Loan Credit Agreement, dated as of September 27, 2019, by and among the Registrant, the other loan parties thereto, Barclays Bank PLC, as administrative agent, collateral agent and fronting bank, and each participating lender party thereto.</u>
+10.8(11)	<u>ABL Credit Agreement, dated as of February 1, 2019, by and among the Registrant, Barclays Bank PLC, as administrative agent and collateral agent, the other borrowers from time to time party thereto, and the lenders and letters of credit issuers from time to time party thereto.</u>
+10.9(13)	<u>Amendment No. 1 to ABL Credit Agreement, dated as of April 26, 2019, by and among the Registrant, Barclays Bank PLC, as administrative agent and collateral agent, the other borrowers from time to time party thereto, and the lenders and letters of credit issuers from time to time party thereto.</u>
+10.10(5)*	<u>2014 Stock Incentive Plan</u>
+10.11(5)*	<u>2014 Employee Stock Purchase Plan</u>
+10.12(5)*	<u>Form of Restricted Stock Unit Agreement for Non-Employee Directors under the 2014 Stock Incentive Plan</u>
+10.13(14)*	<u>Form of Restricted Stock Unit Agreement for Employees under the 2014 Stock Incentive Plan</u>
+10.14(15)*	<u>MKS Instruments, Inc. Management and Key Employee Bonus Plan</u>
+10.15(16)*	<u>Employment Agreement, dated as of July 1, 2005, between John Bertucci and the Registrant</u>
+10.16(17)*	<u>Employment Agreement, dated October 22, 2013, between Gerald Colella and the Registrant</u>
+10.17(15)*	<u>Amendment, dated March 27, 2018, to Employment Agreement, dated as of October 22, 2013, between Gerald Colella and the Registrant</u>
+10.18(18)*	<u>Amendment No. 2, dated October 29, 2018, to Employment Agreement, dated as of October 22, 2013, between Gerald Colella and the Registrant</u>
+10.19(19)*	<u>Form of Stock Appreciation Right Award Agreement under Newport Corporation's 2006 Performance-Based Stock Incentive Plan</u>
+10.20(19)*	<u>Newport Corporation's 2011 Stock Incentive Plan</u>
+10.21(19)*	<u>Newport Corporation's Amended and Restated 2011 Stock Incentive Plan</u>
+10.22(19)*	<u>Form of Stock Appreciation Right Award Agreement used under Newport Corporation's 2011 Stock Incentive Plan and the Amended and Restated 2011 Stock Incentive Plan</u>
+10.23(19)*	<u>Form of the Registrant's SAR Assumption Agreement for U.S. Employees Relating to Newport Corporation's Amended and Restated 2011 Stock Incentive Plan, 2011 Stock Incentive Plan and 2006 Performance-Based Stock Incentive Plan</u>

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<u>Exhibit No.</u>	<u>Title</u>
+10.24(19)*	<u>Form of the Registrant's SAR Assumption Agreement for Employees Outside of the United States Relating to Newport Corporation's Amended and Restated 2011 Stock Incentive Plan, 2011 Stock Incentive Plan and 2006 Performance-Based Stock Incentive Plan</u>
+10.25(20)*	<u>Employment Agreement, dated November 18, 2019, between John Lee and the Registrant</u>
+10.26(21)*	<u>Employment Agreement, dated August 1, 2016, between Seth Bagshaw and the Registrant</u>
+10.27(18)*	<u>Amendment No. 1, dated October 29, 2018, to Employment Agreement, dated as of August 1, 2016, by and between Seth Bagshaw and the Registrant</u>
+10.28(13)*	<u>Employment Agreement, dated May 9, 2018, between Kathleen Burke and the Registrant, as amended on October 29, 2018</u>
10.29*	<u>Employment Agreement, dated as of August 6, 2019, between James Schreiner and the Registrant</u>
+10.30(22)*	<u>Transition and Retirement Agreement, dated as of May 9, 2018, by and between the Registrant and John Abrams</u>
+10.31(14)*	<u>Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan</u>
+10.32(14)*	<u>Form of Restricted Stock Units Award Agreement (with time-based vesting) used under Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan for 2016-2017</u>
+10.33(14)*	<u>Form of Restricted Stock Units Award Agreement (with time-based vesting) used under Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan for 2018</u>
+10.34(14)*	<u>Form of Restricted Stock Units Award Agreement (with performance-based vesting) used under Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan for 2016-2017</u>
+10.35(14)*	<u>Form of Restricted Stock Units Award Agreement (with performance-based vesting) used under Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan for 2018</u>
+10.36(14)*	<u>Form of the Registrant's RSU Assumption Agreement (with time-based vesting) for U.S. Employees Relating to Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan</u>
+10.37(14)*	<u>Form of the Registrant's RSU Assumption Agreement (with time-based vesting) for Employees Outside of the United States Relating to Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan</u>
+10.38(14)*	<u>Form of the Registrant's RSU Assumption Agreement (with performance-based vesting) for U.S. Employees Relating to Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan</u>
+10.39(14)*	<u>Form of the Registrant's RSU Assumption Agreement (with performance-based vesting) for Employees Outside of the United States Relating to Electro Scientific Industries, Inc.'s 2004 Stock Incentive Plan</u>
+10.40(23)*	<u>Annual Profit Improvement Bonus Plan</u>
21.1	<u>Subsidiaries of the Registrant</u>
23.1	<u>Consent of PricewaterhouseCoopers LLP</u>
31.1	<u>Certification of Principal Executive Officer pursuant to Rule 13a-14(a)/Rule 15d-14(a) of the Securities Exchange Act of 1934</u>
31.2	<u>Certification of Principal Financial Officer pursuant to Rule 13a-14(a)/Rule 15d-14(a) of the Securities Exchange Act of 1934</u>
32.1	<u>Certification of Chief Executive Officer and Chief Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002</u>

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<u>Exhibit No.</u>	<u>Title</u>
101.INS**	Inline XBRL Instance Document - the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document.
101.SCH**	Inline XBRL Taxonomy Extension Schema Document
101.CAL**	Inline XBRL Taxonomy Calculation Linkbase
101.DEF**	Inline XBRL Taxonomy Extension Definition Linkbase Document
101.LAB**	Inline XBRL Taxonomy Labels Linkbase Document
101.PRE**	Inline XBRL Taxonomy Presentation Linkbase Document
104	Cover Page Interactive Data File (formatted as inline XBRL with applicable taxonomy extension information contained in Exhibits 101)

+ Previously filed

* Management contract or compensatory plan arrangement

** Filed with this Annual Report on Form 10-K for the year ended December 31, 2019 are the following documents formatted in iXBRL (Inline Extensible Business Reporting Language): (i) the Consolidated Balance Sheets; (ii) the Consolidated Statements of Operations and Comprehensive Income; (iii) the Consolidated Statements of Stockholders' Equity; (iv) the Consolidated Statements of Cash Flows; and (v) the Notes to Consolidated Financial Statements.

The following materials from MKS Instruments, Inc.'s Annual Report on Form 10-K for the year ended December 31, 2019, are formatted in XBRL (Extensible Business Reporting Language): (i) the Consolidated Balance Sheets, (ii) the Consolidated Statements of Operations and Comprehensive Income, (iii) the Consolidated Statements of Stockholders' Equity, (iv) the Consolidated Statements of Cash Flows, and (v) Notes to the Consolidated Financial Statements.

- (1) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on October 30, 2018.
- (2) Incorporated by reference to the Registration Statement on Form S-4 (File No. 333-49738), filed with the Securities and Exchange Commission on November 13, 2000.
- (3) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended June 30, 2001 (File No. 000-23621), filed with the Securities and Exchange Commission on August 14, 2001.
- (4) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended June 30, 2002 (File No. 000-23621), filed with the Securities and Exchange Commission on August 13, 2002.
- (5) Incorporated by reference to the Registrant's Current Report on Form 8-K (File No. 000-23621), filed with the Securities and Exchange Commission on May 6, 2014.
- (6) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on April 29, 2016.
- (7) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on June 9, 2016.
- (8) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on December 14, 2016.
- (9) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on July 6, 2017.
- (10) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on April 12, 2018.

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- (11) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on February 1, 2019.
- (12) Incorporated by reference to the Registrant's Current Report on Form 8-K, filed with the Securities and Exchange Commission on October 1, 2019
- (13) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended June 30, 2019 (File No. 000-23621), filed with the Securities and Exchange Commission on August 7, 2019.
- (14) Incorporated by reference to the Registrant's Annual Report on Form 10-K for the year ended December 31, 2018 (File No.000-23621) filed with the Securities and Exchange Commission on February 26, 2019.
- (15) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended March 31, 2018 (File No. 000-23621), filed with the Securities and Exchange Commission on May 8, 2018.
- (16) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on July 5, 2005
- (17) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on October 24, 2013.
- (18) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on November 1, 2018.
- (19) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended March 31, 2016 (File No. 000-23621), filed with the Securities and Exchange Commission on May 6, 2016.
- (20) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on November 20, 2019.
- (21) Incorporated by reference to the Registrant's Quarterly Report on Form 10-Q for the quarter ended June 30, 2016 (File No. 000-23621), filed with the Securities and Exchange Commission on August 3, 2016.
- (22) Incorporated by reference to the Registrant's Current Report on Form 8-K filed with the Securities and Exchange Commission on May 11, 2018.
- (23) Incorporated by reference to the Registrant's Current Report on Form 8-K with the Securities and Exchange Commission on February 12, 2020.
 - (b) Exhibits
MKS hereby files as exhibits to our Annual Report on Form 10-K those exhibits listed in Item 15(a) above.
 - (c) Financial Statement Schedules

Item 16. Form 10-K Summary

Not applicable.

MKS INSTRUMENTS, INC.
SCHEDULE II—VALUATION AND QUALIFYING ACCOUNTS

<u>Description</u>	<u>Balance at Beginning of Year</u>	<u>Acquisition Beginning Balance</u>	<u>Additions</u>		<u>Deductions & Write-offs</u>	<u>Balance at End of Year</u>
			<u>Charged to Costs and Expenses</u>	<u>Charged to Other Accounts</u>		
(in thousands)						
Allowance for doubtful accounts:						
Years ended December 31,						
2019	\$ 5,243	\$ 201	\$ (728)	\$ —	\$ (2,933)	\$ 1,783
2018	\$ 4,135	\$ —	\$ 1,435	\$ —	\$ (327)	\$ 5,243
2017	\$ 3,909	\$ —	\$ 825	\$ —	\$ (599)	\$ 4,135

<u>Description</u>	<u>Balance at Beginning of Year</u>	<u>Acquisition Beginning Balance</u>	<u>Additions</u>		<u>Deductions & Write-offs</u>	<u>Balance at End of Year</u>
			<u>Charged to Costs and Expenses</u>	<u>Charged to Other Accounts</u>		
(in thousands)						
Allowance for sales returns:						
Years ended December 31,						
2019	\$ 1,033	\$ —	\$ 200	\$ —	\$ 162	\$ 1,395
2018	\$ 1,295	\$ —	\$ 124	\$ —	\$ (386)	\$ 1,033
2017	\$ 1,138	\$ —	\$ (142)	\$ —	\$ 299	\$ 1,295

<u>Description</u>	<u>Balance at Beginning of Year</u>	<u>Acquisition Beginning Balance</u>	<u>Additions</u>		<u>Deductions</u>	<u>Balance at End of Year</u>
			<u>Charged to Costs and Expenses</u>	<u>Charged to Other Accounts</u>		
(in thousands)						
Valuation allowance on deferred tax asset:						
Years ended December 31,						
2019	\$ 17,936	\$ 5,876	\$ 4,934	\$ —	\$ (1,386)	\$ 27,360
2018	\$ 13,629	\$ —	\$ 4,825	\$ —	\$ (518)	\$ 17,936
2017	\$ 12,527	\$ —	\$ 1,603	\$ —	\$ (501)	\$ 13,629

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this annual report on Form 10-K for the fiscal year ended December 31, 2019, to be signed on its behalf by the undersigned, thereunto duly authorized on the 28th day of February 2020.

MKS INSTRUMENTS, INC.

By: /s/ John T.C. Lee
John T.C. Lee
President and Chief Executive Officer
(Principal Executive Officer)

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the date indicated.

<u>SIGNATURES</u>	<u>TITLE</u>	<u>DATE</u>
<u>/s/ John R. Bertucci</u> John R. Bertucci	Chairman of the Board of Directors	February 28, 2020
<u>/s/ John T.C. Lee</u> John T.C. Lee	President, Chief Executive Officer and Director (Principal Executive Officer)	February 28, 2020
<u>/s/ Seth H. Bagshaw</u> Seth H. Bagshaw	Senior Vice President, Chief Financial Officer and Treasurer (Principal Financial and Accounting Officer)	February 28, 2020
<u>/s/ Rajeev Batra</u> Rajeev Batra	Director	February 28, 2020
<u>/s/ Gregory R. Beecher</u> Gregory R. Beecher	Director	February 28, 2020
<u>/s/ Gerald G. Colella</u> Gerald G. Colella	Director	February 28, 2020
<u>/s/ Rick D. Hess</u> Rick D. Hess	Director	February 28, 2020
<u>/s/ Jacqueline F. Moloney</u> Jacqueline F. Moloney	Director	February 28, 2020
<u>/s/ Elizabeth A. Mora</u> Elizabeth A. Mora	Director	February 28, 2020
<u>/s/ Michelle M. Warner</u> Michelle M. Warner	Director	February 28, 2020



MKS INSTRUMENTS, INC.

MKS

COMMON STOCK

INCORPORATED UNDER THE LAWS OF THE COMMONWEALTH OF MASSACHUSETTS

SEE REVERSE FOR CERTAIN DEFINITIONS
CUSIP 55306N 10 4

THIS CERTIFIES THAT

[Large blank area for owner name and details]

is the owner of

FULLY PAID AND NON-ASSESSABLE SHARES OF COMMON STOCK, NO PAR VALUE, OF

MKS INSTRUMENTS, INC.

transferable only on the books of the Corporation by the holder hereof in person or by duly authorized attorney upon surrender of this Certificate properly endorsed. This Certificate and the shares represented hereby are issued under and subject to the laws of The Commonwealth of Massachusetts and to the articles of Organization and By-laws of the Corporation, all as amended from time to time. This Certificate is not valid unless countersigned and registered by the Transfer Agent and Registrar.

IN WITNESS WHEREOF, the Corporation has caused this Certificate to be signed by the facsimile signatures of its duly authorized officers and a facsimile seal of its corporate seal to be hereunto affixed.

Dated:

Arthur H. Bagshaw

TREASURER



Ray Chy Lee

PRESIDENT

COUNTERSIGNED AND REGISTERED:
AMERICAN STOCK TRANSFER & TRUST COMPANY, LLC
(BOSTON) MEMBER FINRA
TRANSFER AGENT AND REGISTRAR

AUTHORIZED SIGNATURE

MKS INSTRUMENTS, INC.

The Corporation has more than one class of stock authorized to be issued. The Corporation will furnish without charge to each stockholder upon written request, a copy of the full text of the preferences, voting powers, qualifications and special and relative rights of the shares of each class of stock (and any series thereof) authorized to be issued by the Corporation.

The following abbreviations, when used in the inscription on the face of this Certificate, shall be construed as though they were written out in full according to applicable laws or regulations:

TEN COM	- as tenants in common	UNIF GIFT MIN ACT	- Custodian
TEN ENT	- as tenants by the entireties			(Child) (Minor)
JT TEN	- as joint tenants with right of survivorship and not as tenants in common			under Uniform Gifts to Minors Act
				(State)

Additional abbreviations may also be used though not in the above list.

For value received, _____ hereby sell, assign and transfer unto

PLEASE INSERT SOCIAL SECURITY OR OTHER IDENTIFYING NUMBER OF ASSIGNEE

(PLEASE PRINT OR TYPEWRITE NAME AND ADDRESS, INCLUDING ZIP CODE, OF ASSIGNEE)

Shares of the capital stock represented by the within Certificate, and do hereby irrevocably constitute and appoint

_____ Attorney to transfer the said stock on the books of the within named Corporation with full power of substitution in the premises.

Dated _____

(Signature) _____
 NOTICE: THE SIGNATURE TO THIS ASSIGNMENT MUST CORRESPOND WITH THE NAME AS WRITTEN UPON THE FACE OF THE CERTIFICATE IN EVERY PARTICULAR, WITHOUT ALTERATION OR ENLARGEMENT OR ANY CHANGE WHATSOEVER.

Signature Guaranteed: _____
 ALL GUARANTEES MUST BE MADE BY A FINANCIAL INSTITUTION (SUCH AS A BANK OR BROKER) WHICH IS A PARTICIPANT IN THE SECURITIES TRANSFER AGENTS MEDALLION PROGRAM ("STAMP"), THE NEW YORK STOCK EXCHANGE, INC. MEDALLION SIGNATURE PROGRAM ("MSP") OR THE STOCK EXCHANGES MEDALLION PROGRAM ("SEMP") AND MUST NOT BE DATED. GUARANTEES BY A NOTARY PUBLIC ARE NOT ACCEPTABLE.

MKS INSTRUMENTS, INC.
DESCRIPTION OF CAPITAL STOCK REGISTERED
UNDER SECTION 12 OF THE EXCHANGE ACT

The following description is a summary of the terms of our capital stock registered pursuant to Section 12 of the Securities Exchange Act of 1934, as amended (the “Exchange Act”) and is qualified in its entirety by reference to our Restated Articles of Organization, as amended (“Charter”) and our Amended and Restated By-laws (“By-laws”), each of which is incorporated by reference as an exhibit to this Annual Report on Form 10-K, and certain applicable provisions of Massachusetts law. As used in this “Description of Capital Stock Registered Under Section 12 of the Exchange Act,” the terms “Company,” “we,” “our” and “us” refer to MKS Instruments, Inc.

Authorized Capital Shares

Our authorized capital stock consists of 200,000,000 shares of common stock, no par value per share (“Common Stock”), and 2,000,000 shares of preferred stock, \$0.01 par value per share (“Preferred Stock”).

Common Stock

Voting Rights. Holders of our Common Stock are entitled to one vote per share on all matters voted on by the shareholders, including the election of directors. Our Common Stock does not have cumulative voting rights.

Board of Directors. Our By-laws divide the board of directors into three classes with staggered three-year terms. Under our By-laws, any vacancy on our board of directors, including a vacancy resulting from an enlargement of our board of directors, may be filled by vote of a majority of our directors then in office, unless and until filled by the shareholders. Furthermore, our By-laws provides that the authorized number of directors may be changed only by the resolution of our board of directors. The classification of our board of directors and the limitations on the ability of our shareholders to change the authorized number of directors and fill vacancies could make it more difficult for a third party to acquire, or discourage a third party from seeking to acquire, control of our company.

Advance Notice Requirements. Our By-laws require that we be given advance notice of proposals that shareholders wish to present for action at an annual meeting of shareholders (“Annual Meeting”), including director nominations (other than proposals made in compliance with Rule 14a-8 of the Exchange Act). The required written notice must be delivered to our Secretary at our principal office at least 90 days but no more than 120 days prior to the first anniversary of the preceding year’s Annual Meeting or it will be considered untimely. However, in the event that the date of the Annual Meeting is advanced by more than 20 days, or delayed by more than 60 days, from the first anniversary of the preceding year’s Annual Meeting, a shareholder’s notice must be received no earlier than the 120th day prior to the Annual Meeting and not later than the close of business on the later of (i) the 90th day prior to the Annual Meeting and (ii) the seventh day following the day on which notice of the date of the Annual Meeting was mailed or public disclosure of the date of the Annual Meeting was made, whichever occurs first.

Action by Written Consent; Special Meetings. Although our Charter and By-laws allow shareholders to act by written consent, such written consent must be signed by all shareholders entitled to vote on the matter to be approved. This significantly restricts the ability of our shareholders to act by written consent.

In addition, under our By-laws, special meetings of shareholders may be called only by our President or our Board of Directors. In addition, upon written application by one or more shareholders holding at least 40% of the shares of stock entitled to vote on the matter, special meetings of shareholders may be called by our Secretary.

Dividend Rights. Subject to the rights of holders of outstanding shares of Preferred Stock, if any, the holders of Common Stock are entitled to receive dividends, if any, that may be declared from time to time by our Board of Directors in its discretion out of funds legally available for the payment of dividends.

Liquidation Rights. Subject to the rights of holders of outstanding shares of Preferred Stock, if any, holders of Common Stock will share ratably in all assets legally available for distribution to our shareholders in the event of dissolution.

Other Rights and Preferences. Our Common Stock has no sinking fund or redemption provisions or preemptive, conversion or exchange rights.

Blank Check Preferred Stock.

Our Charter allows our Board of Directors to issue shares of Preferred Stock without the further approval of our shareholders. This is sometimes referred to as “blank check” preferred stock. The effects of such issuance, among other things, could include the dilution in the voting power of our Common Stock if the Preferred Stock has voting rights and the reduction or restriction of the rights of holders of Common Stock to receive a payment in the event of any liquidation, dissolution or winding up of our Company. In some circumstances, the issuance of Preferred Stock may render more difficult or expensive or tend to discourage a merger, tender offer, or proxy contest, the assumption of control by a holder of a large block of our securities, or the removal of incumbent management. In addition, our Board of Directors could utilize the shares of Preferred Stock in order to adopt a shareholder rights plan, or “poison pill,” which could have the effect of discouraging or delaying a takeover of our Company.

Provisions of Our Charter and By-laws and Massachusetts Law that Could Delay or Defer a Change in Control. Our Charter and Bylaws contain provisions that may make the acquisition of control of our Company without the approval of our Board of Directors more difficult, as described above.

The Massachusetts General Laws contain anti-takeover provisions regarding, among other things, business combinations with an affiliated shareholder. In general, the Massachusetts General Laws prevent a publicly held Massachusetts corporation from engaging in a business combination, as defined in the Massachusetts General Laws, with an interested shareholder for a period of three years after the date of the transaction in which the person became an interested shareholder, unless:

- before the date on which the person became an interested shareholder, the board of directors of the corporation approved either the business combination or the transaction in which the person became an interested shareholder;
- the interested shareholder acquires at least 90% of the outstanding voting stock of the corporation at the time it becomes an interested shareholder; or
- the business combination is approved by the board of directors and the holders of at least two-thirds of the outstanding voting stock of the corporation voting at a meeting, excluding the voting stock owned by the interested shareholder.

An interested shareholder is generally a person owning 5% or more of the outstanding voting stock of the corporation. A business combination includes mergers, consolidations, stock and asset sales and other transactions with the interested shareholder that result in a financial benefit to the interested shareholder.

The Massachusetts General Laws also contain control share acquisitions provisions. We have elected to opt out of the control share acquisitions provisions, however, we may opt into these control share acquisitions provisions by amending our By-laws. In general, the control share acquisitions provisions of the Massachusetts General Laws provide that any person, including his, her or its affiliates, who acquires shares of a corporation that are subject to the control share acquisitions statute and whose shares represent one-fifth or more, one-third or more, or a majority or more, of the voting power of the corporation in the election of directors, cannot exercise any voting power with respect to those shares, or any shares acquired by the person within 90 days before or after an acquisition of this nature, unless these voting rights are authorized by the shareholders of the corporation.

The authorization of voting rights requires the affirmative vote of the holders of a majority of the outstanding voting shares, excluding shares owned by:

- the person making an acquisition of this nature;
- any officer of the corporation; and
- any employee who is also a director of the corporation.

There are several other types of share acquisitions that are not subject to these provisions of the Massachusetts General Laws, including acquisitions of shares under a tender offer, merger or consolidation which is made in connection with an agreement to which the corporation is a party, and acquisitions of shares directly from the corporation or a wholly-owned subsidiary of the corporation.

EMPLOYMENT AGREEMENT

MKS Instruments, Inc., a Massachusetts corporation (the "Company"), and James A. Schreiner of Savage, MN ("Employee") agree, effective September 16, 2019, as follows.

1. Employment. The Company is employing Employee on an at-will basis in the position of Chief Operating Officer. Employee agrees to comply with the Company's policies.

2. Confidential Information Agreement. Employee will sign and deliver to the Company, at the same time that Employee executes this Employment Agreement, the Confidential Information, Intellectual Property and Non-Solicitation Agreement of MKS Instruments, Inc. ("Confidential Information Agreement") that is Attachment 1 to this Employment Agreement.

3. Duty to The Company. While employed by the Company, Employee: (a) will devote his or her full working time and best efforts to the business of the Company; and (b) will not (without the prior, express, written consent of the Chief Executive Officer of the Company) engage in any business activity (whether or not for gain) that interferes with Employee's work for the Company. Notwithstanding the previous sentence, this Employment Agreement does not prohibit Employee from managing his or her personal investments or engaging in charitable and unpaid professional activities (including serving on charitable and professional boards), so long as doing so does not materially interfere with Employee's work for the Company or violate Section 7 of this Employment Agreement.

4. Compensation.

(a) **Base Salary.** The Company will pay Employee base salary at the rate of \$400,000 per year (the "Base Salary"), in accordance with the Company's normal payroll practices. The Company may review and adjust the amount of the Base Salary from time to time in its sole discretion.

(b) **Incentive Compensation Plan.** Employee will be entitled to participate in the Company's Annual Corporate Management/Key Employee Bonus Plan, to the extent applicable to Employee's position.

(c) **Stock Incentive Plan.** Employee will be entitled to participate in the Company's stock incentive plan to the extent applicable to Employee's position.

(d) **Benefits.** Employee will be eligible to participate in the Company's generally available employee benefit plans, which currently include medical, dental, vision, life, accidental death and dismemberment, short-term disability and long-term disability insurance, a 401(k) savings plan and an employee stock purchase plan, subject to the terms and conditions of each plan.

(e) **Paid Time Off.** Employee will be eligible for 15 days of paid vacation per year, plus paid sick time and holidays, all subject to the terms and conditions of the Company's policies.

(f) **Expenses.** The Company will reimburse Employee for expenses Employee reasonably incurs in performing his or her duties, to the extent provided in the Company's expense reimbursement policies. Reimbursement of expenses in one tax year will not affect reimbursement of expenses in any other tax year.

5. End of Employment. Either Employee or the Company may end the employment relationship at any time, for any reason, with or without notice or cause. The employment relationship will end automatically and immediately upon Employee's death or entitlement to long-term disability benefits under the Company's long-term disability program. The date on which Employee's employment ends, whether as the result of a resignation by Employee, a termination of employment by the Company, or an automatic termination of employment upon death or disability, is referred to in this Employment Agreement as the "Employment End Date." If Employee resigns or the Company terminates Employee's employment, the Company will (in either case) have the right at any time, for any reason in its sole discretion to decide the Employment End Date. In no event will the Company's deciding the Employment End Date following Employee's resignation be considered termination by the Company of Employee's employment.

6. Company Obligations Upon End of Employment. When the employment relationship ends, the Company will have no obligation to pay or provide Employee at any time any compensation, payment or benefit of any kind, except as expressly provided in Sections 6(a) through 6(e) below.

(a) **Minimum Obligations.** When the employment relationship ends, no matter how it ends: (i) the Company will pay Employee any unpaid Base Salary through the Employment End Date; (ii) Employee will be entitled to accrued, vested benefits under the Company's benefit plans and programs to the extent provided in Section 4(d); (iii) the Company will pay Employee for any accrued but unused vacation; and (iv) the Company will reimburse Employee for any unreimbursed expenses incurred through the Employment End Date to the extent provided in Section 4(f).

(b) **30 Days' Base Salary After Certain Resignations.** If Employee provides the Company at least 30 days' advance written notice of resignation of employment, is an active employee in good standing at the time of such notice and continues to perform his or her duties diligently and professionally to the extent requested thereafter, the Company will pay Employee his or her Base Salary for at least 30 days after such notice, even if the Employment End Date is earlier.

(c) **30 Days' Base Salary After Certain Terminations.** If the Company terminates Employee's employment other than for Cause, as defined below, the Company will provide Employee with written notice of termination and pay Employee his or her Base Salary for at least 30 days after such notice of termination, even if the Employment End Date is earlier.

(d) **Eligibility for Ordinary Severance Compensation.** If the Company terminates Employee's employment, Employee will be eligible for Ordinary

Severance Compensation, as described below, provided that all of the following conditions are satisfied: (i) the Company's primary reason for terminating Employee's employment was a change to the Company's business needs (such as reduction in force or elimination of position) and not Cause as defined below; (ii) Employee has complied with and continues to comply with all of Employee's obligations under this Employment Agreement and the Confidential Information Agreement; and (iii) Employee executes, provides to the Company within 45 days after the Employment End Date and does not thereafter revoke or attempt to revoke, a general release of claims, which may at the Company's option and in the Company's sole discretion include post-employment restrictions substantially identical to the post-employment restrictions contained in Section 7 below, all in a form satisfactory to the Company ("General Release Agreement"). The Company's good-faith determination that one or more of the conditions listed above has not been satisfied will be binding and conclusive.

(e) **"Ordinary Severance Compensation."** If employee becomes eligible for Ordinary Severance Compensation:

(i) **Base Salary.** The Company will pay Employee, within 14 days after the General Release Agreement become irrevocable, a lump sum in an amount equal to 12 months of Base Salary.

(ii) **Continuation of Benefits.** For a period of 12 months after the Employment End Date, to the extent Employee elects to continue group medical, vision, or dental insurance coverage under COBRA and timely remits the amount of premium assessed to similarly situated active employees for comparable coverage, the Company will pay the Company's usual share of such premiums. Benefits payable under this Section 6(e)(ii) will terminate to the extent Employee ceases to be eligible for COBRA coverage under the Company's medical benefits plan. Notwithstanding the foregoing, the Company will not pay the contribution toward COBRA coverage described above to the extent that the Company reasonably determines that doing so would subject the Company to the excise tax under Section 4980D of the Internal Revenue Code (the "Code") (as a result of discriminatory coverage under a group health plan).

(f) **Eligibility for Enhanced Severance Compensation.** Employee will become eligible for the "Enhanced Severance Compensation," as described below, instead of Ordinary Severance Compensation under Section 6(d) and (e) above or under any other program or policy of the Company, if and only if all of the following conditions are satisfied: (i) the Company terminates Employee's employment without "Cause" (as defined below) or Employee resigns for "Good Reason" (as defined below); (ii) the Employment End Date is within 24 months after the effective date of a Change in Control (as defined below); (iii) Employee has complied with and continues to comply with all of Employee's obligations under this Employment Agreement and the Confidential Information Agreement; and (iv) Employee executes, provides to the Company within 45 days after the Employment End Date and does not thereafter revoke or attempt to revoke, a General Release Agreement, as defined above. The Company's good-faith determination that one or more of the conditions listed above has not been satisfied will be binding and conclusive.

- (g) **“Enhanced Severance Compensation.”** If Employee becomes eligible for the Enhanced Severance Compensation:
- (i) **Base Salary.** The Company will pay Employee, within 14 days after the General Release Agreement become irrevocable, a lump sum in an amount equal to one and one half times annual Base Salary (determined without regard to any reduction in Base Salary giving rise to “Good Reason,” as defined below).
 - (ii) **Incentive Compensation.** The Company will pay Employee, within 14 days after the General Release Agreement becomes irrevocable, a lump sum equal to one and one half times the annual amount of incentive compensation for which Employee was eligible under any Incentive Compensation Plan of the Company then in effect for the year containing the Employment End Date. Additionally, the Employee will receive a payment for target bonus, prorated for the current year.
 - (iii) **Continuation of Benefits.** For a period of 18 months after the Employment End Date, to the extent Employee elects to continue group medical, vision, or dental insurance coverage under COBRA and timely remits the amount of premium assessed to similarly situated active employees for comparable coverage, the Company will pay the Company’s usual share of such premiums. Benefits payable under this Section 6(g)(iii) will terminate to the extent Employee ceases to be eligible for COBRA coverage under the Company’s medical benefits plan. Notwithstanding the foregoing, the Company will not pay the contribution toward COBRA coverage described above to the extent that the Company reasonably determines that doing so would subject the Company to the excise tax under Section 4980D of the Internal Revenue Code (the “Code”) (as a result of discriminatory coverage under a group health plan).
 - (iv) **Restricted Stock Units or Stock Appreciation Rights.** Employee’s unvested equity awards as of the Employment End Date will be subject to accelerated vesting to the extent provided in the respective equity award agreement issued to Employee under the then effective MKS Instruments, Inc. equity incentive plan (including the MKS Instruments, Inc. 2014 Stock Incentive Plan).
- (h) **No Obligation to Mitigate Damages; Effect on Other Contractual Rights.** Employee will not be required to mitigate damages, by seeking other employment or otherwise, as a condition of receiving any portion of the Ordinary Severance Compensation or the Enhanced Severance Compensation. Nor will the Ordinary Severance Compensation or the Enhanced Severance Compensation be reduced by any compensation earned by Employee as the result of employment by an employer other than the Company or a direct or indirect parent, subsidiary or affiliate of the Company after the Employment End Date. Nothing in this Section 6(h) is intended to or shall delay, prevent or require any compensation for any termination of COBRA benefits that may occur pursuant to Section 6(e)(ii) or Section 6(g)(iii) above.

- (i) **“Cause.”** “Cause” to terminate Employee’s employment will exist if Employee:
- (i) commits a felony or engages in fraud, misappropriation or embezzlement;
 - (ii) knowingly fails or refuses to perform Employee’s duties in a material way and, to the extent that the Company determines such failure or refusal can reasonably be cured, fails or refuses to effect a cure within 10 days after the Company notifies Employee in writing of the failure or refusal;
 - (iii) knowingly causes, or knowingly creates a serious risk of causing, material harm to the Company’s business or reputation; or
 - (iv) breaches, in a material way, this Employment Agreement, the Confidential Information Agreement or any other agreement between Employee and the Company, and, to the extent that the Company determines such breach can reasonably be cured, fails or refuses to effect a cure within 10 days after the Company notifies Employee in writing of the breach.
- (j) **“Good Reason.”** “Good Reason” for Employee to resign will exist if, without Employee’s express written consent:
- (i) the Company materially reduces Employee’s position, duties or responsibilities;
 - (ii) the Company reduces Employee’s Base Salary as in effect on the date hereof or as the same may be increased from time to time during the term of this Employment Agreement;
 - (iii) the Company changes Employee’s principal place of work to a location more than 50 miles from Employee’s current principal place of work.

Notwithstanding the foregoing, an action described above will not constitute Good Reason unless: (A) Employee, within 30 days after the he or she learns, or with reasonable diligence should have learned, of such action, delivers to the Company written notice identifying the action as Good Reason and demanding its correction; (B) the Company fails to correct such event within 30 days after receipt of such notice; and (C) Employee resigns for Good Reason within 90 days after the date Employee learned, or with reasonable diligence should have learned, of such action.

- (k) **“Change in Control.”** For purposes of this Employment Agreement, the term “Change in Control” will mean the first to occur of any of the following events: (i) any “person” (as that term is used in Section 13 and 14(d)(2) of the

Securities Exchange Act of 1934 (“Exchange Act”)) becomes the beneficial owner (as that term is used in Section 13(d) of the Exchange Act), directly or indirectly, of fifty percent (50%) or more of MKS’ capital stock entitled to vote in the election of directors; (ii) the shareholders of MKS approve any consolidation or merger of MKS other than a consolidation or merger of MKS in which the holders of the common stock of MKS immediately prior to the consolidation or merger hold more than fifty percent (50%) of the common stock of the surviving corporation immediately after the consolidation or merger; or (iii) the shareholders of MKS approve the sale or transfer of all or substantially all of the assets of MKS to parties that are not within a “controlled group of corporations” (as defined in Code Section 1563) in which MKS is a member.

7. Non-Competition.

- (a) During Employee’s MKS Employment (as defined below) and for 12 months immediately thereafter (together, the “Non-Compete Period”), Employee will not engage in or otherwise carry on, directly or indirectly anywhere in the world (as principal, agent, employee, employer, investor, shareholder (except for holdings of no greater than 1% of the total outstanding shares in a publicly-traded company), consultant, partner, member, manager, financier or in any other individual or representative capacity of any kind whatsoever), any Competitive Activity (as defined below).
- (b) “MKS Employment” means the period beginning on the first day that Employee is employed by the Company and ending on the first day on which Employee is no longer employed by any MKS Entity (as defined below).
- (c) “MKS Entity” means (i) the Company; (ii) any current or future parent, subsidiary or affiliate of the Company; or (iii) any successor or assign of (i) or (ii).
- (d) “Competitive Activity” means business or activity competitive with an MKS Entity but only to the extent that business or activity is related to, similar to, or competitive with the activities of the business unit(s), division(s), laborator(y)(ies), facilit(y)(ies) and other operational unit(s) in or for which Employee performed work for an MKS Entity or about which Employee acquired Proprietary Information (as defined in the Confidential Information Agreement).
- (e) The Non-Compete Period shall be extended to two (2) years upon Employee’s breach of his/her fiduciary duty and/or unlawful taking, physically or electronically, of property belonging to the Company.
- (f) If any court of competent jurisdiction determines that this Section 7 is unenforceable because the Non-Compete Period is too long or because Competitive Activity includes too great a range of activities or too wide a geographic scope, the parties agree that this Section 7 should be interpreted to extend only over the maximum period of time or range of activities or geographic scope as to which it may be enforceable.
- (g) The post-employment restrictions on Employee’s conduct contained in this Employment Agreement and in the Confidential Information Agreement will continue to apply even if Employee’s duties, title, compensation, location or other terms or conditions of employment change, and even if such change or changes are material.

(h) The Company and Employee agree that violation by Employee of any of the provisions of this Section 7 of this Employment Agreement would cause the Company irreparable harm beyond what could reasonably or adequately be compensated in damages, and that the Company would therefore be entitled (in addition to the Company's other remedies) to an injunction, declaratory judgment or restraining order against any such violation or threatened violation.

(i) Employee has had an opportunity to have this Agreement reviewed by an attorney before signing.

(j) Employee acknowledges and agrees that this non-competition covenant is supported by the following mutually-agreed upon consideration, which the parties acknowledge and agree is fair and reasonable: at-will employment with the Company, the compensation and benefits associated therewith and the other terms and conditions of this Agreement.

(k) If and to the extent Employee is employed in California, the provisions of this Section 7 shall not apply.

8. Code Section 409A Compliance.

(a) Where this Employment Agreement refers to Employee's termination of employment for purposes of receiving any payment, whether such a termination has occurred will be determined in accordance with Section 409A of the Internal Revenue Code (the "Code") and Treasury Regulation Section 1.409A-1(h) (or any successor provisions) to the extent required by law.

(b) To the extent that benefits under Section 6 are contingent upon Employee providing a General Release Agreement, Employee will sign and return the General Release Agreement within the reasonable time period designated by the Company, which will not be more than 45 days. If the period for Employee to review a General Release Agreement plus any revocation period crosses calendar years, payments contingent upon the Release will be made in the later calendar year. Any payments contingent upon the General Release Agreement that would otherwise be made during the period for review and revocation of the General Release Agreement will be made, provided that the General Release Agreement is timely executed and returned to the Company and not revoked, on the first scheduled payment date after such period ends. Each payment in respect of Employee's termination of employment under Section 6 of the Employment Agreement is designated as a separate payment for Section 409A purposes.

(c) If Employee is designated as a "specified Executive" within the meaning of Code Section 409A (while the Company is publicly traded), any deferred compensation payment subject to Section 409A to be made during the six-month period following Employee's termination of employment will be withheld and the amount of the payments withheld will be paid in a lump sum, without interest, during the seventh month after Employee's termination; provided, however, that if

Employee dies prior to the expiration of such six month period, payment to Employee's beneficiary will be made as soon as reasonably practicable following Employee's death. The Company will identify in writing delivered to Employee any payments it reasonably determines are subject to delay under this Section 8(c). In no event will the Company have any liability or obligation with respect to taxes for which Employee may become liable as a result of the application of Code Section 409A.

9. Code Sections 280G/4999. If (a) any payments or benefits to Employee in connection with this Employment Agreement ("Payments") would be subject to the excise tax imposed by Code Section 4999 (the "Parachute Tax"), (b) paying Employee a lesser amount would avoid the Parachute Tax entirely and (c) payment of such lesser amount would, after taking into account applicable federal, state and local income taxes and the Parachute Tax, result in Employee receiving a greater after-tax payment than if the Company made the Payments in full, then the Company will pay Employee such lesser amount instead of making the Payments in full. The reporting and payment of any Parachute Tax will in all events be Employee's responsibility. The Company will not in any event provide a gross-up or any other payment to compensate Employee for the payment of the Parachute Tax or for any reduction in the Payments. The Company will withhold from the Payments any amounts it reasonably determines are required under Code Section 4999(c) and the Treasury Regulations thereunder.

10. Withholding. The Company will deduct from the amounts payable to Employee pursuant to this Employment Agreement all withholding amounts and deductions required by law or authorized by Employee.

11. Changes to Plans and Policies. Nothing in this Employment Agreement will: (a) require the Company or its affiliates to establish, maintain or continue any incentive compensation plan, stock incentive plan or other benefit plan, policy or arrangement; (b) restrict the right of the Company or any of its affiliates to amend, modify or terminate any such plan, policy or arrangement; (c) entitle Employee to participate in any such plan policy or arrangement at any specified level (or at all) in any year; or (d) prevent any future change to any such plan, policy or arrangement from applying to Employee in accordance with the terms of the change.

12. Assignment. The rights and obligations of the Company under this Employment Agreement will inure to the benefit of, and be binding upon, the Company's successors and assigns. The rights and obligations of Employee under this Employment Agreement will inure to the benefit of, and will be binding upon, Employee's heirs, executors and legal representatives. Employee may not delegate or assign any obligations under this Employment Agreement.

13. Entire Agreement and Severability. This Employment Agreement and the Confidential Information Agreement supersede any and all other agreements, either oral or in writing, between Employee and the Company with respect to the Company's employment of Employee. They contain all of the covenants and agreements between the parties with respect to such employment. Neither party is entering into this Employment Agreement on the basis of any representation, inducement, promise or agreement, oral or otherwise, by any party, or by any one acting on behalf of any party, which is not stated herein. Any modification of this Employment Agreement will be

effective only if it is in writing and signed by both parties to this Employment Agreement. If any provision in this Employment Agreement is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions will nevertheless continue in full force and effect without being impaired or invalidated in any way.

14. Miscellaneous. This Employment Agreement and the rights and obligations of the parties hereunder will be governed by, and construed in accordance with, the laws of the Commonwealth of Massachusetts, excluding (but only to the extent permitted by law) its conflict of laws and choice of law rules. The parties agree that service of any process, summons, notice or document by U.S. certified mail or overnight delivery by a generally recognized commercial courier service to Employee's last known address (or any mode of service recognized to be effective by applicable law) will be effective service of process for any action, suit or proceeding brought against Employee. The failure of either party hereto to enforce any right under this Employment Agreement will not be considered a waiver of that right, or of damages caused thereby, or of any other rights under this Employment Agreement.

15. Arbitration and Waiver of Jury Trial.

(a) Any "Legal Dispute" (as defined below) between Employee and any MKS Entity (or between Employee and any employee or agent of any MKS Entity, to the extent directly or indirectly arising from or relating in any way to Employee's employment with or separation from the Company) will be resolved by final and binding arbitration. Notwithstanding the foregoing sentence, the Company may, in its sole discretion, obtain preliminary injunctive relief enforcing the provisions of the Confidential Information Agreement or Section 7 of this Employment Agreement from any court of competent jurisdiction.

(b) "Legal Dispute" means a dispute about legal rights or legal obligations, including but not limited to any rights or obligations arising under this Employment Agreement; the Confidential Information Agreement; any other agreement; any applicable legal or equitable doctrine; any applicable common law theory; or any applicable federal, state or local, statute, regulation or other legal requirement.

(c) The arbitration will be held in the Commonwealth of Massachusetts. It will be conducted in accordance with the then-prevailing Employment Arbitration Rules of the American Arbitration Association.

(d) Notwithstanding any other provision of this Employment Agreement or any other agreement or of any arbitration rules, no Legal Dispute involving any MKS Entity may be included in any class or collective arbitration or any other class or collective proceeding. The exclusive method for resolving any such Legal Dispute will be arbitration on an individual basis.

(e) Any issues about whether a dispute is subject to arbitration will be determined by a court of competent jurisdiction and not by an arbitrator. Any issues about the meaning or enforceability of Section 15(d) will be decided by a court of competent jurisdiction and not by an arbitrator.

(f) The Company, Employee and the arbitrator will treat all aspects of the arbitration proceedings, including without limitation, discovery, testimony and other evidence, briefs and the award, as strictly confidential, except that the arbitration award may be disclosed to the extent necessary to enforce the award, the provisions of the Confidential Information Agreement, or the provisions of this Employment Agreement.

(g) Employee and the Company understand and acknowledge that by agreeing to arbitrate the disputes covered by this Section 15, they are waiving the right to resolve those disputes in court and waiving any right to a jury trial with respect to those disputes.

16. Knowing and Voluntary Agreement. Employee understands that Employee has the right to consult counsel before signing this Employment Agreement.

IN WITNESS WHEREOF, the parties hereto have executed, in the Commonwealth of Massachusetts, this Employment Agreement as a sealed instrument, all as of the day, month and year first written above.

MKS INSTRUMENTS, INC.

By:

/s/ CarolAnn Chory

Dated: August 3, 2019

Name: CarolAnn Chory

Title: Consultant, Global Talent Acquisition

/s/ J. A. Schreiner

Employee Signature

Dated: August 6, 2019

Mr. James A. Schreiner
8320 West 132nd Street
Savage, MN 55378

SUBSIDIARIES OF THE REGISTRANT

SUBSIDIARY	JURISDICTION OF INCORPORATION
Beijing Newport Spectra-Physics Technologies Co., Ltd.	China
Electro Scientific Industries Europe Ltd	United Kingdom
Electro Scientific Industries GmbH	Germany
Electro Scientific Industries Singapore Pte. Ltd.	Singapore
Electro Scientific Industries, Inc.	Oregon
Eolite Systems SAS	France
ESI China, Inc.	Oregon
ESI Electronic Equipment (Shanghai) Co., Ltd.	China
ESI International Corporation	Oregon
ESI Japan, K.K.	Japan
ESI Korea, Inc.	Korea
ESI Vietnam Company Limited	Vietnam
High Q Laser GmbH	Austria
Micro-Controle Spectra-Physics S.A.S.	France
MKS Denmark ApS	Denmark
MKS German Holding GmbH	Germany
MKS Instruments (China) Company Ltd.	China
MKS Instruments (Hong Kong) Limited	Hong Kong
MKS Instruments (Singapore) Pte. Ltd.	Singapore
MKS Instruments Deutschland GmbH	Germany
MKS Instruments ESI Switzerland GmbH	Switzerland
MKS Instruments Holdings Ltd	United Kingdom
MKS Instruments Israel Ltd.	Israel
MKS Instruments Italy S.r.l.	Italy
MKS Instruments Mexico S. de R.L. de C.V.	Mexico
MKS Instruments UK Limited	United Kingdom
MKS Spectra Holdings Limited	United Kingdom
MKS Japan, Inc.	Japan
MKS Korea Ltd.	Korea
MKS Taiwan Technology Limited	Taiwan
Newport Corporation	Nevada
Newport Instruments Canada Corporation	Canada
Newport Laser Holding GmbH	Austria
Newport Ophir Holdings Ltd.	Israel
Newport Opto-Electronics Technologies (Korea), LLC	Korea
Newport Opto-Electronics Technologies (Singapore) Pte. Ltd.	Singapore
Newport Opto-Electronics Technologies (Wuxi) Company Limited	China
Newport Spectra-Physics B.V.	Netherlands
Newport Spectra-Physics GmbH	Germany
Newport Spectra-Physics Limited	United Kingdom
Ophir Japan Ltd.	Japan
Ophir Optics S.R.L.	Romania
Ophir Optronics GmbH	Germany
Ophir Optronics Ltd.	Israel
Ophir Optronics Solutions Ltd.	Israel
Ophir Spiricon Europe GmbH	Germany
Ophir-Spiricon, LLC	Utah
Spectra-Physics, K.K.	Japan
V-Gen Ltd.	Israel

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We hereby consent to the incorporation by reference in the Registration Statements on Form S-3 (Nos. 333-34450 and 333-109753) and Form S-8 (Nos. 333-78069, 333-78071, 333-78073, 333-31224, 333-54486, 333-54488, 333-54490, 333-90498, 333-90500, 333-90502, 333-116385, 333-116387, 333-116389, 333-127221, 333-161211, 333-195750, 333-211026, and 333-229483) of MKS Instruments, Inc. of our report dated February 28, 2020 relating to the consolidated financial statements and financial statement schedule and the effectiveness of internal control over financial reporting, which appears in this Form 10-K.

/s/ PricewaterhouseCoopers LLP
Boston, Massachusetts
February 28, 2020

CERTIFICATION OF PRINCIPAL EXECUTIVE OFFICER
PURSUANT TO RULE 13a-14(a)/RULE 15d-14(a) OF THE
SECURITIES EXCHANGE ACT OF 1934, AS AMENDED

I, John T.C. Lee, certify that:

1. I have reviewed this annual report on Form 10-K of MKS Instruments, Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:
 - a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this annual report is being prepared;
 - b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - d) Disclosed in this report any changes in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Dated: February 28, 2020

/s/ John T.C. Lee

John T.C. Lee
President and Chief Executive Officer
(Principal Executive Officer)

CERTIFICATION OF PRINCIPAL FINANCIAL OFFICER
PURSUANT TO RULE 13a-14(a)/RULE 15d-14(a) OF THE
SECURITIES EXCHANGE ACT OF 1934, AS AMENDED

I, Seth H. Bagshaw, certify that:

1. I have reviewed this annual report on Form 10-K of MKS Instruments, Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:
 - a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this annual report is being prepared;
 - b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - d) Disclosed in this report any changes in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Dated: February 28, 2020

/s/ Seth H. Bagshaw

Seth H. Bagshaw
Senior Vice President, Chief Financial Officer and Treasurer
(Principal Financial Officer)

CERTIFICATION OF CHIEF EXECUTIVE OFFICER AND CHIEF FINANCIAL OFFICER

PURSUANT TO 18 U.S.C. SECTION 1350,

AS ADOPTED PURSUANT TO

SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

In connection with the Annual Report on Form 10-K of MKS Instruments, Inc. (the "Company") for the period ended December 31, 2019 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), the undersigned, John T.C. Lee, President and Chief Executive Officer of the Company, and Seth H. Bagshaw, Senior Vice President, Chief Financial Officer and Treasurer of the Company, each hereby certifies, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, based on his knowledge:

- (1) The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and
- (2) The information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Dated: February 28, 2020

/s/ John T.C. Lee

John T.C. Lee
President and Chief Executive Officer
(Principal Executive Officer)

Dated: February 28, 2020

/s/ Seth H. Bagshaw

Seth H. Bagshaw
Senior Vice President, Chief Financial Officer and Treasurer