MKS INSTRUMENTS INC
Form 10-K
February 26, 2019
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UNITED STATES SECURITIES AND EXCHANGE COMMISSION

WASHINGTON, D.C. 20549

Form 10-K

(MARK ONE)

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

or

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

Commission File number 0-23621

MKS INSTRUMENTS, INC.

(Exact Name of Registrant as Specified in Its Charter)

Massachusetts	**04-2277512**
(State or other Jurisdiction of	*(IRS Employer*
Incorporation or Organization)	*Identification No.)*
2 Tech Drive, Suite 201, Andover, Massachusetts	**01810**
(Address of Principal Executive Offices)	*(Zip Code)*

(978) 645-5500

(Registrant s Telephone Number, including area code)

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

Title of class	Name of exchange on which registered
Common Stock, no par value	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 if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§ 229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant s knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K.

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, 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 30, 2018 based on the closing price of the registrant s common stock on such date as reported by the Nasdaq Global Select Market: $5,217,380,580.

Number of shares outstanding of the issuer s common stock, no par value, as of February 19, 2019: 54,197,726

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the definitive Proxy Statement for MKS Annual Meeting of Stockholders to be held on May 8, 2019 are incorporated by reference into Part III of this 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. When used herein, the words believe, anticipate, plan, expect, estimate, intend, may, see, will, would and similar expressions are intended to identify forward-looking statements altho forward-looking statements contain these identifying words. These forward-looking statements reflect management s current opinions and are subject to certain risks and uncertainties that could cause actual results to differ materially from those stated or implied. MKS assumes no obligation to update this information. Risks and uncertainties include, but are not limited to, those discussed in the section entitled Risk Factors of this annual report on Form 10-K.

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, 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. Our products are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, residual gas analysis, leak detection, control technology, ozone generation and delivery, RF & DC power, reactive gas generation, vacuum technology, lasers, photonics, sub-micron positioning, vibration control, and optics. We also provide services relating to the maintenance and repair of our products, installation services and training.

Recent Events

Acquisition of Electro Scientific Industries, Inc.

On February 1, 2019, we completed our previously announced acquisition of Electro Scientific Industries, Inc., an Oregon corporation (ESI), pursuant to the Agreement and Plan of Merger (the ESI Merger). ESI is an innovator in laser-based manufacturing solutions for micro-machining applications. Micro-machining applications are used extensively in the manufacture of mobile devices, electronic components, thin film devices and semiconductor packaging. At the effective time of the ESI Merger and pursuant to the terms and conditions of the Agreement and Plan of Merger, each share of ESI s common stock issued and outstanding as of immediately prior to the effective time of the ESI Merger was converted into the right to receive $30.00 per share in cash, without interest and subject to deduction for any required withholding tax. We paid to the former ESI stockholders aggregate consideration of approximately $1 billion, excluding related transaction fees and expenses. We funded the payment of the aggregate consideration with a combination of our available cash on hand and proceeds from our term loan facility described below.

In connection with the completion of the ESI Merger, we entered into an amendment (Amendment No. 5) to our Term Loan Credit Agreement with Barclays Bank PLC as administrative agent and collateral agent, that provided additional tranche B-5 term loan commitment in the principal amount of $650.0 million, which we used to partially fund the ESI Merger.

Also, in connection with the completion of the ESI Merger, we terminated our $50.0 million asset-based credit agreement with Deutsche Bank AG New York Branch as administrative and collateral agent, and we entered into an asset-based credit agreement with Barclays Bank PLC, as administrative agent and collateral agent, that provides senior secured revolving credit financing of up to $100.0 million, subject to a borrowing base limitation.

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Other Dispositions and Acquisitions

Sale of Data Analytics Solutions Business

In April 2017, we completed the sale of our Data Analytics Solutions business for total proceeds of $72.5 million, net of cash sold 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.

Acquisition of Newport Corporation

On April 29, 2016, we completed our acquisition of Newport Corporation (Newport) pursuant to an Agreement and Plan of Merger dated as of February 22, 2016 (the Newport Merger). At the effective time of the Newport Merger, each share of Newport s common stock issued and outstanding as of immediately prior to the effective time of the Newport Merger was converted into the right to receive $23.00 in cash, without interest and subject to deduction for any required withholding tax. We paid to the former Newport stockholders aggregate consideration of approximately $905 million, excluding related transaction fees and expenses, and repaid approximately $93 million of Newport s U.S. indebtedness outstanding as of immediately prior to the effective time of the Newport Merger. We funded the payment of the aggregate consideration with a combination of our available cash on hand of approximately $240 million and the proceeds from the senior secured term loan facility in the principal amount of $780 million (see Note 13 to Notes to Consolidated Financial Statements in Item 8 of this Annual Report on Form 10-K).

Newport was a global supplier of advanced-technology products and systems to customers in the scientific research and defense/security, microelectronics, life and health sciences and industrial manufacturing markets.

Reportable Segments

Effective April 29, 2016, in conjunction with our acquisition of Newport, we changed the structure of our reportable segments based upon our organizational structure and how our Chief Operating Decision Maker utilizes information provided to allocate resources and make decisions. Our two reportable segments are the Vacuum & Analysis segment and the Light & Motion segment. The Vacuum & Analysis segment represents primarily the legacy MKS business and the Light & Motion segment represents the remaining legacy Newport business. With the acquisition of ESI, we will be adding a third segment.

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, residual gas analysis, leak detection, control technology, ozone generation and delivery, RF & DC power, reactive gas generation 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, sub-micron positioning, vibration control, and optics.

We group our products into six product groups based upon the similarity of the product function, type of product and manufacturing processes. These six groups are: Analytical and Controls Solutions Products; Power, Plasma and Reactive Gas Solutions Products; Vacuum Solutions Products; Photonics Products; Optics Products; and Laser Products. The Analytical and Controls Solutions Products, the Power, Plasma and Reactive Gas Solutions Products and the Vacuum Solutions Products are included in the Vacuum & Analysis segment and the Photonics Products, Optics Products and Laser Products are included in the Light & Motion segment.

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For further information on our segments, see Note 19 to the Notes to the Consolidated Financials contained in this Annual Report on Form 10-K.

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.

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. Approximately 55%, 57% and 56% of our net revenues for the years 2018, 2017 and 2016, respectively, were from sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers.

Approximately 45%, 43% and 44% of our net revenues in the years 2018, 2017 and 2016, respectively, were from advanced manufacturing applications. These include, but are not limited to, industrial technologies, life and health sciences, as well as research and defense.

A significant portion of our net revenues are from sales to customers in international markets. For the years 2018, 2017 and 2016, international net revenues accounted for approximately 51%, 50% and 48% of our total net revenues, respectively. A significant portion of our international net revenues were in South Korea, Japan, Germany and Israel. 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 ninety percent of ESI s customers are located in Asia. Long-lived assets, located in the United States, were $147 million, $125 million and $123 million as of December 31, 2018, 2017 and 2016, respectively, excluding goodwill and intangibles and long-term tax-related accounts. Long-lived assets, located outside of the United States, were $77 million, $78 million, and $78 million as of December 31, 2018, 2017 and 2016, respectively, excluding goodwill and intangibles and long-term tax-related accounts.

Semiconductor Manufacturing Applications

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 manufacturing 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.

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Advanced Markets

In addition to semiconductor manufacturing, 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 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

In addition, our products 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.

Product Groups

Vacuum &Analysis Segment

The Vacuum & Analysis segment includes Analytical and Control Solutions Products; Vacuum Solutions Products; and Power, Plasma and Reactive Gas Solutions Products.

Analytical and Control Solutions. Our Analytical and Control Solutions Products include gas analyzers, automation control products, I/O modules, automation software, and precision machined components and electromechanical assemblies.

Vacuum Solutions. Our Vacuum Solutions Products consist of two primary product offerings: Pressure and Vacuum Measurement Solutions Products and Materials Delivery Solutions Products.

Pressure and Vacuum Measurement Solutions Products. Our Pressure and Vacuum Measurement Solutions Products consist of direct and indirect pressure measurement and integrated process solutions. Each of our pressure measurement and vacuum product lines consist of products that are designed for a variety of pressure ranges and accuracies.

Materials Delivery Solutions Products. Our Materials Delivery Solutions Products include flow and valve technologies as well as integrated pressure measurement and control subsystems to provide customers with precise control capabilities that are optimized for a given application.

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Power, Plasma and Reactive Gas Solutions. Our Power, Plasma and Reactive Gas Solutions Products include power delivery, plasma and reactive gas products used in semiconductor and other thin film applications and in medical imaging equipment applications.

Power Delivery Products. We design and manufacture microwave, direct current and radio frequency power delivery systems as well as radio frequency matching networks and metrology products. In the semiconductor, industrial technologies and other market sectors, our power supplies are used to provide energy to various etching, stripping and deposition processes. Our power amplifiers are also used in medical imaging equipment.

Plasma and Reactive Gas Products. We design and manufacture reactive gas products, which create reactive species. A reactive species is an atom or molecule in an unstable state, which is used to facilitate various chemical reactions in the processing of thin films (deposition of films, etching and cleaning of films and surface modifications). A number of different technologies are used to create reactive gas including different plasma technologies and barrier discharge technologies.

Light and Motion Segment

The Light and Motion segment includes Laser Products; Photonics Products; and Optics Products.

Lasers. Our Laser Products include lasers and laser-based systems including ultrafast lasers and amplifiers, fiber lasers, diode-pumped solid-state lasers, high-energy pulsed lasers and tunable lasers. In addition to providing a wide range of standard and configured laser products and accessories to our end-user customers, we also work closely with our original equipment manufacturer (OEM) customers to develop lasers and laser system designs optimized for their product and technology roadmaps.

Photonics. Our Photonics Products include optical components, lens assemblies and vibration isolation solutions as well as three-dimensional non-contact measurement sensors and equipment. We also design, develop and manufacture subsystems and subassemblies that integrate our broad portfolio of products and technologies into solutions that meet the specific application requirements of our OEM and select end-user customers. Our Photonics Products also includes our instruments and motion products which includes high-precision motion stages and controls, hexapods, photonics instruments for measurement and analysis, and production equipment for test and measurement customers.

Optics. Our Optics Products include precision optics, thin-film filters and coatings, replicated mirrors and ruled and holographic diffraction gratings.

Customers

We sell our products to thousands of customers worldwide, in a wide range of end markets. Our largest customers include leading semiconductor capital equipment manufacturers such as Applied Materials, Inc. and Lam Research Corporation. Revenues from our top ten customers accounted for approximately 41%, 43% and 39% of net revenues for the years 2018, 2017 and 2016, respectively. Applied Materials, Inc. accounted for 12%, 13% and 14% and Lam Research Corporation accounted for 11%, 12% and 11% of our net revenues for the years 2018, 2017 and 2016, respectively.

Sales, Marketing, Service and Support

Our worldwide sales, marketing, service and support organization is critical to our strategy of maintaining close relationships with semiconductor capital equipment and 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, 2018, we had 475 sales employees worldwide, located in the United States, United

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Kingdom, China, Japan, Israel, South Korea, Germany, France, Taiwan, Singapore, Netherlands and Italy. We maintain a marketing staff that identifies customer requirements, assists in product planning and specifications, and focuses on future trends in semiconductor and other markets.

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 from offices located in China, Germany, Japan, South Korea, Singapore, Taiwan, the United Kingdom, Israel and the United States. 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, 2018, we had 663 research and development employees, primarily located in the United States, France and Israel. Our research and development expenses were $135.7 million, $132.6 million and $110.6 million for the years 2018, 2017 and 2016, 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, South Korea, Mexico, Romania, 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, 2018, we had 3,109 manufacturing-related employees, located primarily in North America (United States) and Asia (primarily China and Israel).

Backlog

At December 31, 2018, our backlog of unfilled orders for all products and services was $400 million, compared to $464 million at December 31, 2017. The decrease in backlog of $64 million in 2018 compared to

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2017 is primarily attributed to a decrease in business levels throughout our company in the second half of 2018. As of December 31, 2018, approximately $391 million of our consolidated backlog was scheduled to be shipped on or before December 31, 2019. 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 highly competitive. Principal competitive factors include:

- historical customer relationships;
- 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, there can be no assurance 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 product line of mass flow controllers. Inficon, Inc. offers products that compete with our vacuum measurement and gas analysis products and our vacuum gauging products. Nor-Cal Products, Inc. and VAT, Inc. offer products that compete with our vacuum components.

Ametek, Inc. offers products that compete with our optics and photonics products. Coherent, Inc. offers products that compete with our lasers and photonics instruments. Excelitas Technologies Corp. offers products that compete with our laser and optics products. IDEX Corporation offers products that compete with our lasers, optics, and photonics subsystems. 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 offers products that compete with our laser products.

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, 2018, we owned 510 U.S. patents and 984 foreign patents that expire at various dates through 2038. As of December 31, 2018, we had 82 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.

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Employees

As of December 31, 2018, we employed 4,851 persons. We believe that 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 counsel or trade unions, as is common practice or required by law. We believe that 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 results of operations could 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 substantially on capital spending in the semiconductor industry, which is characterized by periodic fluctuations that may cause a reduction in demand for our products.

Approximately 55%, 57% and 56% of our net revenues for the years 2018, 2017 and 2016, respectively, were from sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers. While our acquisition of Newport Corporation, (Newport) in 2016, has reduced our concentration of customers in these markets and we expect some additional reduction as a result of our February 2019 acquisition of Electro Scientific Industries, Inc. (ESI), we anticipate that sales to such customers will continue to account for a substantial portion of our net revenues. Our business depends upon the capital expenditures of semiconductor device manufacturers, which in turn depends upon the demand for semiconductors.

The semiconductor industry is characterized by rapid technological change, frequent product introductions, changing customer requirements and evolving industry standards. Because our customers face uncertainties with regard to the growth and requirements of these markets, their products and components may not achieve, or continue to achieve, anticipated levels of market acceptance. If our 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 and subsystems in advance of significant sales of these products and subsystems to such customers. A failure on the part of our customers products to gain market acceptance, or a failure of the semiconductor market to sustain current sales levels or to grow would have a significant negative effect on our business, financial condition and results of operations.

The semiconductor industry has historically been characterized by cyclical variations in product supply and demand. These sometimes sudden and severe cycles may result from a number of 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. The cyclicality of the semiconductor market is demonstrated by the changes in sales to semiconductor capital equipment and device manufacturers in past years. For example, our sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers increased compared to the prior year by 4%, 52% and 29% in 2018, 2017 and 2016, respectively. While we experienced strong sales to these customers during the first half of 2018, we saw moderation in capital spending in the semiconductor capital equipment industry in the third and fourth quarters of 2018 with a similar effect on our semiconductor-related revenue, and we expect that to continue into the first half of 2019. The 52% increase in 2017, compared to 2016, was mainly attributable to an increase in volume from our semiconductor customers and from the full year effect of net sales from Newport, which we acquired in April 2016.

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During semiconductor market downturns, 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 our 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 and subsystems we sell to this market, we may incur expenditures or purchase raw materials or components for products we are unable to sell. Accordingly, downturns in the semiconductor capital equipment market may materially harm our business, financial condition and operating results. Conversely, when upturns in this market 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 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 acquisition of ESI involves numerous risks, including the inability to effectively integrate ESI s business and operations or realize the expected benefits from the acquisition, which could materially harm our operating results.

Our February 2019 acquisition of ESI has increased our product offerings, end markets, and number of employees and facilities. ESI s products and certain of its technology, markets and customer base are significantly different from our historical experience. Combining our businesses could make it more difficult to maintain relationships with customers, employees or suppliers. Integrating ESI s business and operations with ours will require significant management attention, efforts and expenditures, and we may not be able to achieve the integration in an effective, complete, timely or cost-efficient manner.

Potential risks related to our acquisition of ESI include our ability to:

- expand our financial and management controls and reporting systems and procedures to integrate and manage ESI;
- integrate our information technology systems to enable the management and operation of the combined business;
- realize expected synergies and cost savings resulting from the acquisition;
- maintain and improve ESI s operations while integrating our combined manufacturing organization;
- avoid lost revenue due to customer confusion, alienation or misinformation regarding the transaction, and retain and expand ESI s customer base while aligning our sales efforts;
- avoid lost revenue resulting from the distraction or confusion of our personnel as a consequence of the acquisition and ongoing integration efforts;
- identify and retain key ESI personnel;
- recognize and capitalize on anticipated product sales and technology enhancement opportunities presented by our combined businesses;
- adequately familiarize ourselves with ESI s products and technology and certain of its markets and customer base such that we can manage ESI s business effectively; and

successfully integrate our respective corporate cultures such that we achieve the benefits of acting as a unified company.
Other potential risks related to our acquisition of ESI include:

the assumption of unknown or contingent liabilities, or other unanticipated events or circumstances; and 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 ESI. ESI will initially remain a separate division from our Light & Motion segment 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 ESI business, however, these customers may choose to source their laser and motion products from alternate suppliers, which could result in a potentially significant loss of revenue for our laser and motion business.

If we are unable to successfully or timely integrate the operations of ESI s business into our business, we may be unable to realize the revenue growth, synergies and other anticipated benefits resulting from the acquisition and our business could be adversely affected. Additionally, we have incurred and will continue to incur transaction-related costs, including legal, regulatory and other costs associated with implementing integration plans, including facilities and systems consolidation costs and employment-related costs. Although we expect that the elimination of duplicative costs, as well as the realization of other efficiencies related to the integration of the businesses, should allow us to offset transaction and integration-related costs over time, this net benefit may not be achieved in the near term, or at all. Further, we may not realize the expected benefits from the acquisition. ESI s business and operations may not achieve the anticipated revenues and operating results. We may in the future choose to close or divest certain sectors of ESI, which could require us to record losses and/or spend cash relating to such closures or divestitures. Any of the foregoing risks could materially harm our business, financial condition and results of operations.

The terms of our term loan credit facility and asset-based revolving credit facility impose significant financial obligations and risks upon us, limit our ability to take certain actions, and could discourage a change in control.

In February 2019, we amended our existing term loan credit facility and obtained a new revolving credit facility in connection with financing our acquisition of ESI. The term loan credit facility, as amended, provided us with additional senior secured financing in the principal amount of $650 million as of February 1, 2019, with a term of seven years. Together with this additional financing, we have $998 million in total outstanding debt as of February 1, 2019. The revolving credit facility provides us with senior secured financing of up to $100 million, subject to a borrowing base limitation.

Our indebtedness under these credit facilities has increased our interest expense and could have the effect, among other things, of reducing the funds available to flexibly respond to changing business and economic conditions. Our indebtedness could also reduce funds available for working capital, capital expenditures, acquisitions and other general corporate purposes and may create competitive disadvantages relative to other companies with lower debt levels. If we do not achieve the expected benefits from the acquisition, or if the financial performance of the combined company does not meet current expectations, then our ability to service our indebtedness may be adversely impacted.

A significant portion of the amounts outstanding under the credit facilities bear interest at variable interest rates. Although we hedge some of that exposure, if interest rates increase, variable rate debt will create higher debt service requirements, which could 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. There can be no assurance 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 arrange 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. There can be no assurance that we will be able to obtain additional financing or refinancing on terms acceptable to us or at all.

Our term loan credit facility, as amended, uses LIBOR as a reference rate for our term loans, 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 borrowings 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. The future of LIBOR at this time is uncertain. 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 term loan credit facility, or the loans using LIBOR as a reference rate will convert to 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) which could result in higher interest rates.

The term loan credit facility and the revolving credit facility contain a number of 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 covenants restrict our ability to engage in or benefit from these actions, thereby limiting our flexibility in planning for, or reacting to, changes and opportunities in the markets in which we compete, 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 results of operations, we may be unable to comply with the terms of our credit facilities or experience an event of default.

The term loan credit agreement and the revolving credit agreement 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.

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.

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 the credit facilities immediately due and payable. In such case, we would need to obtain additional financing or significantly deplete our available cash, or both, in order to repay this indebtedness. Any additional financing may not be available on reasonable terms or at all, and significant depletion of our available cash could 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 results of operations.

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 material adverse effect on our results of operations in any particular period. Further, with respect to certain of our business lines, we often recognize a significant portion of net revenues 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 certain of our 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 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 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 disproportionately high impact on our ESI business, 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. The inability to adjust spending quickly enough to compensate for any shortfall would magnify the adverse impact of a shortfall in net revenues on our results of operations. 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 industry), market seasonality (particularly in the research and defense market), 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 delays;

disruption in sources of supply;

production capacity constraints;

specific features requested by customers;

the timing and level of cancellations and delays of orders in backlog for our products;

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.

As a result of the factors discussed above, among others, it is likely that we may in the future experience quarterly or annual fluctuations, 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 results of operations, 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 41%, 43% and 39% of our net revenues for the years 2018, 2017 and 2016, respectively. One customer, Applied Materials, Inc., accounted for approximately 12%, 13% and 14% of our net revenues for the years 2018, 2017 and 2016, respectively, and another customer, Lam Research Corporation, accounted for 11%, 12% and 11% of our net revenues for the years 2018, 2017 and 2016, respectively. In any one reporting period, a single customer or several customers may contribute even a larger percentage of our consolidated revenues. Further, our recently-acquired ESI business also depends on a few significant customers for a large portion of 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 results of operations. None of our significant customers has entered into an agreement with us requiring it to purchase any minimum quantity of our products. Because our largest customers are semiconductor capital equipment manufacturers, we are particularly susceptible to the cyclicality of the semiconductor market.

Attempts to lessen the adverse effect of any loss or reduction of net revenues through the rapid addition of new customers could be difficult because a relatively small number of companies dominate the semiconductor equipment market. 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 customers in creating demand for their capital equipment products that incorporate our products.

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 sales, with a substantial portion of such sales originating in Asia (especially South Korea, Japan, Israel, China and Taiwan) and Europe (especially Germany). We expect that international revenues will continue to account for a significant percentage of total net sales 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 ninety percent of ESI s customers are located in Asia. 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 pending exit of the United Kingdom from the European Union;
- 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;
- 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;
- 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 results of operations could be significantly harmed.

In particular, 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 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.

Recently, 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 such customers. In the event we are unable to do business with any such customer, we will lose the anticipated revenue from these product sales, the amount of which could be significant. In addition, such customers could also 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 would result in costs, penalties and litigation.

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 made acquisitions and, as a part of our business strategy, we may enter into additional business combinations and acquisitions. Our most recent acquisitions of Newport in April 2016 and ESI in February 2019 have significantly increased our size, including with respect to revenue, 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, including our recent acquisitions, 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 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 s 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, and we may incur substantial expenses and devote significant management time and resources in seeking to complete proposed acquisitions that may not generate benefits for us.

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 could 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. We expect to continue to integrate the ERP systems in phases over the next few years. 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.

An inability to convince semiconductor device manufacturers to specify the use of our products to our customers that are semiconductor capital equipment manufacturers would weaken our competitive position.

The markets for our products, in particular the semiconductor capital equipment market, are highly competitive. Our competitive success 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.

If our products are not designed into successive generations of our customers products, we will lose significant net revenues during the lifespan of those products.

New products designed by capital equipment manufacturers typically have a lifespan of five to fifteen years. Our success depends on our products being designed into new generations of equipment. We must develop products that are technologically advanced so that they are positioned to be chosen for use in each successive generation of capital equipment. If customers do not choose our products, our net revenues may be reduced during the lifespan of our customers products. 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. We are thus also at risk during the development phase that our products may fail to meet our customers technical or cost requirements and may be replaced by a competitive product or alternative technology solution. If that happens, we may be unable to recover our development costs.

Many of the markets and industries that we serve are subject to rapid technological change, 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 results of operations 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 recently acquired ESI 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 revenue 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 results of operations could be harmed.

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Because many of our products are sophisticated and complex, they can be 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. 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. 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 results of operations will be harmed.

Further, we are constantly investing in products for emerging applications, and we expect to generate increasingly significant 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 revenue growth we anticipate from sales of our products for these emerging applications, and our results of operations could be harmed.

Because the sales cycle for some of our products is long and difficult to predict, and certain of our orders are subject to rescheduling or cancellation, we may experience fluctuations in our operating results.

Many of our products are complex and customers for these products 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 by us. 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 results of operations would be harmed.

Our orders are generally subject to rescheduling without penalty or cancellation without penalty other than reimbursement for certain labor and material costs. We from time to time experience order rescheduling and cancellations, which can result in fluctuation of our operating results from period to period.

Certain of our markets, sales regions and customers may be adversely affected by a lack of government funding and the availability of credit.

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 results of operations.

Concerns regarding the global availability of credit also may make it more difficult for our customers to raise capital, whether debt or equity, to finance their projects and purchases of capital equipment. Delays in our customers ability to obtain such financing, or the unavailability of such financing, could adversely affect sales of our products and systems, including, but not limited to, high-value lasers and systems, and therefore harm our business and operating results.

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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 accurately predict 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 markets, which depends on our displacing entrenched 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 markets 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 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, our business, financial condition and results of operations would be harmed.

Further, serving diverse markets requires an understanding of different sales cycles, 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 results of operations would 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 its timely supply of equipment, services and related products 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, floods or storms, regional economic downturns, pandemics, social unrest, political instability, terrorism, or acts of war), particularly where we or our 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 results of operations.

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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, 2018, our goodwill and intangible assets, net, represented approximately $906.8 million, or 35% 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 expect to add in excess of $500 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 results of operations.

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:

- historical customer relationships;
- 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 at such customers fabrication facilities. In addition, our competitors can be expected to continue to improve the design and performance of their products. Competitors may develop products that offer price, 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 products or systems on their behalf.

Increased pressure on price may result in pricing concessions, extended payment terms and decreased margins.

We have 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 the

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semiconductor industry, 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 results of operations may be materially and adversely affected by competitive pressure and price-based competition.

If significant additional tariffs or other trade restrictions are placed on our products made in China and/or the components that we or our suppliers source from China, our business, financial condition and results of operations may be materially harmed.

General trade tensions between the U.S. and China have been escalating throughout 2018 and into 2019, with one round of U.S. tariffs on Chinese goods taking effect in July 2018, and a second round implemented in September 2018. Although we do not anticipate a material impact on our products made in China from the first and second rounds of U.S. tariffs, a third round of tariffs has been proposed by the U.S. In July 2018, the Trump Administration proposed a new list of thousands of categories of goods, including electronics, that could face tariffs of 10%. The Trump Administration subsequently proposed that the third round tariffs be increased from 10% to 25%. If the proposed new tariff list remains unaltered and these additional tariffs are placed on our products made in China and/or the components that we or our suppliers source from China, or any related counter-measures are taken by China, as we ship certain of our products from the U.S. into China, our business, financial condition and results of operations may be materially harmed. We will explore all of our options to reduce the potential impact of these proposed tariffs on our business, including but not limited to, seeking alternative sources for our components, modifying other business practices, raising our prices, and shifting production outside of China. Additionally, the Trump Administration continues to signal that it may alter trade agreements and terms between China and the United States, including limiting trade with China, and may impose additional tariffs on imports from China. Even if the currently proposed tariffs are not imposed on our products or on the components that we or our suppliers source from China, it is possible further tariffs will be imposed on imports of our products or the components used in our products, or that our business will be impacted by retaliatory tariffs imposed by China or other countries in response to existing or future tariffs, causing us to seek alternative suppliers, raise prices or make changes to our operations, any of which could materially harm our business, financial condition and results of operations.

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, and we cannot be certain that we will be successful in attracting and retaining such personnel. In addition, many of our product manufacturing processes 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. 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 results of operations would be harmed.

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

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

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selected contract manufacturers in Asia. In the future, we may expand the level of manufacturing, administrative and certain other operations that we perform offshore in order 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 a lower cost region. Additionally, if we are unable to successfully manage the relocation, initiation or oversight of the manufacture of these products, our business, financial condition and results of operations could 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 results of operations and our reputation with our customers, and loss of customers. Further, the utilization of overseas 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 and shipping costs in China and the potential for new tariffs on our products manufactured in China and Mexico.

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 contracts, we will likely suffer manufacturing and shipping delays, lost revenue, increased costs and damage to our customer relationships, any of which could harm our business, financial condition and results of operations.

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 results of operations could be negatively impacted. In particular, ESI s system products are extremely complex, and have historically had much higher warranty costs as a percentage of revenues than our other products. As a result, our overall warranty costs as a percentage of revenues will likely increase as a result of our acquisition of ESI.

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 results of operations.

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

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 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 results of operations.

In addition, we are currently involved in securities class action litigation in connection with the acquisitions of Newport and 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, results of operations 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 results of operations. In addition, the terms 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 results of operations.

We also on occasion receive notification from customers who believe that we owe them indemnification or other obligations related to other claims made against such customers by third parties. 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. There can be no assurance 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. Similar export regulations govern exports of our products and technology developed or manufactured in certain other countries, including Austria, France, Germany, Israel, Romania and Singapore. 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 revenue, harm our relationships with our customers and could adversely affect our business, financial condition and results of operations. 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 and damage to our reputation, and our business and results of operations 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. For example, as a result of a 2012 U.S. Government investigation, a former employee of our Shanghai office and a third party not affiliated with us were imprisoned for export violations relating to the sale of certain of our products. We were not a target of the government s investigation and we cooperated fully with the government s investigation. In addition, although we conducted our own internal investigation and took corrective human resources actions and have, since 2012, implemented additional export compliance procedures, we cannot be certain these efforts will be sufficient to avoid similar situations in the future.

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 2018, 2017 and 2016, international net revenues accounted for approximately 51%, 50% and 48% of our total revenues, respectively. Currency exchange rate fluctuations could have an adverse effect on our net revenues and results of operations 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 results of operations could 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 could affect results of operations.

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 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 make adjustments to our tax estimates in future periods. The Securities and Exchange Commission has issued Staff Accounting Bulletin No. 118 (SAB 118) acknowledging that companies will potentially encounter situations for which the analysis of certain income tax effects of the Act will be incomplete by the time financial statements are required to be issued for reporting periods that include the enactment date. In these situations, SAB 118 provides that reasonable estimates may be made for certain effects of the Act up to one year from enactment. We recorded provisional amounts with respect to the Act at December 31, 2017 and for the nine months ended September 30, 2018. During the quarter ended December 31, 2018, we completed our analysis and finalized the provisional amounts that were previously recorded. 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, there can be no assurance 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 results of operations.

We are exposed to risks related to cybersecurity threats and incidents.

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 manufacturing, research and development, supply chain management, sales and accounting. This information includes confidential information 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 results of operations 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 or loss of confidential information and critical data; 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.

Changes in laws and regulations governing data privacy and data protection could have a material adverse impact on our business.

We are subject to data privacy laws and regulations that apply to the collection, transmission, storage and use of personally identifiable information, as well as numerous other countries, federal and state privacy and breach notification laws, including the California Consumer Privacy Act, which gives California residents rights with respect to the nature, sources and uses of their personal information by companies. We are also subject to many international data protection laws and regulations, including the General Data Protection Regulation, which imposes robust European Union (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 European Union 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 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 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, such 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 results of operations.

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 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, 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 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 results of operations. 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, 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 were the object 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 such dividends when and if they are declared by our Board of Directors. Further, 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.

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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;
- 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 may be long if we were required to obtain alternative sources. Seeking alternative sources for these parts could require us to redesign our systems, resulting in increased costs and likely shipping delays. In such an event, any inability to redesign our systems 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 results of operations.

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, such 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 such equipment become unavailable, such 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 results of operations.

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, results of operations 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 state and federal 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 business, located in Mountain View, California, and certain portions of the aquifer surrounding the facility, through which contaminated groundwater flowed, 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 results of operations could 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 European Union 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 OEM 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 European Union 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.

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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.

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Item 2. ***Properties***

The following table provides information concerning MKS principal and certain other owned and leased facilities as of December 31, 2018:

Country	City	Sq. Ft.	Activity	Reportable Segment	Lease Expires
CHINA	Shenzhen	302,000	Manufacturing	Vacuum & Analysis	August 31, 2025
	Wuxi	64,500	Manufacturing	Light & Motion	October 31, 2021
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	(4)	(4)
	Boulder, CO	86,000	Manufacturing, Customer Support, Service, Research and Development	Vacuum & Analysis	(5)
	Franklin, MA	55,600	Manufacturing, Customer Support, Research and Development	Light & Motion	January 31, 2026
	Irvine, CA	254,900	Manufacturing, Research and Development	Light & Motion	(6)
	Longmont, CO	60,900	Manufacturing, Customer Support, Service, Research and Development	Vacuum & Analysis	February 29, 2020
	Methuen, MA	85,000	Manufacturing, Customer Support, Service, Research and Development	Vacuum & Analysis	Owned
	Rochester, NY	46,000	Manufacturing, Customer Support, Research and Development	Light & Motion	(7)
	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

(1) MKS owns two facilities, one in Beaune-la-Rolande with 57,000 square feet and one in Brigueil 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. In addition to the Company s Corporate Headquarters, manufacturing and research and development activities for Vacuum & Analysis take place in Andover, MA.

(5) MKS owns two facilities which aggregate to 47,000 square feet and leases another facility with 39,000 square feet with a lease expiration date of May 31, 2020.

(6) 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.

(7) MKS leases one facility with 6,000 square feet with a lease expiration date of September 27, 2184 and leases another facility with 40,000 square feet with a lease expiration date of July 31, 2021.

In addition to the material manufacturing and other operations conducted at the above listed leased or owned facilities, 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.

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Item 3. ***Legal Proceedings***

Newport Litigation

In March 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 between the Company, Newport, and 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 complaints sought injunctive relief, including to enjoin or rescind the Merger Agreement, and an award of attorneys and other fees and costs, among other relief. On April 14, 2016, the Court consolidated the actions.

On October 19, 2016, plaintiffs in the consolidated action 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 Merger Agreement. The amended complaint contained substantially similar allegations related to Newport s former board of directors alleged breaches of their fiduciary duties to Newport s stockholders. The amended complaint sought monetary damages, including pre- and post-judgment interest. On June 22, 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. Discovery is ongoing in this action.

ESI Litigation

On November 29, 2018, a complaint captioned Brian Morris et. al. v. Electro Scientific Industries, Inc. et al. was filed in the U.S. District Court for the District of Oregon by alleged former stockholders of ESI in connection with the acquisition of ESI by the Company. The complaint named the Company s subsidiary, Electro Scientific Industries, Inc. (ESI), and the former members of ESI s board of directors as defendants. Five additional complaints were subsequently filed, two in the U.S. District Court for the District of Oregon and three in the Multnomah County Circuit Court in the State of Oregon. The cases filed in the U.S. District Court were dated December 6, 2018 and December 12, 2018 and captioned Melvyn Klein et. al. v. Electro Scientific Industries, Inc. et al. and Donald Mager et. al. v. Electro Scientific Industries, Inc. et al., respectively. The complaints filed in Multnomah County Circuit Court were dated December 5, 2018, December 5, 2018 and December 13, 2018 and captioned Michael Kent et. al v. Electro Scientific Industries, Inc. et al., Christopher Stanley et. al v. Electro Scientific Industries, Inc. et al. and Eduardo Colmenares et. al. v. Electro Scientific Industries, Inc., MKS Instruments, Inc., et al., respectively (collectively with Brian Morris et. al. v. Electro Scientific Industries, Inc. et. al., the Lawsuits). On February 16, 2019, the parties came to an agreement on a settlement in principle that would resolve the Lawsuits, which is subject to the execution of a settlement agreement and dismissal of the Lawsuits with prejudice.

These lawsuits are purported class actions brought on behalf of former ESI stockholders, asserting various claims against the former members of the ESI board of directors, ESI, MKS, and MKS merger subsidiary, including breach of fiduciary duty and aiding and abetting the breach of fiduciary duty. The lawsuits allege that the consideration paid to the ESI shareholders did not appropriately value ESI, and that ESI s merger related disclosures failed to disclose certain material information regarding the merger. These complaints purport to seek unspecified damages.

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The Company believes that the claims in these complaints are without merit and intends to vigorously defend this litigation. ESI provided supplemental merger related disclosures to eliminate the burden and expense of litigation and to avoid any possible disruption to the merger that could result from further litigation.

We are 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.

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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, 2019, we had 89 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 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. During 2017, our Board of Directors declared a cash dividend of $0.175 per share during the first, second and third quarters of 2017 and $0.18 per share during the fourth quarter of 2017, which totaled $38.2 million or $0.71 per share.

On February 11, 2019, our Board of Directors declared a quarterly cash dividend of $0.20 per share to be paid on March 8, 2019 to shareholders of record as of February 25, 2019.

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.

Purchase of Equity Shares

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 Program). 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 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. During 2017, the Company did not repurchase any shares of common stock. We have repurchased approximately 2,588,000 shares of common stock for approximately $127.0 million pursuant to the program since its adoption.

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Comparative Stock Performance

The following graph compares the cumulative total shareholder return (assuming reinvestment of dividends) from investing $100 on December 31, 2013, and plotted at the last trading day of each of the fiscal years ended December 31, 2014, 2015, 2016, 2017 and 2018, 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 one-half (1/2) and one-half (1/2), respectively; 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.

Performance Graph

	2013	2014	2015	2016	2017	2018
MKS Instruments, Inc.	$ 100.00	$ 124.90	$ 125.20	$ 209.90	$ 336.91	$ 232.26
Nasdaq Market Index	$ 100.00	$ 114.75	$ 122.74	$ 133.62	$ 173.22	$ 168.30
Morningstar Semiconductor Equipment & Materials/Scientific & Technical Instruments	$ 100.00	$ 116.67	$ 102.09	$ 131.35	$ 197.23	$ 165.05

* Semiconductor Equipment & Materials and Scientific & Technical Instruments indices weighted $^1/_2$ and $^1/_2$, respectively.

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Item 6. ***Selected Financial Data***

Selected Consolidated Financial Data

	2018	2017	2016	2015	2014
	(in thousands, except per share data)				
Statement of Operations Data(1)					
Net revenues	$ 2,075,108	$ 1,915,977	$ 1,295,342	$ 813,524	$ 780,869
Gross profit(2)	979,476	891,451	565,619	362,872	337,766
Income from operations(3)	494,059	406,634	157,267	156,612	135,142
Net income(4)	$ 392,896	$ 339,132	$ 104,809	$ 122,297	$ 115,778
Basic net income per share	$ 7.22	$ 6.26	$ 1.96	$ 2.30	$ 2.17
Diluted net income per share	$ 7.14	$ 6.16	$ 1.94	$ 2.28	$ 2.16
Cash dividends paid per common share	$ 0.78	$ 0.71	$ 0.68	$ 0.68	$ 0.66
Balance Sheet Data(1)					
Cash and cash equivalents, including restricted cash	$ 644,345	$ 333,887	$ 233,910	$ 227,574	$ 305,437
Short-term investments(5)	73,826	209,434	189,463	430,663	286,795
Working capital(5)	1,200,819	946,431	761,469	848,527	791,665
Total assets	2,614,246	2,414,018	2,212,242	1,273,347	1,224,044
Short-term debt(6)	3,986	2,972	10,993		
Long-term debt, net(6)	343,842	389,993	601,229		
Other liabilities(7)	133,932	145,296	131,921	21,482	38,595
Stockholders equity	$ 1,873,187	$ 1,588,907	$ 1,241,792	$ 1,160,881	$ 1,081,822

(1) The Statement of Operations Data and the Balance Sheet Data for 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).

(2) 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 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 our acquisition of Electro Scientific Industries, Inc., which closed on February 1, 2019. 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. Income from operations for 2014 includes $2.5 million of restructuring charges.

(4) 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 a French 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 the term loan credit agreement 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. Net income for 2014 includes charges, net of tax, of $1.5 million of restructuring costs and also includes $14.6 million in tax credits for reserve releases related to the settlement of tax audits and the expiration of the statute of limitations.

(5) Effective December 31, 2015, the Company changed the method of classification of its investments previously classified as long-term investments to short-term investments within current assets. For the year ended December 31, 2014, short-term investments have been re-classified to include investments with contractual maturities greater than one year from the date of purchase as management had the ability and intent, if necessary, to liquidate any of its cash equivalents and investments in order to meet the Company s liquidity needs in the next twelve months. Accordingly, working capital includes investments with contractual maturities greater than one year from the date of purchase.

(6) 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 the term loan credit agreement.

(7) Other liabilities include non-current deferred taxes and non-current accrued compensation.

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

Overview

We are a global provider of instruments, 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. Our products are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, residual gas analysis, leak detection, control technology, ozone generation and delivery, RF & DC power, reactive gas generation, vacuum technology, lasers, photonics, sub-micron positioning, vibration control, and optics. We also provide services relating to the maintenance and repair of our products, installation services and training.

Our primary served markets are manufacturers of capital equipment for semiconductor manufacturing, industrial technologies, life and health sciences, as well as research and defense.

Recent Events

Acquisition of Electro Scientific Industries, Inc.

On February 1, 2019, we completed our previously announced acquisition of Electro Scientific Industries, Inc., an Oregon corporation (ESI), pursuant to the Agreement and Plan of Merger (the ESI Merger). ESI is an innovator in laser-based manufacturing solutions for micro-machining applications. Micro-machining applications are used extensively in the manufacture of mobile devices, electronic components, thin film devices and semiconductor packaging. At the effective time of the ESI Merger and pursuant to the terms and conditions of the Agreement and Plan of Merger, each share of ESI s common stock issued and outstanding as of immediately prior to the effective time of the ESI Merger was converted into the right to receive $30.00 per share in cash, without interest and subject to deduction for any required withholding tax. We paid to the former ESI stockholders aggregate consideration of approximately $1 billion, excluding related transaction fees and expenses. We funded the payment of the aggregate consideration with a combination of our available cash on hand and proceeds from our term loan facility described below.

In connection with the completion of the ESI Merger, we entered into an amendment (Amendment No. 5) to our Term Loan Credit Agreement with Barclays Bank PLC as administrative agent and collateral agent, that provided additional tranche B-5 term loan commitment in the principal amount of $650.0 million, which we used to partially fund the ESI Merger.

Also, in connection with the completion of the ESI Merger, we terminated our $50.0 million asset-based credit agreement with Deutsche Bank AG New York Branch as administrative and collateral agent, and we entered into an asset-based credit agreement with Barclays Bank PLC, as administrative agent and collateral agent, that provides senior secured revolving credit financing of up to $100.0 million, subject to a borrowing base limitation.

We currently have two reportable segments, the Vacuum & Analysis segment and the Light & Motion segment. With the acquisition of ESI, we will be adding a third segment.

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, residual gas analysis, leak detection, control technology, ozone generation and delivery, RF & DC power, reactive gas generation 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, sub-micron positioning, vibration control, and optics.

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. Approximately 55%, 57% and 56% of our net revenues for the years 2018, 2017 and 2016, respectively, were from sales to semiconductor capital equipment manufacturers and semiconductor device manufacturers. While our acquisition of Newport Corporation (Newport) in 2016 reduced our concentration of customers in these markets and we expect some additional reduction as a result of the ESI Merger, we anticipate that sales to such customers will continue to account for a substantial portion of our net revenues. Approximately 45%, 43% and 44% of our net revenues in the years 2018, 2017 and 2016, respectively, were from advanced manufacturing applications. These include, but are not limited to, industrial technologies, life and health sciences, and research and defense.

Net revenues from semiconductor capital equipment manufacture and semiconductor device manufacture customers increased by $48 million or 4% in 2018 compared to 2017, and increased by $373 million or 52% in 2017 compared to 2016. The increase in 2018 compared to 2017 is driven by strong sales to semiconductor customers during the first half of 2018 and is comprised of an increase in net semiconductor revenues of $26 million in the Vacuum & Analysis segment and $22 million in the Light & Motion segment. We have seen a decrease in sales to semiconductor customers during the second half of 2018 and we expect that to continue into the first half of 2019. The increase in 2017 compared to 2016 is comprised of an increase in net semiconductor revenues of $315 million in the Vacuum & Analysis segment and $58 million in the Light & Motion segment. These increases were primarily due to volume increases from our semiconductor customers. The semiconductor capital equipment industry is subject to rapid demand shifts, which are difficult to predict, and we are uncertain as to the timing or extent of future demand or any future weakness in the semiconductor capital equipment industry.

Our net revenues from customers in advanced markets, which exclude semiconductor capital equipment and semiconductor device manufacture customers, increased by $111 million or 14% in 2018 compared to 2017, and increased by $248 million or 43% in 2017 compared to 2016. The increase in 2018 compared to 2017, is attributed to an increase in net revenues from customers in our advanced markets of $83 million in the Light & Motion segment and $28 million in the Vacuum & Analysis segment. These increases are primarily due to revenue from customers in our industrial technologies market. The increase in 2017 compared to 2016 is primarily attributed to a $228 million increase in net revenues from customers in our Light & Motion segment due to the fact that 2016 only included eight months of revenue in the Light & Motion segment. In addition, net revenues from customers in our Vacuum & Analysis segment increase primarily due to revenues from the industrial technologies market of $20.1 million.

A significant portion of our net revenues are from sales to customers in international markets. For the years ended December 31, 2018, 2017 and 2016, international net revenues accounted for approximately 51%, 50% and 48% of our total net revenues, respectively. A significant portion of our international net revenues were in South Korea, Japan, Germany and Israel. We expect that international revenues will continue to account for a significant portion of total net sales for the foreseeable future, and that in particular, the proportion of our sales of Asian customers will continue to increase, due in large part to our acquisition of ESI, as approximately ninety percent of ESI s customers are located in Asia. Long-lived assets, located in the United States, were $147 million, $125 million and $123 million as of December 31, 2018, 2017 and 2016, respectively, excluding goodwill and intangibles and long-term tax-related accounts. Long-lived assets, located outside of the United States, were $77 million, $78 million, and $78 million as of December 31, 2018, 2017 and 2016, respectively, excluding goodwill and intangibles and long-term tax-related accounts.

Critical Accounting Policies and Estimates

Management s Discussion and Analysis of Financial Condition and Results of Operations discuss 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

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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, 2018 reflect the application of ASC 606 guidance while the reported results for 2017 and 2016 were prepared under the guidance of ASC 605, Revenue Recognition.

We recorded a net increase to opening retained earnings of $1.8 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, 2018 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.

Our standard assurance warranty period is normally 12 to 24 months and we provide for estimated warranty costs at the time of sale based upon historical experience. 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. For 2018, 2017 and 2016, our charges for excess and obsolete inventory totaled $22.3 million, $20.2 million and $16.0 million, respectively.

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 share-based compensation awards to employees and directors based upon the estimated fair market value of the underlying instrument. Accordingly, share-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. We are also required to estimate forfeitures at the time of grant and revise those estimates in subsequent periods if actual forfeitures differ from those estimates.

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,

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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 acquisition of Newport (the Newport Merger), we assumed the outstanding stock appreciation rights (SARs) of Newport. 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 reflects the remaining fair value for all unvested SARs as of the acquisition date, 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. 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 judgments about appropriate discount rates, perpetual growth rates, projected revenues and projected profit 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, 2018, we performed our annual impairment assessment of goodwill using the qualitative assessment 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.

In-Process Research and Development. We value tangible and intangible assets acquired through our business acquisitions, including in-process research and development (IPR&D), at fair value. We determine IPR&D through established valuation techniques for various projects for the development of new products and technologies and capitalize IPR&D as an intangible asset. If the projects are completed, the intangible asset will be amortized to earnings over the expected life of the completed product. If the R&D projects are abandoned, we will write-off the related intangible asset.

The value of IPR&D is determined using the income approach, which discounts expected future cash flows from projects under development to their net present value. Each project is analyzed and estimates and judgments are made to determine the technological innovations included in the utilization of core technology, the complexity, cost, time to complete development, any alternative future use or current technological feasibility and the stage of completion.

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.

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On December 22, 2017, the President of the United States signed into law the Tax Cuts and Jobs Act (the Act), which included significant changes to U.S. tax law. Some of the more significant changes impacting us are 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 territorial tax system and the imposition of a transition tax on deemed repatriated cumulative earnings of foreign subsidiaries (Transition Tax).

Income tax effects resulting from changes in tax are generally accounted for 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. We have 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 we finalized and recorded the effects of the Act during the quarter ended December 31, 2018. The ultimate impact of the Act is based upon our understanding and interpretation of the regulatory guidance that has been issued regarding the Act. There remain significant provisions of the Act that impact us for which no regulatory guidance has yet been issued. Our estimated accruals for 2018 and future periods expected income tax expense may change as regulatory guidance on provisions of the Act are released.

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,		
	2018	2017	2016
Net revenues:			
Product	88.4%	88.8%	86.4%
Service	11.6	11.2	13.6
Total net revenues	100.0%	100.0%	100.0%
Cost of revenues:			
Product	46.7	47.3	48.6
Service	6.1	6.2	7.7
Total cost of revenues	52.8	53.5	56.3
Gross profit	47.2%	46.5%	43.7%
Research and development	6.5	6.9	8.5
Selling, general and administrative	14.4	15.2	17.6
Acquisition and integration costs	0.1	0.3	2.1
Restructuring	0.2	0.2	
Environmental costs	0.1		
Asset impairment		0.3	0.4
Fees and expenses related to repricing of term loan			0.1
Amortization of intangible assets	2.1	2.4	2.8
Income from operations	23.8%	21.2%	12.2%
Interest income	0.3	0.2	0.2
Interest expense	0.8	1.6	2.4
Gain on sale of business		3.9	
Other expense, net	0.1	0.3	0.1
Income before income taxes	23.2%	23.4%	9.9%
Provision for income taxes	4.3	5.7	1.8
Net income	18.9%	17.7%	8.1%

Year Ended December 31, 2018, Compared to 2017 and 2016

Net Revenues

(Dollars in millions)	Years Ended December 31, 2018	2017	2016
Product	$ 1,835.2	$ 1,701.3	$ 1,118.5
Service	239.9	214.7	$ 176.8
Total net revenues	$ 2,075.1	$ 1,916.0	$ 1,295.3

Product revenues increased $133.9 million during 2018, compared to 2017. Product revenues for the Vacuum & Analysis segment increased by $32.7 million during 2018 compared to 2017, due to an increase in product revenues from customers in our advanced markets of $30.9 million and an increase in product revenues from our semiconductor customers of $1.8 million. Product revenues for our Light & Motion segment increased by $101.2 million during 2018, compared to 2017, due to an increase in product revenues from customers in our advanced markets of $77.2 million and an increase in product revenues from our semiconductor customers of $24.0 million. The increase in product revenues from customers in our advanced markets for both the Vacuum & Analysis segment and the Light & Motion segment were primarily due to volume increases in revenues from customers in our industrial technologies market.

Product revenues increased $582.8 million during 2017, compared to 2016. Product revenues for the Vacuum & Analysis segment increased by $316.2 million during 2017 compared to 2016, due to an increase in product revenues from our semiconductor customers of $293.9 million, primarily due to volume increases, and an increase in product revenues from customers in our advanced markets of $22.3 million. Product revenues for our Light & Motion segment increased by $266.6 million during 2017, compared to 2016, primarily due to the Newport Merger and consisted of an increase in product revenues from customers in our other advanced markets of $215.5 million and an increase in product revenues from our semiconductor customers of $51.1 million.

Service revenues consisted mainly of fees for services related to the repair of our products, maintenance, installation services and training. In 2018, we started to record the sales of spare parts in our service revenue and related cost of sales line items rather than in our product revenue and related cost of sales line items. As a result, for 2017 and 2016, we reclassified $22.1 million and $15.4 million, respectively, of product revenue for spare parts from product to service revenue. Service revenues increased $25.2 million during 2018, compared to 2017, primarily due to an increase in service revenues from the Vacuum & Analysis segment of $20.7 million, primarily from semiconductor customers. The remaining increase of $4.5 million was primarily due to an increase in service revenues from our industrial technologies market from our Light & Motion segment.

Service revenues increased $37.9 million during 2017, compared to 2016, primarily due to an increase in service revenues from the Light & Motion segment of $19.0 million, due to the fact that 2016 only included eight months of revenue from Newport as the Newport Merger occurred in April 2016. The remaining increase of $18.9 million was primarily due to an increase in service revenues from our semiconductor customers from our Vacuum & Analysis segment.

Total international net revenues, including product and service, were $1.1 billion or 50.7% of total net revenues for 2018, $960.7 million or 50.1% of total net revenues for 2017 and $619.7 million or 47.8% of total net revenues for 2016. A significant portion of the increases in 2018 and 2017 international net revenue, were in China, Germany and Japan. The increase in 2017, compared to 2016 was partially the result of the Newport Merger and consisted of increases mainly in South Korea, Japan, Israel and Germany. We expect that international revenues will continue to account for a significant percentage of total net sales 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 ninety percent of ESI s customers are located in Asia.

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

Net Revenues

(Dollars in millions)	Years Ended December 31, 2018	2017	2016
Vacuum & Analysis	$ 1,260.9	$ 1,207.5	$ 872.3
Light & Motion	814.2	708.5	423.0
Total net revenues	$ 2,075.1	$ 1,916.0	$ 1,295.3

Net revenues for our Vacuum & Analysis segment increased $53.4 million in 2018, compared to 2017, due to an increase in net revenues from customers in our advanced markets of $27.9 million, primarily due to increases in net revenues from customers in our industrial technologies market, and from our semiconductor customers of $25.5 million. Net revenues for our Vacuum & Analysis segment increased $335.2 million in 2017, compared to 2016, due to an increase in net revenues from our semiconductor customers of $315.0 million and an increase in net revenues from customers in our advanced markets of $20.2 million, primarily due to increases in net revenues from customers in our industrial technologies markets.

Net revenues from our Light & Motion segment increased $105.7 million in 2018, compared to 2017, due to an increase in net revenues from customers in our advanced markets of $83.3 million, primarily due to volume increases in net revenues from customers in our industrial technologies market of $58.5 million and an increase in revenues from customers in our semiconductor market of $22.4 million. Net revenues from our Light & Motion segment increased $285.5 million in 2017, compared to 2016, primarily due to the Newport Merger and consisted of an increase in net revenues from customers in our advanced markets of $228.1 million, primarily due to increases in net revenues from customers in our industrial technologies and research and defense markets and an increase in revenues from customers in our semiconductor market of $57.4 million. Net revenues from our Light & Motion segment in 2016 were $423.0 million and only represented eight months of revenue in 2016, as the Newport Merger occurred in April 2016.

The following is gross profit as a percentage of net revenues by product and service:

Gross Profit

(As a percentage of net revenues)	Years Ended December 31, 2018	2017	2016	% Points Change in 2018	% Points Change in 2017
Product	47.2%	46.7%	43.7%	0.5%	3.0%
Service	47.3%	45.0%	43.7%	2.3%	1.3%
Total gross profit percentage	47.2%	46.5%	43.7%	0.7%	2.8%

Gross profit on product revenues increased by 0.5 percentage points during 2018 compared to 2017. The increase was primarily due to an increase of 0.9 percentage points due to higher revenue volumes and 0.6 percentage points due to favorable product mix, partially offset by a decrease of 0.6 percentage points due to higher material costs and a decrease of 0.5 percentage points due to higher overhead costs.

Gross profit on product revenues increased by 3.0 percentage points during 2017 compared to 2016. The increase was primarily due to an increase of 5.5 percentage points due to higher revenue volumes, partially offset by 1.6 percentage points due to higher overhead costs, both mainly related to the Newport Merger.

Cost of service revenues consists primarily of costs for providing services for repair and training which includes salaries, related expenses and other overhead costs. Service gross profit increased by 2.3 percentage

points during 2018 compared to 2017, primarily due to an increase of 5.3 percentage points due to lower overhead paid and favorable overhead absorption, partially offset by a 2.8 percentage points decrease due to higher material costs.

Service gross profit increased by 1.3 percentage points during 2017, compared to 2016, primarily due to a net increase of 1.6 percentage points due to net favorable direct labor and overhead absorption, partially offset by 0.4 percentage points due to unfavorable product mix.

The following is gross profit as a percentage of net revenues by reportable segment.

Gross Profit

	Years Ended December 31,			% Points Change in	% Points Change in
(As a percentage of net revenues)	**2018**	**2017**	**2016**	**2018**	**2017**
Vacuum & Analysis	45.8%	45.6%	44.5%	0.2%	1.1%
Light & Motion	49.3%	48.0%	41.9%	1.3%	6.1%
Total net revenues	47.2%	46.5%	43.7%	0.7%	2.8%

Gross profit for our Vacuum & Analysis segment remained relatively flat in 2018, compared to 2017. Gross profit for our Vacuum & Analysis segment increased by 1.1 percentage points in 2017, compared to 2016, primarily due to higher revenue volumes related to revenues from customers in our semiconductor market, partially offset by unfavorable product mix.

Gross profit for our Light & Motion segment increased 1.3 percentage points in 2018, compared to 2017, primarily due to higher revenue volumes and favorable product mix, partially offset by higher material costs. Gross profit for our Light & Motion segment increased 6.1 percentage points in 2017, compared to 2016, primarily due to higher revenue volumes and lower material costs, as the prior year included $15.1 million of inventory step-up amortization charges related to the Newport Merger, and favorable product mix, partially offset by higher overhead costs.

Research and Development

	Years Ended December 31,		
(Dollars in millions)	**2018**	**2017**	**2016**
Research and development expenses	$ 135.7	$ 132.6	$ 110.6

Research and development expenses increased $3.1 million during 2018, compared to 2017, primarily due to an increase in compensation costs and related benefits of $2.6 million.

Research and development expenses increased $22.0 million during 2017, compared to 2016. The increase was primarily due to the fact that the Newport Merger occurred in 2016 and thus the Light & Motion segment only accounted for eight months of expense in 2016. The increase included $13.4 million of compensation costs and related benefits, $5.7 million for project materials and $1.1 million of occupancy costs.

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, and we expect to continue to make significant investment in research and development activities. We are subject to risks if products are not developed in a timely manner, due to 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

	Years Ended December 31,		
(Dollars in millions)	**2018**	**2017**	**2016**
Selling, general and administrative expenses	$ 298.1	$ 290.1	$ 227.9

Selling, general and administrative expenses increased $8.0 million during 2018, compared to 2017. The increase was primarily due to an increase of $7.4 million of compensation costs and related benefits and $4.8 million of consulting and professional fees, primarily information technology and business development related expenses, partially offset by a decrease of $1.3 million of commissions expense, $0.9 million in travel and entertainment expenses and $0.9 million of occupancy costs.

Selling, general and administrative expenses increased $62.2 million during 2017, compared to 2016. The increase was primarily due to the fact that the Newport Merger occurred in April 2016 and thus the Light & Motion segment only accounted for eight months of expense in 2016. The increase included $37.6 million of compensation costs and related benefits, $6.4 million of commissions expense, $4.0 million of information technology related expenses, $3.3 million of consulting and professional fees and $2.5 million of depreciation expense.

Acquisition and Integration Costs

	Years Ended December 31,		
(Dollars in millions)	**2018**	**2017**	**2016**
Acquisition and integration costs	$ 3.1	$ 5.3	$ 27.3

We incurred $4.2 million of acquisition costs during 2018 related to the announced acquisition of ESI which closed on February 1, 2019. We recorded acquisition and integration costs related to the Newport Merger during 2017 and 2016 of $5.3 million and $27.3 million, respectively, which consisted primarily of information technology related expenses, legal and other professional fees, as well as compensation expenses related to change in control provisions in agreements for certain executives of Newport. During 2018, we reversed $1.1 million of these Newport Merger acquisition costs related to severance provisions that were not met.

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Restructuring

(Dollars in millions)	Years Ended December 31, 2018	2017	2016
Restructuring	$ 3.6	$ 3.9	$ 0.6

During 2018, we recorded $3.6 million of restructuring charges, which was primarily comprised of severance costs related to a worldwide reduction in workforce during the third quarter of 2018 and transferring a portion of our shared accounting functions in the United States to a third party, as well as the consolidation of certain shared accounting functions in Asia.

During 2017, we recorded $3.9 million of restructuring charges related to the consolidation of two manufacturing plants, the restructuring of one of our international facilities and the consolidation of sales offices.

During 2016, we recorded $0.6 million of restructuring charges primarily related to the closing of one of our international facilities.

Environmental Costs

(Dollars in millions)	Years Ended December 31, 2018	2017	2016
Environmental costs	$ 1.0	$	$

We recorded environmental costs during the twelve months ended December 31, 2018, related to a U.S. Environmental Protection Agency-designated Superfund site, acquired as part of the Newport Merger.

Asset Impairment

(Dollars in millions)	Years Ended December 31, 2018	2017	2016
Asset impairment	$	$ 6.7	$ 5.0

During 2017, we recorded $6.7 million of impairment charges related to the consolidation of two manufacturing plants. These charges primarily related to the write-off of certain goodwill and intangible assets. During 2016, we recorded an asset impairment charge of $5.0 million on our investment in a private company.

Fees and Expenses Related to Repricing of Term Loan

(Dollars in millions)	Years Ended December 31, 2018	2017	2016
Fees and expenses related to repricing of term loan	$ 0.4	$ 0.5	$ 1.2

We recorded fees and expenses related to repricings of our Term Loan Facility (as defined below under Liquidity and Capital Resources Term Loan Credit Agreement.

Amortization of Intangible Assets

(Dollars in millions)	Years Ended December 31, 2018	2017	2016
Amortization of intangible assets	$ 43.5	$ 45.7	$ 35.7

Amortization of intangible assets decreased by $2.2 million in 2018, due to certain intangible assets becoming fully amortized.

Amortization increased by $10.0 million during 2017, compared to 2016. The increase in 2017, compared to prior year, was primarily related to the amortization of intangible assets acquired through the Newport Merger. The increase during 2017, compared to 2016 was primarily due to the fact that the Light & Motion segment only accounted for eight months of expense in 2016.

Interest Expense, Net

	Years Ended December 31,		
(Dollars in millions)	**2018**	**2017**	**2016**
Interest expense, net	$ 11.2	$ 28.0	$ 28.0

Interest expense, net, decreased by $16.8 million in 2018, compared to 2017, primarily related to principal prepayments of $275.0 million since the beginning of 2017, and three repricings of our Term Loan Facility in 2017 and 2018.

Interest expense, net, remained flat and during 2017 and 2016.

Gain on Sale of Business

	Years Ended December 31,		
(Dollars in millions)	**2018**	**2017**	**2016**
Gain on sale of business	$	$ 74.9	$

We recorded a $74.9 million gain for 2017 on the sale of our Data Analytics Solutions business during the second quarter of 2017.

Other Expense, Net

	Years Ended December 31,		
(Dollars in millions)	**2018**	**2017**	**2016**
Other expense, net	$ 1.9	$ 5.9	$ 1.2

Other expense, net for 2018 and 2017 primarily related to changes in foreign exchange rates.

Other expense, net for 2016 includes $2.8 million of foreign exchange losses and other income, net of $1.6 million, primarily attributed to $1.3 million of net proceeds received from a Company-owned life insurance policy.

Provision for Income Taxes

	Years Ended December 31,		
(Dollars in millions)	**2018**	**2017**	**2016**
Provision for income taxes	$ 88.1	$ 108.5	$ 23.2

Our effective tax rate for the years 2018, 2017 and 2016 was 18.3%, 24.2% and 18.1%, respectively. The effective tax rate in 2018 and related income tax expense was impacted by the Tax Cuts and Jobs Act which was enacted into law on December 22, 2017. We account for income tax effects resulting from changes in tax laws in accordance with the authoritative guidance, which requires that these tax effects be recognized in the period in which the law is enacted and that the effects are recorded as a component of provision for income taxes from continuing operations. As a result, we recorded provisional amounts as of December 31, 2017 related to the one-time Transition Tax and the change in U.S. net deferred tax liabilities resulting from the change in the U.S. statutory rate resulting from the enactment of the Act in accordance with SAB 118. The provisional amounts recorded for the Act were finalized as of December 22, 2018 and resulted in a net decrease to our annual tax expense of approximately $0.6 million. The effective tax rate for the period ending December 31, 2018 was lower than the U.S. statutory rate due to foreign earnings taxed at lower rates, windfall benefits of stock compensation and the new deduction for foreign derived intangible income from the Act, offset by state income taxes.

The effective tax rate in 2017 was lower than the U.S. statutory tax rate due to foreign earnings taxed at lower rates, windfall benefits of stock compensation and the domestic production deduction offset by deferred taxes recorded as a result of a change in the indefinite reinvestment assertion with respect to certain foreign subsidiaries.

At December 31, 2018, the total amount of gross unrecognized tax benefits, which excludes interest and penalties, was approximately $32.7 million. At December 31, 2017, the total amount of gross unrecognized tax benefits, which excludes interest and penalties, was approximately $27.3 million. The net increase from December 31, 2017 was primarily attributable to the addition of reserves for the federal Transition Tax from the Act along with certain non-U.S. items offset by decreases from settlement of an audit by the U.S. Internal Revenue Service (IRS) and the expiration of certain statutes of limitations. At December 31, 2018, excluding interest and penalties, there were approximately $25.1 million of net unrecognized tax benefits that, if recognized, would impact our annual effective tax rate. We accrue interest and, if applicable, penalties for any uncertain tax positions. Interest and penalties are classified as a component of income tax expense. At December 2018, 2017 and 2016, we had accrued interest on unrecognized tax benefits of approximately $0.6 million, $0.3 million and $0.5 million, respectively.

Over the next 12 months it is reasonably possible that we may recognize approximately $2.1 million of previously net unrecognized tax benefits, excluding interest and penalties, related to federal, state and foreign tax positions as a result of the expiration of statutes of limitations. The U.S. statute of limitations remains open for tax years 2015 through present. The statute of limitations for our tax filings in other jurisdictions varies between fiscal years 2013 through the 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.

We are subject to examination by U.S. federal, state and foreign tax authorities. 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. During the quarter ended March 31, 2018 we received notification from the IRS of its intent to audit our U.S. subsidiary, Newport, for tax year 2015. This audit commenced during the quarter ended June 30, 2018 and there have been no proposed adjustments through December 31, 2018.

On a quarterly basis, we evaluate both positive and negative evidence that affects the realizability of net deferred tax assets and assess the need for a valuation allowance. 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.

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. In 2017 we recorded a net benefit to income tax expense of $3.1 million, excluding interest and penalties, due to reserve releases related to the expiration of statutes of limitations for previously open tax years. For 2016 we recorded a net benefit to income tax expense of $2.6 million, excluding interest and penalties, due to reserve releases related to the expiration of the statutes of limitations for previously open tax years.

The United Kingdom is negotiating its withdrawal from the European Union (EU). It is possible that the United Kingdom may leave the EU without having negotiated terms of its withdrawal (no deal Brexit). If there is a no deal Brexit, tax treaties between the United Kingdom and member states of the EU will displace certain EU directives now in effect including the Parent / Subsidiary Directive. The Parent Subsidiary Directive currently eliminates withholding taxes on the payment of dividends between associated companies of different EU member states. The United Kingdom tax treaties with EU member states generally permit withholding taxes to be applied at reduced rates. If there is a no deal Brexit, our tax expense may increase due to the imposition of withholding taxes on dividends paid from our EU subsidiaries to our United Kingdom subsidiaries.

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 the enactment of the Act, the adoption of the proposed regulations issued by the U.S. IRS on the one-time transition tax and the global intangible low-taxed income provision, 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 that 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 $718.2 million at December 31, 2018, an increase of $174.9 million compared to $543.3 million at December 31, 2017. This increase and 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 $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 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 provided by operating activities was $355.2 million for 2017 and resulted from net income of $339.1 million, which included non-cash net charges of $66.5 million, offset by an increase in working capital of $50.4 million. The increase in working capital consisted of an increase in inventories of $72.4 million, an increase in trade accounts receivable of $44.1 million and an increase in current and non-current assets of $8.6 million, all as a result of a significant increase in our business in 2017. These increases were offset by an increase in accrued compensation of $32.5 million mainly related to variable compensation, other current and non-current liabilities of $18.0 million, income taxes of $12.8 million and accounts payable of $11.4 million.

Net cash provided by operating activities was $180.1 million for 2016 and resulted from net income of $104.8 million, which included non-cash net charges of $97.6 million, offset by an increase in working capital of

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$22.3 million. The increase in working capital consisted of an increase in trade accounts receivable of $58.1 million, an increase in inventories of $13.8 and an increase in current and non-current assets of $12.2 million. These increases were offset by an increase in income taxes of $30.9 million, accounts payable of $16.2 million, an increase in accrued compensation of $11.0 million and an increase in other current and non-current liabilities of $3.7 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 production-related equipment of $62.9 million. Net cash provided by investing activities was $22.6 million for 2017 and resulted primarily from proceeds received of $72.5 million from the sale of our Data Analytics Solutions business, partially offset by purchases of production-related equipment of $31.3 million and net purchases of short-term investments of $18.7 million. Net cash used in investing activities was $727.0 million for 2016 and resulted primarily from $939.6 million of cash, primarily used for the Newport Merger and $19.1 million used for the purchase of production-related equipment, partially offset by net proceeds from sales and maturities of investments of $231.5 million. The purchase of production-related equipment could increase to support future sales growth.

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. Net cash used in financing activities was $279.7 million and resulted primarily from partial repayment of the Term Loan Facility of $228.1 million, dividend payments made to common stockholders of $38.2 million and net payments related to tax payments for employee stock awards of $12.2 million. Net cash provided by financing activities was $560.1 million for 2016 and resulted from net proceeds of $598.5 million, primarily related to the Term Loan Facility used to finance the Newport Merger, offset by dividend payments made to common stockholders of $36.4 million and net payments related to tax payments made for employee stock awards of $1.9 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 2018, we repurchased approximately 818,000 shares of our common stock for $75.0 million, or an average price of $91.67 per share. During 2017, we did not repurchase any shares of our common stock. During 2016, we repurchased approximately 45,000 shares of our common stock for $1.5 million at an average price of $34.50 per share.

Holders of our common stock are entitled to receive dividends when and if they are declared by our Board of Directors. For the year ended December 31, 2018, we paid cash dividends of $42.4 million in the aggregate, or $0.78 per share. For the year ended December 31, 2017, we paid cash dividends of $38.2 million in the aggregate, or $0.71 per share. For the year ended December 31, 2016, we paid cash dividends of $36.4 million in the aggregate, or $0.68 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. In addition, under the terms of our Term Loan Facility and our senior secured asset-based revolving credit facility, we may be restricted from paying dividends under certain circumstances.

On February 11, 2019, the Company s Board of Directors declared a quarterly cash dividend of $0.20 per share to be paid on March 8, 2019 to shareholders of record as of February 25, 2019.

Acquisition of Electro Scientific Industries, Inc.

On February 1, 2019, we completed our previously announced acquisition of ESI pursuant to the ESI Merger. At the effective time of the ESI Merger and pursuant to the terms and conditions of the Agreement and

Plan of Merger, each share of ESI s common stock issued and outstanding as of immediately prior to the effective time of the ESI Merger was converted into the right to receive $30.00 per share in cash, without interest and subject to deduction for any required withholding tax. We paid to the former ESI stockholders aggregate consideration of approximately $1 billion, excluding related transaction fees and expenses. We funded the payment of the aggregate consideration with a combination of our available cash on hand and proceeds from our term loan facility described below.

Sale of Data Analytics Solutions Business

In April 2017, we completed the sale of our Data Analytics Solutions business for total proceeds of $72.5 million, net of cash sold, and we 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 the Vacuum & Analysis segment, was no longer a part of our long-term strategic objectives.

Term Loan Credit Agreement

In connection with the completion of the Newport Merger, we entered into a term loan credit agreement (the 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 senior secured financing in the original principal amount of $780.0 million, subject to increase at our option and subject to the receipt of lender commitments in accordance with the Credit Agreement (the Term Loan Facility). 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 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 0.75%, plus an applicable margin. We have elected the interest rate as described in clause (b). The Credit Agreement provides that 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, and for other reasons. The Term Loan Facility was issued with original issue discount of 1.00% of the principal amount thereof.

In June 2016, we entered into Amendment No. 1 (the Repricing Amendment 1) to the Credit Agreement by and among the Company, the Lenders and Barclays Bank PLC, as administrative agent and collateral agent for the Lenders. The Repricing Amendment 1 decreased the applicable margin for borrowings under our Term Loan Facility to 2.50% for base rate borrowings and 3.50% for LIBOR borrowings and extended the period during which a prepayment premium may be required for a Repricing Transaction (as defined in the Credit Agreement) until six months after the effective date of the Repricing Amendment 1. In connection with the execution of the Repricing Amendment 1, we paid a prepayment premium of 1.00%, or $7.3 million, as well as certain fees and expenses of the administrative agent and the Lenders, in accordance with the terms of the Credit Agreement. Immediately prior to the effectiveness of the Repricing Amendment 1, we prepaid $50.0 million of principal under the Credit Agreement. In September 2016, we prepaid an additional $60.0 million under the Credit Agreement.

In September 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 under the Credit Agreement. The rate is fixed at 1.198% per annum plus the applicable credit spread, which was 1.75% at December 31, 2018. The notional amount of the interest rate swap agreement was $290.0 million and had a fair value of $6.1 million at December 31, 2018.

In December 2016, we entered into Amendment No. 2 (the Repricing Amendment 2) to the Credit Agreement by and among the Company, the Lenders and Barclays Bank PLC, as administrative agent and collateral agent for the Lenders. The Repricing Amendment 2 decreased the applicable margin for our term loan under the Credit Agreement to 2.75% for LIBOR borrowings and 1.75% for base rate borrowings and reset the period during which a prepayment premium may be required for a Repricing Transaction until six months after the effective date of the Repricing Amendment 2. In November 2016, prior to the effectiveness of the Repricing Amendment 2, we prepaid an additional $40.0 million of principal under the Credit Agreement. In March 2017, we prepaid an additional $50.0 million of principal under the Credit Agreement.

In July 2017, we entered into Amendment No. 3 (the Repricing Amendment 3) to our Credit Agreement by and among the Company, the Lenders and Barclays Bank PLC, as administrative agent and collateral agent for the Lenders. The Repricing Amendment 3 decreased the applicable margin for our term loan under the Credit Agreement to 2.25% for LIBOR rate loans when the Total Leverage Ratio (as defined in the Credit Agreement) is at or above 1.25:1 and decreased to 2.00% when the Total Leverage Ratio was below 1.25:1, both with a LIBOR floor of 0.75%. The margin for base rate borrowings decreased to 1.25% when our Total Leverage Ratio was at or above 1.25:1 and will decrease to 1.00% when the Total Leverage Ratio is below 1.25:1. The period in which a prepayment premium may be required for a Repricing Transaction was reset to six months after the effective date of the Repricing Amendment 3.

In April 2018, we entered into Amendment No. 4 (the Repricing Amendment 4) to the Credit Agreement by and among the Company, the Lenders and Barclays Bank PLC, as administrative agent and collateral agent for the Lenders. The Repricing Amendment 4 decreased the applicable margin for our term loan under the Credit Agreement to 1.75% for LIBOR rate loans, with a LIBOR rate floor of 0.75%. The margin for base rate borrowings decreased to 0.75% with a base rate floor of 1.75%. The period during which a prepayment premium may be required for a Repricing Transaction was reset to six months after the effective date of the Repricing Amendment 4.

In July 2017, August 2017, November 2017 and March 2018 we voluntarily prepaid $50.0 million, $75.0 million, $50.0 million and $50.0 million, respectively, of principal under the Credit Agreement. As of December 31, 2018, after total principal prepayments of $425.0 million and regularly scheduled principal payments of $6.5 million, the total outstanding principal balance was $348.5 million. The interest rate as of December 31, 2018 was 4.1%.

We incurred $28.7 million of deferred finance fees, original issue discount and repricing fees related to the term loans under the 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. A portion of these fees have been accelerated in connection with the various debt prepayments during 2016, 2017 and 2018. As of December 31, 2018, the remaining balance of the deferred finance fees, original issue discount and repricing fees related to the Term Loan Facility was $4.7 million.

Under the 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 asset sales, certain casualty and condemnation events and the incurrence or issuance of certain debt. As a result of our Total Leverage Ratio, we were not required to make a prepayment of excess cash flow for fiscal year end 2018. We are also required to make scheduled quarterly payments each equal to 0.25% of the principal amount of the term loan, less the amount of certain voluntary and mandatory repayments after such date, with the balance due on the seventh anniversary of the closing date. As a result of making total prepayments of $425.0 million through December 31, 2018, we are no longer required to make any scheduled quarterly principal payments on the Term Loan Facility we had in place as of December 31, 2018 until maturity of the loan.

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

The 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, 2018, we were in compliance with all covenants under the Credit Agreement.

Incremental Term Loan Facility

On February 1, 2019, in connection with the completion of the ESI Merger, we entered into Amendment No. 5 to the Credit Agreement. Amendment No. 5 provides an additional tranche B-5 term loan commitment in the principal amount of $650.0 million (the Incremental Term Loan Facility), all of which was drawn down in connection with the closing of the ESI Merger. The Incremental Term Loan Facility matures on February 1, 2026 and bears 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 1.00%; 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 Incremental Term Loan Facility was issued with original issue discount of 1.00% of the principal amount thereof and the applicable margin for borrowings under the Incremental Term Loan Facility is 1.25% with respect to base rate borrowings and 2.25% with respect to LIBOR borrowings. As a consequence of the pricing of the Incremental Term Loan Facility, the applicable margin for the existing Term Loan Facility currently outstanding under the Credit Agreement (in the approximate outstanding principal amount of $348.0 million) was increased to 1.00% (from 0.75%) with respect to base rate borrowings and 2.00% (from 1.75%) with respect to LIBOR borrowings.

We are required to make scheduled quarterly payments each equal to 0.25% of the original principal amount of the tranche B-5 term loans, with the balance due on the seventh anniversary of the closing date of Amendment No. 5. If on or prior to the date that is six months after the closing date of Amendment No. 5 we prepay any tranche B-5 term loan 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.

Except as described above, the terms, covenants and events of default applicable to the Incremental Term Loan Facility are materially consistent with the terms, covenants and events of default applicable to tranche B-4 term loans currently outstanding under the Credit Agreement. The Incremental Term Loan Facility is guaranteed and secured on the same basis as the tranche B-4 term loans currently outstanding under the Credit Agreement. Pursuant to Amendment No. 5, we also effectuated certain amendments to the Credit Agreement which make certain of the negative covenants and other provisions less restrictive and, therefore, provide us with additional flexibility.

Senior Secured Asset-Based Revolving Credit Facility

In connection with the completion of the Newport Merger, we entered into an asset-based credit agreement with Deutsche Bank AG New York Branch, 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, that provided senior secured financing of up to $50.0 million, which we never borrowed against. On February 1, 2019, in connection with the completion of the ESI Merger, we terminated the $50.0 million asset-based credit agreement with Deutsche Bank AG New York Branch and entered into an asset-based 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 senior secured revolving credit financing of up to $100.0 million, subject to a borrowing base limitation (the ABL Facility). The borrowing base for the ABL Facility at any time equals the sum of: (a) 85% of certain eligible accounts; plus (b) subject to certain notice and field examination and appraisal 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; provided that until the administrative agent s receipt of a field examination of accounts receivable (and certain eligible inventory if eligible inventory is included in the borrowing base) the borrowing base shall be equal to the greater of $50.0 million and the borrowing base otherwise in effect. If such field exam has not occurred by the 90th day after the closing date (subject to certain extensions), the borrowing base shall be reduced to zero on such 90th day until such field exam occurs. 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 unutilized commitments thereunder equal to 0.25% per annum. We must also pay customary letter of credit fees and agency fees.

Mandatory Prepayments. 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.

Voluntary Prepayments. We may voluntarily reduce the unutilized portion of the commitment amount and repay outstanding loans from time to time. Prepayments of the loans may be made without premium or penalty other than customary breakage costs with respect to LIBOR loans.

Amortization and Final Maturity. There is no scheduled amortization under our ABL Facility. The principal amount outstanding under the ABL Facility is due and payable in full on the fifth anniversary of the closing date; provided, that if any balance of the Term Loan Facility remains outstanding under the Credit Agreement on the date that is 180 days prior to April 29, 2023, then the ABL Facility will become due and payable in full on the date that is 91 days prior to April 29, 2023.

Guarantees and Security. All obligations under the ABL Facility are unconditionally guaranteed by certain of our existing domestic subsidiaries and are required to be guaranteed by certain of our future domestic subsidiaries. All obligations under the ABL Facility, and the guarantees of those obligations, are secured, subject

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to certain exceptions, by substantially all of our assets and the assets of our subsidiaries that have guaranteed the ABL Facility (referred to herein as the subsidiary guarantors), including, in each case subject to customary exceptions and exclusions:

- a first-priority security interest in personal property consisting of, among other things, accounts receivable, inventory, deposit accounts, securities accounts, commodities accounts, cash and cash equivalents, instruments, chattel paper, and certain assets related to the foregoing and, in each case, proceeds thereof (such property, the Current Asset Collateral);

- a second-priority pledge of all of the capital stock directly held by us and any subsidiary guarantors (which pledge, in the case of the capital stock of each (a) domestic subsidiary that is directly owned by us or by any subsidiary guarantor and that holds no material assets other than equity interests in one or more controlled foreign corporations or (b) foreign subsidiary, is limited to 65% of the stock of such subsidiary); and

- a second-priority security interest in substantially all other tangible and intangible assets, including substantially all of our owned equipment and intellectual property.

Certain Covenants and Events of Default. The ABL Credit Agreement contains a number of negative covenants that, among other things and subject to certain exceptions, restrict the ability of us and each of our subsidiaries to:

- incur additional indebtedness;

- incur liens;

- pay dividends on our capital stock or redeem, repurchase or retire our capital stock or our other indebtedness;

- make investments, loans and acquisitions;

- create restrictions on the payment of dividends or other amounts to us from our restricted subsidiaries;

- engage in transactions with its affiliates;

- sell assets, including capital stock of its subsidiaries;

- materially alter the business it conducts;

- consolidate or merge; and

- engage in sale-leaseback transactions.

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.

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 provide for aggregate borrowings as of December 31, 2018, of up to an equivalent of $20.9 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, 2018 and 2017.

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, 2018 of up to an equivalent of $11.3 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 $3.4 million and $3.0 million at December 31, 2018 and 2017.

One of our Austrian subsidiaries has various outstanding loans from the Austrian government to fund research and development. These loans are unsecured and do not require principal repayment as long as certain conditions are met. Interest on these loans is payable semi-annually. The interest rates associated with these loans range from 0.75% 2.00%.

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, 2018, our maximum exposure as a result of these financial guarantees and standby letters of credit was approximately $5.4 million.

Our total cash and cash equivalents, including restricted cash and short-term marketable investments at December 31, 2018 consisted of $464.7 million held in the United States and $253.5 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 the amendment to our Term Loan Facility described above, we assumed certain contractual lease obligations and purchase obligations. None of those items are included in the table below.

Future contractual obligations as of December 31, 2018 are as follows:

		Payment Due By Period				
Contractual Obligations (In thousands)	**Total**	**Less than 1 Year**	**1-3 years**	**3-5 years**	**After 5 years**	**Other(1)**
Operating lease obligations	$ 66,296	$ 20,106	$ 27,467	$ 9,984	$ 8,739	$
Purchase obligations(2)	295,194	254,069	26,474	11,008	3,643	
Pension obligations	31,548	1,046	2,462	2,441	25,599	
Debt	352,536	3,986	86	348,464		
Other long-term liabilities reflected on the Balance Sheet under U.S. GAAP(3)	102,383	881	20,033	449	56,096	24,924
Total	$ 847,957	$ 280,088	$ 76,522	$ 372,346	$ 94,077	$ 24,924

(1) This balance relates to our reserve for uncertain tax positions.

(2) As of December 31, 2018, 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 $254.1 million.

(3) 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 $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. We had forward exchange contracts with notional amounts totaling $208.9 million outstanding at December 31, 2017 of which $79.7 million were outstanding to exchange South Korean Won to U.S. dollars and $70.2 million were outstanding to exchange Japanese Yen to U.S. dollars.

As of December 31, 2018, 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 2018, 2017 and 2016 and totaled a loss of $3.4 million, a loss of $2.7 million and a loss of $1.4 million, respectively. There were no ineffective portions of the derivatives recorded in 2018, 2017 and 2016.

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 2018, 2017 and 2016. 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 an interest rate swap agreement related to our Credit Agreement. See details above under Term Loan Credit Agreement.

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 other contractually narrow or limited purposes. Accordingly, we are not exposed to any financing, liquidity, market or credit risk that could arise if we had such relationships.

Recently Issued Accounting Pronouncements

In October 2018, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update (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. We are currently evaluating the requirements of this standard and have not yet determined its impact on our 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 of 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 standard and have not yet determined its impact on our consolidated financial statements.

In March 2018, the FASB issued ASU 2018-05, Income Taxes (Topic 740). This standard is an amendment that adopts the language of SAB 118 and aims to address certain circumstances that may arise for registrants in accounting for the income tax effects of the Act and to address any uncertainty or diversity of views in practice regarding the application of Topic 740 in situations where a registrant does not have the necessary information available, prepared, or analyzed (including computations) in reasonable detail to complete the accounting under Topic 740 for certain income tax effects of the Act for the reporting period in which the Act was enacted. The provisions of this ASU were applied to our December 31, 2017 financial statements. We recorded provisional amounts with respect to the Act at December 31, 2017 and for the nine months ended September 30, 2018. During the quarter ended December 31, 2018, we completed our analysis and finalized the provisional amounts that were previously recorded. 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 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. We do not expect adoption of this ASU to have a material impact on our consolidated financial statements.

In February 2016, the FASB issued ASU 2016-02, Leases (Topic 842). This standard requires the recognition of lease assets and liabilities for all leases, with certain exceptions, on the balance sheet. In transition, lessees and lessors have the option to either apply the standard retrospectively through a cumulative-effect adjustment to the opening balance of retained earnings in the period of adoption or they can apply the new standard to comparative periods presented. This ASU is effective for annual periods beginning after December 15, 2018, including interim periods within those fiscal years. The FASB issued additional updates to the new standard in Topic 842 (Update 2018-01 in January 2018 Land Easement Practical Expedient for Transition to Topic 842, (Update 2018-10 Codification Improvements to Topic 842 and Update 2018-11 in July 2018 Targeted Improvements). We have reviewed the requirements of the new standard and have formulated a plan for implementation. We have communicated our approach to our Audit Committee and have provided regular updates as appropriate. We have accumulated details on the population of leases and entered these details into a selected software database, which will be a repository and accounting solution for reporting and disclosure requirements required by the standard. We estimate that the balance sheet gross up (recording the right-of-use asset and lease liability) will be approximately $60 to $65 million at adoption on January 1, 2019. We will continue to assess and disclose the impact that this ASU will have on our consolidated financial statements, disclosures and related controls, when known.

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 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 $159.4 million outstanding and a net fair value liability totaling $1.3 million at December 31, 2018. We had forward exchange contracts with notional amounts totaling $208.9 million outstanding and a net fair value asset of $6.0 million at December 31, 2017. The potential fair value loss for a hypothetical 10% adverse change in the currency exchange rate on our forward exchange contracts at December 31, 2018 and 2017 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, 2018, we owed $348.5 million with $290.0 million at a fixed interest rate of 1.198%, plus the applicable credit spread which was 1.75% at December 31, 2018, and $58.5 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, 2018. 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.

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, 2018, $3.4 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, 2018 and 2017, and the related consolidated statements of operations and comprehensive income, stockholders equity and cash flows for each of the three years in the period ended December 31, 2018, including the related notes and schedule of valuation and qualifying accounts for each of the three years in the period ended December 31, 2018 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, 2018, 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, 2018 and 2017, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2018 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, 2018, based on criteria established in *Internal Control Integrated Framework* (2013) issued by the COSO.

Change in Accounting Principle

As discussed in Note 3 to the consolidated financial statements, the Company changed 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 Annual 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.

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.

/s/ PricewaterhouseCoopers LLP

Boston, Massachusetts

February 26, 2019

We have served as the Company s auditor since 1981.

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MKS Instruments, Inc.

Consolidated Balance Sheets

	December 31, 2018	December 31, 2017
	(in thousands, except share data)	
ASSETS		
Current assets:		
Cash and cash equivalents	$ 644,345	$ 333,887
Short-term investments	73,826	209,434
Trade accounts receivable, net of allowance for doubtful accounts of $5,243 and $4,135 at December 31, 2018 and 2017, respectively	295,454	300,308
Inventories	384,689	339,081
Other current assets	65,790	53,543
Total current assets	1,464,104	1,236,253
Property, plant and equipment, net	194,367	171,782
Goodwill	586,996	591,047
Intangible assets, net	319,807	366,398
Long-term investments	10,290	10,655
Other assets	38,682	37,883
Total assets	$ 2,614,246	$ 2,414,018
LIABILITIES AND STOCKHOLDERS EQUITY		
Current liabilities:		
Short-term debt	$ 3,986	$ 2,972
Accounts payable	83,825	82,518
Accrued compensation	82,350	96,147
Income taxes payable	16,358	21,398
Deferred revenue and customer advances	14,246	26,194
Other current liabilities	62,520	60,593
Total current liabilities	263,285	289,822
Long-term debt, net	343,842	389,993
Non-current deferred taxes	48,223	61,571
Non-current accrued compensation	55,598	51,700
Other liabilities	30,111	32,025
Total liabilities	741,059	825,111
Commitments and contingencies (Note 21)		
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; 54,039,554 and 54,355,535 shares issued and outstanding at December 31, 2018 and 2017, respectively	113	113
Additional paid-in capital	793,932	789,644
Retained earnings	1,084,797	795,698
Accumulated other comprehensive (loss) gain	(5,655)	3,452
Total stockholders equity	1,873,187	1,588,907

Total liabilities and stockholders equity	$ 2,614,246	$ 2,414,018

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

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MKS Instruments, Inc.

Consolidated Statements of Operations and Comprehensive Income

	Years Ended December 31,		
	2018	2017	2016
	(in thousands, except per share data)		
Net Revenues:			
Products	$ 1,835,202	$ 1,701,301	$ 1,118,579
Services	239,906	214,676	176,763
Total net revenues	2,075,108	1,915,977	1,295,342
Cost of revenues:			
Cost of products	969,288	906,369	630,208
Cost of service	126,344	118,157	99,515
Total cost of revenues (exclusive of amortization shown separately below)	1,095,632	1,024,526	729,723
Gross profit	979,476	891,451	565,619
Research and development	135,720	132,555	110,579
Selling, general and administrative	298,118	290,056	227,932
Acquisition and integration costs	3,113	5,332	27,279
Restructuring	3,567	3,920	642
Environmental costs	1,000		
Asset impairment		6,719	5,000
Fees and expenses related to repricing of term loan	378	492	1,239
Amortization of intangible assets	43,521	45,743	35,681
Income from operations	494,059	406,634	157,267
Interest income	5,775	3,021	2,560
Interest expense	16,942	30,990	30,611
Gain on sale of business		74,856	
Other expense, net	1,942	5,896	1,239
Income before income taxes	480,950	447,625	127,977
Provision for income taxes	88,054	108,493	23,168
Net income	$ 392,896	$ 339,132	$ 104,809
Other comprehensive income:			
Changes in value of financial instruments designated as cash flow hedges, net of tax expense (benefit)(1)	$ 4,942	$ (4,568)	$ 3,380
Foreign currency translation adjustments, net of tax of $0 for 2018, 2017 and 2016	(14,161)	37,172	(22,713)
Unrecognized pension gain (loss), net of tax benefit(2)	149	323	(266)
Unrealized (loss) gain on investments, net of tax (benefit) expense(3)	(37)	1,072	223
Total comprehensive income	$ 383,789	$ 373,131	$ 85,433
Net income per share:			
Basic	$ 7.22	$ 6.26	$ 1.96
Diluted	$ 7.14	$ 6.16	$ 1.94
Cash dividends paid per common share	$ 0.78	$ 0.71	$ 0.68

Weighted average common shares outstanding:			
Basic	54,406	54,137	53,472
Diluted	54,992	55,074	54,051

(1) Tax expense (benefit) was $1,347, $(1,468), and $2,535 for the years ended December 31, 2018, 2017 and 2016, respectively.

(2) Tax expense (benefit) was $86, $(88) and $(199) for the years ended December 31, 2018, 2017 and 2016, respectively.

(3) Tax expense (benefit) was $2, $(769), and $167 for the years ended December 31, 2018, 2017 and 2016, respectively.

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

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MKS Instruments, Inc.

Consolidated Statements of Stockholders Equity

(in thousands, except share data)	Common Stock Shares	Common Stock Amount	Additional Paid-In Capital	Retained Earnings	Accumulated Other Comprehensive Income/(Loss)	Total Stockholders Equity
Balance at December 31, 2015	53,199,720	$ 113	$ 744,725	$ 427,214	$ (11,171)	$ 1,160,881
Net issuance under stock-based plans	517,939		6,902			6,902
Stock-based compensation			25,228			25,228
Tax effect from stock-based plans			1,254			1,254
Stock repurchase	(44,798)		(627)	(918)		(1,545)
Cash dividend				(36,361)		(36,361)
Comprehensive income (net of tax):						
Net income				104,809		104,809
Other comprehensive loss					(19,376)	(19,376)
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				(38,178)		(38,178)
Comprehensive income (net of tax):						
Net income				339,132		339,132
Other comprehensive loss					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				(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

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

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MKS Instruments, Inc.

Consolidated Statements of Cash Flows

(in thousands)

	Years Ended December 31,		
	2018	2017	2016
Cash flows from operating activities:			
Net income	$ 392,896	$ 339,132	$ 104,809
Adjustments to reconcile net income to net cash provided by operating activities:			
Depreciation and amortization	79,853	82,556	65,926
Amortization of inventory step-up adjustment to fair value			15,090
Amortization of debt issuance cost and original issue discount	4,718	10,699	9,265
Stock-based compensation	27,262	24,378	25,228
Provision for excess and obsolete inventory	22,324	20,213	16,039
Provision for doubtful accounts	1,435	825	1,109
Deferred income taxes	(19,388)	(4,831)	(38,822)
Excess tax benefits from stock-based compensation			(1,468)
Asset impairment		6,719	5,000
Gain on sale of business		(74,856)	
Other	2,649	824	256
Changes in operating assets and liabilities:			
Trade accounts receivable	(546)	(44,077)	(58,111)
Inventories	(73,779)	(72,471)	(13,798)
Income taxes	(11,430)	12,805	30,914
Other current and non-current assets	(1,639)	(8,631)	(12,165)
Accrued compensation	(8,649)	32,502	10,965
Other current and non-current liabilities	(3,948)	18,030	3,681
Accounts payable	2,023	11,405	16,180
Net cash provided by operating activities	413,781	355,222	180,098
Cash flows from investing activities:			
Acquisition of business, net of cash acquired			(939,591)
Net proceeds from sale of business		72,509	
Purchases of investments	(253,598)	(229,557)	(268,458)
Maturities of investments	181,749	157,342	160,917
Sales of investments	207,542	53,564	338,996
Purchases of property, plant and equipment	(62,941)	(31,287)	(19,123)
Other		66	273
Net cash provided by (used in) investing activities	72,752	22,637	(726,986)
Cash flows from financing activities:			
Proceeds from short-term borrowings	67,629	28,360	18,964
Payments of short-term borrowings	(67,163)	(29,711)	(11,742)
Proceeds from long-term borrowings	40	191	744,653
Payments of long-term borrowings	(50,003)	(228,141)	(153,395)
Repurchases of common stock	(75,000)		(1,545)
Net proceeds related to employee stock awards	(11,104)	(12,216)	(1,922)
Dividend payments	(42,405)	(38,178)	(36,361)
Excess tax benefit from stock-based compensation			1,468

Net cash (used in) provided by financing activities	(178,006)	(279,695)	560,120
Effect of exchange rate changes on cash and cash equivalents	1,931	1,813	(6,896)
Increase in cash and cash equivalents	310,458	99,977	6,336
Cash and cash equivalents, including restricted cash, at beginning of year	333,887	233,910	227,574
Cash and cash equivalents, including restricted cash, at end of year	$ 644,345	$ 333,887	$ 233,910
Supplemental disclosure of cash flow information:			
Cash paid during the period for:			
Interest	$ 14,593	$ 20,467	$ 20,839
Income taxes	$ 91,765	$ 104,691	$ 44,967

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

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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, 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. 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, residual gas analysis, leak detection, control technology, ozone generation and delivery, power, reactive gas generation, vacuum technology, lasers, photonics, sub-micron positioning, vibration control, and optics. The primary served markets are manufacturers of capital equipment for semiconductor manufacturing, industrial technologies, life and health sciences, as well as research and defense. The Company groups its products into six product groups based upon the similarity of the product function, type of product and manufacturing processes. These six groups are: Analytical and Controls Solutions Products; Power, Plasma and Reactive Gas Solutions Products; Vacuum Solutions Products; Photonics Products; Optics Products; and Laser Products.

The Company has two reportable segments: Vacuum & Analysis and Light & Motion.

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.

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MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (continued)

(in thousands, except share and per share data)

Reclassification of certain line items in prior period financial statements

The Company has historically recorded the revenue and related cost of revenue for the sale of its spare parts within Products in its Statements of Operations for the Vacuum & Analysis segment. The Company has now determined that these items are better presented within revenue and related cost of revenue within Services for the Vacuum & Analysis segment in its Statements of Operations to align with the current manner in which the Company operates it service business, and has elected to reclassify these amounts in previously issued financial statements as shown below. This change in presentation has no impact on total revenue or total cost of revenue.

	Twelve Months Ended December 31, 2017		
	As previously reported	Adjustment	As revised
Net revenues:			
Products	$ 1,723,433	$ (22,132)	$ 1,701,301
Services	192,544	22,132	214,676
Total net revenues	1,915,977		1,915,977
Cost of revenues:			
Cost of products	901,546	4,823	906,369
Cost of services	122,980	(4,823)	118,157
Total cost of revenues	$ 1,024,526	$	$ 1,024,526

	Twelve Months Ended December 31, 2016		
	As previously reported	Adjustment	As revised
Net revenues:			
Products	$ 1,134,013	$ (15,434)	$ 1,118,579
Services	161,329	15,434	176,763
Total net revenues	1,295,342		1,295,342
Cost of revenues:			
Cost of products	627,850	2,358	630,208
Cost of services	101,873	(2,358)	99,515
Total cost of revenues	$ 729,723	$	$ 729,723

3) Summary of Significant Accounting Policies

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, 2018 reflect the application of ASC 606 guidance while the reported results for 2017 were prepared under the guidance of Accounting Standards Codification 605, Revenue Recognition.

The Company has recorded a net increase to opening retained earnings of $1,809 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.

MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (continued)

(in thousands, except share and per share data)

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 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. None of the Company s contracts as of December 31, 2018 contained a significant financing component. Contract assets as of January 1 and December 31, 2018 were $3,065 and $3,624, respectively, and included in other current assets.

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

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(in thousands, except share and per share data)

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 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, 2018, as the majority have a duration of less than one year.

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

	Year Ended December 31, 2018
Beginning balance, January 1(1)	$ 27,800
Amount of deferred revenue and customer advances recognized in income(3)	(83,497)
Additions to deferred revenue and customer advances	73,171
Ending balance, December 31(2)	$ 17,474

(1) Beginning deferred revenue and customer advances as of January 1, 2018 included $12,842 of current deferred revenue, $3,126 of long-term deferred revenue and $13,352 of current customer advances, net of a $1,520 adjustment related to the adoption of ASC 606.

(2) Ending deferred revenue and customer advances as of December 31, 2018 included $8,134 of current deferred revenue, $3,228 of long-term deferred revenue and $6,112 of current customer advances.

(3) The deferred revenue and customers advances recognized in income that relates to fiscal year 2018 was $61,012.

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.

The Company monitors and tracks the amount of product returns and reduces revenue at the time of shipment for the estimated amount of future returns, based on historical experience. The Company makes estimates evaluating its allowance for doubtful accounts. The Company continuously monitors collections and

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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.

Disaggregation of Revenue

The following table summarizes revenue from contracts with customers:

	Year Ended December 31, 2018		
	Vacuum & Analysis	Light & Motion	Total
Net revenues:			
Products	$ 1,080,343	$ 754,859	$ 1,835,202
Services	180,519	59,387	239,906
Total net revenues	$ 1,260,862	$ 814,246	$ 2,075,108

	Year Ended December 31, 2017		
	Vacuum & Analysis	Light & Motion	Total
Net revenues:			
Products	$ 1,047,639	$ 653,662	$ 1,701,301
Services	159,818	54,858	214,676
Total net revenues	$ 1,207,457	$ 708,520	$ 1,915,977

	Year Ended December 31, 2016		
	Vacuum & Analysis	Light & Motion	Total
Net revenues:			
Products	$ 731,364	$ 387,215	$ 1,118,579
Services	140,927	35,836	176,763
Total net revenues	$ 872,291	$ 423,051	$ 1,295,342

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.

Refer to Note 19 for revenue by reportable segment, geography and groupings of similar products.

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.

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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 2018, 2017 and 2016.

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 the fair value on the date of grant that normally vests 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 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, its 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

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potential dilutive common equivalent shares outstanding. The dilutive effect of options is 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.

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.

The Company had one customer, Applied Materials, Inc., comprising 12%, 13% and 14% of net revenues for 2018, 2017 and 2016, respectively, and another customer, Lam Research Corporation, comprising 11%, 12% and 11% of net revenues for 2018, 2017 and 2016, respectively. During the years 2018, 2017 and 2016, approximately 55%, 57% and 56% 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, 2018. One customer, Applied Materials, Inc., represented 10% or more of the Company s accounts receivable balance as of December 31, 2017.

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

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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 sixteen 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.

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 rates, perpetual growth rates, projected revenues and projected profit 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.

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.

As of October 31, 2018, the Company performed its annual impairment assessment of goodwill using the qualitative assessment 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. In 2017, the Company recorded an impairment charge of $6,719 related to certain long-lived assets as a result of consolidating two manufacturing plants.

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 losses resulting from re-measurement were $2,497 and $6,132 for the years ended December 31, 2018 and 2017, respectively, and are included in other expense (income). Net foreign exchange losses resulting from re-measurement were $2,823 for the year ended December 31, 2016. In 2016, we reclassified the impact of foreign exchange losses (gains), from selling, general and administrative expenses to other expense (income), net. These amounts do not reflect the corresponding gain (loss) from foreign exchange contracts. See Note 7 Derivatives regarding foreign exchange contracts.

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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.

During 2016, the Company increased its valuation allowance by $6,400 primarily related to the addition of historical valuation allowances for Newport Corporation (Newport) and its subsidiaries which were included as a result of the acquisition in April 2016. As a result, the valuation allowance was $12,527 at December 31, 2016. During 2017, the Company increased its valuation allowance by $1,102, primarily related to certain state tax credits. As a result, the valuation allowance was $13,629 at December 31, 2017. During 2018, the Company increased its valuation allowance by $4,307 which is attributable to certain tax credit and net operating loss carry forward amounts. As a result, the valuation allowance was $17,936 at December 31, 2018.

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.

On December 22, 2017, the President of the United States signed into law the Tax Cuts and Jobs Act (the Act), which included significant changes to U.S. tax law. Some of the more significant changes impacting the Company are 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 territorial tax system and the imposition of a transition tax on deemed repatriated cumulative earnings of foreign subsidiaries (Transition Tax).

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 has obtained, prepared and analyzed the information needed to complete the accounting requirements under Accounting Standards Codification (ASC) Topic 740 and as a result, in accordance with SAB 118, the Company has finalized and recorded the effects of the Act during the quarter ended December 31, 2018. The ultimate impact of the Act on the Company is based upon the Company s understanding and interpretation of the regulatory guidance that has been issued regarding the Act.

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4) Recently Issued Accounting Pronouncements

In October 2018, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update (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 is currently evaluating the requirements of this standard and has not yet determined the impact on its 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 of 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 standard and has not yet determined the impact on its consolidated financial statements.

In March 2018, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update (ASU) 2018-05, Income Taxes (Topic 740). This standard is an amendment that adopts the language of Securities and Exchange Commission Staff Accounting Bulletin No. 118 (SAB 118) and aims to address certain circumstances that may arise for registrants in accounting for the income tax effects of the Tax Cuts and Jobs Act (the Act) and to address any uncertainty or diversity of views in practice regarding the application of Topic 740 in situations where a registrant does not have the necessary information available, prepared, or analyzed (including computations) in reasonable detail to complete the accounting under Topic 740 for certain income tax effects of the Act for the reporting period in which the Act was enacted. The provisions of this ASU were applied to the Company s December 31, 2017 financial statements. The Company recorded provisional amounts with respect to the Act under SAB 118 at December 31, 2017 and for the nine months ended September 30, 2018. During the quarter ended December 31, 2018, the Company completed its analysis and finalized the provisional amounts that were previously recorded. The ultimate impact of the Act is based upon the Company s understanding and interpretation of the regulatory guidance that has been issued regarding the Act.

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 does not expect adoption of this ASU to have a material impact on the Company s consolidated financial statements.

In May 2017, the FASB issued ASU 2017-09, Compensation-Stock Compensation (Topic 718)-Scope of Modification Accounting. This standard provides guidance about which changes to the terms or conditions of a share-based payment award require an entity to apply modification accounting in Topic 718. The provisions of this ASU are effective for annual periods beginning after December 15, 2017, including interim periods within

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those fiscal years. The Company adopted this ASU during the first quarter of 2018 and the adoption of this ASU did not have a material impact on the Company s consolidated financial statements.

In March 2017, the FASB issued ASU 2017-07, Compensation-Retirement Benefits (Topic 715) Improving the Presentation of Net Periodic Pension Cost and Net Periodic Postretirement Benefit Cost. This standard requires that an employer disaggregate the service cost component from the other components of net benefit cost. This standard also provides explicit guidance on how to present the service cost component and the other components of the net benefit cost in the income statement and allows only the service cost component of net benefit cost to be eligible for capitalization. The provisions of this ASU are effective for annual periods beginning after December 31, 2017, including interim periods within those fiscal years. The Company adopted this ASU during the first quarter of 2018 and the adoption of this ASU did not have a material impact on the Company s consolidated financial statements.

In November 2016, the FASB issued ASU 2016-18, Statement of Cash Flows (Topic 230) Restricted Cash, an amendment to ASU 2016-15. This standard requires that a statement of cash flows explain the change during the period in the total of cash, cash equivalents and amounts generally described as restricted cash and restricted cash equivalents. Therefore, amounts generally described as restricted cash and restricted cash equivalents should be included with cash and cash equivalents when reconciling the beginning-of-period and end-of-period total amounts shown on the statement of cash flows. The provisions of this ASU are effective for annual periods beginning after December 15, 2017, including interim periods within those fiscal years and should be applied at the time of adoption of ASU 2016-15. The Company adopted this ASU during the first quarter of 2018 and the adoption of this ASU did not have a material impact on the Company s consolidated financial statements.

In October 2016, the FASB issued ASU 2016-16, Income Taxes (Topic 740) Intra-Entity Transfer of Assets Other Than Inventory. This standard requires that an entity recognize the income tax consequences of an intra-entity transfer of an asset other than inventory when the transfer occurs as opposed to when the assets have been sold to an outside party. The provisions of this ASU are effective for annual periods beginning after December 15, 2017, including interim periods within those fiscal years. The Company adopted this ASU during the first quarter of 2018 and the adoption of this ASU did not have a material impact on the Company s consolidated financial statements.

In August 2016, the FASB issued ASU 2016-15, Statement of Cash Flows (Topic 230) Classification of Certain Cash Receipts and Cash Payments. This standard addresses eight specific cash flow issues with the objective of addressing the diversity in practice in how certain cash receipts and cash payments are presented and classified in the statement of cash flows under Topic 230. The provisions of this ASU are effective for annual periods beginning after December 15, 2017, including interim periods within those fiscal years. The Company adopted this ASU during the first quarter of 2018 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 (Topic 842). This standard requires the recognition of lease assets and liabilities for all leases, with certain exceptions, on the balance sheet. In transition, lessees and lessors have the option to either apply the standard retrospectively through a cumulative-effect adjustment to the opening balance of retained earnings in the period of adoption or they can apply the new standard to comparative periods presented. This ASU is effective for annual periods beginning after December 15, 2018, including interim periods within those fiscal years. The FASB issued additional updates to the new standard in Topic 842 (Update 2018-01 in January 2018 Land Easement Practical Expedient for

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Transition to Topic 842, Update 2018-10 Codification Improvements to Topic 842 and Update 2018-11 in July 2018 Targeted Improvements). The Company has reviewed the requirements of this standard and has formulated a plan for implementation. The management team has communicated its approach to the Audit Committee and have provided regular updates as appropriate. The Company has accumulated details on the population of leases and entered these details into a selected software database, which will be a repository and accounting solution for reporting and disclosure requirements required by the standard. The Company estimates that the balance sheet gross up (recording the right-of-use asset and lease liability) will be approximately $60,000 to $65,000 at adoption on January 1, 2019. The Company will continue to assess and disclose the impact that this ASU will have on its consolidated financial statements, disclosures and related controls, when known.

In January 2016, the FASB issued ASU 2016-01, Financial Instruments-Overall (Subtopic 825-10)-Recognition and Measurement of Financial Assets and Financial Liabilities. This ASU provides guidance for the recognition, measurement, presentation, and disclosure of financial instruments. The new standard revises accounting related to equity investments and the presentation of certain fair value changes for financial assets and liabilities measured at fair value. Among other things, it amends the presentation and disclosure requirements of equity securities that do not result in consolidation and are not accounted for under the equity method. Changes in the fair value of these equity securities will be recognized directly in net income. This standard is effective for annual periods beginning after December 15, 2017, including interim periods within those fiscal years. The Company adopted this ASU during the first quarter of 2018 and the adoption of this ASU did not have a material impact on the Company s consolidated financial statements.

In May 2014, the FASB issued ASU 2014-09, Revenue from Contracts with Customers (Topic 606) (ASC 606). This ASU provides for a single comprehensive model to use in accounting for revenue arising from contracts with customers and has replaced most existing revenue recognition guidance in GAAP. This ASU is effective for fiscal years and interim periods within those years beginning after December 15, 2017. The two permitted transition methods under the new standard are the full retrospective method, in which case the standard would be applied to each prior reporting period presented, or the modified retrospective method, in which case the cumulative effect of applying the standard would be recognized at the date of initial application. The Company used the modified retrospective method upon adoption in the first quarter of 2018. The FASB issued additional updates to the new revenue standard in Topic 606 relating to reporting revenue on a gross versus net basis (Update 2016-08 in March 2016), identifying performance obligations and licensing arrangements (Update 2016-10 in April 2016), narrow-scope improvements and practical expedients (Update 2016-12 in May 2016), technical corrections and improvements (Update 2016-20 in December 2016), and SEC Updates (Update 2017-13 in September 2017 and Update 2017-14 in November 2017). The adoption of this ASU did not have a material impact on the Company s consolidated financial statements as described further in Note 3.

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5) Investments

Investments classified as short-term consist of the following:

	Years Ended December 31, 2018	2017
Available-for-sale investments:		
Time deposits and certificates of deposit	$ 102	$ 9,757
Bankers acceptance drafts	989	5,330
Asset-backed securities	9,113	36,990
Commercial paper	19,359	13,750
Corporate obligations	9,352	77,821
Municipal bonds		1,970
U.S. treasury obligations	13,298	28,078
U.S. agency obligations	21,613	35,738
	$ 73,826	$ 209,434

Investments classified as long-term consist of the following:

	Years Ended December 31, 2018	2017
Available-for-sale investments:		
Group insurance contracts	$ 5,890	$ 6,255
Cost method investments:		
Minority interest in a private company	4,400	4,400
	$ 10,290	$ 10,655

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

As of December 31, 2018:	Cost	Gross Unrealized Gains	Gross Unrealized (Losses)	Estimated Fair Value
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
	$ 73,994	$ 7	$ (175)	$ 73,826

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MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (continued)

(in thousands, except share and per share data)

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

As of December 31, 2017:	Cost	Gross Unrealized Gains	Gross Unrealized (Losses)	Estimated Fair Value
Short-term investments:				
Available-for-sale investments:				
Time deposits and certificates of deposit	$ 9,756	$ 1	$	$ 9,757
Bankers acceptance drafts	5,330			5,330
Asset-backed securities	37,017	15	(42)	36,990
Commercial paper	13,810		(60)	13,750
Corporate obligations	77,788	58	(25)	77,821
Municipal bonds	1,970			1,970
U.S. treasury obligations	28,054	24		28,078
U.S. agency obligations	35,728	10		35,738
	$ 209,453	$ 108	$ (127)	$ 209,434

As of December 31, 2017:	Cost	Gross Unrealized Gains	Gross Unrealized (Losses)	Estimated Fair Value
Long-term investments:				
Available-for-sale investments:				
Group insurance contracts	$ 6,006	$ 249	$	$ 6,255

The tables above, which show the gross unrealized gains and (losses) aggregated by investment category for available-for-sale investments as of December 31, 2018 and 2017, 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 stock 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 2018, 2017 and 2016.

6) 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.

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MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (continued)

(in thousands, except share and per share data)

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 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.

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MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (continued)

(in thousands, except share and per share data)

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

		Fair Value Measurements at Reporting Date Using		
Description	**December 31, 2018**	**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 does 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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MKS INSTRUMENTS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS (continued)

(in thousands, except share and per share data)

Assets and liabilities of the Company measured at fair value on a recurring basis as of December 31, 2017, are summarized as follows:

		Fair Value Measurements at Reporting Date Using		
Description	**December 31, 2017**	**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	$ 4,987	$ 4,987	$	$
Time deposits and certificates of deposit	2,100		2,100	
Commercial paper	30,475		30,475	
Restricted cash money market funds	119	119		
Available-for-sale securities:				
Time deposits and certificates of deposit	9,757		9,757	
Bankers acceptance drafts	5,330		5,330	
Asset-backed securities	36,990		36,990	
Commercial paper	13,750		13,750	
Corporate obligations	77,821		77,821	