NANOMETRICS INC
Form 10-K
March 03, 2017

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, 2016

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: 000-13470

NANOMETRICS INCORPORATED

(Exact name of registrant as specified in its charter)

Delaware	94-2276314
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification Number)
1550 Buckeye Drive	
Milpitas, California	95035
(Address of principal executive offices)	(Zip Code)

Registrant’s telephone number, including area code: (408) 545-6000

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

Title of each class	Name of each exchange on which registered
Common Stock, $0.001 par value per share	The NASDAQ Stock Market LLC
	(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 and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes No .

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

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

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

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

As of June 24, 2016, the last business day of the Registrant's most recently completed second fiscal quarter, the aggregate market value of the common stock of Registrant held by non-affiliates, based upon the closing sales price for the Registrant's common stock for such date, as quoted on the NASDAQ Global Select Market, was approximately $498.8 million. Shares of common stock held by each officer and director and by each person who owned 5% or more of the outstanding common stock have been excluded because such persons may be deemed to be "affiliates" as that term is defined under the rules and regulations of the Exchange Act. This determination of affiliate status is not

necessarily a conclusive determination for any other purpose.

The number of shares of the Registrant's common stock outstanding as of February 24, 2017 was 25,160,223.

DOCUMENTS INCORPORATED BY REFERENCE

The Registrant has incorporated by reference into Part III of this Annual Report on Form 10-K portions of its Proxy Statement for its 2016 Annual Meeting of Stockholders to be filed pursuant to Regulation 14A. The Proxy Statement will be filed within 120 days of Registrant's fiscal year ended December 31, 2016.

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NANOMETRICS INCORPORATED

FORM 10-K

FOR THE FISCAL YEAR ENDED DECEMBER 31, 2016

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CAUTIONARY INFORMATION REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K for the year ended December 31, 2016, or "Form 10-K," contains forward-looking statements concerning our business, operations, and financial performance and condition as well as our plans, objectives, and expectations for business operations and financial performance and condition. Any statements contained herein that are not of historical facts may be deemed to be forward-looking statements. You can identify these statements by words such as "anticipate," "believe," "could," "estimate," "expect," "intend," "may," "plan," "should," "w and other similar expressions that are predictions of or indicate future events and future trends. These forward-looking statements are based on current expectations, estimates, forecasts, and projections about our business and the industry in which we operate and management's beliefs and assumptions and are not guarantees of future performance or development and involve known and unknown risks, uncertainties, and other factors that are in some cases beyond our control. As a result, any or all of our forward-looking statements in this Form 10-K may turn out to be inaccurate. Factors that could materially affect our business operations and financial performance and condition include, but are not limited to, those risks and uncertainties described herein under "Item 1A - Risk Factors." You are urged to consider these factors carefully in evaluating the forward-looking statements and are cautioned not to place undue reliance on the forward-looking statements. The forward-looking statements are based on information available to us as of the filing date of this Form 10-K. Unless required by law, we do not intend to publicly update or revise any forward-looking statements to reflect new information or future events or otherwise. You should, however, review the factors and risks we describe in the reports we will file from time to time with the Securities and Exchange Commission, or SEC, after the date of this Form 10-K.

PART I

ITEM 1. BUSINESS

Overview

Nanometrics Incorporated and its subsidiaries ("Nanometrics", the "Company", or "we") is a leading provider of advanced, high-performance process control metrology and inspection systems used primarily in the fabrication of semiconductors and other solid-state devices, including sensors, optoelectronic devices, high-brightness LEDs, discretes, and data storages components. Our automated and integrated metrology systems measure critical dimensions, device structures, topography and various thin film properties, including three-dimensional features and film thickness, as well as optical, electrical and material properties. Our process control solutions are deployed throughout the fabrication process, from front-end-of-line substrate manufacturing, to high-volume production of semiconductors and other devices, to advanced three-dimensional wafer-level packaging applications. Our systems enable advanced process control for device manufacturers, providing improved device yield at reduced manufacturing cycle time, supporting the accelerated product life cycles in the semiconductor and other device markets.

We were incorporated in California in 1975, and reincorporated in Delaware in 2006. We have been publicly traded since 1984 (NASDAQ: NANO). We have an extensive installed base of thousands of systems in the majority of advanced semiconductor device production factories worldwide. Our major customers include Samsung Electronics Co. Ltd., Intel Corporation, SK Hynix Semiconductor, Inc., Micron Technology, Inc., Taiwan Semiconductor Manufacturing Company Limited and Toshiba Corporation.

Additional information about us is available on our website at http://www.nanometrics.com. The information that can be accessed through our website, however, is not part of this Annual Report. The investor relations section of our website is located at http://www.nanometrics.com/investor.html. Our Annual Reports on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K and any amendments to those reports are available on the investor relations section of our website free of charge as soon as reasonably practicable after we electronically file or furnish such materials to the United States Securities and Exchange Commission ("SEC"). In addition, the reports and materials that we file with the SEC are available at the SEC's website (http://www.sec.gov) and at the SEC's Public Reference Room at 100 F Street, NE, Washington DC 20549. Interested parties may obtain information on the operation of the Public Reference Room by calling the SEC at 1-800-SEC-0330.

Industry Background

We participate in the sale, design, manufacture, marketing and support of process control systems for optical critical dimension metrology, thin film metrology, and wafer defect inspection used for semiconductor manufacturing. Semiconductors, primarily packaged as integrated circuits within electronic devices, include consumer electronics, server and enterprise systems, mobile computing (including smart phones and tablets), data storage devices, and embedded automotive and control systems. Integrated circuits are made up of semiconductor material layers integrating millions or billions of transistors and other electronic components, connected through a complex wiring scheme of small copper wires, ultimately packaged into thin form factors to be mounted on circuit boards or other substrates. Our core focus is the measurement and control of the structure, composition, and geometry of the devices from the transistor layer through advanced wafer-level packaging to improve device performance and manufacturing yields. Our end customers manufacture many types of integrated circuits for a multitude of applications, each having unique manufacturing challenges. This includes integrated circuits to enable information processing and management (logic integrated circuits), memory storage (NAND, 3D-NAND, NOR, and DRAM), analog devices (e.g., Wi-Fi and 4G radio integrated circuits, power devices) MEMS sensor devices (accelerometers, pressure sensors, microphones), image sensors, thin film head components for hard disk drives and alternative energy devices such as LEDs, power inverters and solar cells.

Demand for our products continues to be driven by our customers' desire for higher overall chip performance, including improvements in power efficiency, logic processing capability, data storage volume and manufacturing yield. To achieve these goals, our customers have increased their use of more complex materials and processing methods in their manufacturing flow. The majority of our chip customers manufacture devices in production runs defined by the smallest printed feature and the associated circuit manufacturing methods, known as a technology node, which are measured in nanometers ("nm"), or one-billionth of a meter. Current volume production is running at the 1Xnm nodes across foundry, logic, and memory, with customers ramping 1Y or 10nm node and developing next generation 7 nm and below devices. In some cases, our customers are implementing new materials and methods in high volume manufacturing, including materials and device architectures to reduce power consumption including high dielectric constant (or high-k) materials, FinFET or tri-gate transistors, stacked memory devices including 3D-NAND, and additional system on chip solutions. To shrink features, new methods including multiple patterning lithography have been deployed. We believe the use of these new materials and methods has increased demand for our products. Next-generation devices with features smaller than 10nm are beginning to ramp production, which in turn likely will require new advancements in metrology and inspection capabilities. DRAM memory makers have shifted to 1X node production with development for subsequently smaller node devices currently underway (where X, Y and Z represent successively smaller geometries). Non-volatile memory makers of NAND and NOR devices have

ramped 1X and 1Y node devices into high volume manufacturing with work extending into 1Z node development and production as well as simultaneously developing and ramping stacked or 3D non-volatile memory structures. Current 3D NAND devices are built around a stack of 24-48 layer pairs, and are expected to migrate to 64-96 layer pairs in the next generation of devices. Foundry and logic manufacturers are in volume production of both 16nm and 22nm node devices, ramping volume production of 10nm node devices and in advanced development of 7nm devices.

Our Business

We offer a diverse line of process control products and technologies to address the manufacturing requirements of the semiconductor (and other solid state device) manufacturing industry. Our metrology systems measure and characterize the physical dimensions, material composition, optical and electrical characteristics and other critical parameters of solid state devices, from initial wafer substrate manufacturing through final packaging.

We are continually working to strengthen our competitive position by developing new technologies and products in our market segment. We have expanded our product offerings to address growing applications within the semiconductor manufacturing and adjacent industries. In pursuit of our goals, we have:

- Introduced new products, applications, and upgrades in every core product line and primary market served;
- Diversified our product line and strengthened our position with our top customers securing tool of record positions of one or more products in each of the top seven customers (as defined by capital expenditures for wafer fab equipment); and
- Continued development of new measurement and inspection technologies for advanced fabrication processes.

Nanometrics Products

We offer a diverse line of systems to address the broad range of process control requirements of the semiconductor manufacturing industry. In addition, we believe that our product development and engineering expertise and strategic acquisitions will enable us to develop and offer advanced process control solutions that, in the future, should address industry advancement and trends.

Automated Systems

Our automated systems primarily consist of fully automated metrology systems that are employed in semiconductor production environments. The Atlas® III, Atlas II+, and Atlas XP/Atlas XP+ represent our line of high-performance metrology systems providing optical critical dimension (“OCD”®), thin film metrology and wafer stress for transistor and interconnect metrology applications. The OCD technology is supported by our NanoCD® suite of solutions including our NanoDiffract® software and NanoGen™ scalable computing engine that enables visualization, modeling, and analysis of complex structures. The UniFire™ system measures multiple parameters at any given process step in the advanced packaging process flow for critical dimension, overlay, and topography applications and has recently added inspection capabilities for both front-end of line patterned wafer and advanced packaging related applications.

Integrated Systems

Our integrated metrology (“IM”) systems are installed directly onto wafer processing equipment to provide near real-time measurements for improved process control and maximum throughput. Our IM systems are sold directly to end user customers. The IMPULSE+ and IMPULSE® represent our latest metrology platform for OCD, and thin film metrology, and have been successfully qualified on numerous independent Wafer Fabrication Equipment Suppliers’ platforms. Our NanoCD suite of solutions is sold in conjunction with our IMPULSE® systems. Our Trajectory® system provides in-line measurement of layers in thin film thickness and composition in semiconductor applications and is qualified in production with major device makers.

Materials Characterization

Our materials characterization products include systems that are used to monitor the physical, optical, electrical and material characteristics of discrete electronic industry, opto-electronic, HB-LED (high brightness LEDs), solar PV (solar photovoltaics), compound semiconductor, strained silicon and silicon-on-insulator ("SOI") devices, including composition, crystal structure, layer thickness, dopant concentration, contamination and electron mobility.

The RPMBlue™ is our photoluminescence mapping system designed specifically for the HB-LED market, and is complemented by the RPMBlue-FS, enabling a breadth of research and development configurability. We sell Fourier-Transform Infrared ("FTIR") automated and manual systems in the QS2200/3300 and QS1200 respectively. The NanoSpec® line,

including the NanoSpec II, supports thin film measurement across all applications in both low volume production and research applications.

Our process control systems can be categorized as follows:

System	Market	Applications
Automated Systems		
Atlas III, Atlas II+/Atlas XP/Atlas XP+	Semiconductor	Film Thickness, Film Stress, CD
UniFire	Semiconductor	Film Thickness, Overlay, CD, and Advanced Packaging Applications, Inspection
OCD Analysis		
NanoDiffract	Semiconductor	OCD
NanoGen	Semiconductor	OCD
Integrated Systems		
IMPULSE/IMPULSE+	Semiconductor	Film Thickness, CD
Trajectory	Semiconductor, Solar PV	Film Thickness, Composition
Materials Characterization Systems		
ECVPro	Compound Semiconductor, Solar PV, HB-LED	Electrical Properties
HL5500	Compound Semiconductor, Solar PV, HB-LED	Electrical Properties
QS1200	Substrate Semiconductor, Solar PV	Substrate Properties, Film Composition and Thickness
QS2200/3300	Substrate Semiconductor	Substrate Properties, Film Composition
NanoSpec® II	Semiconductor	Film Thickness (Tabletop)
RPMBlue™	HB-LED	Epitaxial Layer Properties
Stratus	Semiconductor	Substrate Properties, Film Composition and Thickness (Tabletop)

See Note 16 of our consolidated financial statements in Item 8, "Financial Statements and Supplementary Data," for revenues by product type, which information is incorporated by reference here.

Customers

We sell our metrology and inspection systems worldwide to semiconductor manufacturers, and producers of solid state devices. The majority of our systems are sold to customers located in Asia and the United States.

The following customers accounted for 10% or more of our total net revenues:

	2016	2015	2014
Micron Technology, Inc.	20.3%	15.8%	10.4%
Intel Corporation	18.0%	***	12.6%
SK Hynix	15.3%	10.7%	12.2%

Taiwan Semiconductor Manufacturing Company Limited	10.0%	19.4%	***
Samsung Electronics Co. Ltd.	***	13.2%	26.9%
Toshiba Corporation	***	10.2%	***

***The customer accounted for less than 10% of total net revenues during the period.

Sales and Marketing

We believe that the capability for direct sales and support is beneficial for developing and maintaining close customer relationships and for rapidly responding to changing customer requirements. We provide local direct sales, service and application support through our worldwide offices located in the United States, South Korea, Japan, Taiwan, China, Singapore and France, and work with selected dealers and sales representatives in Asia, in the United States and other countries. Our applications team is comprised of technically experienced sales engineers who are knowledgeable in the use of metrology systems generally and the unique features and advantages of our specific products. Supported by our technical applications team, our sales and support teams work closely with our customers to offer cost-effective solutions to complex measurement and process problems.

Net revenues from customers located in the United States and in foreign countries, as a percentage of total net revenues were as follows:

	2016	2015	2014
United States	14%	20%	22%
China	20%	9%	17%
South Korea	20%	16%	25%
Singapore	17%	9%	5%
Japan	12%	17%	9%
Taiwan	12%	25%	12%
All other countries	5%	4%	10%

See Note 16 of our consolidated financial statements in Item 8, "Financial Statements and Supplementary Data," for segment and geographical financial information, including revenues and long-lived assets by geographic region, and our consolidated financial statements for net revenue information, which is incorporated by reference here.

Customer Service and Support

We believe that customer service and technical support for our systems are important factors that distinguish us from our competitors and are essential to building and maintaining close, long-term relationships with our customers. We provide a standard one-year warranty on parts and labor for most of our products. We provide system support to our customers through factory technical support and globally deployed field service personnel. The factory technical support operations provide customers with telephonic technical support access, direct training programs, operating manuals and other technical support information to enable effective use of our metrology and measurement instruments and systems. We have field service operations based in various locations throughout the United States, South Korea, Taiwan, China, Japan, Singapore, Israel, France, Italy, and Germany.

Service revenues, including sales of replacement parts, represented 16%, 22%, and 20% of total net revenues in 2016, 2015 and 2014, respectively.

Backlog

As of December 31, 2016 and December 26, 2015, our backlog was $28.5 million and $32.1 million, respectively. Backlog includes orders received and booked, both shipped and not yet recognized in revenue, and not shipped, for products, services and upgrades where written customer requests have been received and we expect to ship and/or recognize revenue within 12 months. Orders are subject to cancellation or delay by the customer subject to possible penalties. However, historically, order cancellations have not been significant. Because orders presently in backlog could be cancelled or rescheduled and some orders can be received and shipped within the same quarter, we do not believe that current backlog is an accurate indication of our future revenues or financial performance.

Competition

We offer different products for various semiconductor manufacturing process steps, and several of our products extend across the same process flow. However, for process control of each of these process steps, we have multiple competitors. In every market in which we participate, the global semiconductor equipment industry is intensely competitive, and driven by rapid technological adoption cycles. Our ability to effectively compete depends upon our

ability to continually improve our products, applications and services, and our ability to develop new products, applications and services that meet constantly evolving customer requirements.

We believe that our competitive position in each of our markets is based on the ability of our products and services to address customer requirements related to numerous competitive factors. Competitive selections are based on many factors involving technological innovation, productivity, total cost of ownership of the system, including impact on end of line yield, price, product performance and throughput capability, quality, reliability and customer support.

In automated systems for the semiconductor industry, our principal competitors are KLA-Tencor Corporation (“KLA-Tencor”) and Nova Measuring Instruments Ltd. ("Nova") for thin film and critical dimension metrology, and Bruker Corp. and other suppliers for advanced packaging. Our primary competitor in integrated systems is Nova. The opto-electronics and discrete device are addressed primarily by our material characterization systems, are served by numerous competitors and no single competitor or group of competitors has established a majority position.

Manufacturing

Our manufacturing operations are in Milpitas, California and at various contract manufacturers around the world. It is our strategy to outsource all assemblies that do not contain elements that we believe lead to a direct competitive advantage. The majority of our automated and integrated products are currently manufactured at our Milpitas facility. We also use contract manufacturers in other locations in the United States, China, Israel and Japan. We currently do not expect our manufacturing operations to require additional major investments in capital equipment.

We produce key parts and components and make reasonable efforts to ensure that any externally purchased parts or raw materials are available from multiple suppliers, but this is not always possible. Certain components, subassemblies and services necessary for the manufacture of our systems are obtained either from a sole supplier or limited group of suppliers. We also have an established long-term supply agreement for supply of our spectroscopic ellipsometers and interferometers for use in our products. Although we seek to reduce our dependence on sole and limited source suppliers, partial or complete loss of these sources could disrupt production, delay scheduled deliveries to customers and have a material adverse effect on our revenues and results of operations.

Research and Development

We continue to invest in research and development ("R&D") to provide our customers with products that add value to their manufacturing processes and that provide a better and differentiated solution than our competitors, so that our products stay in the forefront of current and future market demands. Whether it is for an advancement of current technology, yield and manufacturing improvement, enabling new end device technology, or the development of a new application in our core or emerging markets, we are committed to product excellence and longevity.

In our automated markets, our R&D efforts resulted in the successful product launch of the Atlas III product in the marketplace, our flagship product for OCD. The Atlas III product provides enhanced OCD capability with a significantly lower cost of ownership model. In our integrated markets, the IMPULSE system has been further developed for inline lithography track configuration to extend our tool of record position for lithography OCD. The IMPULSE+ system, which incorporates performance and productivity enhancements to the IMPULSE was introduced in 2015 and has been qualified across numerous OEM platforms.

Our research and development expenses for fiscal 2016, 2015 and 2014 were $31.4 million, $32.7 million and $33.8 million, respectively.

Patents and Intellectual Property

Our success depends in large part on the technical innovation of our products and protecting such innovations through a variety of methods. We actively pursue a program of filing patent applications to seek protection of technologically sensitive features of our metrology and inspection systems.

As of December 31, 2016, we had 212 patents, including foreign patents, with expiration dates ranging from 2016-2035. We believe that our success will depend to a great degree upon innovation, technological expertise and our ability to adapt our products to new technology. While we attempt to establish our intellectual property rights through patents and trademarks and protect intellectual property rights through non-disclosure agreements, we may not be able to fully protect our technology, and competitors may be able to develop similar technology independently. Others may obtain patents and assert them against us. In addition, the laws of certain foreign countries may not protect our intellectual property to the same extent as do the laws of the United States. From time to time we receive communications from third parties asserting that our metrology systems may contain design features that the third parties claim may infringe upon their proprietary rights.

Employees

At December 31, 2016, we employed 532 persons worldwide with sales, applications and service support in key geographic areas aligned with our customer locations. None of our employees are represented by a union and we have never experienced a work stoppage as a result of union actions. We consider our employee relations to be good. Many of our employees have specialized skills that are of value to us. Our future success will depend in large part upon our ability to attract, retain and motivate highly skilled scientific, technical and managerial personnel, who are in great demand in our industry.

Environmental Matters

Our operations are subject to various federal, state and local environmental protection regulations governing the use, storage, handling and disposal of hazardous materials, chemicals, and certain waste products. We believe that compliance with federal, state and local environmental protection regulations will not have a material adverse effect on our capital expenditures, earnings and competitive and financial position.

In the event that we fail to comply with such laws and regulations, we could be liable for damages, penalties and fines. We further discuss the impact of environmental regulation under “Risk Factors- We are subject to various environmental laws and regulations that could impose substantial costs upon us and may harm our business, operating results and financial condition.” in Item 1A.

Executive Officers of the Registrant

The names of our executive officers and their ages, titles and biographies as of February 24, 2017, are set forth below:

Name	Age	Position
Timothy J. Stultz, Ph.D.	69	President, Chief Executive Officer and Director
Jeffrey Andreson	55	Chief Financial Officer
S. Mark Borowicz, Ph.D.	44	Executive Vice President, Business Operations
Rollin Kocher	51	Sr. Vice President, Commercial Operations
Kevin Heidrich	46	Sr. Vice President, Strategic Marketing and Business Development
Janet Taylor	59	General Counsel

Dr. Timothy J. Stultz has served as President, Chief Executive Officer and director of Nanometrics Incorporated since August 2007. Dr. Stultz has more than 30 years of executive management experience. Prior to joining Nanometrics, Dr. Stultz was President and Chief Executive Officer of Imago Scientific Instruments Corporation, a supplier of proprietary 3-D atom probe microscopes to the research, materials and microelectronics industries; President and Chief Executive Officer for ThauMDx, a developer of diagnostic systems for the healthcare industry; and Vice President and General Manager of Veeco Instruments' Metrology and Instrumentation Business. Dr. Stultz received his B.S., M.S. and Ph.D. in Materials Science and Engineering from Stanford University.

Jeffrey Andreson joined Nanometrics as Chief Financial Officer in September 2014. Prior to Nanometrics, Mr. Andreson served at Intevac Corporation from August 2007 to September 2014 most recently as Executive Vice President, Finance and Administration, Chief Financial Officer, Treasurer and Secretary from August 2007 and in this role, was responsible for finance, information services and legal. From June to August 2007, Mr. Andreson served as Executive Vice President, Finance at Intevac. Prior to joining Intevac, Mr. Andreson served 12 years with Applied Materials in various controllership positions within the company most recently as Managing Director and Controller of the $2 billion Applied Materials’ Global Services product group. Mr. Andreson joined Applied Materials in 1995 and held a number of senior financial positions, including: Managing Director, Global Financial Planning and Analysis; Controller, Metron Subsidiary; Controller, North American Sales and Service; and Controller, Volume Manufacturing. From 1989 through 1995, Mr. Andreson held various roles at Measurex Corporation. Mr. Andreson holds an MBA from Santa Clara University and a B.S. degree in finance from San Jose State University.

Dr. S. Mark Borowicz joined Nanometrics as Senior Vice President, Product & Field Operations Group in March 2013. In September 2016, Dr. Borowicz was promoted to Executive Vice President, Business Operations. Prior to

Nanometrics, Dr. Borowicz held senior management positions in business development and product marketing at KLA-Tencor, Inc. from 2000 to 2013, where he was responsible for sales and product management for inspection and metrology businesses. Dr. Borowicz has seven patents in the field of electron beam technologies. Dr. Borowicz holds a B.S. in Mechanical Engineering from West Virginia University and a Ph.D. in Materials Engineering from Auburn University.

Rollin Kocher joined Nanometrics in March 2013 as Vice President of Worldwide Sales and Service. In September 2016, Mr. Kocher was promoted to Senior Vice President, Commercial Operations. Prior to joining Nanometrics, Mr. Kocher held several senior management positions over 17 years at KLA-Tencor, including Global Sales for Films and Scatterometry, Sales for Taiwan, North America and Europe, and Sr. Director of Sales for the Samsung Business Unit. His last position at KLA-Tencor was General Manager of the Samsung Business Unit, and in that capacity, was responsible for Sales, Marketing, Applications, and Service. Mr. Kocher holds a B.S. degree in Electrical Engineering Technology from the University of North Texas.

Kevin Heidrich, Sr. Vice President, Strategic Marketing and Business Development, joined Nanometrics in 2006. Mr. Heidrich has participated in many functions, expanding his scope to include new product development, corporate marketing, product marketing and business development. Mr. Heidrich is now responsible for both corporate strategy and marketing, as Nanometrics expands its

overall solution space within process control metrology. Prior to Nanometrics, Mr. Heidrich spent a decade at Intel Corporation in a variety of roles including process research and development at Intel's Technology Development facility. Mr. Heidrich received B.S. and M.S. degrees from the Colorado School of Mines in Chemical Engineering.

Janet Taylor joined Nanometrics as General Counsel in July 2015. Ms. Taylor served as Senior Vice President, General Counsel and Company Secretary of STATS ChipPAC Ltd., from June 2005 to June 2015, where she was responsible for all legal matters, including corporate governance, intellectual property, litigation and securities compliance. Prior to joining STATS ChipPAC Ltd, Ms. Taylor was engaged in transactional practices at international law firms in New York, Singapore and London. Ms. Taylor was admitted to the Bar in New York in 1990 and in Singapore in 2010. Ms. Taylor holds a J.D. from the Harvard Law School and a B.A. in History from the University of Texas at Austin.

ITEM 1A. RISK FACTORS

In addition to the other information contained in this Annual Report on Form 10-K, we have identified the following risks and uncertainties that may have a material adverse effect on our business, financial condition or results of operations. Investors should carefully consider the risks described below before making an investment decision. The risks described below are not the only ones we face. Additional risks not currently known to us or that we currently believe are immaterial may also impair our business operations. Our business could be harmed by any of these risks. The trading price of our common stock could decline due to any of these risks and investors may lose all or part of their investment. This section should be read in conjunction with the Consolidated Financial Statements and Notes thereto, and Management's Discussion and Analysis of Financial Condition and Results of Operations contained in this Annual Report on Form 10-K.

The Global economic conditions and the cyclical nature of the semiconductor industry can reduce demand for our products which in turn may cause us to operate unprofitably and may cause reductions in available cash, and may negatively impact our financial performance.

Global economic conditions, the gradual recovery of the global economy and the cyclical nature of the semiconductor industry have impacted and could impact future customer demand for our products and our financial performance. Demand for our products is largely dependent on our customers' capital spending on semiconductor equipment, which depends, in large part, on consumer spending, required manufacturing capacity, and customer access to capital. Economic uncertainty, unemployment, higher interest rates, higher tax rates, fluctuations in foreign currency exchange rates, and other economic factors may lead to a decrease in consumer spending and may cause certain customers to cancel existing orders or delay placing orders. If we are unable to timely and appropriately adapt to changes resulting from difficult economic conditions, it may cause volatility in our operating results, business, and financial condition, and results of operations may be adversely affected.

In addition, demand for our products is highly inelastic which means we have little ability to control product revenues created by customer demand for more capacity. The market for our products is characterized by constant and rapid technological change, price erosion, product obsolescence, evolving standards, short product life cycles and significant volatility in supply and demand. Due to the inelastic nature of demand in the semiconductor industry, we may need to take actions to reduce costs in the future, which could reduce our ability to significantly invest in research and development at levels we believe are necessary. If we are unable to effectively align our cost structure with prevailing market conditions, our business, financial condition and results of operations may be materially and adversely affected.

We may also experience supplier or customer issues as a result of adverse macroeconomic conditions. If our customers have difficulties in obtaining capital or financing, this could result in lower sales. Customers with liquidity issues could also result in an increase in bad debt expense. These conditions could also affect our key suppliers, which could affect their ability to supply parts and result in delays of our customer shipments.

Our largest customers account for a substantial portion of our net revenues, and our net revenues would materially decline if one or more of these customers were to purchase significantly fewer of our systems.

Historically, a significant portion of our net revenues in each quarter and each year has been derived from sales to relatively few customers, and we expect this trend to continue. In fiscal year 2016, four customers represented 20%, 18%, 15% and 10%, respectively, or collectively 63%, of our total net revenues. There are only a limited number of large companies operating in the semiconductor manufacturing industry and our market is characterized by continued consolidation in the customer base. Accordingly, we expect that we will continue to depend on a small number of large customers for a significant portion of our net revenues for the foreseeable future. If our current relationships with our large customers are impaired, or if we are unable to develop similar collaborative relationships with important

customers in the future, our net revenues could decline significantly. In addition, because there are a limited number of customers, customers may seek concessions related to price, terms and conditions and intellectual property. Any of these changes could negatively impact our financial performance and results of operations.

We rely on a limited number of outside suppliers and subcontractors to supply certain components and subassemblies, and on a single or a limited group of outside suppliers for certain materials for our products, which could result in a potential inability to obtain an adequate supply of required components due to the suppliers' failure or inability to provide such components in a timely manner, or at all, and reduced control over pricing and timely delivery of components and materials, any of which could adversely affect our results of operations.

Our manufacturing activities consist of integrating, assembling and testing components and subassemblies. We rely on a limited number of outside suppliers and subcontractors to manufacture certain components and subassemblies. We order one of the most

critical components of our technology, the spectroscopic ellipsometer component incorporated into our advanced measurement systems, from external suppliers.

We procure some of our other critical systems' components, subassemblies and services from single suppliers or a limited group of outside suppliers in order to ensure overall quality and timeliness of delivery. Many of these components and subassemblies have significant production lead times. To date, we have been able to obtain adequate supplies of components and subassemblies for our systems in a timely manner. However, disruption or termination of certain of these sources could have a significant adverse impact on our ability to manufacture our systems. In addition, our failure to timely use components in our manufacturing processes due to delays or cancellation of orders may lead to write-downs of inventory. A disruption in supply or inventory window would, in turn, have a material adverse effect on our business, financial condition and results of operations. Our reliance on a sole supplier or a limited group of suppliers and our reliance on subcontractors involve several risks, including:

- a potential inability to obtain an adequate supply of required components due to the suppliers' failure or inability to provide such components in a timely manner, or at all; and
- reduced control over pricing and timely delivery of components.

Although the timeliness, yield and quality of deliveries to date from our subcontractors have been acceptable, manufacture of certain of these components and subassemblies is an extremely complex process, and long lead times are required. Any inability to obtain adequate deliveries or any other circumstance that would require us to seek alternative sources of supply or to manufacture such components internally could delay our ability to ship our products, which could damage relationships with current and prospective customers and have a material adverse effect on our business, financial condition and results of operations.

Some of our current and potential competitors have significantly greater resources than we do, and increased competition could impair sales of our products.

We operate in the highly competitive semiconductor industry and face competition from a number of companies, some of which have greater financial, engineering, manufacturing, research and development, marketing and customer support resources than we do. As a result, our competitors may be able to respond more quickly to new or emerging technologies or market developments by devoting greater resources to the development, promotion and sale of products, which could impair sales of our products. Moreover, there has been merger and acquisition activity among our competitors and potential competitors. These transactions by our competitors and potential competitors may provide them with a competitive advantage over us by enabling them to rapidly expand their product offerings and service capabilities to meet a broader range of customer needs. Many of our customers and potential customers in the semiconductor industry are large companies that require global support and service for their metrology systems. Some of our larger or more geographically diverse competitors might be better equipped to provide this global support and service.

Because of the high cost of switching equipment vendors in our markets, it may be difficult for us to attract customers from our competitors even if our metrology systems are superior to theirs.

We believe that once a semiconductor customer has selected one vendor's metrology system, the customer generally relies upon that system and, to the extent possible, subsequent generations of the same vendor's system, for the life of the application. Once a vendor's metrology system has been installed, a customer must often make substantial technical modifications and may experience downtime to switch to another vendor's metrology system. Accordingly, unless our systems offer performance or cost advantages that outweigh a customer's expense of switching to our systems; it will be difficult for us to achieve significant sales from that customer once it has selected another vendor's system for an application.

Our integrated metrology systems are integrated onto systems sold independently by Wafer Fabrication Equipment Suppliers, and a decrease in sales by these suppliers, or the development of competing systems by these suppliers, could harm our business.

We believe that sales of integrated metrology systems will continue to be an important source of our net revenues. Sales of our integrated metrology systems depend upon the ability of a small number of Wafer Fabrication Equipment Suppliers to sell semiconductor manufacturing equipment products that are compatible with our metrology systems as components. If these suppliers, such as Applied Materials, Inc., Lam Research Corporation and Tokyo Electron, are unable to sell such products, if they choose to focus their attention on products that do not integrate our systems, or if they choose to develop competing systems, our business could suffer.

We are subject to order and shipment uncertainties. Our profitability will decline if we fail to accurately forecast customer demand when managing inventory.

We generally sell our products on the basis of purchase orders rather than long-term purchase commitments from our customers. Our customers can typically cancel purchase orders or defer product shipments for some period without incurring liabilities to us. We typically plan production and inventory levels based on internal forecasts of customer demand, which can be highly unpredictable and can fluctuate substantially, which could lead to excess inventory write-downs and resulting negative impacts on gross margin and net income. We have limited visibility into our customers' inventories, future customer demand and the product mix that our customers will require, which could adversely affect our production forecasts and operating margins. In addition, innovation in our industry could render significant portions of our inventory obsolete. If we overestimate our customers' requirements, we may have excess inventory, which could lead to obsolete inventory and unexpected costs. Conversely, if we underestimate our customers' requirements, we may have inadequate inventory, which could lead to foregone revenue opportunities, loss of potential market share and damage to customer relationships as product deliveries may not be made on a timely basis, disrupting our customers' production schedules. In response to anticipated long lead times to obtain inventory and materials from outside suppliers and foundries, we periodically order materials in advance of customer demand. This advance ordering has in the past and may in the future result in excess inventory levels or unanticipated inventory write-downs if expected orders fail to materialize, or other factors make our products less saleable. In addition, any significant future cancellation or deferral of product orders could adversely affect our revenue and margins, increase inventory write-downs due to obsolete inventory, and adversely affect our operating results and stock price.

If we do not manage our supply chain effectively, our operating results may be adversely affected.

We need to continually evaluate our global supply chains and assess opportunities to reduce costs. We must also enhance quality, speed and flexibility to meet changing demand for our products and product mix and uncertain market conditions. Our success also depends in part on refining our cost structure and supply chains so that we have flexibility and are able to protect and improve profitability. To improve our margins on a product, we will need to establish high volume supply agreements with our vendors. We cannot be certain that we will be able to timely negotiate vendor supply agreements on improved terms and conditions, or at all. Failure to achieve the desired level of cost reductions could adversely affect our financial results. Despite our efforts to control costs and increase efficiency in our facilities, changes in demand could still cause us to realize lower operating margins and profitability.

If we choose to acquire new and complementary businesses, or products or technologies instead of developing them ourselves, we may be unable to complete these acquisitions or may not be able to successfully integrate an acquired business in a cost-effective and non-disruptive manner.

Our success depends on our ability to continually enhance and broaden our product offerings in response to changing technologies, customer demands and competitive pressures. To achieve this, from time to time we have acquired complementary businesses, products, or technologies instead of developing them ourselves and may choose to do so in the future. If we do identify suitable transactions in the future, we may not be able to complete them on commercially acceptable terms, or at all. We also face intense competition for acquisitions from other acquirers in our industry. These competing acquirers may have significantly greater financial and other resources than us, which may prevent us from successfully pursuing a transaction.

Potential risks associated with acquisitions could include, among other things:

- our inability to realize the benefits or cost savings that we expect to realize as a result of the acquisition;
- diversion of management's attention;
- our inability to successfully integrate our businesses with the business of the acquired company;

- motivating, recruiting and retaining executives and key employees; conforming standards, controls, procedures and policies, business cultures and compensation structures among our company and the acquired company;
- consolidating and streamlining sales, marketing and corporate operations;
- potential exposure to unknown liabilities of acquired companies;
- loss of key employees and customers of the acquired business; and
- managing tax costs or inefficiencies associated with integrating our operations following completion of the acquisitions.

If an acquisition is not successfully completed or integrated into our existing operations, our business, financial condition and results of operations could be adversely impacted.

In addition, to finance any acquisitions we may be required to raise additional funds through public or private equity or debt financings; however:

- to obtain such financing we may be forced to obtain financing on terms that are not favorable to us and, in the case of equity or convertible debt financing, the financing may result in dilution to our stockholders; or
- such financing may not be available to us at all, which could prevent us from entering into or completing the acquisition.

Our success depends on the performance of key personnel, including our senior management and on our ability to identify, hire and retain key management personnel.

We believe our continued ability to recruit, hire, retain and motivate highly-skilled engineering, operations, sales, administrative and managerial personnel is key to our future success. Competition for these employees is intense, particularly with respect to attracting and retaining qualified technical and senior management personnel. We do not have employment agreements with key members of our technical staff and our senior management team. Further, we do not have key person life insurance on any of our executives and these individuals or other key employees may leave us. We have experienced turnover in our senior management team in the past. Our business may be harmed if we are unable to recruit, retain and effectively integrate our senior management into our business operations and our ability to implement our strategy could be compromised.

If we deliver systems with defects, our credibility will be harmed, revenue from, and market acceptance of, our systems will decrease and we could expend significant capital and resources as a result of such defects.

Our products are complex and frequently operate in high-performance, challenging environments. Notwithstanding our internal quality specifications, our systems have sometimes contained errors, defects and bugs, when introduced. If we deliver systems with errors, defects or bugs, our credibility and the market acceptance and sales of our systems would be harmed. Further, if our systems contain errors, defects or bugs, we may be required to expend significant capital and resources to alleviate such problems and incur significant costs for product recalls and inventory write-offs. Defects could also lead to product liability lawsuits against us or against our customers. We have agreed to indemnify our customers in some circumstances against liability arising from defects in our systems. In the event of a successful product liability claim, we could be obligated to pay damages significantly in excess of our product liability insurance limits.

If we experience significant delays in shipping our products to our customers, our business and reputation may suffer.

Our products are complex and require technical expertise to design and manufacture properly. Various problems occasionally arise during the manufacturing process that may cause delays and/or impair product quality. Any significant delays stemming from the failure of our products to meet or exceed our internal quality specifications, or for any other reasons, would delay our shipments. Shipment delays could harm our business and reputation in the industry.

Net average selling prices of our products may decrease over time, which could have a material adverse effect on our revenues and profitability.

It is common in our industry for the average selling price of a given product to decrease over time as production volumes increase, competing products are developed or new technologies featuring higher performance or lower cost emerge. To combat the negative effects that erosion of average selling prices have had in the past and may in the future have on our net revenues, we attempt to actively manage the prices of our existing products and regularly introduce new process technologies and products in the market that exhibit higher performance, that are in demand, or that lower manufacturing cost. Failure to maintain our current prices or to successfully execute on our new product

development strategy will cause our net revenues and gross margin to decline, which adversely affect our operating results and stock price.

Third party infringement claims could be costly to defend, and successful infringement claims by third parties could result in substantial damages, lost product sales and the loss of important intellectual property rights by us.

The semiconductor industry is generally subject to frequent litigation regarding patents and other intellectual property rights. Our commercial success depends, in part, on our ability to avoid infringing or misappropriating patents or other proprietary rights owned by third parties. From time to time we may receive communications from third parties asserting that our metrology systems may contain design features which are claimed to infringe on their proprietary rights. Our new or current products may infringe valid intellectual property rights, but even if our products do not infringe, we may be required to expend significant sums of money to defend against infringement claims, or to actively protect our intellectual property rights through litigation. In the event that a claim is made and there is an adverse result of any intellectual property rights litigation, we could be required to pay substantial damages for

infringement, expend significant resources to develop non-infringing technology, incur material liability for royalty payments or fees to obtain licenses to the technology covered by the litigation, or be subjected to an injunction, which could prevent us from selling our products and materially and adversely affect our net revenues and results of operations. We cannot be sure that we will be successful in any such non-infringing development or that any such license would be available on commercially reasonable terms, if at all. Any claims relating to the infringement of third-party proprietary rights, even if not meritorious, could result in costly litigation, lost sales or damaged customer relationships, and diversion of management's attention and resources.

Our intellectual property may be infringed by third parties despite our efforts to protect it, which could threaten our future success and competitive position and harm our operating results.

Our future success and competitive position depend in part upon our ability to obtain and maintain proprietary technology for our principal product families, and we rely, in part, on patent, trade secret and trademark law to protect that technology. If we fail to adequately protect our intellectual property, it will be easier for our competitors to sell competing products. We own or may license patents relating to our systems, and have filed applications for additional patents. Any of our pending patent applications may be rejected, and we may not in the future be able to develop additional proprietary technology that is patentable. In addition, the patents we own, have been issued or licensed, may not provide us with competitive advantages and may be challenged by third parties. Third parties may also design around these patents.

In addition to patent protection, we rely upon trade secret protection for our confidential and proprietary information and technology. We routinely enter into confidentiality agreements with our employees. However, in the event that these agreements may be breached, we may not have adequate remedies. Our confidential and proprietary information and technology might also be independently developed by or become otherwise known to third parties.

We may be required to initiate litigation to enforce patents issued to or licensed by us, or to determine the scope or validity of a third party's patent or to enforce trade secret, confidentiality or other proprietary rights. Any such litigation, regardless of outcome, could be expensive and time consuming, and could subject us to significant liabilities or require us to re-engineer our product or obtain expensive licenses from third parties, any of which would adversely affect our business and operating results.

Despite our efforts to protect our proprietary rights, unauthorized parties may attempt to copy or otherwise obtain or use our products or technology. Our ability to enforce our patents and other intellectual property is limited by our financial resources and is subject to general litigation risks. If we seek to enforce our rights, we may be subject to claims that the intellectual property rights are invalid, are otherwise not enforceable or are licensed to the party against whom we assert a claim. In addition, our assertion of intellectual property rights could result in the other party seeking to assert alleged intellectual property rights of its own against us, which is a frequent occurrence in such litigation.

Our efforts to protect our intellectual property may be less effective in some foreign countries where intellectual property rights are not as well protected as in the United States.

In 2016, 2015, and 2014, 86%, 80% and 78%, respectively, of our total net revenues were derived from sales to customers in foreign countries, including certain countries in Asia, such as Japan, South Korea, China and Taiwan. The laws of some foreign countries do not protect our proprietary rights to as great an extent as do the laws of the United States, and many U.S. companies have encountered substantial problems in protecting their proprietary rights against infringement in these countries. If we fail to adequately protect our intellectual property in these countries, it would be easier for our competitors to sell competing products and our business would suffer.

Variations in the amount of time it takes for us to sell our systems may cause volatility in our operating results, which could cause our stock price to decline.

Variations in the length of our sales and product acceptance cycles could cause our revenues to fluctuate widely from period to period. Our customers generally take long periods of time to evaluate our metrology systems. We expend significant resources educating and providing information to our prospective customers regarding the uses and benefits of our systems. The length of time that it takes for us to complete a sale depends upon many factors, including:

- the efforts of our sales force and our independent sales representatives;
- the complexity of the customer's metrology needs;
- the internal technical capabilities and sophistication of the customer;

- the customer's budgetary constraints; and
- the quality and sophistication of the customer's current processing equipment.

Because of the number of factors influencing the sales process, the period between our initial contact with a customer and the time at which we recognize revenue from that customer, if at all, varies widely. Our sales cycles, including the time it takes for us to build a product to customer specifications after receiving an order, typically range from three to nine months. Occasionally our sales cycles can be much longer, particularly with customers in Asia who may require longer evaluation and acceptance periods. During the sales cycles, we commit substantial resources to our sales efforts in advance of receiving any revenue, and we may never receive any revenue from a customer despite our sales efforts.

If we do complete a sale, customers often purchase only one of our systems and then evaluate its performance for a lengthy period of time before purchasing additional systems. The purchases are generally made through purchase orders rather than through long-term contracts. The number of additional products that a customer purchases, if any, depends on many factors, including a customer's capacity requirements, and/or shifting to more and advanced manufacturing processes that require more or different products to control. If they change their rate of capacity or have technological change, we cannot compensate for this fluctuation in demand by adjusting the price of our products. The period between a customer's initial purchase and any subsequent purchases and acceptance is unpredictable and can vary from three months to a year or longer. Variations in the length of this period could cause fluctuations in our operating results, which could adversely affect our stock price.

Relatively small fluctuations in our system sales volume may cause our operating results to vary significantly each quarter.

During any quarter, a significant portion of our revenue is derived from the sale of a relatively small number of systems. Our automated metrology systems can be priced from $900,000 to $2,100,000 per system, and our integrated metrology systems can be priced up to $500,000 per system. Accordingly, a small change in the number or mix of systems that we sell could cause significant changes in our operating results.

Lack of market acceptance for our products may affect our ability to generate revenue and may harm our business.

We have invested substantial time and resources into the development of new products, services and technologies. However, we cannot accurately predict the future level of acceptance of our products and services by our customers. As a result, we may not be able to generate anticipated revenue from sales of these products and services, or future new products, services and improvements.

We depend on new products and processes for our success. Consequently, we are subject to risks associated with rapid technological change.

Rapid technological changes in semiconductor manufacturing processes subject us to increased pressure to develop technological advances enabling such processes. We believe that our future success depends in part upon our ability to develop and offer new products with improved capabilities and to continue to enhance our existing products. We cannot make assurances if or when the products and solutions where we have focused our research and development expenditures will become commercially successful. If new products have reliability or quality problems, our performance could be impacted by reduced orders, higher manufacturing costs, and delays in acceptance or payment for new products, and additional service and warranty expenses. We might not be able to develop and manufacture new products successfully, or new products that we introduce may fail in the marketplace. Our failure to complete commercialization of these new products in a timely manner could result in unanticipated costs and inventory obsolescence, which would adversely affect our financial results. Any significant delay in releasing new systems could adversely affect our reputation, give a competitor a first-to-market advantage or allow a competitor to achieve greater market share.

To develop new products and processes, we expect to continue to make significant investments in research and development and to pursue joint development relationships with customers, suppliers or other members of the industry. We must manage product transitions and joint development relationships successfully, as introduction of new products could adversely affect our sale of existing products.

We are subject to risks associated with our competitors' strategic relationships and their introduction of new products, and we may lack the financial resources or technological capabilities of certain of our competitors needed to capture increased market share.

We expect to face significant competition from multiple current and future competitors. We believe that other companies are developing systems and products that are competitive to our products and are planning to introduce new products, which may affect our ability to sell our existing or future products. We face a greater risk if our competitors enter into strategic relationships with

leading semiconductor manufacturers covering products similar to those we sell or may develop, as this could adversely affect our ability to sell products to those manufacturers.

Some of our competitors have substantially greater financial resources and more extensive engineering, manufacturing, marketing and customer service and support resources than we do and therefore have the potential to increasingly dominate the semiconductor equipment industry. These competitors may deeply discount products similar to those that we sell, challenging or even exceeding our ability to make similar accommodations and threatening our ability to sell those products. As a result, we may fail to continue to compete successfully worldwide.

In addition, our competitors may provide innovative technology that may have performance advantages over systems we currently offer or may offer in the future. They may be able to develop products comparable or superior to those that we offer or may adapt more quickly to new technologies or evolving customer requirements. In particular, while we currently are developing additional product enhancements that we believe will address future customer requirements, we may fail in a timely manner to complete the development or introduction of these additional product enhancements successfully, or these product enhancements may not achieve market acceptance or be competitive. Accordingly, we may be unable to continue to compete in our markets and competition may intensify, or future competition, operating results, financial condition, and/or cash flows could suffer.

If we are unable to adjust the scale of our business in response to rapid changes in demand in the semiconductor equipment industry, our operating results and our ability to compete successfully may be impaired.

The business cycle in the semiconductor equipment industry has historically been characterized by frequent periods of rapid change in demand that challenge our management to adjust spending and resources allocated to operating activities. During periods of growth or decline in demand for our products and services, we face significant challenges in maintaining adequate financial and business controls, management processes, information systems and procedures and in training, managing, and appropriately sizing our supply chain, our work force, and other components of our business on a timely basis. Our success will depend, to a significant extent, on the ability of our executive officers and other members of our senior management to identify and respond to these challenges, our gross margins and earnings may be impaired during periods of demand decline, and we may lack the infrastructure and resources to scale up our business to meet customer expectations and compete successfully during periods of demand growth.

We manufacture all of our systems at a limited number of facilities, and any prolonged disruption in the operations of those facilities could reduce our revenues.

We produce all of our systems in our manufacturing facilities located in Milpitas, California. We use contract manufacturers in China, Israel, Japan and the United States. Our manufacturing processes are highly complex and require sophisticated, costly equipment and specially designed facilities. As a result, any prolonged disruption in the operations of our manufacturing facilities, such as those resulting from acts of war, terrorism, political instability, health epidemics, fire, earthquake, flooding or other natural disaster could seriously harm our ability to satisfy our customer order deadlines.

We may outsource select manufacturing activities to third-party service providers, which decreases our control over the performance of these functions and quality of our products.

We may outsource product manufacturing to third-party service providers. Outsourcing reduces our control over the performance of the outsourced functions. Dependence on outsourcing may also adversely affect our ability to bring new products to market. If we do not effectively manage our outsourcing strategy or if third party service providers do not perform as anticipated, we may experience operational difficulties, increased costs, manufacturing interruptions or inefficiencies in the operation of our supply chain, any or all of which could delay our delivery of products to our

customers, and materially and adversely affect our business, financial condition, and results of operations.

Our results of operations could vary as a result of the methods, estimates and judgments we use in applying our accounting policies.

The methods, estimates and judgments we use in applying our accounting policies have a significant impact on our results of operations. See “Note 1. Nature of Business, Basis of Presentation and Significant Accounting Policies” in Part II, Item 8, Note 1 of our consolidated financial statements. These methods, estimates and judgments are, by their nature, subject to substantial risks, uncertainties and assumptions, and factors may arise over time that leads us to change our methods, estimates and judgments. Changes in these methods, estimates and judgments could significantly affect our results of operations. In particular, our operating results have been affected by changes in our valuation allowance against our deferred tax assets, the calculation of share-based compensation expense and by the testing and potential impairment of long-lived assets such as goodwill and other intangible assets. For example, during the year ended December 31, 2016, we recorded a $27.4 million release of valuation allowance against our U.S, certain state

and certain foreign deferred tax assets as we determined, based upon an evaluation of all available objectively verifiable evidence, including but not limited to our operations, current earnings and anticipated future earnings that a release is required. The valuation allowance release had a significant impact to our operating results. The process of evaluating the valuation allowance is highly subjective and requires significant judgment, and our results of operations could vary significantly from estimates. To the extent that we believe it is more likely that we will not realize our deferred tax assets, our financial statements will reflect another significant change to our tax provision and operating results.

Changes in our effective income tax rate could affect our results of operations.

Fluctuations in our effective tax rate may affect operating results. Our effective tax rate is subject to fluctuation based on a variety of factors, such as:

- the jurisdictions in which our profits are determined to be earned and taxed;
- changes to tax laws, regulations and interpretations;
- our ability to obtain approval and the timing of receipt of approval from the Internal Revenue Service of tax elections;
- changes in the valuation of our deferred tax assets and liabilities;
- increases in expenses not deductible for tax purposes, including write-offs of acquired in-process research and development and impairment of goodwill in connection with acquisitions and
- changes in available tax credits.

Any material increase in our effective tax rate would adversely affect our operating results.

We may incur impairments to goodwill or long-lived assets.

We review our long-lived assets, including goodwill and other intangible assets, for impairment annually or more frequently when events or changes in circumstances indicate that the carrying amount of these assets may not be recoverable or it becomes more likely than not that the fair value is reduced below the carrying value of the reporting unit. Our valuation methodology for assessing impairment requires management to make judgments and assumptions based on historical experience and to rely heavily on projections of future operating performance.

If our network security measures are breached and unauthorized access is obtained to a customer's data, to our data, or to our information technology systems, we may incur significant legal and financial exposure and liabilities.

As part of our business, we store our data and certain data about our customers in our information technology system. While our system is designed with access security, if a third party gains unauthorized access to our data, including any data regarding our customers, the security breach could expose us to a risk of loss of this information, loss of business, litigation and possible liability. These security measures may be breached as a result of third-party action, including intentional misconduct by computer hackers, employee error, malfeasance or otherwise. Additionally, third parties may attempt to fraudulently induce employees or customers into disclosing sensitive information such as user names, passwords or other information to gain access to our customers' data or our data, including our intellectual property and other confidential business information, or our information technology systems. Because the techniques used to obtain unauthorized access, or to sabotage systems, change frequently and generally are not recognized until launched against a target, we may be unable to anticipate these techniques or to implement adequate preventative measures. Any security breach could result in a loss of confidence by our customers, damage our reputation, disrupt our business, lead to legal liability and negatively impact our future sales.

Our investment portfolio may suffer losses from changes in market interest rates and changes in market conditions, which could materially and adversely affect our financial condition and liquidity.

Our investment portfolio is primarily comprised of commercial paper, corporate debt securities, debt securities issued by U.S. governmental agencies and municipal debt securities. These investments are subject to general credit, liquidity, and market and interest rate risks. Substantially all of these securities are subject to interest rate and credit risk and will decline in value if interest rates increase or one or more of the issuers' credit ratings is reduced. As a result of any of the foregoing, we may experience a reduction in value or loss of liquidity of our investments, which may have a negative adverse effect on our results of operations, liquidity and financial condition. We follow an established investment policy and set of guidelines to monitor, manage and limit our exposure to interest rate and credit risk. The policy sets forth credit quality standards and limits our exposure to any one issuer, as well as our maximum exposure to various asset classes.

Our operating results have varied in the past and probably will continue to vary significantly in the future, which will cause volatility in our stock price.

Our quarterly and annual operating results have varied significantly in the past and are likely to vary in the future, which volatility could cause our stock price to decline. Some of the factors that may influence our operating results and subject our stock to extreme price and volume fluctuations include:

- general economic growth or decline in the U.S. or foreign markets;
- changes in customer demand for our systems;
- the gain or loss of a key customer or significant changes in the financial condition or one or more key customers;
- economic conditions in the semiconductor industries;
- the timing, cancellation or delay of customer orders and shipments;
- market acceptance of our products and our customers' products;
- our ability to recover the higher costs associated with meeting our customers' increasing service demands;
- competitive pressures on product prices and changes in pricing by our customers or suppliers;
- the timing of new product announcements and product releases by us or our competitors and our ability to design, introduce and manufacture new products on a timely and cost-effective basis;
- fluctuations in foreign currency exchange rates, particularly the Japanese yen, the Korean won and the British pound sterling;
- the occurrence of trade wars or barriers, or the perception that trade wars or barriers will occur;
- the occurrence of tax valuation allowances;
- the occurrence of potential impairments of long-lived assets;
- the timing of acquisitions of businesses, products or technologies;
- the effects of war, natural disasters, acts of terrorism or political unrest;
- the loss of key personnel; and
- the levels of our fixed expenses, relative to our revenue level.

The foregoing factors are difficult to forecast, and these, as well as other factors, could materially and adversely affect our quarterly and annual operating results. If our operating results in any period fall below the expectations of securities analysts and investors, the market price of our common stock would likely decline.

We are highly dependent on international sales and operations, which exposes us to foreign political and economic risks.

A majority of our sales and operations are outside of the United States. As a result, we are subject to regulatory, geopolitical and other risks associated with doing business in foreign countries. We anticipate that international sales will continue to account for a significant portion of our revenues. International sales and operations carry inherent risks such as:

- regulatory limitations imposed by foreign governments;
- obstacles to the protection of our intellectual property, political, military and terrorism risks;
- foreign currency controls and currency exchange rate fluctuations;
- periodic local or international economic downturns;
- political instability, natural disasters, acts of war or terrorism in regions where we have operations;
- repatriation of cash earned in foreign countries;
- longer payment cycles and difficulties in collecting accounts receivable outside of the U.S.;
- disruptions or delays in shipments caused by customs brokers or other government agencies;
- uncertainty regarding liability under foreign laws;

- changes in regulatory requirements (including import and export requirements), tariffs, customs, duties and other trade barriers;
- difficulties in staffing and managing foreign operations;
- potentially adverse tax consequences resulting from changes in tax laws; and
- other challenges caused by distance, language and cultural differences.

If any of these risks materialize and we are unable to manage them, our international sales and operations would suffer.

We are exposed to fluctuations in the foreign currency exchange rates.

As a global concern, we face exposure to adverse movements in foreign currency exchange rates. Our exposure to foreign currency exchange rate fluctuations arise in part from current intercompany accounts in which costs are charged between our U.S. headquarters and foreign subsidiaries. These exposures may change over time as business practices evolve and could have a material adverse impact on our financial results and cash flow.

Anti-takeover provisions in our charter documents and Delaware law could discourage, delay or prevent a change in control of our company and may affect the trading price of our common stock.

The anti-takeover provisions of the Delaware General Corporation Law may discourage, delay or prevent a change in control of our company by limiting our ability to engage in a business combination with an interested stockholder, even if a change of control would be beneficial to our existing stockholders. In addition, our certificate of incorporation and bylaws may discourage, delay or prevent a change in our management or control over us that stockholders may consider favorable. Our certificate of incorporation and bylaws:

- authorize the issuance of “blank check” preferred stock that could be issued by our board of directors to thwart a takeover attempt;
- limit who may call special meetings of stockholders; and
- prohibit stockholder action by written consent, requiring all actions to be taken at a meeting of the stockholders.

We are exposed to various risks related to legal proceedings that could result in substantial costs and disruption to normal business operations.

From time to time, and in the future, we may be, involved in legal proceedings or claims that involve breach of contract, product liability, employment, possible infringement of patents and intellectual property rights of third parties or by third parties. It is difficult to predict the outcome of litigation matters, and there can be no assurance that we will prevail in any litigation. Adverse determinations in such litigation could result in loss of our property rights, subject us to significant liabilities, any of which could significantly and adversely affect our business, financial condition and results of operations.

We have identified a material weakness in internal control over financial reporting, which if not remedied, could adversely affect our business and results of operations.

Pursuant to Section 404 of the Sarbanes-Oxley Act of 2002, our management is required to perform evaluations of our internal control over financial reporting and our independent auditors are required to publicly attest to the effectiveness of our internal control over financial reporting. As described under “Item 9A - Controls and Procedures,” our management identified an internal control weakness surrounding our inventory accounts, and has concluded that the deficiency constitutes a material weakness in our internal control over financial reporting, and as result, internal control over financial reporting was not effective as of December 31, 2016. During our evaluation of internal controls over our cycle counting procedures, we determined that we did not design and maintain an effective control over the existence of inventories subject to the cycle count program. Specifically, the control was not effectively designed and

maintained to verify all inventories that should be subject to the cycle count program were included and were counted at the frequency levels required under the Company's policies. This control deficiency did not result in a material adjustment to the inventory and cost accounts and disclosures for the year ended December 31, 2016

To ensure existence of the Company's inventory balances as recorded at December 31, 2016, we conducted a full physical inventory for the stocking locations subject to the cycle count program which resulted in an immaterial adjustment. The material weakness in the design and effectiveness of the control over the existence of inventories is in the process of being remediated. Our

goal is to remediate this material weakness by the end of 2017, subject to there being sufficient opportunities to conclude, through testing, that the enhanced control is designed and operating effectively.

We are subject to various environmental laws and regulations that could impose substantial costs upon us and may harm our business, operating results and financial condition.

Some of our operations use substances regulated under various federal, state, local, and international laws governing the environment, including those relating to the storage, use, discharge, disposal, labeling, and human exposure to hazardous and toxic materials. We could incur costs, fines and civil or criminal sanctions, third-party property damage or personal injury claims, or could be required to incur substantial investigation or remediation costs, if we were to violate or become liable under environmental laws. Liability under environmental laws can be joint and several and without regard to comparative fault. Compliance with current or future environmental laws and regulations could restrict our ability to expand our facilities or require us to acquire additional expensive equipment, modify our manufacturing processes, or incur other significant expenses. We may unintentionally violate environmental laws or regulations in the future as a result of human error, equipment failure or other causes.

Compliance with federal securities laws, rules and regulations, as well as NASDAQ requirements, is becoming increasingly complex, and the significant attention and expense we must devote to those areas may have an adverse impact on our business.

Federal securities laws, rules and regulations, as well as NASDAQ rules and regulations, require companies to maintain extensive corporate governance measures, impose comprehensive reporting and disclosure requirements, set strict independence and financial expertise standards for audit and other committee members and impose civil and criminal penalties for companies and their chief executive officers, chief financial officers and directors for securities law violations. These laws, rules and regulations have increased, and in the future, are expected to continue to increase, the scope, complexity and cost of our corporate governance, reporting and disclosure practices, which could harm our results of operations and divert management's attention from business operations.

We may be exposed to liabilities under the FCPA and other anti-corruption laws, and any determination that we violated these laws could have a material adverse effect on our business.

We are subject to the Foreign Corrupt Practice Act of 1977 ("FCPA"), and other laws that prohibit improper payments or offers of payments to foreign governments and their officials and political parties by U.S. persons and issuers as defined by the statute, for the purpose of obtaining or retaining business. Also, similar worldwide anti-bribery laws, such as the U.K. Bribery Act and Chinese anti-corruption laws, generally prohibit companies and their intermediaries from making improper payments to non-U.S. officials for the purpose of obtaining or retaining business. Some of our distribution partners are located in parts of the world that have experienced governmental corruption to some degree and, in certain circumstances, strict compliance with anti-bribery laws may conflict with local customs and practices. Although we have implemented policies and procedures to discourage these practices by our employees, our existing safeguards and any future improvements may prove to be less than effective, and our employees, consultants, sales agents or distributors may engage in conduct for which we might be held responsible. Violations of the FCPA or international anti-corruption laws may result in severe criminal or civil sanctions, and we may be subject to other liabilities, which could negatively affect our business, operating results and financial condition. In addition, the U.S. government may seek to hold us liable for successor liability FCPA violations committed by companies in which we invest or that we acquire. We cannot assure you that our internal control policies and procedures will protect us from reckless or negligent acts committed by our employees, distributors, partners, consultants or agents.

Regulations related to conflict minerals could adversely impact our business.

The Dodd-Frank Wall Street Reform and Consumer Protection Act contains provisions to improve transparency and accountability concerning the supply of tin, tantalum, tungsten and gold, known as conflict minerals, originating from the Democratic Republic of Congo, or DRC, and adjoining countries. As a result, in August 2012 the United States Securities and Exchange Commission, or SEC, adopted annual disclosure and reporting requirements for public companies that use conflict minerals mined from the DRC and adjoining countries in their products. We have determined that we use at least one of these conflict minerals in the manufacture of our products, although we have not yet determined the source of the minerals that we use. These new disclosure requirements require us to use diligent efforts to determine which conflict minerals we use and the source of those conflict minerals, and disclose the results of our findings. There have been and will continue to be costs associated with complying with these disclosure requirements, including those costs incurred in conducting diligent efforts to determine which conflict minerals we use and the sources of conflict minerals used in our products. Further, the implementation of these rules could adversely affect the sourcing, supply and pricing of materials used in our products. As there may be only a limited number of suppliers offering conflict free minerals, we cannot be sure that we will be able to obtain necessary conflict free conflict minerals in sufficient quantities or at competitive prices. In addition, we may face reputational

challenges if we determine that our products contain minerals not determined to be conflict free or if we are unable to sufficiently verify the origins for all conflict minerals used in our products through the procedures we implement. If we determine it is necessary to redesign our products to not use conflict minerals, we would incur costs associated with doing so.

ITEM 1B. UNRESOLVED STAFF COMMENTS
None.

ITEM 2. PROPERTIES
At December 31, 2016, our owned or leased facilities included those described below:

Type	Location	Square Footage	Use
Owned	Milpitas, California	135,692	Corporate headquarters, manufacturing and corporate housing
Leased	Taiwan	22,167	Sales and service
Leased	South Korea	21,337	Sales, service and corporate housing
Leased	United States	19,551	Engineering, sales and service
Leased	Japan	16,628	Sales, service and corporate housing
Leased	China	9,046	Sales and service
Leased	Singapore	4,532	Sales and service
Leased	France	828	Sales and service

We believe that our existing facilities are suitable and adequate for our current needs and anticipated growth.

ITEM 3. LEGAL PROCEEDINGS
Not Applicable.

ITEM 4. MINE SAFETY DISCLOSURES
Not Applicable.

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PART II

ITEM 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES

Market Information for Common Stock

Our common stock is quoted on the NASDAQ Global Select Market under the symbol "NANO." The following table sets forth, for the fiscal periods indicated, the high and low closing sales prices per share of our common stock on a quarterly basis as reported on the NASDAQ Global Select Market.

Fiscal Year 2016	High	Low
First quarter	$15.86	$12.63
Second quarter	$20.62	$13.82
Third quarter	$22.66	$19.65
Fourth quarter	$25.83	$19.65

Fiscal Year 2015	High	Low
First quarter	$18.60	$15.32
Second quarter	$17.09	$14.46
Third quarter	$16.30	$12.33
Fourth quarter	$15.91	$12.12

Stockholders

On February 24, 2017, there were approximately 149 holders of record of our common stock. Because brokers and the institutions on behalf of stockholders hold many of our shares of common stock, we are unable to estimate the total number of stockholders represented by these record holders.

Dividend Policy

We have never declared or paid any cash dividends on our capital stock. We currently expect to retain future earnings, if any, for use in the operation, expansion of our business and repurchase of shares and do not anticipate paying any cash dividends in the foreseeable future.

Stock Performance Graph

The following graph presentation compares cumulative five-year stockholder returns on an indexed basis, assuming a $100 initial investment and reinvestment of dividends, of (a) Nanometrics Incorporated, (b) a broad-based equity market index and (c) an industry-specific index. The broad-based equity market index used is the NASDAQ Composite Index and the industry-specific index used is the PHLX Semiconductor Index. The RDG Technology Composite Index was used in prior fiscal years' Form 10-K reports as the industry-specific index; however, the Company believes the PHLX Semiconductor index is a better indicator of how the Company compares to the overall Semiconductor industry.

This performance graph shall not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended or otherwise subject to the liabilities under that Section, and shall not be deemed to be incorporated by reference into any of our filings under the Securities Act of 1933, as amended or the Exchange Act.

	12/11	12/12	12/13	12/14	12/15	12/16
Nanometrics Incorporated	100.00	78.28	103.42	91.31	82.19	136.05
NASDAQ Composite	100.00	116.41	165.47	188.69	200.32	216.54
RDG Technology Composite	100.00	114.61	152.95	178.50	183.08	206.81
PHLX Semiconductor	100.00	110.42	144.83	186.15	174.42	230.82

Recent Sales of Unregistered Securities

None.

ITEM 6. SELECTED FINANCIAL DATA

The selected consolidated financial data set forth below is not necessarily indicative of results of future operations and should not be relied upon as an indicator of our future performance. This data should be read in conjunction with "Management's Discussion and Analysis of Financial Condition and Results of Operations" and the consolidated financial statements and related notes included elsewhere in this Annual Report on Form 10-K. Our fiscal years 2016, 2015, 2014, 2013 and 2012, as referred to below, refer to our fiscal years ended December 31, 2016, December 26, 2015, December 27, 2014, December 28, 2013 and December 29, 2012, respectively.

	Fiscal Year				
	2016[2]	2015	2014[1]	2013	2012
	(in thousands, except per share data)				
Consolidated Statement of Operations Data:					
Total net revenues	$221,129	$187,367	$166,443	$144,307	$182,881
Gross profit	$114,124	$89,667	$75,822	$62,676	$83,928
Income (loss) from operations	$29,095	$4,973	$(11,653)	$(21,709)	$5,478
Net income (loss)	$44,035	$2,905	$(31,118)	$(14,146)	$4,465
Basic net income (loss) per share	$1.79	$0.12	$(1.30)	$(0.61)	$0.19
Diluted net income (loss) per share	$1.75	$0.12	$(1.30)	$(0.61)	$0.19

[1] Our net loss included a non-cash valuation allowance of $21.1 million on certain U.S. deferred tax assets.

[2] Our net income included a release of non-cash valuation allowance of $27.4 million against a significant portion of our U.S. and foreign deferred tax assets.

	Fiscal Year Ended				
	2016	2015	2014	2013	2012
	(in thousands)				
Consolidated Balance Sheet Data:					
Cash, cash equivalents and marketable securities	$129,961	$83,085	$83,962	$92,862	$109,908
Working capital	$174,353	$132,903	$119,797	$141,797	$158,587
Total assets	$287,830	$235,540	$223,236	$262,834	$259,454
Long-term liabilities including current portion of debt obligation	$2,030	$3,001	$5,497	$6,504	$13,884
Total stockholders' equity	$243,774	$187,328	$179,537	$207,373	$215,771

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ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

Overview

You should read the following discussion and analysis of our financial condition and results of operations together with "Selected Financial Data" and our consolidated financial statements and related notes appearing elsewhere in this Annual Report on Form 10-K. This discussion and analysis contains forward-looking statements that involve risks, uncertainties and assumptions. The actual results may differ materially from those anticipated in these forward-looking statements as a result of certain factors, including, but not limited to, those presented under "Risk Factors" in Item 1A and elsewhere in this Annual Report on Form 10-K. Please see "Cautionary Information Regarding Forward-Looking Statements" at the beginning of this Form 10-K for additional information you should consider regarding forward-looking statements.

We are an innovator in the field of metrology and inspection systems for semiconductor manufacturing and other industries. Our systems are designed to precisely monitor optical critical dimensions and film thickness that are necessary to control the manufacturing process and to identify defects that can affect production yields and performance.

Principal factors that impact our revenue growth include capital expenditures by manufacturers of semiconductors to increase capacity and to enable their development of new technologies, and our ability to improve market share. The increasing complexity of the manufacturing processes for semiconductors is an important factor in the demand for our innovative metrology systems. Our strategy is to continue to innovate organically as well as to evaluate strategic acquisitions to address business challenges and opportunities.

Our revenues are primarily derived from product sales but are also derived from customer service and system upgrades for the installed base of our products. In 2016, we derived 84% of our total net revenues from product sales and 16% of our total net revenues from services.

Important Themes and Significant Trends

The semiconductor equipment industry is characterized by new manufacturing processes (node) coming to market every two to three years. At every new node, in the semiconductor industry our customers drive the need for metrology as a major component of device manufacturing. These trends include:

- Proliferation of Optical Critical Dimension Metrology across Fabrication Processes. Device dimensions must be carefully controlled during each step of processing. These patterned structures are measured at many subsequent production stops including Chemical Mechanical Polishing, Etch, and Thin Film processing, all driving broader OCD adoption. Our proprietary OCD systems can provide the critical process control of these circuit dimensions that is necessary for successful manufacturing of these state-of-the-art devices. Nanometrics OCD technology is broadly adopted across NAND, DRAM, and logic semiconductor manufacturing processes.
- Proliferation of 3D Transistor Architectures. Our end customers continue to improve device density and performance by scaling front-end-of-line transistor architectures. Many of these designs, including FinFET transistors, have buried features and high aspect ratio stacked features that enable improved performance and density. The advanced designs require additional process control to manage the complex shapes and materials properties, driving additional applications of our systems.
- Proliferation of High-Density 3D-NAND. Our end customers have migrated to multi (many) layered high aspect ratio 3D-NAND devices. Many stacks of NAND cells are formed in parallel. These 3D-NAND architecture enables cost effective density scaling, removing the burden of density from lithography to deposition and etch processes. These

devices require additional process control of deposition stacks, planarization processes, and critical high aspect ratio etch processes. Nanometrics thin films and OCD technologies are adopted across the 3D-NAND process including the periphery CMOS processing, NAND cell formation, and Interconnect of the devices.

- Adoption of New Types of Thin Film Materials. The need for ever increasing device circuit speed coupled with lower power consumption has pushed semiconductor device manufacturers to new materials and processing methods with single atom/sub nanometer control over these processes.
- Need for Improved Process Control to Drive Process Efficiencies. Competitive forces influencing semiconductor device manufacturers, such as price-cutting, shorter product life cycles and time to market, place pressure on manufacturers to rapidly achieve production efficiency. Device manufacturers are using our integrated and automated systems throughout the fabrication process to ensure that manufacturing processes scale rapidly, are accurate and can be repeated on a consistent basis.

Critical Accounting Policies

The preparation of our financial statements conforms to accounting principles generally accepted in the United States of America, which requires management to make estimates and judgments in applying our accounting policies that have an important impact on our reported amounts of assets, liabilities, revenue, expenses and related disclosures at the date of our financial statements. On an ongoing basis, management evaluates its estimates including those related to bad debts, inventory valuations, warranty obligations, impairment 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 management’s estimates. We believe that the application of the following accounting policies requires significant judgments and estimates on the part of management. For a summary of all of our accounting policies, including those discussed below, see Note 1 to our consolidated financial statements.

Revenue Recognition - We recognize revenue when persuasive evidence of an arrangement exists, delivery has occurred or services have been rendered, the seller's price is fixed or determinable, and collectability is reasonably assured. We derive revenue from the sale of process control metrology and inspection systems and related upgrades (“product revenue”) as well as spare part sales, billable services and service contracts (together “service revenue”). Upgrades are system software and hardware performance upgrades that extend the features and functionality of a product. Beginning in the first quarter of 2016, we include upgrades in product revenue, which consists of sales of complete, advance process control metrology and inspection systems (the “system(s)”). This change was due to the types of upgrades currently being sold, which are primarily system software and hardware performance upgrades to extend the features and functionality of a product. Previously, upgrades consisted of a group of parts and/or software that change the existing configuration of the products.

Nanometrics’ systems consist of hardware and software components that function together to deliver the essential functionality of the system. Arrangements for sales of systems often include defined customer-specified acceptance criteria.

For repeat product sales to existing customers, revenue recognition occurs at the time title and risk of loss transfer to the customer, which usually occurs upon shipment from our manufacturing location, if it can be reliably demonstrated that the product has successfully met the defined customer specified acceptance criteria and all other recognition criteria have been met. For initial sales where we have not previously met the defined customer specified acceptance criteria, we recognize product revenues upon the earlier of receipt of written customer acceptance or expiration of the contractual acceptance period. In Japan, where contractual terms with the customer specify risk of loss and title transfers upon customer acceptance, we recognize revenue upon receipt of written customer acceptance, provided that all other recognition criteria have been met.

We warrant our products against defects in manufacturing. Upon recognition of product revenue, we record a liability for anticipated warranty costs. On occasion, customers request a warranty period longer than our standard warranty. In those instances, where extended warranty services are separately quoted to the customer, we defer and recognize the associated revenue as service revenue ratably over the term of the contract. We include the portion of service contracts and extended warranty services agreements that are uncompleted at the end of any reporting period in deferred revenue.

We also sell software that is considered to be an upgrade to a customer's existing systems. These standalone software sales are not essential to the tangible product's functionality and are accounted for under software revenue recognition rules which require vendor specific objective evidence ("VSOE") of fair value to allocate revenue in a multiple element arrangement. We recognize revenue from standalone software sales when the software is delivered to the

customer, provided that all other recognition criteria have been met.

The majority of other upgrades are sold based on published specifications. For simple upgrades that do not require major configuration, revenue is recognized at the time title and risk of loss transfer to the customer, which is usually upon shipment. For complex and extensive upgrades, specific acceptance or prior acceptance for a similar upgrade is required in order to recognize revenue.

We recognize revenue related to spare parts upon shipment. We recognize revenue related to billable services when the services are completed. Service contracts may be purchased by the customer during or after the warranty period and we recognize revenue ratably over the service contract period.

Frequently, we deliver products and various services in a single transaction. Our deliverables consist of tools, installation, upgrades, billable services, spare parts, and service contracts. Our typical multi-element arrangements include a sale of one or multiple tools that include installation and standard warranty. Other arrangements may consist of a sale of tools bundled with service elements or delivery of different types of services. Our tools, upgrades, and spare parts are generally delivered to customers within a period of

up to six months from order date. Installation is usually performed soon after delivery of the tool. We defer the portion of revenue associated with installation based on relative selling price and we recognize that revenue upon completion of the installation and receipt of final acceptance. Billable services are billed on a time and materials basis and performed as requested by customers. Under service contract arrangements, services are provided as needed over the fixed arrangement term, and such terms can be up to twelve months. We do not generally grant customers a general right of return or refund and may impose a penalty on orders cancelled prior to the scheduled shipment date.

We evaluate our revenue arrangements to identify deliverables and to determine whether these deliverables are separable into multiple units of accounting. We allocate the arrangement consideration among the deliverables based on relative selling price. We have established VSOE for some of our products and services when a substantial majority of selling prices falls within a narrow range when sold separately. For deliverables with no established VSOE, we use best estimate of selling price to determine standalone selling price for such deliverable. We do not use third party evidence to determine standalone selling price since this information is not widely available in the market as our products contain a significant element of proprietary technology and the solutions offered differ substantially from our competitors. We have established a process for developing best estimated selling price ("BESP"), which incorporates historical selling prices, the effect of market conditions, gross margin objectives, pricing practices, as well as entity-specific factors. We monitor and evaluate BESP on a regular basis to ensure that changes in circumstances are accounted for in a timely manner.

When certain elements in multiple-element arrangements are not delivered or accepted at the end of a reporting period, the relative selling prices of undelivered elements are deferred until these elements are delivered and/or accepted. If deliverables cannot be accounted for as separate units of accounting, the entire arrangement is accounted for as a single unit of accounting and we defer revenue until all elements are delivered and all revenue recognition requirements are met.

Allowance for Doubtful Accounts – We maintain allowances for estimated losses resulting from the inability of our customers to make their required payments. We establish credit limits through a process of reviewing the financial history and stability of our customers. Where appropriate and available, we obtain credit rating reports and financial statements of customers when determining or modifying their credit limits. We regularly evaluate the collectability of our trade receivable balances based on a combination of factors such as the length of time the receivables are past due, customary payment practices in the respective geographies and our historical collection experience with customers. We believe that our allowance for doubtful accounts adequately reflects our risk associated with our receivables. If the financial condition of a customer were to deteriorate, resulting in their inability to make payments, we would assess the necessity of recording additional allowances. This would result in additional general and administrative expenses being recorded for the period in which such determination was made

Inventories – Inventories are stated at the lower of cost, which approximates actual cost on a first-in, first-out basis, or market. We have established inventory reserves when conditions exist that suggest that our inventory may be in excess of anticipated demand or is obsolete based upon our assumptions about future demand for our products and market conditions. Once a reserve has been established, it is maintained until the part to which it relates is sold or is otherwise disposed of. Therefore, a sale of reserved inventory has a higher gross profit margin. We regularly evaluate our ability to realize the value of our inventory based on a combination of factors including the following: historical usage rates, forecasted sales of usage, product end-of-life dates, estimated current and future market values and new product introductions. Inventory includes evaluation tools placed at customer sites. For demonstration inventory, we also consider the age of the inventory and potential cost to refurbish the inventory prior to sale. We amortize demonstration inventory over its useful life and the amortization expense is included in total inventory write down on our statements of cash flows. When recorded, our reserves are intended to reduce the carrying value of our inventory to its net realizable value. If actual demand for our products deteriorates, or market conditions are less favorable than those that we project, additional reserves may be required, which would adversely affect gross margin and net income.

Product Warranties – We sell the majority of our products with a standard twelve-month repair or replacement warranty from the date of acceptance or shipment date. We provide an accrual for estimated future warranty costs based upon the historical relationship of warranty costs to the cost of products sold. The estimated future warranty obligations related to product sales are reported in the period in which the related revenue is recognized. The estimated future warranty obligations are affected by the warranty periods, sales volumes, product failure rates, material usage and labor and replacement costs incurred in correcting a product failure. If actual product failure rates, material usage, labor or replacement costs differ from our estimates, revisions to the estimated warranty obligations would be required. For new product introductions where limited or no historical information exists, we may use warranty information from other previous product introductions to guide us in estimating our warranty accrual. The warranty accrual represents the best estimate of the amount necessary to settle future and existing claims on products sold as of the balance sheet date. We periodically assess the adequacy of our recorded warranty reserve and adjust the amounts in accordance with changes in these factors.

Goodwill and Intangible Assets - Intangible assets with finite lives are amortized over their useful lives and are subject to an impairment assessment, as well as an evaluation of the appropriateness of their estimated useful lives, whenever events or changes in circumstances indicate that the carrying amount(s) may not be recoverable. Goodwill and indefinite lived assets are not amortized but tested annually for impairment. The goodwill impairment assessment involves three tests, Step 0, Step 1 and Step 2. The Step 0 test involves performing an initial qualitative assessment to determine whether it is more likely than not that the asset is impaired and thus whether it is necessary to proceed to Step 1 and calculate the fair value of the reporting unit. We may proceed directly to the Step 1 test without performing the Step 0 test. The Step 1 test involves measuring the recoverability of goodwill at the reporting unit level by comparing the reporting unit's carrying amount, including goodwill, to the fair value of the reporting unit.

We perform a Step 0 assessment of the goodwill during the fourth quarter of each fiscal year, or whenever events or circumstances occur which indicate that an impairment may have occurred. As part of this assessment, we consider the trading value of our stock, the industry trends, and our sales forecast and products plans to determine if it is more likely than not that the fair value is higher than the carrying values of our reporting unit. If, after assessing the qualitative factors, we determine that it is not likely that the fair value of a reporting unit is less than its carrying value, then performing the two-step impairment test is unnecessary. However, if we conclude otherwise, then we are required to perform the Step 1 of the two-step goodwill impairment test. The Step 1 test requires a comparison of the fair value of our reporting unit to its net book value. If the fair value of the reporting unit is greater than its net book value, then no impairment is deemed to have occurred. If the fair value is less, then the Step 2 must be performed to determine the amount, if any, of actual impairment.

The process of evaluating the potential impairment of goodwill is highly subjective and requires significant judgment. In estimating the fair value of goodwill at the reporting unit level, we make estimates and judgments about future revenues and cash flows for the reporting unit. To determine the fair value, our review process includes the income method and is based on a discounted future cash flow approach that uses estimates including the following for the reporting unit: estimated revenue, market segment growth rates and market share assumptions; estimated costs; and appropriate discount rates based on the particular reporting unit's weighted average cost of capital. Our estimates of market segment growth, our market segment share and costs are based on historical data, various internal estimates and certain external sources, and are based on assumptions that are consistent with the plans and estimates we are using to manage the underlying businesses. Our business consists of both established and emerging technologies and our forecasts for emerging technologies are based upon internal estimates and external sources rather than historical information. We also consider our market capitalization on the dates of our impairment tests in determining the fair value of the respective businesses. As part of this assessment, we consider the trading value of our stock and our implied value, as compared to our net assets, as well as the valuation of our acquired businesses. If the carrying amount of the reporting unit exceeds its fair value as determined by these assessments, goodwill is considered impaired, and the Step 2 test is performed to measure the amount of impairment loss. As part of the Step 2 test to determine the amount of goodwill impairment, if any, we allocate the fair value of the reporting unit to all of its assets and liabilities as if the reporting unit had been acquired in a business combination and the fair value of the reporting unit was the price paid to acquire the reporting unit. The excess of the fair value of the reporting unit over the amount assigned to its assets and liabilities is the implied fair value of goodwill. When impairment is deemed to have occurred, we will recognize an impairment charge to reduce the carrying amount of our goodwill to its implied fair value.

Income Tax Assets and Liabilities - We account for income taxes such that deferred tax assets and liabilities are recognized using enacted tax rates for the effect of temporary differences between the book and tax accounting for assets and liabilities. Also, deferred tax assets are reduced by a valuation allowance to the extent we cannot conclude that it is more likely than not that a portion of the deferred tax asset will be realized in the future. We evaluate the deferred tax assets on a continuous basis throughout the year to determine whether or not a valuation allowance is appropriate. Factors used in this determination include future expected income and the underlying asset or liability

which generated the temporary tax difference. Our income tax provision is primarily impacted by federal statutory rates, state and foreign income taxes and changes in our valuation allowance.

Recent Accounting Pronouncements

See Note 2 of our consolidated financial statements for a description of recent accounting pronouncements, including the respective dates of adoption and effects on our results of operations and financial condition.

Upgrade Revenue and Related Cost

As discussed above, beginning the first quarter of 2016, we now include revenues associated with upgrade sales under Products Revenues, and the related costs in Cost of Products Revenue. This change was due to the types of upgrades currently being sold, which are primarily system software and hardware performance upgrades to extend the features and functionality of a product. Previously, upgrades consisted of a group of parts and/or software that change the existing configuration of a product. For the twelve months ended December 31, 2016, we included $11.0 million related to upgrade sales and $2.4 million of costs, in Products Revenues and Cost of Products Revenues, respectively. For the twelve months ended December 26, 2015, we included $7.9 million related to

upgrade sales, and $3.0 million of costs, in Service Revenues and Costs of Service Revenues, respectively. In our discussion below comparing revenues and gross margin in 2016 to 2015, we compare as if upgrade sales and related costs have been included in Product Revenue and Cost of Revenues in 2015 to give a more meaningful comparison

Results of Operations

Total net revenues

Our net revenues comprised the following (in thousands, except percentages):

	Fiscal Year				
	2016	2015	Change		
Automated systems	$127,378	$102,386	$24,992	24.4	%
Integrated systems	43,846	31,579	12,267	38.8	%
Materials characterization systems	13,842	12,980	862	6.6	%
Total product revenue	185,066	146,945	38,121	25.9	%
Service	36,063	40,422	(4,359)	(10.8)	%
Total net revenues	$221,129	$187,367	$33,762	18.0	%

	Fiscal Year				
	2015	2014	Change		
Automated systems	$102,386	$108,768	$(6,382)	(5.9	)%
Integrated systems	31,579	15,334	16,245	105.9	%
Materials characterization systems	12,980	9,487	3,493	36.8	%
Total product revenue	146,945	133,589	13,356	10.0	%
Service	40,422	32,854	7,568	23.0	%
Total net revenues	$187,367	$166,443	$20,924	12.6	%

In 2016, total net revenues increased by $33.8 million from 2015. During 2016, we included upgrade sales of $11.0 million, in Product Revenues. For the twelve months ended December 26, 2015, Product Revenues do not include $7.9 million related to upgrade sales, which we included in Service Revenues. For the twelve months ended December 31, 2016, had upgrade sales been included in Product Revenue in 2015, Product Revenues would have increased by $30.2 million. The increase was primarily attributable to an industry-wide improvement in 3D NAND-related semiconductor capital spending. Approximately $17.8 million of the increase related to Automated systems sales and $11.7 million of the increase related to our sales of Integrated Systems (principally IMPULSE®), primarily with 3D-NAND-related customers. Materials Characterization also accounted for $0.7 million of the increased systems sales. Service revenue decreased by $4.4 million in 2016. For the twelve months ended December 31, 2016, had upgrade sales been excluded in Service Revenue in 2015, Service Revenue would have increased by $3.5 million principally due to an increase of $3.9 million in sales of spares and services revenue, offset by $0.4 million decline in extended warranty sales.

In 2015, total net revenues increased by $20.9 million from 2014, principally due to an industry-wide improvement in 3D NAND-related semiconductor capital spending and from an increase in foundry penetration. Approximately $16.2

million of the increase in product revenues was attributable to sales of our Integrated Systems (principally IMPULSE®), primarily with 3D-NAND-related customers. Materials Characterization accounted for $3.5 million of the increase and was partially offset by Automated systems sales which decreased by $6.4 million. Service revenue increased by $7.6 million in 2015 principally due to an increase in upgrade revenue as a result of higher demand for upgrades of installed tools. Upgrades tend to fluctuate based on availability of new functionality from upgrades and customer production cycles, which determine when customers purchase available upgrades.

With a significant portion of the world's semiconductor manufacturing capacity located in Asia, a substantial portion of our revenues continue to be generated in that region. Although sales to customers within individual countries of that region will vary from time to time, we expect that a substantial portion of our revenues will continue to be generated in Asia.

Gross margin

Our gross margin breakdown was as follows:

	Fiscal Year		
	2016	2015	2014
Products	53.1%	46.7%	46.5%
Service	44.1%	51.9%	41.9%

The calculation of product gross margin includes cost of products, amortization of intangibles and in 2016, related upgrades. The gross margin on product revenue increased to 53.1% in 2016 from 46.7% in 2015. Had upgrade sales and related cost been included in Product Revenue and Cost of Revenues in 2015, Product Gross Margin for 2015 would have been 47.5%. The increase in 2016 of 5.6 percentage points was due to a change in product mix, improved installation and warranty related costs and reduced amortization of intangibles as a result of full amortization of the intangible asset. The gross margin of our services business decreased to 44.1% from 51.9% in 2015, reflecting a decrease of 7.8 percentage points. Had upgrade sales and related cost been excluded from Service Revenues and Cost of Service Revenues, Service Gross Margin for 2015 would have been 49.5%, a decrease of 5.4 percentage points, due to the mix of services provided during the year in comparison to the prior year period, and lower labor utilization of service personnel.

The gross margin on product revenue increased to 46.7% in 2015 from 46.5% in 2014. The increase was due primarily to improved factory overhead absorption, lower amortization of intangibles and a 10% increase in product revenue during 2015, offset by higher installation and warranty costs. The gross margin of our services business increased to 51.9% from 41.9% in 2014, reflecting an increase of 10 percentage points, due principally to an increase in upgrade revenues, which typically have higher margins than core service revenue.

Operating expenses

Our operating expenses comprise the following categories (in thousands, except percentages):

	Fiscal Year				
	2016	2015	Change		
Research and development	$31,443	$32,701	$(1,258)	(3.8	)%
Selling	30,181	28,055	2,126	7.6	%
General and administrative	23,381	22,444	937	4.2	%
Amortization of intangible assets	24	114	(90)	(78.9	)%
Restructuring charge	—	1,380	(1,380)	(100.0	)%
Total operating expenses	$85,029	$84,694	$335	0.4	%

	Fiscal Year				
	2015	2014	Change		
Research and development	$32,701	$33,776	$(1,075)	(3.2	)%
Selling	28,055	27,033	1,022	3.8	%

General and administrative	22,444	23,980	(1,536)	(6.4)%
Amortization of intangible assets	114	420	(306)	(72.9)%
Restructuring charge	1,380	2,266	(886)	(39.1)%
Total operating expenses	$84,694	$87,475	$(2,781)	(3.2)%

Research and development

Research and development costs decreased by $1.3 million or 3.8% in 2016 compared to 2015 related primarily due to lower spending for material expenses and related costs associated with research and development investments for our next generation systems.

Research and development costs decreased by $1.1 million or 3.2% in 2015 compared to 2014 related primarily to a decrease in spending for non-recurring engineering projects, including product design and prototype development, along with related material spending and expenses associated with R&D investments for our next generation Automated and Integrated systems, partially offset by increases in variable compensation costs.

Selling

Selling expenses increased by $2.1 million or 7.6% in fiscal year 2016 compared to fiscal year 2015. The increase is due to higher variable compensation, commission expense, and sales related costs, which is consistent with higher revenues in 2016 compared to 2015. In addition, during fiscal year 2016, there was a decrease in utilization of our sales application personnel for installation and warranty, which is included in cost of net revenues.

Selling expenses increased by $1.0 million or 3.8% in fiscal year 2015 compared to fiscal year 2014. The increase is primarily due to an increase in commissions and amortization of demonstration tools, offset in part by a decrease in travel and related expenses.

General and administrative

General and administrative expenses increased by $0.9 million or 4.2% in fiscal year 2016 compared to 2015. The increase was primarily due to higher variable compensation costs.

In fiscal year 2015 compared to 2014, general and administrative expenses decreased by $1.5 million primarily due to lower headcount and a decrease in consulting expenditures.

Amortization of intangible assets

Amortization of intangible assets included in operating expenses in fiscal year 2016 decreased slightly compared to 2015, as a result of the reduction in amortization due to intangible assets that became fully amortized in 2016.

In fiscal year 2015 compared to 2014, amortization of intangible assets included in operating expenses decreased compared to 2014 due to intangible assets that became fully amortized in 2014.

Restructuring charge

There were no restructuring charges recorded in 2016 fiscal year.

We recorded a restructuring charge of $1.4 million in 2015 as a result of our decision to maximize operating effectiveness. This amount includes charges primarily related to employee severance and related costs. As of December 26, 2015, we had completed and settled in full all cash payments related to employee severance.

Other income (expense), net

Our other income (expense), net, consisted of the following items (in thousands, except percentages):

	Fiscal Year			
	2016	2015	Change	
Interest income	$35	$71	$(36)	(50.7)%
Interest expense	(285)	(289)	4	(1.4)%
Interest income (expense), net	$(250)	$(218)	$(32)	14.7 %

Net gains on investments	520	220	300	136.4 %
Other gains (losses), net	(230)	593	(823)	(138.8)%
Other income (loss), net	$290	$813	$(523)	(64.3)%
Total other income (expense), net	$40	$595	$(555)	(93.3)%

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	Fiscal Year				
	2015	2014	Change		
Interest income	$71	$47	$24	51.1	%
Interest expense	(289)	(389)	100	(25.7	)%
Interest income (expense), net	$(218)	$(342)	$124	(36.3	)%
Net gains on investments	220	179	41	22.9	%
Other gains, net	593	195	398	204.1	%
Other income, net	813	374	439	117.4	%
Total other income, net	$595	$32	$563	1759.4	%

Interest income received in fiscal year 2016 compared with fiscal year 2015 decreased minimally as the average balances of our cash and cash equivalents remained relatively flat. Interest expense in 2016 compared with fiscal year 2015 remained relatively flat.

Net gains on investments increased in 2016 as compared with fiscal year 2015, due to an increase in our investment portfolio balance and higher investment yields. The decrease in other income gains and losses in 2016 compared with fiscal 2015, was primarily driven by unfavorable impact of fluctuations of foreign exchange in 2016.

Interest income received in fiscal year 2015 compared with fiscal year 2014 increased minimally as the average balances of cash and cash equivalents balances remained relatively flat. Interest expense was lower in 2015 that in the prior year due primarily to payments made to Zygo to decrease the outstanding liability related to acquisition of certain assets from Zygo.

Net gains on investments increased minimally in 2015 from 2014, driven by slightly improved yields on our investment portfolio. The increase in other income gains and losses in 2015 compared with fiscal 2014 was primarily attributable to favorable impact of fluctuations of foreign exchange in 2015.

Provision for (benefit from) income taxes

We recorded an income tax benefit of $14.9 million in 2016, and income tax expense of $2.7 and $19.5 million in 2015 and 2014, respectively. The decrease in the tax provision for 2016 from 2015 was primarily related to the releasing of a valuation allowance against a significant portion of our U.S. deferred tax assets for the year ended 2016. The increase in the tax provision for 2015 from 2014 was primarily related to the recording of the same valuation allowance for the year ended 2014.

Our benefit for income taxes for 2016 of $14.9 million reflects an effective tax rate of negative 51.1%. This rate differs from the Federal statutory rate of 35.0% primarily due to the release of a valuation allowance against a significant portion of our U.S. deferred tax assets which represented a $23.9 million benefit, as well as foreign income taxed at lower rates, and tax credits generated in the current year, offset by equity compensation expenses for which no current tax deduction is available. Our provision for income taxes for 2015 of $2.7 million reflects an effective tax rate of 47.8 %. This rate differs from the Federal statutory rate of 35.0% primarily due to losses incurred in foreign jurisdictions where no benefit is currently recorded, as well as equity compensation expenses for which no current tax deduction is available. Our provision for income taxes for 2014 of $19.5 million reflects an effective tax rate of negative 167.8%. This rate differs from the Federal statutory rate of 35.0% primarily due to the recording of a valuation allowance against our U.S. deferred tax assets which represented a $23.9 million provision, as well as equity

compensation expenses for which no current tax deduction is available, offset by foreign income being taxed at lower rates.

We maintain valuation allowances when it is likely that all or a portion of a deferred tax asset will not be realized. Changes in valuation allowances from period to period are included in our income tax provision in the period of change. In determining whether a valuation allowance is warranted, we take into account such factors as prior earnings history, expected future earnings, unsettled circumstances that, if unfavorably resolved, would adversely affect utilization of a deferred tax asset, carry-back and carry-forward periods, and tax strategies that could potentially enhance the likelihood of realization of a deferred tax asset. As such, in 2016, we released a valuation allowance against a significant portion of our U.S. deferred tax asset of $23.9 million. We also released $3.5 million of valuation allowance against our deferred tax assets in Israel and United Kingdom, both of which have no impact to our effective tax rate. We currently maintain a valuation allowance against our deferred tax assets in California, Germany, Switzerland, and Singapore.

Liquidity and Capital Resources

Our principal sources of liquidity are cash and cash equivalents, and marketable securities and cash flow generated from our operations. Our liquidity is affected by many factors, including those that relate to our specific operations and those that relate to the uncertainties of global and regional economies and the sectors of the semiconductor industry which we operate in. Although our cash requirements will fluctuate based on the timing and extent of these factors, we believe our existing cash, cash equivalents and marketable securities, combined with cash currently projected to be generated from our operations, will be sufficient to meet our liquidity needs through at least the next twelve months.

The following table presents selected financial information and statistics as of and for the years ended December 31, 2016, December 26, 2015 and December 27, 2014 (in millions):

	December 31, 2016	December 26, 2015	December 27, 2014
Cash, cash equivalents and marketable securities	$ 130.0	$ 83.1	$ 84.0
Working capital	$ 174.4	$ 132.9	$ 119.6
Cash provided by (used in) operating activities	$ 45.7	$ 1.6	$ (0.6)
Cash provided by (used in) investing activities	$ (42.1)	$ 2.0	$ (8.1)
Cash provided by (used in) financing activities	$ 5.3	$ 0.2	$ (0.7)

During 2016, cash provided by operating activities was a result of $44.0 million of net income plus the net effect of non-cash adjustments to net income and net change in operating assets and liabilities of $1.7 million. The increase in cash from operating activities in fiscal 2016 compared to fiscal 2015 was primarily due to improved working capital, higher revenue levels and higher net income. Cash used in investing activities of $42.1 million during 2016, consisted primarily of $82.9 million net purchases of marketable securities and cash used to acquire property, plant and equipment of $4.0 million, partially offset by cash provided by maturities of marketable securities of $38.8 million and cash received from sales of marketable securities of $6.0 million. Cash provided by financing activities of $5.3 million during 2016 consisted primarily of $8.4 million in proceeds from issuance of common stock from the employee stock purchase program and the exercise of stock options, partially offset by cash paid for taxes on net issuance of stock awards of $1.8 million, $1.0 million of excess tax benefit from equity awards and royalty payments to Zygo of $0.3 million.

During 2015, cash provided by operating activities was a result of $2.9 million of net income, non-cash adjustments to net income of $19.4 million and a decrease in net change in operating assets and liabilities of $20.7 million. Increase in cash from operating activities in fiscal 2015 compared to fiscal 2014 was primarily due to improved working capital and increase in sales. Cash provided by investing activities of $2.0 million during 2015, consisted primarily of cash provided by maturities of marketable securities, net of purchases of $0.4 million, and cash received from sales of marketable securities of $3.4 million, partially offset by cash used to acquire property, plant and equipment of $1.8 million. Cash provided by financing activities of $0.2 million during 2015 consisted primarily of $4.0 million in proceeds from issuance of common stock from the employee stock purchase program and the exercise of stock options, partially offset by cash used to repurchase common stock of $1.7 million, royalty and other payments to Zygo of $0.9 million, and cash paid for taxes on net issuance of stock awards of $1.2 million.

During 2014, cash used in operating activities of $0.6 million was a result of $31.1 million of net losses, non-cash adjustments to net income of $37.8 million and a decrease in net change in operating assets and liabilities of $7.3

million. Cash used in investing activities of $8.1 million during 2014 consisted primarily of cash used for purchases of marketable securities, net of maturities, of $2.3 million; and cash used to acquire property, plant and equipment of $5.8 million. Cash used in financing activities of $0.7 million during 2014 consisted primarily of cash used to repurchase common stock of $5.3 million, royalty and other payments to Zygo of $0.6 million, and cash paid for taxes on net issuance of stock awards of $0.7 million, partially offset by $6.0 million in proceeds from issuance of common stock from the employee stock purchase program and the exercise of stock options.

We have evaluated and will continue to evaluate the acquisitions of products, technologies or businesses that are complementary to our business. These activities may result in product and business investments, which may affect our cash position and working capital balances. Some of these activities might require significant cash outlays.

We earn a portion of our operating income outside the United States, which is deemed to be indefinitely reinvested in foreign jurisdictions. As a result, $9.2 million of our cash is held by foreign subsidiaries, a portion of which, would have to be repatriated to the United States. We currently do not intend nor foresee a need to repatriate these funds. We believe our existing balances of cash, cash equivalents and marketable securities will be sufficient to satisfy our working capital needs, capital asset purchases, outstanding commitments and other liquidity requirements associated with our existing operations over the next twelve months.

If we should require more capital in the United States than is generated by our domestic operations, for example to fund significant discretionary activities such as business acquisitions and share repurchases, we could elect to repatriate future earnings from foreign jurisdictions or raise capital in the United States through debt or equity issuances. These alternatives could result in higher effective tax rates, increased interest expense, or dilution of our earnings.

Debt and Repurchases of Common Stock

Line of Credit – Our revolving line of credit facility with Comerica expired on May 30, 2016 and was not renewed. The revolving line of credit agreement included a provision for the issuance of commercial or standby letters of credit by the bank on our behalf. The value of all letters of credit outstanding reduced the total line of credit available. The revolving line of credit was collateralized by a blanket lien on all of our domestic assets excluding intellectual property and real estate. The minimum borrowing interest rate was 3.00% per annum. Borrowing was limited to the lesser of (a) $12.0 million plus the borrowing base, or (b) $20.0 million.

Repurchases of Common Stock - In May 29, 2012, our Board of Directors approved a stock repurchase program to repurchase up to $20.0 million of our common stock. Stock repurchases under the programs may be made through open market and privately negotiated transactions, at times and in such amounts as management deems appropriate. The timing and actual number of shares repurchased is dependent on a variety of factors including price, corporate and regulatory requirements and other market conditions.

There were no shares repurchased during fiscal year 2016.

Shares repurchased and retired for fiscal year 2015 and 2014 of the applicable repurchase programs, with the associated cost of repurchase and amount available for repurchase are as follows (in thousands, except number of shares and weighted average price per share):

	Fiscal Year 2015	Fiscal Year 2014
Number of shares of common stock repurchased	111,050	362,633
Weighted average price per share	$15.49	$14.74
Total cost of repurchase	$1,721	$5,344
Amount available for repurchase at end of period	$4,397	$6,118

$4.4 million remained available for the future repurchase of our common stock under the 2012 program.

Business Partnership –On June 17, 2009, we announced a strategic business partnership with Zygo whereby we purchased inventory and certain other assets from Zygo, and the two companies entered into a supply agreement. We made payments to Zygo over a period of time, as acquired inventory was sold and other aspects of the supply agreement were executed. We made royalty and sustaining engineering payments of $0.3 million and $0.9 million to Zygo in fiscal years 2016 and 2015, respectively.

On December 8, 2016, we amended our supplier agreement with Zygo, of which, we are released from any existing and future contingent liability related to the supply agreement.

Off-Balance Sheet Arrangements

We had no off-balance sheet arrangements or obligations as of December 31, 2016 and December 26, 2015, respectively.

Contractual Obligations

The following table summarizes our contractual cash obligations as of December 31, 2016, and the effect of such obligations.

		Payments due by period			
	Total	Less than 1 year	1-3 years	4-5 years	More than 5 years
Purchase commitments - inventory [1]	$30,592	$30,592	$—	$—	$—
Other long-term liabilities	353	1	—	—	352
Operating lease obligations	3,886	1,562	1,944	380	—
Total	$34,831	$32,155	$1,944	$380	$352

[1] We maintain certain open inventory purchase agreements with our suppliers to ensure a smooth and continuous supply availability for key components. Our liability under these purchase commitments is generally restricted to a forecasted time-horizon as mutually agreed upon between the parties. This forecasted time-horizon can vary among different suppliers. We estimate our open inventory purchase commitment as of December 31, 2016 was approximately $30.6 million. Actual expenditures will vary based upon the volume of the transactions and length of contractual service provided. In addition, the amounts paid under these arrangements may be less in the event that the arrangements are renegotiated or cancelled.

Excluded from the contractual obligation table above are $3.7 million of future payments related to uncertain tax positions because we cannot reliably estimate the timing of the settlements with the respective tax authorities.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

We are exposed to financial market risks related to foreign currency exchange rates and interest rates.

Foreign Currency Risk

A substantial part of our business consists of sales made to customers outside the United States: 86%, 80%, and 78% of sales in 2016, 2015, and 2014, respectively; and 18%, 22%, and 16% of net revenues in 2016, 2015, and 2014, respectively, were denominated in currencies other than the U.S. dollar. Additionally, portions of our costs of net revenues and our operating expenses are incurred by our international operations and denominated in local currencies.

Our exposure to foreign currency exchange rate fluctuations arises in part from intercompany balances in which costs are charged between our U.S. headquarters and our foreign subsidiaries. On our consolidated balance sheet these intercompany balances are eliminated and thus no consolidated balances are associated with these intercompany balances; however, since each foreign entity's functional currency is generally its respective local currency, there is exposure to foreign exchange risk on a consolidated basis. Intercompany balances are denominated primarily in U.S. dollars and, to a lesser extent, other local currencies. The net intercompany balance, exposed to foreign currency risk, at December 31, 2016 was approximately $11.5 million. A hypothetical change of 10% in the relative value of the US dollar versus local functional currencies could result in an increase or decrease of approximately $1.2 million in transaction gains or losses which would be included in our statement of operations.

For 2016, 2015 and 2014, foreign currency transactions resulted in a loss of $0.4 million, a gain of $0.5 million and a gain of $0.1 million, respectively.

In order to manage the level of exposure to the risk of foreign currency exchange rate fluctuations, we enter into foreign currency forward exchange contracts to protect against currency exchange risks associated with existing assets and liabilities. A foreign currency forward exchange contract acts as a hedge by increasing in value when underlying assets decrease in value or underlying liabilities increase in value due to changes in foreign exchange rates. Conversely, a foreign currency forward exchange contract decreases in value when underlying assets increase in value or underlying liabilities decrease in value due to changes in foreign exchange rates. These forward contracts are not designated as accounting hedges, so the unrealized gains and losses are recognized in other income, net, in advance of the actual foreign currency cash flows with the fair value of these forward contracts being recorded as accrued liabilities or other current assets.

We do not use forward contracts for trading purposes. Our forward contracts generally have maturities of 30 days or less. We enter into foreign currency forward exchange contracts based on estimated future asset and liability exposures, and the effectiveness of our hedging program depends on our ability to estimate these future asset and liability exposures. Recognized gains and losses with respect to our current hedging activities will ultimately depend on how accurately we are able to match the amount of foreign currency forward exchange contracts with actual underlying asset and liability exposures.

The following table provides information about our foreign currency forward exchange contracts as of December 31, 2016 and December 26, 2015. The information is provided in United States dollar equivalent amounts. The table presents the notional amounts, at contract exchange rates, and the weighted average contractual foreign currency exchange rates expressed as units of the foreign currency per United States dollar, which in some cases may not be the market convention for quoting a particular currency. All of the 2016 and 2015 forward contracts mature during January 2017 and January 2016, respectively.

	As of December 31, 2016		As of December 26, 2015	
	Notional Principal (in millions)	Contract Price	Notional Principal (in millions)	Contract Price
Forward Contracts				
Korean won	$2.6	1,202.79	$ 7.0	