PDF SOLUTIONS INC
Form 10-K
March 16, 2018

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UNITED STATES SECURITIES AND EXCHANGE COMMISSION

Washington, D.C. 20549

Form 10-K

(Mark One)
ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2017

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

000-31311

(Commission file number)

PDF SOLUTIONS, INC.

(Exact name of registrant as specified in its charter)

Delaware *(State or other jurisdiction of Incorporation or organization)*	**25-1701361** *(I.R.S. Employer Identification No.)*
333 West San Carlos Street, Suite 1000 **San Jose, California**	**95110** *(Zip Code)*

(Address of Registrant's principal executive offices)

(408) 280-7900

(Registrant's telephone number, including area code)

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

Title of Class	**Name of Each Exchange on Which Registered**
Common Stock, $0.00015 par value	The NASDAQ Stock Market LLC

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 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 (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes No

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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, smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

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

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

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

The aggregate market value of the voting stock held by non-affiliates of the Registrant was approximately $450.0 million as of the last business day of the Registrant's most recently completed second quarter, based upon the closing sale price on the NASDAQ Global Market reported for such date. Shares of Common Stock held by each officer and director and by each person who owns 10% or more of the outstanding Common Stock have been excluded in that such persons may be deemed to be affiliates. This determination of affiliate status is not necessarily a conclusive determination for other purposes.

There were 32,295,144 shares of the Registrant's Common Stock outstanding as of March 12, 2018.

DOCUMENTS INCORPORATED BY REFERENCE

Part III incorporates certain information by reference from the definitive Proxy Statement to be filed within 120 days from December 31, 2017.

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SPECIAL NOTE REGARDING FORWARD LOOKING STATEMENTS

This Annual Report on Form 10-K, particularly in Item 1 "Business" and Item 7 "Management's Discussion and Analysis of Financial Condition and Results of Operations," includes forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended (the "Securities Act") and Section 21E of the Securities Exchange Act of 1934, as amended (the "Exchange Act"). These statements include, but are not limited to, statements concerning: expectations about the effectiveness of our business and technology strategies; expectations regarding global economic trends; expectations regarding recent and future acquisitions; current semiconductor industry trends; expectations of the success and market acceptance of our intellectual property and our solutions; and our ability to obtain additional financing if needed. Our actual results could differ materially from those projected in the forward-looking statements as a result of a number of factors, risks and uncertainties discussed in this Form 10-K, especially those contained in Item 1A of this Form 10-K. The words "may," "anticipate," "plan," "continue," "could," "proj "expect," "believe," "intend," and "assume," the negative of these terms and similar expressions are used to identify forward-looking statements. All forward-looking statements and information included herein is given as of the filing date of this Form 10-K with the Securities and Exchange Commission ("SEC") and based on information available to us at the time of this report and future events or circumstances could differ significantly from these forward-looking statements. Unless required by law, we undertake no obligation to update publicly any such forward-looking statements.

The following information should be read in conjunction with the Consolidated Financial Statements and notes thereto included in this Annual Report on Form 10-K. All references to fiscal year apply to our fiscal year that ends on December 31. All references to "we", "us", "our", "PDF", "PDF Solutions" or "the Company" refer to PDF Solutions, I

PART I

Item 1. ***Business***

Business Overview

PDF Solutions is a leading provider of electrical characterization and data analytics for process-design optimization and yield enhancement to improve our customers' profitability. Our solutions target the value chain from technology development and the design of an integrated circuit (or IC) through volume manufacturing of that IC. Our solutions combine proprietary software, physical intellectual property (or IP) in the form of on-wafer instruments and cell libraries for IC designs, contact and non-contact electrical measurement tools, proven methodologies, and professional services. We generate and analyze electrical characterization data to optimize process, design, and fabrication of

semiconductor devices for high yield, low cost, and high performance. We monetize our solutions through contract revenue, a value-based royalty that we call a Gainshare performance incentive, and software and hardware licensing. The result of successfully implementing our solutions is the creation of value that can be measured in terms of higher yield, lower cost, and improved IC device and manufacturing performance. Our technologies and services have been sold to integrated device manufacturers, fabless semiconductor companies, foundries, out-sourced semiconductor assembly and test (or OSAT), and system houses.

The key benefits of our solutions and business model to our customers are faster time-to-market, faster time-to-volume and more efficient design and manufacturing processes. For example, our foundry customers are able to generate and analyze key manufacturing data using either our Design-for-Inspection (or DFI) or Integrated Yield Ramp (or IYR) solutions to shorten the time necessary for technology development and provide their fabless customers a higher yielding process, with improved electrical performance, sooner, which increases fabless customer acquisition. Also, for example, our integrated device manufacturers (or IDMs) and fabless customers might use our DFI and Design-for-Manufacturability (or DFM) solution to generate and analyze data to bridge the design and manufacturing interface, resulting in shorter time for initial designs to meet performance requirements with fewer iterations and faster time to market for new designs. Our data analytics, including for process control and assembly and test, are designed to provide insight across the whole electronic supply chain. For example, our customers can gain insight into factors that affect yield and device performance at mass production through final packaging, thus enabling a lower total cost of goods sold. For further example, our volume manufacturing solution may provide a foundry customer with the ability to proactively monitor process health to avoid potential yield problems. Fabless customers also benefit from an integrated insight into their supply chain effectiveness.

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Our long-term business objective is to enable our customers to optimize their processes, designs, and fabrication for high yield, low cost, and high performance, and to be the big data analytics supplier of choice for the electronic supply chain. To achieve this objective, we intend to:

Position for DFI Success. We intend to demonstrate and validate the value of our DFI solution by expanding its use in both process development and volume production. We expect to achieve this by increasing the installed base of our first-generation, contactless measurement tool in our foundry customers' early R&D programs and drive insertion of our on-chip instruments at an increasing number of IDM and fabless companies, on an increasing number of designs. For example, through the date of this report, we have received orders and deployed our DFI eProbe® 150 tool systems at three logic foundry customers and DFI on-chip instruments have been placed in over 100 customers' chips at the 28 nanometer (nm) through 7 nm foundry logic process nodes. Finally, we intend to expand our DFI product offering with the introduction of the second-generation measurement tool targeted for in-line applications.

Broaden Footprint at Existing Software Customers and Expand Software Market Opportunity. We intend to increase the breadth and depth of the use of our software applications by demonstrating additional value-add opportunities at existing customers. For example, we intend to continue to develop and enhance our big data analytics capability to further extract unique electrical characterization data in our yield ramp engagements for our IYR customers. Additionally, we intend to expand the market opportunity vertically by developing new data sources and applications for our Exensio platform. This expansion up the semiconductor supply chain is designed to enable new data sources and application capability to system level designers and product managers. For example, in 2017, the acquisition of the ALPS software enabled us to analyze die-level traceability as an additional data source at the package level.

Align IYR Business Model and Costs to Changing Market Conditions. We intend to expand adoption of our IYR solutions on derivative processes of existing technology, mainstream foundries, and memory applications. Market factors driving this business strategy include the slowing rate at which advanced nodes are introduced and reduced capacities related to those nodes, introduction and expansion of 3-D memory technologies, and continuing concentration in both the foundry and fabless sides of the industry. We intend to focus on new entrants into the foundry and memory markets, in particular in China. This is aimed at taking advantage of increasing investments in China in the semiconductor market. For example, in 2017, we entered into a new engagement with a 3-D memory foundry in China.

Expand Ecosystem. We intend to continue to extend and enhance our relationships with companies at various stages of the design-to-silicon process, such as process licensors, manufacturing and test equipment vendors, electronic design automation vendors, silicon IP providers, semiconductor foundries, and contract test and assembly houses. We believe these relationships will ultimately enhance the value and utility our solutions and help drive standardization on PDF Solutions technology.

Brief History

PDF Solutions was incorporated in Pennsylvania in November 1992, and we reincorporated in California in November 1995. In July 2000, we reincorporated in Delaware, and in July 2001, we completed an initial public offering. Our shares of common stock are currently traded on the NASDAQ Global Market. From 2000 through 2009, we expanded our technology footprint and our operations in various countries through acquisitions. From 2009 to the present, we have primarily focused on the pervasive application of our technology to leading edge logic manufacturing and achieving yield targets with our clients to maximize Gainshare performance incentive revenues. Beginning in 2013, we leveraged our more than 20 years of yield simulation software and Characterization Vehicle test chip development and began new research and development on a solution for contactless in-line electrical characterization and process control for wafer inspection. Starting in 2014, we re-architected our point-solution software tools into an integrated platform based on new generation data analytics and introduced our Exensio platform to the industry. In 2016, the first version of our e-beam tool was commercialized, and we are currently focused on completing development and commercialization of the second version. Headquartered in San Jose, California, PDF Solutions operates worldwide with another principal office in Shanghai, China and additional entities and/or offices in Canada, France, Germany, Italy, Japan, Korea, and Taiwan.

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Industry Background

Rapid technological innovation, with increasingly shorter product life cycles, now fuels the economic growth of the semiconductor industry. IC companies have historically ramped production slowly, produced at high volume once products gained market acceptance, and slowly reduced production volume when price and demand started to decrease near the end of the products' life cycles. Now, companies often need to be the first to market and the first to sell the most volume when a product is first introduced so that they have performance and pricing advantages over their competition, or else they lose market opportunity and revenue. Increased IC complexity and compressed product lifecycles create significant challenges to achieve competitive initial yields and optimized performance. For example, it is not uncommon for an initial manufacturing run to yield only 20%, which means that 80% of the ICs produced are wasted. Yield improvement performance optimization and production efficiencies are critical drivers of IC companies' financial results, because they typically lead to cost reduction and revenue generation concurrently, causing a leveraged effect on profitability.

Technology and Intellectual Property Protection

We have developed proprietary technologies for yield simulation, analysis, loss detection, and improvement. The foundation for many of our solutions is our CV® infrastructure (or CV*i*) that enables our customers to electrically characterize the manufacturing process, and establish fail-rate information needed to calibrate manufacturing yield models, prioritize yield improvement activities and speed-up process learning-cycles. Our CV*i* includes proprietary Characterization Vehicle®test chips, including designs of experiments and layout designs, and a proprietary and patented highly-parallel contact electrical functional and parametric-test system, comprised of hardware and software designed to provide an order-of-magnitude reduction in the time required to test our Characterization Vehicle® test chips. Our DFI solution includes physical IP in the form of test structures specifically designed by our engineers for targeted fail modes and co-optimized to be efficiently measured by our non-contact electrical measurement tool both in test chips, including in scribe lines, and in the fill area of production wafers. In addition, our technology embodies many algorithms, which we have developed over the course of many years, and which are implemented in our products including Exensio®, pdCV™, FIRE™, and Templatyzer™, among others. For a description of these products, see Products and Services below. Further, our IP includes methodologies that our implementation teams use as guidelines to drive our customers' use of our CV® test chips DFI solution, and technologies, quantify the yield-loss associated with each process module and design block, make wafer disposition decisions, control process equipment, simulate the impact of changes to the design and/or to the manufacturing process, and/or analyze the outcome of executing such changes. We continually enhance our core technologies through the codification of knowledge that we gain in our solution implementations.

Our future success and competitive position rely to some extent upon our ability to protect these proprietary technologies and IP, to generate revenue for customers' use of our solutions, and to prevent competitors from using our systems, methods, and technologies in their products. To accomplish this, we rely primarily on a combination of contractual provisions, confidentiality procedures, trade secrets, and patent, copyright, mask work, and trademark laws. We license our products and technologies pursuant to non-exclusive license agreements that impose restrictions

on customers' use. In addition, we seek to avoid disclosure of our trade secrets, including requiring employees, customers, and others with access to our proprietary information to execute confidentiality agreements with us and restricting access to our source code. We also seek to protect our software, documentation, and other written materials under trade secret and copyright laws. We seek to protect our IP under patent laws and as of December 31, 2017, we held 113 U.S. patents. Our issued patents have expiration dates from 2019 through 2037. We intend to prepare additional patent applications when we feel it is beneficial. We also employ protection of our trademarks, with registration on marks including Characterization Vehicle®, CV®, eProbe®, Exensio®, pdFasTest®, PDF Solutions®, the PDF Solutions logo. ALPS,™ Design-to-silicon-yield,™ Design-for-Inspection,™ DFI,™ DirectProbe,™ DirectScan,™ FIRE,™ pdCV,™ Template,™ Templatyzer,™ and YieldAware™ are our common law trademarks of PDF Solutions or its subsidiaries.

Products and Services

Through organic development and targeted acquisitions over more than 20 years, we have accumulated an array of fully-integrated and co-designed proprietary software, physical IP for IC designs, electrical measurement tools, and proven methodologies. Subsets of this array are selected to address each customer's specific technical and business requirements. For example, a fabless customer designing a new product may use our proprietary on-wafer instruments and cell libraries design physical IP to enhance their design for manufacturability. In contrast, an IYR solution on a leading edge process node for a device manufacturer foundry may include our electrical characterization infrastructure, analysis tools, and professional services to accelerate learning and reduce time-to-market. By way of another example, a fabless company in volume manufacturing may use our data analytic software tools, which are also available to their foundry partners, to monitor how the fabless' designs are performing at their foundry partners. The following gives more information about our services and solutions and products.

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Services and Solutions

Design-for-Inspection™ (or DFI)™ Solutions. Our DFI solutions are designed to enable our customers to achieve contactless, inline electrical characterization and process control. DFI provides customers an ability to insert on-chip instruments with calibrated electrical responses directly in the product wafer without any die area penalty. In addition, DFI is designed to be high-throughput, enabling in-line use. The electrical measurements augment and enhance existing inline defect inspection and metrology methods.

Foundry Solution: We provide our foundry customers a complete DFI system for inline characterization and process control. This DFI infrastructure includes not only on-wafer IP, or on-chip instruments, but also the eProbe® measurement system and the Exensio® -Char DFI software for data processing and analysis. The DFI on-chip instruments are co-designed with, and optimized for, the eProbe measurement tool for the best voltage contrast readout, and also with the Exensio -Char DFI software for fast handling and analysis of the huge eProbe data stream.

Fabless IP: We work closely with our fabless customers to tune the DFI on-chip instruments to reflect the key aspects of their product designs. We also provide proprietary software that is designed to efficiently distribute DFI filler cells across the die, for maximum issue coverage with fast readout. DFI is designed to enable every fabless company designing products at 28 nanometers and below to achieve better manufacturing results.

Volume Manufacturing Solutions (or VMS). Our Exensio® volume manufacturing solutions are designed to link the critical data streams from the entire manufacturing process, from bare wafer to packaged part or system; to improve yield and provide both better operational and process control of tools and testers. The systems also maintain comprehensive traceability from starting wafer through to final packaged part or system. When used in conjunction with our Characterization Vehicle infrastructure, our Exensio software and services enable customers to correlate the proprietary CVi data generated with high granularity manufacturing data also generated, to improve yield while simultaneously reducing the overhead of manufacturing.

Manufacturing Process Solutions (or MPS). The IC manufacturing process typically involves four sequential phases: research and development to establish unit manufacturing processes, such as units for the metal CMP or lithography processes; integration of these unit processes into functional modules, such as metal or contact modules; a yield ramp of lead products through the entire manufacturing line; and volume manufacturing of all products through the life of the process. We offer solutions targeted to each of these phases designed to accelerate the efficiency of yield learning by shortening the learning cycle, learning more per cycle, and reducing the number of silicon wafers required. Our targeted offerings include:

- *Process R&D:* Our process R&D solutions are designed to help customers increase the robustness of their manufacturing processes by characterizing and reducing the variability of unit processes and device performance with respect to layout characteristics within anticipated process design rules.

- *Process Integration and Yield Ramp:* Our process integration and yield ramp solutions are designed to enable our customers to more quickly ramp the yield of new products early in the manufacturing process by characterizing the process-design interactions within each key process module, simulating product yield loss by process module, and prioritizing quantitative yield improvement by design block in real products.

Design-for-Manufacturability (or DFM) Solutions. Our DFM solutions are designed to enable our customers to optimize yields, improve parametric performance, and reduce product ramp time by integrating manufacturability considerations into the design cycle before a design is sent to the mask shop to more quickly and cost-effectively manufacture IC products. We target these solutions to customers' requirements by providing the following:

- *DFM Solutions:* DFM solutions include software, IP, CV infrastructure, and services designed to validate customers' process design kit (or PDK) and to maximize functional and parametric yield improvements while achieving requirements for density or performance. A CV test chip optimized to the design style of an IC design provides any necessary design-specific parametric and functional yield models for the design style. Our software helps designers optimize the yield by using process-specific and design style-specific yield models and technology files that enable identification and implementation of IP design building block improvements that result in enhanced yield.

- *Template™ Technology Physical IP Solutions:* Template physical IP solutions include Templatyzer software and IP for first identifying and developing a set of layout patterns that are optimized to a given manufacturing process and target product application and second checking proposed product layout designs against this set of patterns for optimal manufacturability. A complete characterization of all transistor and layout patterns used in these Template layouts can be performed with the CV infrastructure. These Template layouts serve as the building blocks for design organizations to construct standard cell libraries and larger physical IP blocks.

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Products

Our DFI, Volume Manufacturing, Manufacturing Process, and DFM solutions incorporate the use of various elements of our software products and other technologies, depending on the customers' needs. Our software products and other technologies include the following:

Characterization Vehicle Infrastructure. Our test chip design engineers develop a design of experiments (or DOEs) to determine how IC design building blocks interact with the manufacturing process. Our CV® software utilizes the DOE, as well as a library of building blocks that we know has potential yield and performance impact, to generate CV® test chip layouts. Our CV® infrastructure includes:

- *CV Test Chips.* Our family of proprietary test chip products is run through the manufacturing process with intentional process modifications to explore the effects of potential process improvements given natural manufacturing variations. Our custom-designed CV test chips are optimized for our test hardware and analysis software and include DOEs tuned to each customer's process. Our full-reticle short-flow CV test chips provide a fast learning cycle for specific process modules and are fully integrated with third-party failure analysis and inspection tools for complete diagnosis to root cause. Our Scribe CV products are inserted directly on customers' product wafers and collect data from product wafers about critical layers. Our DirectProbe™ CV test chips enable ultra-fast yield learning for new product designs by allowing our clients to measure components of actual product layout.

- *pdCV™ Analysis Software.* Our proprietary software accumulates data from our CV test chips, enabling models of the performance effects of process variations on these design building blocks to be generated for use with our FIRE™ software.

- *pdFasTest® Electrical Tester.* Our proprietary system enables fast defect and parametric characterization of manufacturing processes. This automated system provides parallel functional testing, thus minimizing the time required to perform millions of electrical measurements to test our CV test chips.

Design-for-Inspection (or DFI) Infrastructure. Our DFI IP design engineers develop DOEs to determine how IC design building blocks interact with the manufacturing process. These on-chip measurement instruments are inserted into test and product wafers and measured on custom e-beam measurement hardware. DFI leverages our field proven design and analysis infrastructure, and includes:

- *DFI™ On-Chip Instruments.* Our on-chip characterization instruments are developed with the same proprietary design software as our CV Test Chips and tuned to capture key features of our customers' product layouts using our proprietary FIRE™ layout analysis software. These DFI instruments are based on our Characterization Vehicle (CV) technology and are designed to be placed in test chips, scribe lines, or in product die, without any area penalty, and to

exhibit specific electrical responses.

eProbe® Contactless E-Beam Tool. Our eProbe® e-beam tools are designed to measure the electrical response of the DFI instruments. This new measure, which we call an Electrical Response Index, or ERI, allows for more precise inline characterization of design-process interactions.

Exensio® –Char DFI Software. Exensio –Char DFI software, a part of our Exensio Big Data analytics platform, is designed to analyze the billions of measurements collected from DFI instruments using the eProbe® Tool.

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Exensio Enterprise-wide Platform. Our Exensio platform addresses the big data manufacturing challenge of today's advanced process nodes and highly integrated products, by linking across YMS, FDC, test floor, and other enterprise-wide data types. These data types include in-line and end-of-line metrology, yield, parametric, performance, manufacturing consumables, tool-level sensor data, test floor data, logistical data, as well as custom data types. This enables sensor level, root cause diagnosis of yield and performance issues that impact manufacturing, through building process models of these relationships. The on-line models then enable predictive and proactive optimization decisions for process control, process adjustments, PM scheduling, tool corrective actions, wafer dispatching, and wafer level and final test. The in-line, real-time decision-making based on these models is designed to reduce product variability and cost simultaneously. Our Exensio platform also enables more rapid diagnosis and understanding of yield loss and performance-limiting mechanisms identified at both in-line and end-of -line wafer processing, through application of the developed models. The platform currently consists of four main modules in the field today. These modules can be used separately, or combined to provide seamless integration of these traditionally disparate dataflows and applications. Additionally, specific Exensio functionality is available as either an on-premise installation or through the software as a service, or SaaS, offering.

Exensio -Yield, collects yield data, then loads and stores it in an analysis-ready database. This enables product engineers to identify and analyze production yield, performance, reliability and other issues. The Exensio-Yield module is designed to handle very large data sets, to efficiently improve productivity, yield and time-to-market at our customers' sites. Exensio-Yield contains powerful, interactive visualization and analysis template capabilities, which provide flexibility to address our customers' requirements. Exensio-Yield advanced components include extra proprietary yield analysis software tools that aid in the diagnosis of more complex yield issues. This includes defect analysis tools, spatial signature analysis, excursion and event monitoring, workflows, and data-mining capabilities.

Exensio -Control, provides FDC capabilities for monitoring, alarming and control of manufacturing tool sets. These capabilities include analyzing tool sensor trace data and summary indicators to rapidly identify sources of process variations and manufacturing excursions. This is achieved by monitoring these equipment parameters through proprietary data collection and analysis features. When included with the above Exensio-Yield module, data mining and correlation capabilities enable identification of tool level sources of yield loss and process variation, that are impacting end of line product yield, performance and reliability.

Exensio -*Test*, provides testing and analysis capability. These capabilities include driving test productivity, test operations management and optimization, supporting test floor operations, as well as implementing adaptive test and analysis technologies. It also views diagnostic and predictive information during test, assembly and packaging — maximizing test operations, productivity and yields.

Exensio -*Char*, encapsulates test structure analysis functionality of both electrical and in**-**line inspection data from PDF Solutions' proprietary Characterization Vehicle (CV) test chips and DFI on-chip instruments.

Exensio ALPS™, provides device manufacturers the capability to link final device performance, both at test and in the field, to the totality of device fabrication and characterization data, including data from our Characterization Vehicle electrical test chip infrastructure.

FIRE *Software.* Our FIRE software analyzes an IC design to compute its systematic and random yield loss. FIRE software allows design attribute extraction and feature-based yield modeling. FIRE software takes as input a layout that is typically in industry standard format and proprietary yield models generated by running and testing our CV test chips. FIRE software is designed to estimate the yield loss due to optical proximity effects, etch micro-lading, dishing in CMP, and other basic process issues.

Template Technology. Our Template technology includes Templatyzer software and IP for identifying and developing a set of layout patterns that are tailored to a given manufacturing process and target product application and checking proposed designs against this set of patterns for optimal manufacturability.

With the exception of Exensio -Yield, Exensio -Control, Exensio -Test, Exensio -Char, and Exensio ALPS, the primary distribution method for our software and technologies is through our manufacturing process solutions. The primary distribution method for Exensio -Yield, Exensio -Control, Exensio -Test, Exensio -Char, and Exensio ALPS is standalone license agreements. However, we have in the past and may in the future distributed some or all of these products within solutions as a bundle, or separately license other products or technologies outside of our solutions.

Customers

Our existing customers include foundries, integrated device manufacturers (or IDMs), fabless semiconductor design companies, some off-shore assembly and testing facilities (or OSATs), as well as some equipment manufacturers. Our semiconductor customers' targeted product segments vary significantly, including microprocessors, memory, graphics, image sensor solutions, and communications. Through our acquisition of certain Kinesys assets in 2017, we expanded our customer base to include additional equipment manufacturers that embed and distribute our ALPS product in their equipment. We believe that the adoption of our solutions by such companies for usage in a wide range of products validates the application of our Design-to-silicon-yield solutions to the broader semiconductor market.

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Global Foundries Inc. (“Global Foundries”) represented 40% of our revenues for 2017. Global Foundries and Samsung represented 41% and 11%, respectively, of our revenues for 2016. Global Foundries and Samsung represented 53% and 12%, respectively, of our revenues for 2015. No other customer accounted for 10% or more of our revenues in 2017, 2016, and 2015.

Although a substantial portion of our total revenue is concentrated in a small number of customers, the total revenues for each of these customers in any period is the result of Design-to-silicon-yield solutions and/or Gainshare performance incentives revenues recognized in the period under multiple, separate contracts, with no interdependent performance obligations. These contracts were all entered into in the ordinary course of our business and contain general terms and conditions that are standard across most of our yield improvement solutions customers, including providing services typically targeted to one manufacturing process node, for example the 28 or 20 nanometer node. See the discussion in “Risk Factors” under Item 1A for more information about risks associated with customer concentration and contractual provisions.

International revenues accounted for approximately 61% of our total revenues for 2017 compared to 64% for 2016 and 54% for 2015. We base these calculations on the geographic location of where the work is performed. Revenues from customers by geographic area based on the location of the customers’ work sites for our last three fiscal years can be found in Note 9, “Customer and Geographic Information” to the consolidated financial statements. Additional discussion regarding the risks associated with international operations can be found under Item 1A, “Risk Factors”.

See our “Notes to Consolidated Financial Statements”, included under Part II, Item 8. “Financial Statements and Supplementary Data” for additional geographic information.

Sales and Marketing

Our sales strategy is to pursue targeted accounts through a combination of our direct sales force, our solution implementation teams, and strategic alliances. After we are engaged by a customer and early in the solution implementation, our engineers seek to establish relationships in the organization and gain an understanding of our customers’ business issues. Our direct sales and solution implementation teams combine their efforts to deepen our customer relationships by expanding our penetration across the customer’s products, processes and technologies. This close working relationship with the customer has the added benefit of helping us identify new product areas and technologies in which we should next focus our research and development efforts. From time-to-time, we use sales representatives/agents in various locations to augment direct sales in certain territories. For example, in 2017, we engaged Abrolex in China, Recynergy in Taiwan, Tessolve in India and Southeast Asia. We expect to continue to establish strategic alliances with process licensors, vendors in the electronic design automation software, capital equipment for IC production, and test silicon IP and mask-making software segments to create and take advantage of sales channel and co-marketing opportunities. Additionally, we expect to form relationships with key value chain participants, including foundries and OSATs, to provide services and value across the manufacturing supply chain.

Research and Development

Our research and development focuses on developing and introducing new proprietary technologies, including our DFI solution as well as other software products and enhancements to our existing solutions. We use a rapid-prototyping paradigm in the context of the customer engagement to achieve these goals. We have made, and expect to continue to make, substantial investments in research and development. The complexity of our Design-to-silicon-yield technologies requires expertise in physical IC design and layout, transistor design and semiconductor physics, semiconductor process integration, numerical algorithms, e-beam technology, hardware, statistics and software development. We believe that our team of engineers will continue to advance our market and technological leadership. We conduct in-house training for our engineers in the technical areas, as well as focusing on ways to enhance client service skills. Although it fluctuates, we can have up to one quarter of our research and development engineers operating in the field, partnered with solution implementation engineers in a deliberate strategy to provide direct feedback between technology development and customer needs. We also utilize a variety of skilled independent contractors for specialized development. Our total research and development expenses were $30.1 million, $27.6 million and $19.1 million in 2017, 2016 and 2015, respectively.

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Competition

The semiconductor industry is highly competitive and driven by rapidly changing design and process technologies, evolving standards, short product life cycles, and decreasing prices. We expect market competition to continue to develop and increase as the market for process-design integration technologies and services continues to evolve. We believe the solution to address the needs of IC companies requires a unified system of yield models, design analysis software, CV test chips, physical IP creation, and semiconductor manufacturing software. Currently, we are the leading provider of comprehensive commercial solutions for integrating design and manufacturing processes. We face indirect competition from internal groups at IC companies that use an incomplete set of components not optimized to accelerate process-design integration. Some providers of semiconductor manufacturing software, inspection equipment, electronic design automation, or design IP may seek to broaden their product offerings and compete with us. In each of our product markets, we face competition from established and potential competitors, some of which may have greater financial, research, engineering, manufacturing and marketing resources than we have.

We face competition for some of the point applications of our solutions including some of those used by the internal groups at IC companies. Specifically there are several suppliers of (i) yield management and/or prediction systems, such as KLA-Tencor, Mentor Graphics, Rudolph Technologies, Inc. (“Rudolph”), Synopsys, Inc. (“Synopsys”), and Qualtera, (ii) semiconductor manufacturing software, such as Applied Materials, Inc., BISTel Inc., Invantest, Inc., MKS Instruments, Inc., Optimal+, Rudolph, Siemens AG (through its acquisition of Mentor Graphics, which previously acquired Galaxy Semiconductor Solutions), and Trancom Technology, Inc. and, (iii) inline inspection, metrology and electrical test equipment providers, such as Applied Materials, Inc., Hermes Microvision, Inc., and Keysight Technologies, Inc. Further, ARM Ltd. and Synopsys provide standard cells in the physical IP space and Tela Innovations, Inc. provides software for standard cell synthesis, each of which could compete with our Template™ technology solution. Further, we may compete with the products or offerings of the same or additional companies if we expand our offerings, or they expand their offerings, through acquisition or development. In addition, Synopsys now appears to offer directly competing DFM solutions, while other EDA suppliers provide alternative DFM solutions that may compete for the same budgetary funds.

We believe that our solutions compare favorably with respect to competition because we have demonstrated results and reputation, strong core technology, ability to create innovative technology, and ability to implement solutions for new technology and product generations.

Employees

As of December 31, 2017, we had 417 employees worldwide, including 265 on client service teams, 91 in research and development, 26 in sales and marketing, and 35 in general and administrative functions. Of these employees, 186 are located in the United States and Canada, 190 in Asia, and 41 in Europe.

None of our employees are represented by a labor union. Our employees in France and Italy are subject to collective bargaining agreements in those countries. We believe our relationship with our employees is good. Competition is intense in the recruiting of personnel in our industry. We believe that our future success will depend, in part, on our continued ability to hire and retain qualified management, marketing and technical employees.

Executive Officers

The following table and notes set forth information about our current executive officers as of February 28, 2018.

Name	Age	Position
John K. Kibarian, Ph.D.	53	President, Chief Executive Officer, and Director
Gregory C. Walker	64	Vice President, Finance and Chief Financial Officer
Cees Hartgring, Ph.D.	65	Vice President, Client Services and Sales
Kimon Michaels, Ph.D.	51	Vice President, Products and Solutions
Kwang-Hyun Kim, Ph.D.	62	Vice President, Business Development, PDF Solutions Semiconductor Technology Korea Limited

John K. Kibarian, Ph.D., one of our founders, has served as President since November 1991 and has served as our Chief Executive Officer since July 2000. Dr. Kibarian has served as a director since December 1992. Dr. Kibarian received a B.S. in Electrical Engineering, an M.S. E.C.E. and a Ph.D. E.C.E. from Carnegie Mellon University.

Gregory C. Walker has served as a Chief Financial Officer and Vice President, Finance since November 2011. Prior to joining the Company, Mr. Walker served as Sr. Vice President and Chief Financial Officer at InnoPath Software from 2007 to 2011. Prior to that, Mr. Walker served as Sr. Vice President & Chief Financial Officer of Magma Design Automation, Inc. from 2002 through 2007. Earlier in his career, he held various financial roles at technology companies, including Synopsys, Inc., Integrated Device Technology, Inc., International Business Machines Corporation and Xerox Corporation. Mr. Walker received an M.B.A. from the University of Rochester in Rochester, New York and a B.A. in economics and history from Union College in Schenectady, New York.

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Cees Hartgring, Ph.D., has served as Vice President, Client Services and Sales since June 2007. Dr. Hartgring served as Vice President and General Manager, Manufacturing Process Solutions from January 2004 through May 2007, as Vice President, Worldwide Sales and Strategic Business Development from April 2003 through December 2003 and as Vice President of Sales from September 2002 through March 2003. Prior to joining PDF, Dr. Hartgring served as President and Chief Executive Officer of Trimedia Technologies, a Philips Semiconductor spinout. Dr. Hartgring also held various executive positions at Philips Semiconductor, most recently as Vice President and General Manager of the Trimedia business unit. Dr. Hartgring received an undergraduate degree from the Technical University Delft and an M.S.E.E. and a Ph.D. in Electrical Engineering and Computer Science from the University of California at Berkeley.

Kimon Michaels, Ph.D., one of our founders, has served as Vice President, Products and Solutions since July 2010. Mr. Michaels served as Vice President, Design for Manufacturability from June 2007 through June 2010. Prior to that, Dr. Michaels served as Vice President, Field Operations for Manufacturing Process Solutions from January 2006 through May 2007, and has been a Director since November 1995. From March 1993 through December 2005, he served in various vice presidential capacities. He also served as Chief Financial Officer from November 1995 to July 1998. Dr. Michaels received a B.S. in Electrical Engineering, an M.S. E.C.E. and a Ph.D. E.C.E. from Carnegie Mellon University.

Kwang-Hyun Kim, *Ph. D.,* has served as Vice President, Business Development, PDF Solutions Semiconductor Technology Korea Limited, since February 2014. Prior to joining PDF, Dr. Kim served as Executive Vice President of Samsung Electronics' Foundry Business from 2010 through 2013, and was Senior Vice President of Sales & Marketing for Samsung Electronics' SLSI group from 2005 through 2010. From 1989 through 2005, he held various executive positions within Samsung Electronics' ASIC Library/IP and Design Methodology Development and Communication & Custom SOC Development groups. Dr. Kim received an M.S. and Ph.D. in Electrical Engineering from Virginia Tech and a B.S. in Electrical Engineering from Sogang University in Korea.

Available Information

We file or furnish various reports, such as registration statements, periodic and current reports, proxy statements and other materials with the SEC. Our Internet website address is www.pdf.com. You may obtain, free of charge on our website, copies of our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K, and amendments to those reports filed or furnished pursuant to Section 13(a) or 15(d) of the Exchange Act, as soon as reasonably practicable after we electronically file such material with, or furnish it to, the SEC. The Company's website address provided is not intended to function as a hyperlink, and the information on the Company's website is not, and should not be considered, part of this Annual Report on Form 10-K and is not incorporated by reference herein.

In addition to the materials that are posted on our website, you may read and copy any materials we file with the SEC at the SEC's Public Reference Room at 100 F Street, NE, Washington, DC 20549-0120. You may obtain information on the operation of the Public Reference Room by calling the SEC at 1-800-SEC-0330. The SEC also maintains a Web site (http://www.sec.gov) that contains reports, proxy and information statements and other information regarding issuers, such as us, that file electronically with the SEC.

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Item 1A. Risk Factors

We generate most of our revenues from a limited number of customers, and a large percentage of our revenues from a single customer, so decreased business with, or the loss of, any one of these customers, or pricing pressure, or customer consolidation could significantly reduce our revenue or margins, negatively impacting results of operations, and require us to accept lower margin business on future nodes.

Historically, we have had a small number of large customers for our core Design-to-silicon-yield solutions and that contribute significant Gainshare performance incentives revenue. In the year ended December 31, 2017, one customer, GlobalFoundries, accounted for 40% of our revenues. We could lose a customer due to its decision not to engage us on future process nodes, its decision to reduce the scope of our services or technology used, which is permitted in certain of our contracts if the customer company's business materially adversely changes, its decision not to develop its own future process node, or as a result of industry factors, including but not limited to consolidation. Further, new business may be delayed if a key customer uses its leverage to push for terms that are worse for us and we nonetheless continue to negotiate for better terms, in which case Solutions revenue in any particular quarter or year may fail to meet expectations. Also, the loss of any of these customers or the failure to secure new contracts with these customers could further increase our reliance on our remaining customers. For example, in the first quarter of 2015, we recognized significant one-time revenue associated with closing two contracts with one of our then-largest customers that we were unable to close on the expected schedule. Further, if any of our key customers default, declare bankruptcy or otherwise delay or fail to pay amounts owed, or we otherwise have a dispute with any of these customers, our results of operations would be negatively affected in the short term and possibly the long term. These customers may seek to renegotiate pre-existing contractual commitments due to adverse changes in their own businesses or, in some cases, take advantage of contractual provisions that permit the suspension of contracted work for some period if their business experiences a financial hardship, which would harm our operating results. In particular, these events could cause significant fluctuations in results of operations because our expenses are fixed in the short term and it takes us a long time to replace customers or reassign resources.

If we are unable to complete development of our e-beam measurement tool for in-line wafer inspection on schedule or at all, or successfully commercialize our Design-for-Inspection (DFI) solution, our future market opportunity and revenues will suffer and our costs may not be recouped.

Certain use cases of our DFI solution remain to be proven, and the in-line version is still in development. To date, we have invested significantly in the design and development of our DFI eProbe tool and related intellectual property. If existing foundry customers fail to renew or expand the number or use of the systems they are using, or new foundry customers fail to adopt our DFI solution, and our results may suffer. Also, if the results of our DFI solution are not as we expect, we may not be able to successfully commercialize these technologies on schedule, or at all, and we may miss the market opportunity and not recoup our investment. Further, our DFI tool may cause unexpected damage to wafers or delays processing wafers, which we could be liable for, or which may make customers unwilling to use it. If we are not able to create significant interest and show reliable and useful results, our investment may not be recouped and our future results may suffer.

Decreases in wafer volumes at our customers' manufacturing sites or the volume of ICs that some of our customers are able to sell to their customers would cause our Gainshare performance incentives revenue to suffer.

Our Gainshare performance incentives revenue is largely determined by wafer volumes at manufacturing sites covered by our contracts and, in some cases, the volume of an IC product that our customer is able to sell to its customers. Both of these factors are outside of our control. Further, some of our manufacturing customers' business is largely dependent on customers that use our manufacturing customer as a second or third source. If those customers consolidate and/or otherwise move the orders to manufacturing facilities not covered by our contracts, or suspend their manufacturing at covered facilities for any reason, including consolidation, our Gainshare revenue will decrease. Reduced demand for semiconductor products decreases the volume of wafers and, in some cases, products our customers are able to sell, which would also directly decrease our Gainshare revenue. For example, 28nm volumes were lower in 2017 than expected. Also, our customers may unilaterally decide to implement changes to their manufacturing processes during the period that is covered by Gainshare, which could negatively affect yield results and our revenue. Since we currently work on a small number of large projects at a specified manufacturing sites and, in some cases, on specific IC products, our results of operations are adversely affected by negative changes at those sites or in those products. For example, if wafer orders from sites covered by our contracts are not secured by our customers, if an end product does not achieve commercial viability, if a process line or, in some cases, a specific product, do not achieve significant increases in yield or sustain significant volume manufacturing during the time we receive Gainshare, revenues associated with such volumes or products would be negatively impacted. This could significantly reduce our revenue and results of operations below expectations. In addition, if we work with two directly competitive manufacturing facilities or products, volume in one may offset volume, and thus any of our related Gainshare, in the other facility or product.

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If semiconductor designers and manufacturers do not continue to adopt, or they significantly delay adoption of, our products and solutions, our revenues will suffer.

If semiconductor designers and manufacturers do not continue to adopt our products and solutions, both as currently comprised and as we may offer them in the future, our revenues will decline. We may not be successful if we do not continue to enter into long-term agreements with existing customers and new customers that cover a larger number of IC products, processes, or manufacturing facilities. If we do not continue to develop customer relationships with companies that are integrated device manufacturers (or IDMs), fabless semiconductor companies, foundries, and out-sourced assembly and test companies (or OSATs), as well as system houses, the market acceptance of our solutions will suffer. Factors that may limit adoption of our products and solutions by semiconductor companies include:

- our existing and potential customers' delay in their adoption of the current or next process technology including derivatives of older nodes;
- our inability to keep pace with the rapidly evolving technologies and equipment used in the semiconductor design and manufacturing processes;
- our inability to convince foundry customer to adopt DFI solution or fabless customers to include our on-chip measurement devices in tape outs;
- our customers' failure to achieve satisfactory results using our Design-to-silicon-yield solutions;
- the lack of proven results with new technologies and solutions that we may develop; and
- our inability to develop, market, or sell effective solutions that are outside of our traditional logic focus of manufacturing process solutions, for example 3-D memory processes or our Design-for-Inspection (DFI) IP and hardware technology.

The semiconductor market is volatile and unpredictable and is exacerbated by economic uncertainty, which limits our ability to forecast our business and could negatively impact our results of operations.

The semiconductor industry historically has been volatile with up cycles and down cycles, due to sudden changes in customers' manufacturing capacity requirements and spending, which depend in part on capacity utilization, demand for customers' IC products by consumers, inventory levels relative to demand, and access to affordable capital. As a result of the various factors that affect this volatility, the timing and length of any cycles can be difficult to predict. Economic uncertainty exacerbates negative trends in consumer spending and can cause some of our customers to

delay or refrain altogether from entering into new engagements, licensing new or additional software products, or renewing maintenance and support for existing licensed software. Difficulties in obtaining capital and deteriorating market conditions may also lead to the inability of some customers to obtain affordable financing for other purchases, which could tie up funds otherwise budgeted for purchases of our solutions and technologies. For example, the timing of the build-out of the semiconductor market in China depends significantly on governmental funding on both local and national levels and a delay in this funding could negatively affect our revenues. Any of these events could negatively affect our revenues and make it challenging for us to forecast our operating results, make business decisions, and identify the risks that may affect our business, financial condition and results of operations. Customers with liquidity issues may also lead to additional bad debt expense.

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Our solution implementations or system installation/configurations may take longer than budgeted, which could slow our revenue recognition and may also result in a loss contract, which would negatively affect our operating results.

Our solution implementations require a team of engineers to collaborate with our customers to address complex yield loss issues by using our software and other technologies, and the installation and configuration of our software into our customers' fabrication and test facilities requires experienced engineers working with our customers on active foundry and test equipment. We must estimate the amount of resources needed to complete both of these types of services in order to estimate when the engineers will be able to commence the next engagement. In addition, our accounting for contracts with such services, which generate fixed fees, sometimes require adjustments to profit (loss) based on revised estimates during the performance of the contract. These adjustments may have a material effect on our results of operations in the period in which they are made. The estimates giving rise to these risks, which are inherent in fixed-price contracts, include the forecasting of costs and schedules, and contract revenues related to contract performance.

Our sales cycle is lengthy and customers may delay entering into contracts or decide not to adopt our products or solutions after we have performed services or provided evaluation licenses, which could result in delays in recognizing revenue and negatively impact our results of operations in a quarter or result in lower revenue than we expected if a contract is not consummated at all.

On-going negotiations and evaluation projects for new products, with new customers or in new markets may not result in significant revenues for us if we are unable to close new engagements on terms favorable to us, in a timely manner, or at all. Unexpected delays in our sales cycle could cause our revenues to fall short of expectations. Further, the timing and length of negotiations required to enter into agreements with our customers and the ultimate enforcement of complex negotiated contractual provisions as we intended is difficult to predict. If we do not successfully negotiate certain key complex contractual provisions or there are disputes regarding such provisions and they are not enforced as we intended, the future available market for our solutions could decrease and our revenues and results of operations would suffer. Further, our customers sometimes delay starting negotiations until they begin developing a new process, need to insert a new product, or experience specific yield issues. This means that on occasion we have, and may continue to provide technology and services under preliminary documentation before executing the final contract. In these cases, we could not recognize revenue and would defer associated costs until execution of the final contract, which, if significant, could negatively impact our results of operations in the periods before we execute the final contract. Further, if we were to incur significant effort and then fail to enter into a final contract, we would have to write-off such deferred costs in the period in which the negotiations ended, which would decrease our gross margin and could result in significant operating losses.

If we fail to protect our intellectual property rights, customers or potential competitors may be able to use our technologies to develop their own solutions which could weaken our competitive position, reduce our revenue, or increase our costs.

Our success depends largely on the proprietary nature of our technologies. Our contractual, patent, copyright, trademark, and trade secret protection may not be effective against any particular threat or in any particular location. Our pending patent applications may not result in issued patents, and even if issued, they may not be sufficiently broad to protect our proprietary technologies. Litigation may be necessary from time to time to enforce our IP rights or to determine the validity and scope of the proprietary rights of others. As a result of any such litigation, we could lose our proprietary rights and incur substantial unexpected operating costs. Litigation could also divert our resources, including our managerial and engineering resources. If we are unable to exclude others from using our proprietary technologies and methods without compensation to us, through litigation or otherwise, it could impede our ability to grow our business and our revenues may suffer.

We face operational and financial risks associated with international operations that could negatively impact our revenue.

We derive over half of our revenue from sales outside of the United States, and we expect our international business to continue to grow, in particular in China. We have in the past expanded and reorganized, at different times, our non-U.S. operations and may in the future continue such expansion or reorganization by establishing or restructuring international subsidiaries, offices, or contractor relationships in locations, if and when, deemed appropriate by our management. Thus, the success of our business is subject to risks inherent in doing business internationally, including in particular:

- our growth in China is dependent upon continued investments in the semiconductor industry by both private and public entities within China. Should circumstances change such that the level of investments are substantially reduced, our future growth potential may be limited;

- some of our key engineers and other personnel are foreign nationals and they may not be permitted access to certain technical information under U.S. export laws or by certain of our customers and may have difficulty gaining access to the United States and other countries in which our customers or our offices may be located and it may be difficult for us to recruit and retain qualified technical and managerial employees in foreign offices;

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- ineffective or inadequate protection or enforcement of our intellectual property in foreign jurisdictions;
- greater difficulty in collecting account receivables resulting in longer collection periods;
- language and other cultural differences may inhibit our sales and marketing efforts and create internal communication problems among our U.S. and foreign teams, increasing the difficulty of managing multiple, remote locations performing various development, quality assurance, and yield ramp analysis projects;
- compliance with, inconsistencies among, and unexpected changes in, a wide variety of foreign laws and regulatory environments with which we are not familiar, including, among other issues, with respect to employees, personal data, tax, protection of our IP, and a wide variety of operational regulations and trade and export controls under domestic, foreign, and international law;
- currency risk due to the fact that certain of our payables and for our international offices are denominated in the foreign currency, including the Euro, Yen, and RMB, while virtually all of our revenues is denominated in U.S. dollars, or in the event a larger portion of our revenues becomes denominated in foreign currencies, we would be subject to a potentially significant exchange rate risk;
- quarantine, private travel limitation, or business disruption in regions affecting our operations, stemming from actual, imminent or perceived outbreak of human pandemic or contagious disease; or
- economic or political instability, including but not limited to armed conflict, terrorism, interference with information or communication of networks or systems, and the resulting disruption to economic activity and business operations;

Further, our employees and contractors include professionals located in various international locations, including Shanghai, China, who provide primarily CV test chip-related services, and Ramallah, Palestine, who provide software-related development, quality assurance, maintenance, and other technical support services for certain of our software products. Political changes, including policies regarding export control, that affect these or other international operations could disrupt or limit the work our employees and contractors are able to perform, and thus negatively affect the range of services we are able to provide our customers or our cost for such services.

10. ***Inadvertent disclosure of our customers' confidential information or our failure to comply with our client's security rules for on-site access could result in costly litigation, cause us to lose existing and potential customers, or negatively impact on-going business with existing customers.***

Our customers consider their product yield information and other confidential information, which we must gather in the course of our engagement with the customer, to be extremely competitively sensitive. Many of our clients have strict security rules for on-site access to their confidential information. If we inadvertently disclosed or were required

to disclose this information, or we fail to adequately comply with customers' security protocols for accessing confidential information, we would likely lose existing and potential customers, could be subject to costly litigation, or our on-going business could be negatively impacted. In addition, to avoid potential disclosure of confidential information to competitors, some of our customers may, in the future, ask us not to work with key products or processes, which could limit our revenue opportunities.

Our ability to sell our products may depend on the quality of our support and services offerings, including delivering of software as a service (SaaS), and our failure to offer high-quality support and services could negatively affect our sales and results of operations.

Once our software products are integrated within our customers' hardware and software systems, our customers may depend on our support organization to resolve any issues relating to our products. Further, in connection with delivering our software as a service, which requires us to maintain adequate server hardware and internet infrastructure, including system redundancies, we will need to meet contractual uptime obligations A high level of system and support is critical for the successful marketing and sale of our products. If we do not effectively provide subscription access to our SaaS customers, assist our customers in deploying our products, succeed in helping our customers quickly resolve post-deployment issues, and provide effective ongoing support, our ability to sell our software products to existing customers may be negatively affected, our results of operations could be negatively impacted if we must provide credits for system downtime, and our reputation with potential customers could be harmed. If our software customers have a poor perception of our support and services offerings, they may choose not to purchase via SaaS, renew software support and maintenance or term-based licenses when the current period expires. In addition, due to our international operations, our system and support organization faces challenges associated with delivering support, hours that support is available, training, and documentation where the user's native language may not be English. If we fail to maintain high-quality support and services, our customers may choose our competitors' products instead of ours in the future, which would negatively affect our revenues and results of operations.

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Defects in our proprietary technologies, hardware and software tools, and failure to effectively remedy any such defects could decrease our revenue and our competitive market share.

If the software, hardware, or proprietary technologies we provide to a customer contain defects that negatively impact customers' ability to use our solutions or software, increase our customers' cost of goods sold and time-to-market or damage our customers' property, these defects could significantly decrease the market acceptance of our solutions or results in warranty or other claims. We must adequately train our new personnel, especially our client service and technical support personnel, to effectively and accurately, respond to and support our customers. If we fail to do this, it could lead to dissatisfaction among our customers, which could slow our growth. Further, the cost of support resources required to remedy any defects in our technologies, hardware, or software tools could exceed our expectations. Any actual or perceived defects with our software, hardware, or proprietary technologies may also hinder our ability to attract or retain industry partners or customers, leading to a decrease in our revenue. These defects are frequently found during the period following introduction of new software, hardware, or proprietary technologies or enhancements to existing software, hardware, or proprietary technologies. Our software, hardware, and proprietary technologies may contain errors not discovered until after customer implementation of the silicon design and manufacturing process recommended by us. If our software, hardware, or proprietary technologies contain errors or defects, it could require us to expend significant resources to remedy these problems or defend claims, which could reduce margins and result in the diversion of technical and other resources from our other customer implementations and development efforts.

If we do not effectively manage, support, and safeguard our worldwide information systems, and integrate recent and planned growth, our business strategy may fail.

We have experienced in the past, and may experience in the future, interruptions in our information systems on which our global operations depend. Further, we may face attempts by others to gain unauthorized access through the Internet to our information technology systems whether hosted by us or service providers, to intentionally hack, interfere with, or cause physical or digital damage to or failure of such systems (such as significant viruses or worms), which attempts we or they may be unable to prevent. We or our service providers could be unaware of an incident or its magnitude and effects until after it is too late to prevent it and the damage it may cause. The theft, unauthorized use, or a cybersecurity attack that results in the publication of our trade secrets and other confidential business information as a result of such an incident could negatively affect our competitive position, the value of our investment in product or research and development, and third parties might assert against us or our customers claims related to resulting losses of confidential or proprietary information or end-user data and/or system reliability. In any such event, our business could be subject to significant disruption, and we could suffer monetary and other losses, including reputational harm, which costs we may not be able to recover from our service providers. In addition, we must frequently expand our internal information system to meet increasing demand in storage, computing and communication, which may result in increased costs. Our internal information system is expensive to expand and must be highly secure due to the sensitive nature of our customers' information that we transmit. Building and managing the support necessary for our growth places significant demands on our management and resources. These demands may divert these resources from the continued growth of our business and implementation of our business strategy.

If we are not able to retain, attract, motivate, and strategically locate talented employees, including some key executives, our business may suffer.

Our success and competitiveness depend on our ability to retain, attract, motivate, and strategically locate in our offices around the globe, talented employees, including some of our key executives. Achieving this objective may be difficult due to many factors, including fluctuations in global economic and industry conditions, changes in our management or leadership, the hiring practices at our competitors or customers, cost reduction activities, and the effectiveness of our compensation programs, including equity-based programs. Further, we have had, and expect to continue to have, difficulty in obtaining visas permitting entry for some of our employees that are foreign nationals into the United States, and delays in obtaining visas permitting entry into other key countries, for several of our key personnel, which disrupts our ability to strategically locate our personnel. In recent years, the United State has increased the level of Security in granting H-1(b), L-1 and other business visas. The Trump administration has indicated that immigration reform is a priority. If we lose the services of certain of our key executives or a significant number of our engineers, it could disrupt our ability to implement our business strategy. If we do not successfully attract, retain, and motivate key employees, including key executives, we may be unable to realize our business objectives and our operating results may suffer.

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Our stock price has been volatile in the past, and our earnings per share and other operating results may vary quarter to quarter, which could result in not meeting investors' expectations and cause our stock price to drop.

Our stock price has fluctuated widely during the few years, from a low closing price of $8.99 per share in January 2016 to a high closing price of $24.16 per share in December 2016. A factor in the volatility may be that our historical quarterly operating results have fluctuated. Our future quarterly operating results will likely fluctuate from time to time and may not meet the expectations of securities analysts and investors in some future period, which could cause our stock price to decrease again. A significant reduction in our stock price negatively impacts our ability to raise equity capital in the public markets and increases the cost to us, as measured by dilution to our existing shareholders, of equity financing. In addition, the reduced stock price also increases the cost to us, in terms of dilution, of using our equity for employee compensation or for acquisitions of other businesses. A greatly reduced stock price could also have other negative results, including the potential loss of confidence by employees, the loss of institutional investor interest, a hostile take-over bid, and fewer business development opportunities. Also, significant volatility in the stock price could be followed by a securities class action lawsuit, which could result in substantial costs and a diversion of our management's attention and resources.

Competition in the market for yield improvement solutions and increased integration between IC design and manufacturing may intensify in the future, which could impede our ability to grow or execute our strategy.

Competition in our market may intensify in the future, which could slow our ability to grow or execute our strategy and could lead to increased pricing pressure, negatively impacting our revenues. Our current and potential customers may choose to develop their own solutions internally, particularly if we are slow in deploying our solutions or improving them to meet market needs. These and other competitors may be able to operate with a lower cost structure than our engineering organization, which would give any such competitor's products a competitive advantage over our solutions. We currently face indirect competition from the internal groups at IC companies and some direct competition from providers of (i) yield management and/or prediction systems, such as KLA-Tencor, Mentor Graphics, Rudolph Technologies, Inc. ("Rudolph"), Synopsys, Inc. ("Synopsys"), and Qualtera, (ii) semiconductor manufacturing software, such as Applied Materials, Inc., BISTel Inc., Invantest, Inc., MKS Instruments, Inc., Optimal+, Rudolph, Siemens AG (through its acquisition of Mentor Graphics, which previously acquired Galaxy Semiconductor Solutions), and Trancom Technology, Inc. and, (iii) inline inspection, metrology and electrical test equipment providers, such as Applied Materials, Inc., Hermes Microvision, Inc., and Keysight Technologies, Inc. Further, ARM Ltd. and Synopsys provide standard cells in the physical IP space and Tela Innovations, Inc. provides software for standard cell synthesis, each of which could compete with our Template™ technology solution. Further, we may compete with the products or offerings of these named companies or additional companies if we expand our offerings through acquisition or development. Further, electronic design automation suppliers provide alternative DFM solutions that may compete for the same budgetary funds. There may be other providers of commercial solutions for systematic IC yield and performance enhancement of which we are not aware. Further, some providers of yield management software or inspection equipment may seek to broaden their product offerings and compete with us. In addition, we believe that the demand for solutions that address the need for better integration between the silicon design and manufacturing processes may encourage direct competitors to enter into our market. For example, large integrated organizations, such as IDMs, electronic design automation software providers, IC design service companies or semiconductor equipment vendors, may expand their product offerings or decide to spin-off a business unit to

compete with us. Other potential competitors include fabrication facilities that may decide to offer solutions competitive with ours as part of their value proposition to their customers. If these potential competitors change the pricing environment or are able to attract industry partners or customers faster than we can, we may not be able to grow and execute our strategy as quickly or at all.

Measurement of our Gainshare performance incentives and other variable consideration requires data collection and customers' use of estimates in some cases, and is subject to customer agreement and later offset if actual data differ from customers' estimates, which can result in uncertainty and cause quarterly results to fluctuate.

We can only recognize revenue based on Gainshare performance incentives once we have reached agreement with our customers on their level of yield performance improvements and quarterly agreements are sometimes based on estimates of volume results each quarter. Measuring the amount of yield improvement is inherently complicated and dependent on our customers' internal processes, thus, there may be uncertainty as to some components of measurement. Also, some variable considerations can be highly susceptible to delays in the customer measurement of key factors such as reporting volumes results and level of yield. Therefore, we may have to estimate revenue related to contingent variable fees or usage-based or sales-based royalties prior to the receipt of performance reports, such as Gainshare acknowledgements, or other related information from customers. These estimates are subject judgment to evaluate whether it is probable that a significant revenue reversal will not occur in future periods, which could result in our recognition of less revenue than expected in any particular period and later offset when actual results become available.

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Changes in the structure of our customer contracts, including the mix between fixed and variable revenue and the inclusion of acceptance criteria can adversely affect the amount and timing of our total revenues.

Our long-term success is largely dependent upon our ability to structure our future customer contracts in line with market condition. In addition, if the mix shifts toward more Gainshare, we may increase the variability or timing of recognition of our revenue, and therefore increase the risk that our total future revenues will be lower than expected and fluctuate significantly from period to period. Further, if we agree to contractual acceptance criteria in contracts and fail to meet them, the total revenues we receive under a contract could be delayed or decline.

We have experienced losses in the past and we may incur losses again in the future.

We have experienced losses in the past and we incur losses again in the future if we are not able to adequately control our costs or if total revenues fail to meet expectations. In addition, virtually all of our quarterly operating expenses are fixed, so any shortfall in anticipated quarterly revenue could significantly reduce our operating results below expectations. Our accumulated deficit was $27.1 million as of December 31, 2017. We expect to continue to incur significant expenses in connection with:

- funding for research and development;
- expansion of our solution implementation teams;
- restructuring costs related to our cost control and management efforts;
- expansion of our sales and marketing efforts; and
- additional non-cash charges relating to amortization and stock-based compensation.

Further, if the availability of our new office space is not ready on our expected schedule, we may incur additional costs related to hold-over rates at the current location of our headquarters and other expenses

Our technologies could infringe the intellectual property rights of others, causing costly litigation and the loss of significant rights.

Significant litigation regarding intellectual property rights exists in the semiconductor industry. It is possible that a third party may claim that our technologies infringe their intellectual property rights or misappropriate their trade secrets. Any claim, even if without merit, could be time consuming to defend, result in costly litigation, or require us to enter into royalty or licensing agreements, which may not be available to us on acceptable terms, or at all. A successful claim of infringement against us in connection with the use of our technologies could adversely affect our business.

Changes in effective tax rates could positively affect our earnings, thereby raising investors' expectations, while the final tax rates that are determined could be significantly higher, thereby lowering our earnings and causing us to miss investors' expectations, which could cause our stock price to drop, and we may not be able to use tax credits before their expiration if we fail to have sufficient future income.

We conduct our business globally and, as a result, are subject to taxation in the United States and foreign countries. Our future tax rates could be affected by numerous factors, including recent changes in tax laws or the interpretation of such tax laws and changes in accounting policies. Our filings are subject to reviews or audit by the Internal Revenue Service and state, local and foreign taxing authorities. We cannot be sure that any final determination in an audit would not be materially different than the treatment reflected in our historical income tax provisions and accruals. If additional taxes are assessed as a result of an audit, there could be a significant negative effect on our income tax provision and our operating results in the period or periods for which that determination is made. Any changes in our geographical earnings mix in various tax jurisdictions, including those resulting from transfer pricing adjustments, could materially increase our effective tax rate. Furthermore, we maintain deferred tax assets related to federal, foreign and certain state tax credits. Our ability to use these credits prior to their expiration is dependent upon having sufficient future income.

Uncertainties in the interpretation and application of the 2017 Tax Cuts and Jobs Act could materially affect our tax obligations and effective tax rate.

The 2017 Tax Cuts and Jobs Act (the Tax Act) was enacted on December 22, 2017, and significantly changes how the U.S. imposes income tax on multinational corporations. The U.S. Department of Treasury has broad authority to issue regulations and interpretative guidance that may significantly impact how we will apply the law and affect our results of operations in the period issued.

The Tax Act requires complex computations not previously provided in U.S. tax law. As such, the application of accounting guidance for such items is currently uncertain. Further, compliance with the Tax Act and the accounting for such provisions require accumulation of information not previously required or regularly produced. As a result, we have provided a provisional estimate on the effect of the Tax Act in our financial statements. As additional regulatory guidance is issued by the applicable taxing authorities, accounting treatment is clarified, we perform additional

analysis on the application of the law, and we refine estimates in calculating the impact, our final analysis, which will be recorded in the period completed, may be different from our current provisional amounts, which could materially affect our tax obligations and effective tax rate.

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Item 1B. ***Unresolved Staff Comments***

None.

Item 2. ***Properties***

Our principal executive offices are located in San Jose, California. Our lease is currently for approximately 28,600 square feet of office space and approximately 2,400 square feet of laboratory space and terminates at the end of September 2018. We have identified suitable replacement space nearby and are in the process of closing a long-term lease agreement and preparing to relocate mid-year. In 2017, we leased a 7,800 square feet of space for a clean-room and office space in Milpitas, California. In February 2018, this lease has been expanded to include an additional 10,000 square feet of office space and extended through January 2023. We lease other office space in La Jolla, California, Pennsylvania and Texas with an aggregate of 12,700 square feet under various leases that expire at different times through April 2022. We also lease approximately 25,500 square feet of office space in Shanghai, China that expires in September 2018. We also have offices in France, Germany, Italy, Japan, Korea, and Taiwan with an aggregate of approximately 17,200 square feet under various leases that expire at different times through April 2024. We believe our existing and planned facilities are adequate to meet our current needs and are being utilized consistently with our past practice. We consistently look for opportunities to minimize costs related to office space through improved efficiencies and intend to make changes to leased facilities in the future as appropriate to reflect changes in worldwide operations and headcount.

Item 3. ***Legal Proceedings***

From time to time, we are subject to various claims and legal proceedings that arise in the ordinary course of business. We accrue for losses related to litigation when a potential loss is probable and the loss can be reasonably estimated in accordance with FASB requirements. As of December 31, 2017, we were not party to any material legal proceedings, thus no loss was probable and no amount was accrued.

Item 4. ***Mine Safety Disclosures***

None.

PART II

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

Our common stock trades on the NASDAQ Global Market under the symbol "PDFS." As of March 1, 2018, we had approximately 35 stockholders of record. The number of stockholders of record does not include individuals whose stock is in nominee or "street name" accounts through brokers.

The following table sets forth for the periods indicated the high and low closing sale prices for our common stock as reported by the NASDAQ Global Market:

2017	**High**	**Low**
First Quarter	$23.20	$21.16
Second Quarter	$23.62	$16.24
Third Quarter	$19.69	$14.32
Fourth Quarter	$18.24	$14.32

2016	**High**	**Low**
First Quarter	$13.92	$8.99
Second Quarter	$15.24	$12.20
Third Quarter	$18.17	$13.74
Fourth Quarter	$24.16	$17.77

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Dividend Policy

No cash dividends were declared or paid in 2017, 2016 or 2015. We currently intend to retain all available funds to finance future internal growth and product development and stock repurchases and therefore do not anticipate paying any cash dividends on our common stock for the foreseeable future.

Stock Performance Graph

The following graph and tables compare the cumulative total stockholder return data for our stock since December 31, 2012 to the cumulative return over such period of (i) The NASDAQ Composite Index and (ii) the RDG Technology Composite Index. The graph assumes that $100 was invested on December 31, 2012. The graph and tables further assume that such amount was initially invested in the Common Stock of the Company at a per share price of $13.78 (closing price on December 31, 2012) and that of any dividends were reinvested. This performance graph and the corresponding tables are not “soliciting material,” is not deemed filed with the SEC and is not to be incorporated by reference in any filing by us under the Securities Act or the Exchange Act whether made before or after the date hereof and irrespective of any general incorporation language in any such filing. The stock price performance on the following graph and tables is not necessarily indicative of future stock price performance.

	12/12	12/13	12/14	12/15	12/16	12/17
PDF Solutions, Inc.	100.00	185.92	107.84	78.66	163.64	113.93
NASDAQ Composite Index	100.00	141.63	162.09	173.33	187.19	242.29
RDG Technology	100.00	132.51	155.05	161.00	181.12	247.79

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Purchases of Equity Securities by the Issuer and Affiliated Purchasers

On October 25, 2016, the Board of Directors adopted a program, effective immediately, to repurchase up to $25.0 million of the Company's common stock both on the open market and in privately negotiated transactions over the next two years. During the year ended December 31, 2017, the Company repurchased 842,182 shares under this program. As of December 31, 2017, 842,182 shares had been repurchased at an average price of $15.93 per share under this program for a total purchase price of $13.4 million, and $11.6 million remained available for future repurchases.

There were no purchases made by or on behalf of the Company or any "affiliated purchaser" (as the term is defined in Rule 10b-18(a)(3) under the Exchange Act) of our common stock during the fourth quarter ended December 31, 2017.

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

The following selected consolidated financial information has been derived from the audited consolidated financial statements. The information set forth below is not necessarily indicative of results of future operations and should be read in conjunction with Item 7. "Management's Discussion and Analysis of Financial Condition and Results of Operations" and the consolidated financial statements and notes to those statements included therein and in Part IV of this Form 10-K.

	Year Ended December 31,				
	2017	2016	2015	2014	2013
	(In thousands, except per share amounts)				
Consolidated Statements of Operations Data:					
Revenues:					
Design-to-silicon-yield solutions	$74,436	$77,162	$63,839	$52,769	$61,710
Gainshare performance incentives	27,435	30,299	34,138	47,394	39,743
Total revenues	101,871	107,461	97,977	100,163	101,453
Cost of Design-to-silicon-yield solutions:					
Direct costs of Design-to-silicon-yield solutions	47,050	44,074	38,847	37,822	39,470
Impairment of deferred costs	—	—	—	1,892	—
Amortization of acquired technology	471	374	176	—	—
Total cost of Design-to-silicon-yield solutions	47,521	44,448	39,023	39,714	39,470
Gross profit	54,350	63,013	58,954	60,449	61,983
Operating expenses:					
Research and development	30,078	27,559	19,096	14,064	13,314

Selling, general and administrative	23,684	22,056	20,421	18,457	17,025
Amortization of other acquired intangible assets	398	432	196	31	74
Restructuring charges	—	—	—	57	197
Total operating expenses	54,160	50,047	39,713	32,609	30,610
Income from operations	190	12,966	19,241	27,840	31,373
Interest and other income (expense), net	(264)	(10)	181	119	(64)
Income before taxes	(74)	12,956	19,422	27,959	31,309
Income tax provision (benefit)	1,263	3,853	7,015	9,497	10,380
Net income (loss)	$(1,337)	$9,103	$12,407	$18,462	$20,929
Net income per share:					
Basic	$(0.04)	$0.29	$0.39	$0.60	$0.70
Diluted	$(0.04)	$0.28	$0.39	$0.58	$0.67
Weighted average common shares:					
Basic	32,038	31,373	31,424	30,743	29,826
Diluted	32,038	32,431	32,164	31,939	31,393

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	December 31,				
	2017	2016	2015	2014	2013
	(In thousands)				
Consolidated Balance Sheets Data:					
Cash and cash equivalents	$101,267	$116,787	$126,158	$115,464	$89,371
Working capital	144,263	151,757	148,795	147,032	120,915